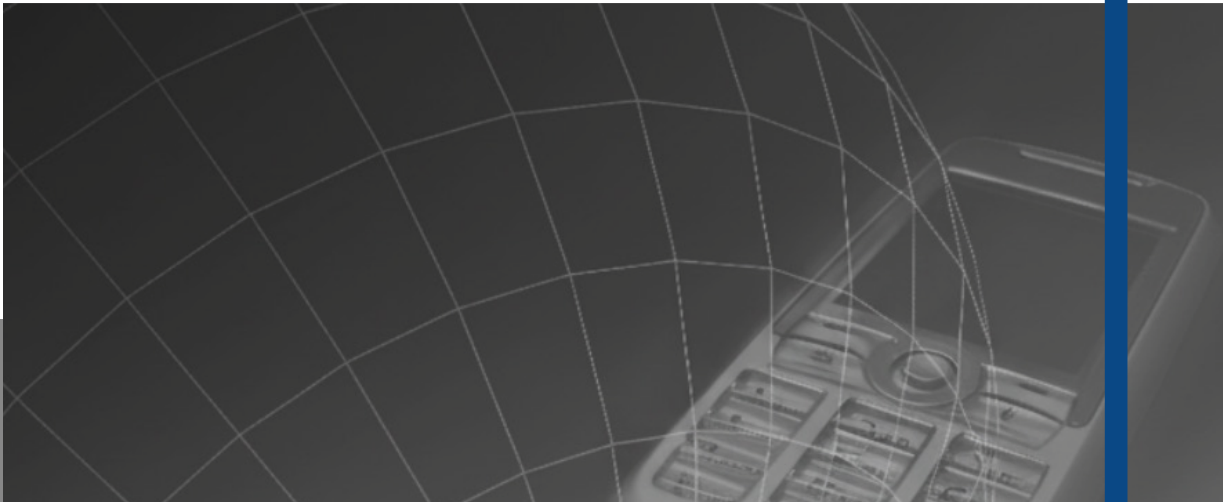




15th International Conference on Recent Challenges in Engineering and Technology ICRCET-2026



22nd-23rd April, 2026



Bangalore, India

**Organized by: Primus School of Management Studies, India
IFERP Academy, India**





15th International Conference on Recent Challenges in Engineering and Technology
(ICRCET 2026)

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Conference Theme



“Engineering for a Changing World: Creating Sustainable Solutions for the Future.”

Preface

We cordially invite you to attend the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) on 22nd-23rd April, 2026. The main objective of ICR CET-2026 is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in relevant fields of Recent Challenges in Engineering and Technology. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on cutting edge development of academia as well as industries. All accepted papers were subjected to strict peer-reviewing by a panel of expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results but also will provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities, research institutes and colleges. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in there view process, and to the authors for contributing their research result to the conference.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of ICR CET-2026. We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

About ICR CET - 2026

Emphasizes the critical role of engineering and technology in addressing today's global challenges while shaping a resilient tomorrow. As the world faces rapid urbanization, climate change, and technological disruption, ICR CET 2026 provides a platform for researchers, academicians, industry leaders, and innovators to collaborate on transformative ideas. The focus is on developing sustainable infrastructure, advancing digital technologies, and fostering interdisciplinary research that aligns with the United Nations Sustainable Development Goals (SDGs). By uniting diverse perspectives, the conference aims to inspire forward-thinking solutions that ensure a more sustainable, inclusive, and technologically empowered future.

Conference Objectives – ICR CET 2026

Objectives of 15th International Conference on Recent Challenges in Engineering and Technology (ICR CET-2026)

- **Foster Knowledge Exchange:** Provide a global platform for researchers, academicians, industry experts, and practitioners to share innovative ideas, research findings, and best practices in engineering and technology
- **Promote Interdisciplinary Collaboration:** Encourage collaboration across diverse engineering disciplines to address current and emerging global challenges through integrated and sustainable solutions.
- **Highlight Emerging Technologies:** Explore advancements in areas such as Artificial Intelligence, IoT, Renewable Energy, Smart Infrastructure, Robotics, and Sustainable Materials that are shaping the future of engineering.
- **Encourage Research and Innovation:** Inspire participants to present novel research outcomes, prototype developments, and innovative approaches that contribute to industrial growth and societal development.
- **Focus on Sustainable Development:** Align engineering solutions with global sustainability goals to create technologies that balance economic growth, environmental protection, and social well-being.
- **Provide Networking Opportunities:** Facilitate meaningful interactions, collaborations, and partnerships among participants for future research, publications, and professional growth.

Scope of the Conference

The scope of ICR CET-2026 covers a wide range of topics and disciplines within engineering and technology, including but not limited to:

- Emerging Technologies: Artificial Intelligence, Machine Learning, Internet of Things (IoT), Robotics, Blockchain, and Cloud Computing.
- Sustainable Engineering Solutions: Renewable Energy Systems, Smart Grids, Green Manufacturing, and Sustainable Materials.
- Civil & Structural Engineering: Smart Cities, Urban Infrastructure, and Disaster-Resilient Design.
- Electronics & Communication Engineering: 5G/6G Networks, Embedded Systems, Wireless Communication, and VLSI Design.
- Mechanical & Automotive Engineering: Advanced Manufacturing, Mechatronics, and Automotive Technologies.
- Computer Science & IT Innovations: Cybersecurity, Data Science, Human-Computer Interaction, and Software Engineering.
- Interdisciplinary Approaches: Engineering Education, Technological Entrepreneurship, and Cross-Disciplinary Research.

The conference also provides opportunities for networking, industry-academia collaboration, and exploring global partnerships that promote innovation-driven growth.

About IFERP

The IFERP Academy is a committed professional organization that advances engineering, science, and technology. IFERP anticipates a global scientific community brought together by digital innovation. This organization puts a great emphasis on promoting research activities, communicating the newest insights, and driving industrial trends.

IFERP has built strong networks throughout Asia, the Middle East, Europe, and countries such as Iraq, Malaysia, Australia, and more. They have incorporated networking, research support, publications, and worked in other scientific areas.

IFERP excels in organizing **International Conferences** that connect researchers worldwide. It holds important **international webinars**, publishes journals and publications that are indexed by Web of Science and SCOPUS, and provides thorough **research assistance and guidance**. Engaging in Youth Empowerment projects and encouraging Industry-Institute Interaction are key components of IFERP's goal. The organization is committed to enabling professionals through faculty advancement, skill development, and persistent research and publication initiatives.

- **Global Community Building:** IFERP exerts a lot of effort in building new communities all over the world. As community organizers, we control the conversations & inculcate passion for innovation amongst diverse groups.
- **Promoting Innovation Schemes:** IFERP has several schemes for students, professionals, researchers & organizations to being distinct innovators across all technology streams & sub disciplines.
- **Publicizing Research Publication:** Publication of research is the crucial aspect of IFERP's activities. IFERP also serves as a support center for early - career researchers aspiring to publish world-class research papers.
- **Our Origin:** Established by the Technoarete Research & Development Association (TRADA), IFERP was meant to serve as an accelerant for technological innovation worldwide.
- **Facilitating Multi-Disciplinary Collaborations:** IFERP encourages networking & collaborative partnerships on all fronts to result in a diverse collaborative atmosphere to gain abundance knowledge.
- **Access To Critical Funding & Resources:** IFERP has dedicated itself to fund for various efficient projects & activities to make it achieve successful outcomes beyond just meeting expectations.

What IFERP Does

IFERP is committed to improving the professional experience by providing a world-class platform to professionals. Their dedication extends to the following activities:

- **Academic Resource Accessibility :** They make academic resources and support available to aspiring scholars in both rural and urban locations.
- **Diverse Educational Program :** They organize a wide range of educational events such as workshops, conferences, webinars, seminars, guest lectures, short-term training programs, and faculty development programs.
- **Drive Innovation:** They work hard to foster curiosity and creativity, and stay up to date on the newest trends and advancements in the dynamic field of Engineering, Science, and Technology.
- **Knowledge Sharing and Collaboration:** They believe in the strength of the exchange of knowledge and actively collaborate with institutions, organizations, and associations to contribute to our shared objective of a better future.
- **Publication & Recognition:** They also provide opportunities for research articles to be published in reputable journals and actively promote and encourage transdisciplinary research activities.

IIFERP Mission & Vision

IIFERP's Mission: Upskilling the knowledge hub through technological innovation & excellence for the benefit of humanity.

IIFERP's Vision: A Digitally equipped robust, dynamic & swift professional community integrating academics & industry for upgraded technical implementation.

IIFERP's Value: IIFERP values the restoration of high level technological research, learning, collaboration, resource sharing & community-building traditions.

IIFERP's Goal: To serve as the foundation for all technological progress and advancement activities around the world.

Managing Director, IFERP



Mr. A. Siddh Kumar Chhajer

Managing Director & Founder, IFERP
Technoarete Group, India



Message:

On behalf of IFERP & the organizing Committee, I express my hearty gratitude to the Participants, Keynote Speakers, Delegates, Reviewers and Researchers.

The goal of the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) is to provide knowledge enrichment and innovative technical exchange between international researchers or scholars and practitioners from the academia and industries in various fields of academics. This conference creates solutions in different ways and to share innovative ideas in the field of Recent Challenges in Engineering and Technology. ICR CET-2026 provides a world class stage to the Researchers, Professionals, Scientists, Academicians, and students to engage in very challenging conversations, assess the current body of research and determine knowledge and capability gaps.

ICRCET-2026 will explore the new horizons of innovations from distinguished researchers, scientists and eminent authors in academia and industry working for the advancements in Recent Challenges in Engineering and Technology from all over the world. ICR CET-2026 hopes to set the perfect platform for participants to establish careers as successful and globally renowned specialists in various fields of Academics.

Chief Executive Officer, IFERP



Mr. Rudra Bhanu Satpathy

Chief Executive Officer & Founder, IFERP
Technoarete Group, India



Message:

IFERP is hosting the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) this year in month of April. The main objective of ICRCET-2026 is to grant the amazing opportunity to learn about groundbreaking developments in modern industry, talk through difficult workplace scenarios with peers who experience the same pain points, and experience enormous growth and development as a professional. There will be no shortage of continuous networking opportunities and informational sessions. The sessions serve as an excellent opportunity to soak up information from widely respected experts. Connecting with fellow professionals and sharing the success stories of your firm is an excellent way to build relations and become known as a thought leader.

I express my hearty gratitude to all my Colleagues, Staffs, Professors, Reviewers and Members of organizing committee for their hearty and dedicated support to make this conference successful. I am also thankful to all our delegates for their pain staking effort to make this conference successful.

Principal & Director, PRIMUS



Dr. Shaista Banu Harris

Principal & Director
Primus School of Management Studies
Bengaluru, India



Message:

It gives me immense pleasure to welcome all distinguished delegates, researchers, academicians, industry professionals, and students to the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026), held on 22nd and 23rd April 2026 in Bangalore, India.

We are living in a time of unprecedented transformation. Technologies such as artificial intelligence, automation, and advanced data systems are rapidly reshaping industries across the world. Recent developments in the global technology sector, including reports of large organizations restructuring their workforce while simultaneously increasing investments in AI infrastructure, highlight the speed and scale at which businesses are evolving. Roles are being redefined, traditional job structures are changing, and new opportunities are emerging at the intersection of technology and innovation.

This reality sends a clear message to all of us in academia and industry: education can no longer remain static. We must continuously redesign our teaching, learning, and research approaches to prepare individuals for a future where adaptability, digital capability, and innovative thinking are essential.

In this context, the theme "Engineering for a Changing World: Creating Sustainable Solutions for the Future" becomes highly relevant. It challenges us to move beyond conventional thinking and develop solutions that are not only technologically advanced but also sustainable, ethical, and inclusive.

ICRCET 2026 provides a valuable platform for exchanging ideas, presenting cutting-edge research, and building meaningful collaborations between academia and industry. It is through such collective efforts that we can respond effectively to global challenges and drive impactful innovation.

At Primus School of Management Studies, we are committed to nurturing future-ready professionals who can thrive in an AI-driven world. We believe that conferences like this play a vital role in encouraging critical thinking, interdisciplinary collaboration, and global engagement.

I extend my sincere appreciation to the organizers, speakers, and participants for their valuable contributions. I am confident that the discussions and interactions during this conference will be insightful, inspiring, and transformative.

I wish you all a productive and enriching conference experience.

Thank you.

Invited Keynote Speaker



Prof. Dr. Nagendra Kumar Sharma

Chandra Shekhar Azad University of
Agriculture & Technology
india



Biography:

Dr. Nagendra Kumar Sharma is a Professor, Dean, and Head of the Department of Electronics & Communication Engineering at the College of Agricultural Engineering & Technology, Etawah, a constituent faculty of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, India. He has over 30 years of teaching and research experience and has held several administrative positions, including Dean of the College of Fisheries Science & Research Centre and Chairman of the Board of Faculty of Technology. Dr. Sharma completed his M.Phil and Ph.D. in Physics from Aligarh Muslim University. His research interests include cosmic rays, space physics, and the application of electromagnetic energy in agriculture. He has published numerous research papers, delivered invited talks, and chaired sessions at national and international conferences. He has received several prestigious awards, including the International Best Teacher Award (2023) and Outstanding Achievement Award (2024).

Invited Keynote Speaker



Dr. Nagaraju L. G.

REVA University
india



Biography:

Dr. Nagaraju L G is an accomplished academican and Assistant Professor and IQAC vertical Head at REVA University, with over 14 years of teaching and research experience. He has successfully completed his Ph.D. in Social Entrepreneurship and is NET qualified, JRF and KSET cleared, reflecting strong academic and research credentials. Dr. Nagaraju specializes in integrating Artificial Intelligence with business strategy, social entrepreneurship, and sustainable development, aligned with Industry 5.0. He holds postgraduate degrees in M.Com and MTTM and has completed advanced certifications in Generative AI, Prompt Engineering, and AI for Business from Google, IBM, and be10x. He has published research in reputed journals and actively contributes to academia as a reviewer, editorial board member, and associate editor. His editorial and reviewing roles include associations with the Journal of Agriculture and Ecology Research International, Asian Journal of Current Research, International Journal of Creative Research Thoughts (IJCRT), Journal of Scientific Research and Reports, Journal of Small Business and Entrepreneurship Development, and publications under BP International. He serves on the editorial boards of REST Publisher's Trends in Finance and Economics Journal and the Asian Journal of Agriculture and Rural Development, and is an Associate Editor of the International Journal of Economics, Finance and Management Sciences (IJEFM). He is also associated with Eastasouth journals covering Management, Accounting & Finance, Economics & Entrepreneurship, and Social Sciences & Humanities. A recipient of the IMRF Skill India Award and former NAAC Coordinator, Dr. Nagaraju is a sought-after speaker on AI in Business, Digital Transformation, Social Entrepreneurship, Research Methodology, and Bibliometric Analysis.

Keynote Speaker



Assoc. Prof. Dr. Abdul Halim Abdullah

Associate Professor
Universiti Teknologi MARA
Malaysia



Biography:

Abdul Halim Abdullah is an Associate Professor and the Deputy Dean (Research & Industrial Linkages) at the Faculty of Mechanical Engineering, Universiti Teknologi MARA (UiTM), Malaysia. He is also a member of the Biomechanical and Clinical Engineering (BioMeC) Research Group. He obtained his Doctor of Engineering (Dr.Eng.) in Biomechanical Engineering from Kyushu University, Japan, a Master of Engineering (M.Eng.) in Mechanical Engineering from Universiti Teknologi Malaysia, and a Bachelor of Engineering (B.Eng.) from Universiti Sains Malaysia. Dr. Abdul Halim's research focuses on orthopedic engineering and the development of adaptive assistive devices for rehabilitation management. His expertise includes biomechanics, computational analysis, and 3D printing technology, particularly in integrating mechanical engineering principles with medical and biological sciences. He actively leads collaborative research and industrial partnerships to promote innovation in biomedical and rehabilitation engineering.

Keynote Speaker



Prof. Dr. Ramachandra C G

Professor
Presidency University
India



Biography:

An accomplished Academic Professional with over 25 years of experience in Academics, Training, Research & Development, and Academic Administration, holding qualifications of B.E., M.Tech., Ph.D., and Post-Doctorate. Proficient in building visionary teams and motivating students and faculty toward excellence, with strong interpersonal skills to maintain cordial relations with parents, educators, industry professionals, and academic experts. Recognized by the Guinness World Records for authoring the "Thickest Book in the World" (5.8 meters / 19 feet 0.34 inches, 100,100 pages) titled World 2023 (Wide Outcomes on Research & Latest Development), published by ESN Publications and LOSD (London Organization of Skills Development). Recipient of 8 patents and 19 academic excellence awards from national and international professional bodies. Authored 27 books and 33 book chapters, published 128 research papers in reputed journals, and presented 124 papers at international and national conferences. Serves as a member of the Editorial Board for over 100 reputed journals and as a Reviewer for 35 journals. Holds memberships in 59 international/national advisory committees and is a life member of 32 professional societies. Actively contributes as a Global Executive Committee member, Scientific Committee member, Advisory Board member, and Organizing Committee member for numerous international conferences. Has delivered several technical talks and keynote addresses, served as Guest of Honour, Jury Member, and Session Chairperson at academic events, and organized various workshops, FDPs, and seminars. Currently serving as a Ph.D. Guide at Presidency University, Bengaluru and Visvesvaraya Technological University, Belagavi, having guided 9 Ph.D. scholars with 4 ongoing, and supervised numerous UG and PG projects. Also serves as a Panel Examiner for multiple reputed universities including Presidency University, VTU, Anna University, JSS STU, Shivaji University, Nitte University, and Reva University.

Keynote Speaker



Prof. Dr. J. Sathik Basha

International Maritime College Oman
National University of Science &
Technology (IMCO), Sohar, Oman



Biography:

Prof. Dr. J. Sathik Basha obtained his Doctorate Degree in Mechanical Engineering at the NIT, Trichy, India in the year 2011. He is currently working as a Professor & Head @ NU-IMCO, Sohar. Dr. Basha is an experienced educator and researcher for more than two decades. His current research interests include water-diesel/biodiesel emulsions, thermal desalination, carbon capture techniques, and renewable energy. He has received various research projects totaling over \$1,00,000 in the fields of thermal desalination, waste plastic oil synthesis, etc. He is an expert referee, editorial board member, and advisory board member for more than fifty reputed international journals in the fields of energy, combustion, and power engineering. He has more than ten patents, and published more than eighty research articles, and participated in several national and international conferences. Further, the contents of his research work have been cited more than two thousand times in various technical articles, magazines, and international journals. He is a Recipient of "Best Supervisor Award" by MEDRC & GPCA in the year 2021 & 2023 respectively, and "Best Researcher Award" by IMCO in the year 2021. He has won "Best Teaching Cash Awards" several times. He is one of the top 2% academically cited researchers as per the global Stanford University Ranking consecutively for the past four years. Dr. Sathik is currently working in the area of zero-emission techniques, Carbon capture techniques, and conversion of waste feedstock to potential feedstocks for alternative power generation.

Keynote Speaker



Prof. Dr. Balaji Prabhu BV

Professor
Malnad College of Engineering
India



Biography:

Dr. Balaji Prabhu B V is a Professor in the Department of Computer Science and Engineering at Malnad College of Engineering, Hassan, and a distinguished researcher in the domains of Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Cloud Computing, and IoT. He holds a Ph.D. in Computer Science from Visvesvaraya Technological University and completed his Postdoctoral Research at the prestigious Indian Institute of Science (IISc), Bengaluru, where he worked under the Computational Intelligence Lab in the Department of Aerospace Engineering with a focus on AI and Remote Sensing. With extensive research contributions, Dr. Balaji Prabhu has authored more than 20 papers in SCI and Scopus-indexed journals, multiple international book chapters with Springer, and co-authored the book "IoT Technologies Application for Industry." His innovative work has led to three published patents and recognition through prestigious awards such as the Excellence in Research Award (2021) and Best Young Researcher in Data Analytics (2019). Dr. Balaji Prabhu is widely known for his national-level academic engagement and has delivered 80+ hours of training programs and expert sessions on AI, ML, DL, Data Science, Python, and Data Visualization. He is regularly invited as a resource person, keynote speaker, and session chair for IEEE and other global conferences, contributing significantly to the advancement of next-generation technologies and skill-based education.

Keynote Speaker



Dr. Kavitha A Karkera

Nagarjuna Degree College
India



Biography:

Dr. Kavitha A Karkera is Gold medallist and Rank holder from Mangalore University. She has been honoured with a Doctor of Philosophy degree in Management from University of Mysore. A seasoned academic and finance professional with over 21 years of teaching and 6 years of corporate experience. She has completed an Executive program in Applied Finance from Indian Institute of Management, Lucknow. She has worked in management colleges across India in Mumbai, Bangalore, Hyderabad and Mangalore. A dedicated researcher with a strong focus on finance, having presented papers at national and international conferences and published research in reputed UGC, Scopus, ABDC and Web of Science indexed journals. With 32 research papers published/presented, 2 patents published/ in process and reviewer of online journals, She contributes to advancement in academic knowledge. Actively engaged in academic development through participation in conferences, workshops, FDPs, and seminars. Completed Certificate programmes in Artificial Intelligence, reflecting a commitment to continuous learning and interdisciplinary growth. Served as a Member of the Board of Examiner (BOE) at Bengaluru City University (BCU) and Paper Setter for reputed colleges. She has convened Conferences, workshops, seminars and session chair in conferences. In administration activities she has played a key role in LIC, NAAC, IQAC, AICTE and UGC, coordinating the regulatory and quality assurance framework.

Keynote Speaker



Dr. Rakesh Kumar Donthi

Malla Reddy University
India



Biography:

Dr. Rakesh Kumar Donthi did my postdoctoral school at the School of Computer Science, University College Dublin, Ireland. I completed my Ph.D. in Computer Science Engineering at the National Institute of Technology Patna, India. I have achieved a gold medal in B.Tech Information Technology, the best state rank for admission in M.Tech Software Engineering and the Best International Conference Paper Award NIT. Trichy, given Foreign guest lecturer, Applies many government schemes project contributions, e.g., ANRF, DST, AICTE, ISRO. As a keynote speaker, I got appreciation from a foreign international conference.

Keynote Speaker



Prof. Dr. S.V.A.R.Sastry

Harcourt Butler Technical University
India



Biography:

Dr. S.V.A.R.Sastry has more than 20 years of teaching and research experience. He was B.Tech Gold Medalist from NIT Jalandhar, M.Tech Silver Medalist from IIT Delhi and got Best Ph.D Thesis Award from JNTU Kakinada. He has authored 15 Patents, 25 International Books in the area of Renewable Energy, Unit Operations & Heat Transfer. He has published more than 75 Research Papers and presented papers in more than 60 International Conferences. He is a Member Scientist of CORE GROUP of Scientists on Tree Borne Oil seeds for promotion, utilization and socio-economic linkages in Southern India. He is a Senior Member of Institution of Engineers, Indian Institute of Chemical Engineers, Indian Desalination Association, International Association of Computer Science and Information Technology and Institute for Engineering Research and Publication. He has been awarded Outstanding reviewer status by Elsevier, U.S. and granted full free access to Scopus by Elsevier, U.S. He is an Editor for five International Journals and Editorial Board member for six International Journals. His Biography has been published in Marquis Who's Who in the World, 31st, 32nd & 33rd editions consecutively. He got the Andhra Pradesh University Best Teacher Award from JNTU Kakinada for five consecutive years from 2008 to 2013. He is a Recipient of International Awards from IBC, Cambridge, England. He got selected for inclusion in "100 Best Educators of 2014"; "2000 Outstanding Intellectuals of the 21st Century"; "CAMBRIDGE CERTIFICATE for Outstanding Educational Achievement"; and the prestigious "Leading Professionals of the World-2014" by International Biographical Centre (IBC), Cambridge, England. He is giving consultation in the design and implementation of 'High Speed Industrial Vaporizer', 'Mixing Device for Chemical

Absorption Process’ and ‘Exploring Disruptions, Formulations, and Technologies in Lubricant Industry’ to Convetit, U.S. He has given more than 40 Keynote lectures in various International Conferences held at Brazil, Dubai, Spain, China, Canada, Germany, Italy, France and UK. He received the Pillars of the Nation Award for Excellence and Innovation in Education Sector from the Delhi Vidhan Sabha in 2023. He got the Outstanding Alumni Faculty Award from IIT Delhi in 2023. He got the University Research Excellence Award for 2023, 2024 and 2025 from Hon’ble Governor of Uttar Pradesh. He is selected as Fellow by Institution of Engineers (India) in 2024. He is appointed as ‘Regional Mentor of Change for Uttar Pradesh’ by Atal Innovation Mission, NITI Aayog, GOI, New Delhi in 2024. He was honored with the “Outstanding Leadership in Research and Innovation” Award in the 29 th World Education Summit, New Delhi on 5 th July, 2024. Presently, he is working as Professor and Associate Dean (Research & Development and University Counsellor at the Harcourt Butler Technical University, Kanpur, Uttar Pradesh, India.

Keynote Speaker



Prof. Dr. Nandini Prasad K S

Dean - Foreign Affairs and HoD
Dayananda Sagar Academy of Technology
and Management, Bangalore, India



Biography:

Dr. Nandini Prasad K.S is a Professor, Dean of Foreign Affairs, and Head of the Department of Information Science and Engineering at Dayananda Sagar Academy of Technology and Management (DSATM), Bengaluru. With over 22 years of experience in academia, research, and industry, she holds a Post-Doctoral Fellowship from City University of London (2023), a Ph.D. in Electronics and Communication Engineering (2014), an M.Tech in Computer Science (2005), and a B.E. in Computer Science (2002). Her academic and research expertise spans Compiler Design, Machine Learning, Big Data Analytics, System Modeling, and more. She has published 84+ papers in reputed journals, authored five books, filed 12 patents, and has received multiple national and international recognitions including the Bharat Jyothi Award, Women Researcher of the Year 2023, and NPTEL STAR awards. A Senior Member of IEEE, Dr. Nandini actively guides Ph.D. and post-doctoral scholars, serves as a research supervisor under VTU, and has secured research funding from AICTE and KSCST. She has delivered lectures across India and represented her work internationally in countries such as the UK, Singapore, and Thailand.

Keynote Speaker



Dr. Agughasi Victor Ikechukwu

Assistant Professor
Maharaja Institute of Technology
Mysore, India



Biography:

Good morning/afternoon, everyone. It is a pleasure to introduce Dr. Agughasi Victor Ikechukwu, keynote speaker for this session and Assistant Professor in the Department of Computer Science and Engineering with a specialization in Artificial Intelligence at Maharaja Institute of Technology, Mysore. He earned his Ph.D. from the University of Mysore in 2024, where his research focused on machine learning algorithms for the diagnosis of chronic obstructive pulmonary disease from chest X-ray images. His areas of expertise include medical imaging, explainable AI, deep learning, computer vision, multimodal machine learning, data science, and agentic AI." Dr. Victor has established a strong research profile through publications in respected Scopus- and SCI/SCIE-indexed journals and conferences, with notable work in AI-driven healthcare, medical image analysis, and intelligent systems. He has also served as a reviewer for leading international journals, including International Journal of Computer Vision, Computers in Biology and Medicine, Information Sciences, Machine Learning: Science and Technology, and Applied Soft Computing. In addition, he holds two patents in Medical Imaging, reflecting his growing contribution to innovation in intelligent healthcare technologies." His academic excellence has been recognized with multiple Best Paper Awards, including awards in 2021 and 2024, and earlier in his career he was honored as a Gold Medallist and Best Outgoing Student in PG Science in Computer Science from St. Joseph's University Bangalore. Beyond research, he has actively contributed as a resource person and speaker in workshops and faculty development programs on artificial intelligence, deep learning, research methodology, blockchain, and mobile application development. Please join me in warmly welcoming Dr. Agughasi Victor Ikechukwu.

Keynote Speaker



Dr. Mohd Natashah Bin Norizan

Associate Professor
Universiti Malaysia Perlis (UniMAP)
Malaysia



Biography:

Associate Professor EUR ING Ir. Ts. Dr. Mohd Natashah Bin Norizan is an accomplished researcher, educator, and industry collaborator in electronic engineering and renewable energy. He holds a Ph.D. in Sustainable Energy and Environmental Engineering from Osaka University, Japan (2019), an M.Sc. in Microelectronics from Universiti Kebangsaan Malaysia (UKM), and a B.Eng. (Hons) in Electronic Engineering from Universiti Malaysia Perlis (UniMAP). With over a decade of academic experience, he has significantly contributed to scientific discovery, interdisciplinary collaboration, and engineering education. Currently serving as an Associate Professor at UniMAP, Dr. Mohd Natashah is actively engaged in research related to solar cells, nanomaterials, embedded systems, IoT, FPGA, and thermoelectric technologies, with a strong focus on sustainability. His work has led to numerous publications in high-impact journals and presentations at international conferences. His research excellence is reflected in his H-index scores across Web of Science, Scopus, and Google Scholar. Dr. Mohd Natashah holds the prestigious title of EUR ING (European Engineer), awarded by the European Federation of National Engineering Associations (FEANI), recognizing his high level of expertise, competence, and contributions to the engineering field. He is also a Chartered Engineer (CEng) of the Engineering Council UK, an ASEAN Chartered Professional Engineer (ACPE), a Professional Engineer (P.Eng.) registered with the Board of Engineers Malaysia (BEM), and a Professional Technologist (P.Tech.) under the Malaysia Board of Technologists (MBOT). Additionally, he is a Senior Member of IEEE and an International Professional Registration Advisor for The Institution of Engineering and Technology (IET), UK.

Furthermore, he holds several management positions at the university, demonstrating his leadership capabilities and commitment to academic and institutional development. He is also actively involved in industry collaborations, securing various research grants, and receiving numerous innovation awards. With a strong passion for renewable energy, engineering innovation, and academic excellence, Dr. Mohd Natashah continues to contribute towards a more sustainable and technologically advanced future.

Keynote Speaker



Prof. Dr. V. J. K Kishor Sonti

Pro Vice-Chancellor
Jeppiaar University
India



Biography:

Dr. V. J. K. Kishor Sonti is a distinguished academician and administrator with over 20 years of experience in teaching, research, and academic leadership. He currently serves as the Pro Vice Chancellor of Jeppiaar University, Chennai. He has published over 60 research papers, authored multiple books and book chapters, and holds several patents. Dr. Sonti is actively involved in mentoring students and fostering innovation ecosystems, with significant contributions to institutional development, research guidance, and international academic collaborations.

Session Speaker



Prof. Dr. Budi Nurani Ruchjana

Professor
Padjadjaran University
Indonesia



Biography:

Budi Nurani Ruchjana is a full professor in the Department of Mathematics at Universitas Padjadjaran, Indonesia. She received her B.Sc. in Mathematics from Universitas Padjadjaran in 1987, a Master's degree in Applied Statistics from Institut Pertanian Bogor in 1992, and a Doctorate in Mathematics and Natural Sciences from Institut Teknologi Bandung in 2002. Her research focuses on spatiotemporal modelling, stochastic processes, time series analysis, spatial analysis, geostatistics, and ethnomathematics. She was a Dean of Faculty of Mathematics and Natural Sciences Universitas Padjadjaran and a President of the Indonesian Mathematical Society (IndoMS) at 2012-2016. She was a member of the Commission of Developing Countries International Mathematical Union (CDC IMU) period 2015-2018. She was a coordinator from Universitas Padjadjaran in the International Consortium of Research Innovation and Staff Exchange Social media Analytics (RISE_SMA) year 2019-2024, on H2020 Schema funded by the European Union, with Coordinator Prof. Stefan Stieglitz from Potsdam University. Until now, she was a member of IAENG, European Women in Mathematics (EWM), Association Women in Mathematics (AWM), CWM IMU Ambassador for Indonesia, and EC member of Asian Oceanian Women in Mathematics (AOWM).

Session Speaker



Prof. Dr. Murad Mohammed Al-Nashmi

Arab Academy for Management
Banking and Financial Sciences
Yemen



Biography:

Prof. Dr. Murad Mohammed Al-Nashmi is a distinguished academic and researcher with a Ph.D. in Business Administration from Universiti Utara Malaysia (UUM). He currently serves as the Director of the Yemen Branch of the Arab Academy for Management, Financial, and Banking Sciences, where he is also a faculty member in the Department of Administrative Sciences. Dr. Al-Nashmi has played a key role in developing and evaluating academic programs in administrative sciences for several higher education institutions, including the Arab Academy, the Lebanese University, Al-Rasheed University, and the University of Science and Technology. Renowned for his significant contributions to scientific research, Dr. Al-Nashmi has earned numerous certifications and awards. He has authored over forty-five published research papers, many of which appear in high-impact international journals classified under Q1 and Q2 categories. Additionally, he has written three books on administrative sciences and has supervised numerous master's and doctoral theses. He has also served as Editor-in-Chief of two peer-reviewed journals and has actively participated in various international conferences. Dr. Al-Nashmi is an expert in strategic and institutional development and has contributed to designing organizational structures and strategic plans for various institutions, companies, and banks. He has also worked as a consultant for several organizations, companies, and universities. Furthermore, he is a certified trainer in governance, strategic, and institutional development and has developed multiple training modules and programs.

Session Speaker



Prof. Dr. Beulah Soundarabai P

Professor
CHRIST (Deemed to be University)
India



Biography:

Dr. Beulah Soundarabai P is a Professor in the Department of Computer Science at Christ (Deemed to be) University, Bangalore. She holds an MCA, MPhil, and PhD, with academic and research expertise in Distributed Systems, Machine Learning, Artificial Intelligence, and Data Analytics. Her teaching and research focus on applying advanced computing techniques to solve real-world problems, including IoT-based healthcare systems for the elderly, quantum-inspired optimization, and deep reinforcement learning for keyphrase generation. Dr. Soundarabai has published extensively in reputed journals such as Multimedia Tools and Applications, Advances in Computers, and the International Journal of Intelligent Engineering and Systems. Her recent works explore cutting-edge topics like 5G communication paradigms, portfolio optimization using quantum models, and intelligent text generation. In addition to her research, she actively mentors MPhil and PhD scholars in domains such as semantic keyphrase generation and quantum machine learning. Dr. Soundarabai also conducts workshops and training sessions on data visualization using Power BI and advanced analytics tools, bridging academia and industry needs. Through her publications, projects, and academic leadership, she continues to contribute significantly to the growth of computational intelligence and applied data science education at Christ University.

Session Speaker



Dr. Karthikeyan Dinesh Kumar

University of Jyväskylä
Finland



Biography:

Dr. Karthikeyan Dinesh Kumar is currently a Postdoctoral Researcher at the University of Jyväskylä, Finland, with over a decade of combined experience in academia and industry. His teaching portfolio spans Software Engineering and Artificial Intelligence, and he is supervising several Master's and Ph.D. students in these areas. Dr. Dinesh is actively involved in a Business Finland-funded project, "6G Software for Extremely Distributed and Heterogeneous Massive Networks of Connected Devices," focusing on developing energy-efficient EdgeAI frameworks for computation and communication across distributed edge environments. His research interests include Software Engineering for Edge Intelligence, Cyber-Physical Systems, and Sustainable EdgeAI, with a focus on low-power, green, and context-aware computing for next-generation intelligent systems.

Session Speaker



Dr. V. Harini

Assistant Professor
Vardhaman College of Engineering
India



Biography:

Dr. V. Harini is currently working as an Assistant Professor in the Department of Electronics and Communication Engineering (ECE) at Vardhaman College of Engineering, Hyderabad. She serves as the Faculty Advisor for the IEEE Antennas and Propagation Society under the IEEE Vardhaman Student Branch. She is also actively leading the Industry-Institute Interaction Cell (IIIC) as Convener and serves as an Innovation Ambassador for the Institution Innovation Council (IIC) at Vardhaman College of Engineering. She was awarded her Ph.D. in Millimeter-Wave Antennas from Jawaharlal Nehru Technological University, Kakinada (JNTUK), Andhra Pradesh, India, in January 2024. She completed her B.Tech in Electronics and Communication Engineering from JNTU Hyderabad, Telangana, in 2008, and her M.Tech in Communication Engineering from VIT University, Vellore, Tamil Nadu, in 2010. Her research interests include Wireless Communications, 5G Communications, Femtocells, and Millimeter-Wave Microstrip Antennas, with a special focus on fractal, log-periodic, aperture-coupled, and CPW-fed array antennas. She has published five SCIE-indexed papers along with several publications in Scopus-indexed journals, and has received the Best Paper Award twice at international IEEE conferences held in 2024 and 2025.

Session Speaker



Dr. Sandeep Kumar .R

Associate Professor & Research Head
Faculty of Management
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Bangalore, India



Biography:

Dr. Sandeep Kumar R has completed BBM (HR) from Bangalore University, MBA (MARKETING) from Visvesvaraya Technological University, Ph.D from University of Mysore. He has qualified KSET and UGC-NET (Management), PGDMM from Jain University and M.com From Madurai Kamaraj University. He has handled MBA, M.COM & PGDBA courses. He has 09 years of Corporate Experience having served positions like HR & Marketing Manager, Senior Associate, Associate and 11 years of experience in teaching profession at PG Level. Currently pursuing his teaching career as Associate Professor & Research Head in the Post Graduate Department of Management Studies, Primus School of Management Studies, Bengaluru City University, Singanayakanahalli, Bengaluru- 560064. He has profound knowledge in the subjects of his expertise. Guided several MBA & M.COM final year students in successfully completing their university projects affiliated to Bangalore University & Bengaluru City University (formerly known as Bengaluru Central University). Chaired as the honorable member of the judging committee to judge the papers presented in the National Conference on "Emerging Trends in Business Management", Bangalore. Actively participated in several National Level and International Level Conferences, Seminars, Endowment Lectures, Faculty Development Programmes, Management Development Programmes, Workshops, Symposiums and Faculty Orientation Programme at university level on the research methodology for the guidance of MBA dissertations. He is the Lifetime Member of Management Teachers Consortium (MTC) Global Trust, Lifetime Member of Institute of Scholars (INSC), Bengaluru, Karnataka., Lifetime Member of Inspira Research Association (IRA), Jaipur,

Rajasthan & Member of Indian Academicians and Researchers Association (IARA), Guwahati, Assam. He is an eminent scholar and has authored several research papers at national and international conferences which have been presented and included in the book of proceedings and also in journal publications bearing ISSN and ISBN numbers. Published 23 research papers in several National and International research journals recognized by UGC, UGC-CARE and Scopus indexed journals of international repute and standards. His area of expertise includes Talent and Knowledge Management, Entrepreneurship and Ethics, Organizational Behaviour, Commodity Markets, Human Resource Management, Business Ethics and Corporate Governance, Business Marketing, Services Marketing, Strategic Brand Management, International Marketing Strategy, Advertising and Integrated Brand Management, Talent Management and Employee Engagement, Consumer Behaviour and Neuro Marketing, International Business Dynamics, Management and Organizational Behaviour, Marketing Management and Strategic Management and Business Ethics.

Session Speaker



Assoc. Prof. Dr. Javed Alam

Associate Professor
Chandigarh University
India



Biography:

Dr. Javed Alam is an Associate Professor in the Department of Computer Applications at Chandigarh University, India, bringing over 18 years of experience across academia, research, and industry. He holds a Ph.D. in Computer Application (Artificial Intelligence) and specializes in machine learning, deep learning, fuzzy Logic and AI applications for healthcare and industrial systems. Dr. Alam has around 5 years of industrial experience, during which he led AI-driven healthcare projects at Digibionics LLC and Quantlase Lab LLC in the UAE. He has published widely in Scopus and SCI-indexed journals, serves as a reviewer for journals by Elsevier, Springer, and IOP Science etc. Dr. Alam is also member of professional bodies including the Royal Statistical Society, Royal Society of Chemistry, and others. Beyond research and teaching, he has contributed as a mentor, curriculum designer, and research group coordinator, and has been recognized with appreciation letters for expert sessions and academic contributions. His commitment to advancing AI in real-world applications, combined with his dedication to teaching, research and mentoring, underscores his vision of leveraging technology for societal benefit.

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Prof. Dr. G.P. Ramesh

Conference Convenor
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Biography:

Dr.G.P.Ramesh is a distinguished academician, visionary technologist and ambitious researcher with over 26 years of multifaceted experience spanning higher education, advanced research and industry leadership. His career reflects a seamless integration of academic excellence and technological innovation, positioning him as a transformative force in engineering education and applied research. A dynamic leader and passionate educator, Dr.G.P.Ramesh has served as Professor and Head of Electronics and Communication Engineering at prestigious institutions across India and abroad. He has mentored undergraduate, postgraduate and doctoral scholars, successfully guiding Twenty-Two Ph.D. candidates and nurturing a culture of inquiry and excellence. His academic expertise encompasses artificial intelligence, machine learning, embedded systems, VLSI design and antenna technologies. With more than 125 publications in Scopus-indexed journals, his scholarly influence is evidenced by an H-index of 32 and an i10-index of 70, marking him as a prominent contributor to global research discourse. He has also organized Twelve International and Six National conferences, publishing proceedings with Springer and ensuring global visibility through Scopus and Web of Science. A pioneer in Outcome-Based Education and a strategic advisor for NAAC, NBA and Autonomous frameworks, Dr.G.P.Ramesh continues to shape future-ready engineers and scalable, tech-driven solutions for India and beyond.

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Detecting Brain Tumor Using Deep Learning Techniques

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Abstract

Detection of brain tumors is one of the most important medical imaging tasks that can have a great impact on patient outcomes. An accurate and fast diagnosis is needed to increase treatment success rates and patient's survival. CNNs (Convolutional Neural Networks), where a deep learning techniques, have been very effective in automated tumor classification with MRI scans in recent years. These programs are able to very exactly detect cancers and also help the radio logists by analyzing huge volume of medical pictures with their effective. This work base donkey factors like preprocessing of data, model selection and metric for assessment provides the entire approach eg for identifying brain tumors through deep learning methods. By performing automatically the tumor detection process, this approach will help medical doctors in making more faster and more accurate diagnoses, therefore, patient care will be improved. The proposed method is a good chance for application in real the scenario of medicines inceit can bring down the errors in diagnosis and also increase efficiency in clinical settings. Future investigations might concentrate on the expansion of datasets, enhancement of model generalization, and integration of explainability techniques to build trust in AI-assisted medical decisions.

Keywords

Brain Tumor, Convolutional Neural Networks (CNNs), Medical Imaging, MRI (Magnetic Resonance Imaging), Tumor Classification, Image Preprocessing.

Detecting and Enhancing the Operational Efficiency in ADAS During Wraithgloom

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Abstract

This paper presents an Advanced Driver Assistance System (ADAS) that is intended to improve the safety of vehicles in various harsh weather conditions like fog, snow, heavy rain, and darkness, collectively known as 'Wraithgloom.' By combining YOLOv8 object detection models tailored for specific weather conditions with a real time weather classification and conditional model-switching framework, the system demonstrates excellent detection performance for vehicles, pedestrians, animals, and road potholes. Further complementing the system, various video processing methods such as dehazing and monocular distance estimation offer visual and auditory alerts for unsafe proximity. The experimental results demonstrate a high detection mAP of 85-88 accuracy of weather classification above 90 its efficacy for real-time driver assistance.

Keywords

ADAS, YOLOv8, Weather Classification, Dehazing, Distance Estimation, Conditional Model Switching.

AI-Enabled Autonomous Unmanned Ground Vehicle for Vision and Sensor Fusion-Based Anomaly Detection

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Abstract

Continuous surveillance in defense zones and sensitive areas is often constrained by human risk, operational fatigue, and limited situational awareness. To address these challenges, this work proposes an **AI-enabled Autonomous Ground Patrol Vehicle (UGV)** capable of intelligent patrolling and **multi-modal anomaly detection**. The system combines **real-time vision-based object detection** with proximity sensing to achieve reliable perception in dynamic environments. A **YOLO-based deep learning model**, trained on a custom dataset derived from real surveillance scenarios, enables accurate identification of humans, vehicles, animals, and unidentified objects. Ultrasonic sensors provide complementary spatial awareness for obstacle detection and autonomous navigation. High-level intelligence is executed on a **Raspberry Pi**, while an **ESP32 controller** manages motion control and low-level sensing. The fusion of visual and distance-based information significantly reduces false alarms and enhances detection of confidence. The developed UGV demonstrates effective autonomous movement, real-time anomaly recognition, and flexible operation modes, offering a **cost-effective and deployable solution** for defense surveillance, border patrolling, and security monitoring tasks.

Keywords

Autonomous Ground Vehicle (UGV), Sensor Fusion, Autonomous Patrolling, Defense Surveillance, Deep Learning, YOLO-based Object Detection.

IOT - Enabled Smart Vision Analyzer and Retinal Screening System for Global Health Partnership

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Abstract

The number of world-related vision disorders is rapidly growing, and it concerns persons of any age. The retinal diseases that cause the cases of irreversible blindness include diabetic retinopathy, glaucoma and macular degeneration that cannot be reversed especially when they are not early detected. The availability of ophthalmologists and diagnostic facilities is limited in most of the rural and semi-urban regions; hence, they are usually diagnosed late and their sight is lost forever. Several models of classical retinal screening require manual inspection by experts, which is not only time-consuming but also expensive and highly reliant on the availability of specialists. Convolutional Neural Networks (CNN) can be used to detect the patterns of particular diseases, whereas Internet of Things (IoT) enables the transmission of data in real-time and remote monitoring. In this work, a portable retinal screening system, based on AI and IoT, is suggested, which consists of retinal image capture, OpenCV-based retina image preprocessing and classification of the disease severity on the scales of Normal, Mild, Moderate or Severe based on a trained CNN model. Its results are represented on a web dashboard and sent to an ESP32-based IoT device to provide immediate notifications and have doctors access it remotely. The suggested system is a low-cost, fast and easy-to-use solution that could be implemented in clinics, health camps and rural health facilities and help people to detect early and prevent the occurrence of permanent vision loss.

Keywords

Deep Learning, Convolutional Neural Network, Image Processing, ESP32 Microcontroller, LCD Display.

Electrical Fault Detection in Underground Cables using Arduino UNO and IoT-Based Wi-Fi Module

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Abstract

This project aims to identify fault distortion and classify the type of fault in underground cables using an IoT-based Micro Arduino. Typically, underground cable circuits often experience earth faults or leakage currents, leading to unnecessary power loss. The design detects the occurrence of earth faults, open circuits, and short circuits, providing alerts for each. Using this technique, the exact fault location and type can be easily determined. The voltage passing through the system is continuously monitored by a microcontroller-based system. In such cases, the system sends alerts via text messages on an LCD and mobile notifications through the Cadio App, indicating the type of fault. Additionally, a buzzer alarm provides an audible alert. This approach enhances the efficiency and speed of fault detection.

Finance Tracker

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Abstract

In an era of economic turbulence, effective Personal Financial Management (PFM) is essential; however, many individuals lack organized, real-time tracking tools necessary to succeed. This paper presents the foundational architecture and impact framework for an intelligent and secure Finance Tracker application designed to foster financial discipline and self-efficacy, functioning as a digital financial manager that records, categorizes, and analyzes transactions via reliable automated data synchronization from bank APIs and payment gateways, with advanced features like real-time alerts, customizable budgets, and machine learning-driven predictive analytics. Critically addressing the behavioral paradox of automation reducing self-awareness, it integrates 'active tracking' checkpoints—such as manual verification prompts and gamified reviews—to boost user engagement, mental accounting, and decision-making. Featuring multi-layered security with end-to-end encryption and biometric authentication, a scalable microservices backend, and React Native for cross-platform use, the app supports IoT expense logging; preliminary studies show 25 percent better savings adherence. By promoting financial stability, it advances Sustainable Development Goal 8 (SDG 8): Decent Work and Economic Growth, especially in emerging economies.

Keywords

Component, formatting, style, styling, insert.

Intelligent Smart Footwear with AI-Powered Object Detection and Emergency Alert System for the Visually Impaired

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Abstract

Blind people face a lot of difficulties in moving around safely and getting help in emergencies quickly when the environment keeps changing. Most of the current assistive devices do not have the ability to understand the environment intelligently and also cannot communicate reliably. This paper proposes an AI powered smart shoe system that brings together real time environmental sensing, vision-based perception and emergency notification using IoT. A small camera and ultrasonic sensors take pictures and measure the environment. Data processing is performed on an external computer using a YOLO based object detector, a Haar Cascade based face detector and OCR with text to speech conversion. Processed information is sent to an ESP32 microcontroller via UDP communication over a wireless link, and the user receives real time feedback through vibrations and buzzer alerts. During emergencies, location aware notifications are sent via Arduino IoT Cloud and internet-based SMS support is optional using cloud services. The prototype of such a system has been developed as a proof of concept and it has been tested for remote and instant monitoring, user feedback and obstacle detection functionalities that can help visually impaired users to be more mobile, independent and safe.

Keywords

Assistive Technology, Smart Footwear, Object Detection, YOLO, IoT, ESP32, Visually Impaired Navigation.

Mechanical Behaviour and Characterization of Hot Isostatic Pressing in Inconel 740H

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Abstract

In this work, Inconel 740H is selected due to its excellent high-temperature creep resistance compared with commonly used Inconel alloys such as 625 and 718, making it suitable for next-generation power plant and gas turbine components. To enhance its mechanical properties and creep performance, a powder metallurgy route will be adopted. Based on literature reports highlighting the effectiveness of advanced consolidation techniques in achieving refined microstructures, Prior to HIP, Inconel 740H powder will be subjected to ball milling to improve powder homogeneity. The rapid heating rates and enhanced densification characteristics of HIP are expected to promote porosity reduction, grain refinement, and improved interparticle bonding. The planned work aims to investigate the influence of HIP processing on densification behavior, microstructural evolution, and mechanical properties of Inconel 740H. This includes tensile testing and fatigue analysis to quantitatively validate the anticipated ~10% improvement in mechanical performance including an approximately 7% increase in Tensile strength, compared with conventionally processed Inconel alloys. These evaluations are essential to confirm the suitability of HIP-processed Inconel 740H for long-term high-temperature service.

Keywords

Inconel 740H, Nickel-based Superalloy, Hot Isostatic Pressing, Ball milling, Densification Behavior, Microstructural evolution, Grain Refinement, Mechanical Properties, Tensile Testing.

Analyzing the Thermal Behaviour of Additive Manufacturing of Inconel 740h with Reinforced Graphene

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Abstract

In this investigation, Inconel 740H was selected owing to its superior high-temperature creep resistance and exceptional thermal stability relative to conventional Inconel alloys, rendering it highly suitable for advanced ultra-supercritical power plants and gas turbine applications. To further augment its high-temperature thermal performance, a powder metallurgy approach incorporating graphene as a nanoscale reinforcement was employed within an additive manufacturing framework. Drawing upon prior studies emphasizing the efficacy of advanced consolidation techniques in mitigating thermal gradients and residual porosity, Hot isostatic pressing (HIP) was adopted as the principal densification strategy. Prior to HIP processing, Inconel 740H powder was subjected to high-energy ball milling with controlled graphene additions of up to 10 wt.% to achieve homogeneous dispersion and enhanced interfacial interaction. The synergistic influence of elevated temperature and isostatic pressure during HIP is anticipated to facilitate near-full densification, porosity annihilation, microstructural refinement, and improved matrix-graphene interfacial bonding, thereby enhancing thermal transport characteristics. This study systematically evaluates the influence of graphene-assisted HIP processing on sintering kinetics, thermal behaviour, and microstructural evolution of additively manufactured Inconel 740H, with an anticipated enhancement of approximately 10% in thermal conductivity compared to conventionally processed counterparts.

Keywords

Inconel 740H, Additive Manufacturing, Hot Isostatic Pressing (HIP), Graphene Reinforcement, Thermal Behaviour, Thermal Conductivity, Powder Metallurgy, Sintering Kinetics, Microstructural Evolution, High-Temperature Stability.

Multimodal Industrial Predictive Maintenance using Graph Neural Networks and Large Language Model Fusion

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Abstract

Unanticipated failures in industrial equipment can lead to substantial operational disruption, increased maintenance expenditure, and reduced system reliability. Consequently, the development of intelligent predictive maintenance frameworks has become essential for modern industrial environments. This study introduces a multimodal predictive maintenance methodology that integrates data-driven machine learning, graph-based relational modeling, and Large Language Model (LLM) assisted interpretation to support accurate failure forecasting and actionable maintenance planning. Multivariate time-series sensor measurements from the NASA CMAPSS turbofan engine dataset are utilized to estimate the Remaining Useful Life (RUL) of machinery across operational cycles. The proposed workflow begins with systematic preprocessing, including feature normalization, sensor selection, and RUL target formulation. A supervised learning model is trained to capture degradation behaviour from historical observations, while interdependencies among sensor variables are represented through a graph structure processed by a Graph Neural Network. To enhance interpretability, prediction outputs are further translated into human-readable maintenance insights using an LLM-based reasoning module. The framework is designed to improve predictive reliability while simultaneously providing explainable decision support for industrial monitoring and maintenance scheduling applications.

Keywords

Predictive Maintenance, Graph Neural Networks, Multimodal Industrial Analytics, Remaining Useful Life Prediction, Sensor Time-Series Modeling, Explainable Industrial AI, Large Language Models.

Developing an End-to-End Quantum Network

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Abstract

Many classical cryptographic schemes such as RSA, Diffie Hellman, and Elliptic Curve Cryptography can be broken by quantum computers using Shor's algorithm which can efficiently factorise large integers and solve discrete logarithm problems. Even Grover's algorithm weakens symmetric key cryptography by speeding up brute force key search reducing the security level of schemes like AES, DES and Hash (SHA). To overcome this problem we use a Quantum One Time Pad (QOTP) which encrypts information using random Pauli operations and provides security based on the laws of quantum physics rather than mathematical difficulty. This encrypted data is sent using Free Space Optical (FSO) communication where the information that is transmitted is done via a narrow laser beam through free space and polariser rotating at different angles making the communication fast and difficult to intercept. By combining QOTP based quantum encryption with FSO transmission, the proposed approach offers a quantum-safe end-to-end communication framework.

This can be used in various fields in our day to day applications such as military applications where information security is critical so in our scheme intercepting the signal is almost impossible because we have used Line-of-Sight communication, hence any interception by a 3rd party can be easily detected as it causes a signal disturbance or loss of signal at the receiver, after which the receiver can stop the transmission or take any necessary action. Another application can be space communication where laser light can be used as a form of optical wireless communication between spacecraft, satellites, and ground stations. Let us assume satellite A has to communicate with satellite B. Our satellite A will be the source of green laser (FSO) and our satellite B will have a photoresistor. Knowing that the signal disturbance in vacuum/space is non-existent there will be 100% accuracy in sending across the data.

To add an extra layer of security we have also designed our own encoding and encryption scheme hence, even if the signal is intercepted the cipher text is pretty much useless without the decoding and decryption key.

Keywords

Quantum-Inspired Cryptography, Free-Space Optical Communication (FSO), Quantum One-Time Pad (QOTP), Polarization-Based Optical Modulation, Embedded Optical Communication Systems.

A Cross Format Solar Filament Detection using Enhanced Memory Optimized ResNet Framework

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Abstract

Solar filaments, dark thread-like structure on the surface of sun, are essential for understanding the varying nature of Earth's magnetic field dynamics. The behavioural changes that occurred in the stellar magnetic field due the eruptions in filaments are a major problem, so it is crucial to identify the emission and explosion of these plasma features, as it is vital in predicting atmospheric and geographical changes. Despite various manual detection methods that deliver satisfactory accuracy, it is impractical in processing high-resolution spectroscopic data, especially the Chinese H-alpha Solar Explorer. Extracting heterogeneous features from these massive solar scale observations was time consuming and labour intensive. In this work we have introduced a memory optimized U-Net with ResNet-50 for extracting complex features from the high-resolution solar imagery. Also the model pre-process the raw data by creating an automated mask generation pipeline using K-means clustering. The distinct intensity populations of solar data can be efficiently separated with fewer annotations. In order to ensure cross-format applicability, we have standardised the PNG H-alpha images from ground-based observatories. The experimental results show that our model achieves an average Intersection over Union of 0.9683 with a high precision and obtained a strong generalization across diverse datasets.

Keywords

Solar Filaments, Chinese H-alpha Solar Explorer (CHASE), ResNet-50, IoU, U-Net, Cross Format.

An Intelligent Self Learning Quantum Neural Model for Multi- Horizon Stock Price Forecasting - Stage 1

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Abstract

This work introduces an artificial intelligence-driven multi-timeframe trading system leveraging MetaTrader 5 (MT5) and an ensemble of machine learning models to improve trade signal accuracy. Leveraging higher timeframes (15M, 30M, 1H, 1D) for signal validation, the system runs on a 5-minute Heikin-Ashi (HA) candlestick chart. To create buy/sell signals, it combines SVM, Random Forest, XGBoost, Catboost, MLP, LSTM, RNN models taught on HA OHLC values and technical indicators. While daily automated retraining updates parameters without interfering with ongoing trading, a dynamic weighted ensemble changes model weights depending on real-time accuracy. Through alignment of short-term predictions with more general trends, a multi-timeframe signal aggregation module filters false signals. The system also supports live trading integrated with the MT5 application and Paper trading for demo and backtesting purposes.

The system enhanced the trading accuracy by using HA candlesticks, ensemble learning, and adaptive retraining, thus providing an efficient artificial intelligence-based trading solution.

Keywords

AI-driven trading system, Heikin-Ashi, Ensemble learning, Multi-timeframe analysis, Algorithmic trading.

Exploring Intrinsic Vocal Characteristics through Unsupervised Density-Driven Learning

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Abstract

Human voices differ in pitch, tone, frequency distribution, and overall vocal texture, reflecting complex acoustic and physiological differences across individuals. Previous research focused on traditional speaker diarization systems that rely on supervised identity labels, this study shifts attention towards clustering speakers based on intrinsic vocal characteristics in a fully unsupervised setting. We propose a label-independent framework that groups speakers according to inherent acoustic characteristics rather than predefined identities. A set of pretrained speech encoders, including WaveLM, Wav2Vec 2.0, and OpenSMILE, were employed to extract high level embeddings from raw audio, eliminating the need for manual annotation.

The resulting embeddings are projected into a lower-dimensional space using UMAP to preserve structural relationships within the feature space. Subsequently HDBSCAN is applied for density-based clustering, enabling adaptive cluster discovery without requiring prior specification of the number of clusters. By integrating self-supervised representation learning, manifold learning, and density-based clustering, the proposed framework facilitates structure-preserving exploratory analysis of vocal characteristics. The resulting clusters are evaluated using internal validation metrics such as Silhouette Score and Cluster stability analysis. Experiments conducted on publicly available speech corpora investigate whether the discovered clusters naturally correspond to tonal quality, age-related variation, or speaking dynamics. This work positions speaker clustering as a tool for exploratory acoustic profiling beyond conventional diarization systems.

Keywords

Unsupervised Learning, UMAP, HDBSCAN, Silhouette Score, Cluster Stability Analysis, Speech Representation Learning.

Design and Development of Agentic AI Driven Decision Support Platform for Startups and MSMEs

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Abstract

Startups and Micro, Small, and Medium Enterprises (MSMEs) constitute a fundamental component of economic development by fostering innovation, generating employment opportunities, and contributing to industrial growth. To support entrepreneurial development, governments and financial institutions introduce numerous welfare schemes, subsidies, and financial assistance programs aimed at strengthening the MSME ecosystem. Despite the availability of these initiatives, many entrepreneurs experience significant challenges in identifying suitable schemes due to limited awareness, complex eligibility conditions, and insufficient guidance regarding application procedures and documentation requirements. This project presents the Design and Development of an Agentic AI Driven Decision Support Platform for Startups and MSMEs, which aims to facilitate the discovery and accessibility of relevant government support programs. The proposed system adopts an intelligent decision support approach by analyzing business related attributes and recommending schemes that align with the specific requirements of entrepreneurs. The platform collects essential information such as business type, industrial sector, geographical location, investment capacity, and the stage of enterprise development to construct a comprehensive contextual business profile. To generate accurate recommendations, the system employs advanced artificial intelligence techniques including semantic similarity analysis and vector-based information retrieval methods. These techniques enable the platform to analyze scheme descriptions and identify programs that closely correspond to the user's business profile. A ranking mechanism is further applied to prioritize and present the most relevant schemes, thereby supporting informed and efficient decision making for startups and MSMEs. The proposed platform incorporates an Agentic Artificial Intelligence architecture, in which multiple intelligent agents collaborate to perform specialized tasks such as profile interpretation, eligibility filtering, semantic matching, and recommendation ranking. In addition to recommendation capabilities, the system integrates an interactive Scheme Assistance Chatbot that provides step-by-step guidance on scheme application procedures, including detailed information regarding eligibility conditions and required documentation. Furthermore, the platform includes an AI-based document validation module, which allows users to upload application documents and verifies their completeness and validity through automated text extraction and verification techniques. This functionality reduces errors in document submission and enhances the reliability of the application process. Overall, the proposed platform improves accessibility to government welfare schemes and simplifies the process of identifying and applying for appropriate support programs. By integrating AI-driven recommendations, conversational assistance, and automated document verification, the system serves as an intelligent decision support tool that empowers startups and MSMEs to effectively utilize available opportunities for sustainable business growth and development.

Sustainable Power Flow Optimization in Renewable-Driven Microgrids Using Population-Based Multi-Objective Meta-Heuristics

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Abstract

Optimal Power Flow (OPF) is a critical challenge in the efficient and sustainable operation of modern smart grid technologies, particularly in microgrids, where diverse energy resources and fluctuating demand patterns complicate decision-making processes. The increasing penetration of renewable energy sources has introduced significant variability and uncertainty, necessitating advanced optimization techniques to balance competing objectives. In this paper, the OPF problem is formulated as a Multi-Objective Optimal Power Flow (MOOPF) problem, with objectives including minimization of operational costs, voltage stability, and emissions, as well as maximization of renewable energy utilization and grid reliability. To address the complexity of this problem, population-based metaheuristic algorithms such as Non-Dominated Sorting Genetic Algorithm-II (NSGA-II) and Multi-Objective Particle Swarm Optimization (MOPSO) are employed as they effectively explore the solution space, handling the nonlinear, multimodal, and constraint-heavy nature of the MOOPF problem while providing a set of Pareto-optimal solutions that capture trade-offs among conflicting objectives. The proposed approach is validated through simulations in microgrid test systems with diverse renewable energy profiles, demonstrating its ability to handle high levels of renewable penetration. The results highlight significant improvements in operational efficiency, renewable energy integration, and computational performance. This work emphasizes the potential of population-based metaheuristic algorithms and highlights the critical role of multi-objective OPF in enabling the sustainable and reliable integration of renewables in smart grids, paving the way for a greener energy future.

Keywords

Optimal Power Flow, Microgrids, Renewable Energy Integration, Multi-Objective Optimization, Population based Meta-Heuristics.

RakshaNetra: Securing Intelligent AI-Powered Framework for Vigilance and Cyber Awareness

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Abstract

Cybercrime complaints have shot up lately, and honestly, the old reporting systems just can't keep up. Most websites only collect complaints and leave investigators to sift through everything by hand. It's slow, and cases often get stuck in limbo or aren't prioritized the right way. That's where RakshaNetra comes in. It's a secure, practical setup that actually helps with reporting and investigating cybercrimes using AI. The system sorts complaints automatically, figures out how risky they are, and puts together quick summaries so investigators can get the gist of each case right away. Access and permissions are handled with a three-tier, role-based model, so everything stays secure and accountable. Anyone can use RakshaNetra—victims can report anonymously or register if they want, and there's a mobile app for them, plus a web dashboard for investigators. In tests, even in a simulated setup, RakshaNetra made everything faster: cases got handled sooner, the important ones got flagged first, and investigators had a much clearer view of how things were moving along.

Comprehensive AI-Powered Mental Health Analysis and Crisis Prevention System with Multi-Modal Behavioural Intelligence and Predictive Risk Assessment

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Abstract

Mental illnesses are on the rise and are mostly unaddressed because they are based on subjective scores and accounts and are late in administering clinical care. The study introduces a machine learning-driven predictive system related to analyzing mental health behavioural aspects and satisfying treatment needs with the help of structured behavioural and demographic information. The system combines the preprocessing steps of data, categorical encoding of data, scaling of the features and supervised learning models to categorize mental health cases and determine whether they require treatment assistance or not. Two analysis pipelines are introduced, one is devoted to predicting behavioural risks, and the other to classifying the outcomes of the treatment. To measure model performance, proper classification measures are used so that reliability and generalizability is achieved. The suggested approach proves the adequacy of the data-based mental evaluation systems in detecting patterns of psychological risks at their initial stages. The framework will help healthcare practitioners anticipate intervention planning and tailored mental health care thus enhancing the accuracy of early detection and efficiency in decision-making during clinical and digital health situations.

Keywords

Mental Health Prediction, Machine Learning, Behavioural Analysis, Treatment Classification, Supervised Learning, Data Preprocessing, Feature Engineering, Classification Models, Psychological Risk Assessment, Digital Health Analytics.

Experimental Validation of an IoT-Based Dual-Tank Water Monitoring System

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Abstract

In homes and community water management systems, ensuring continuous, effective, and automated water distribution continues to be a major difficulty. The design and implementation of an Internet of Things (IoT)-based Dual-Tank Water Monitoring and Management System that uses intelligent sensing and control to handle these issues is presented in this study. The suggested system uses a DS18B20 temperature sensor to monitor water temperature across two connected tanks, an ESP32-S3 microcontroller combined with ultrasonic and capacitive level sensors for precise water-level measurement, and a YF-S201 flow sensor for flow-rate monitoring. In the created architecture, a secondary backup tank automatically sustains the system when the water level drops below predetermined thresholds, while the primary tank provides water to nearby homes. Through a Flask-based API, real-time sensor data is concurrently stored in a MySQL database for historical recording and analytical insights, and it is sent to a Blynk IoT dashboard for live viewing. A relay-controlled pump mechanism enables autonomous tank switching, and integrated alarm modules offer email and optional SMS warnings in the event of anomalous operating conditions. Reliable connectivity, accurate level estimate, efficient pump management, and seamless tank changeover were all shown by experimental assessment. The findings verify that the suggested system offers a reliable, scalable, and economical solution for intelligent water distribution in residential complexes, smart homes, and community-level water resource management applications.

Keywords

IoT, Dual Tank Automation, Water Level Monitoring, Blynk Cloud Dashboard, Smart Water Management.

Energy-Efficient, Scalable, and Secure Routing Protocols for Wireless Body Area Networks: A Comprehensive Survey and Future Directions

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Abstract

Wireless Body Area Networks provides constant health monitoring using wearable and fixed sensors. These nodes work with batteries of one hundred to five hundred mAh and often transmit dynamic data every one to five seconds. Routing plan directly distresses network lifetime, suspension, and patient security. Many present protocols progress one metric but damage others. Energy sanitations quickly due to frequent retransmissions, thermal things in implanted nodes, and flexibility caused by body movement. Safety adds upstairs that further decreases lifetime. This work shows a complete review of routing protocols for Wireless Body Area Networks with concentration on energy efficacy, scalability, and security. We analysis more than 70 papers published between 2015 and 2025. We categorize protocols into flat, ranked, cross-layer, thermal-aware, QoS-aware, and trust-based categories. We compare them using quantifiable metrics such as network lifetime, packet delivery ratio, end-to-end delay, output, and energy per bit. According to the results, frivolous encryption increases energy consumption by 5 to 15%, while cluster-based routing can extend network lifetime by 20 to 35% when compared to flat routing. Scalability beyond 20 nodes is addressed by rare protocols. Flexibility and dynamic circulation cause the majority to fail. We categories deficiencies in adaptive routing, lightweight security integration, and thermal management under mobility. We concentrate on practical approaches such as federated learning for dispersed optimization, AI-driven routing, energy harvesting support, and frivolous cryptanalysis. These insights direct researchers toward reliable, implementable routing outcomes for healthcare structures of the future.

Keywords

Wireless Body Area Networks, Safe Routing Protocols, Network Scalability, Thermal-Aware Routing, Energy- Efficient Routing.

An Interpretable Cross-Modal Attention-Based Deep Learning Framework for Multimodal Cancer Detection

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Abstract

Early and accurate cancer diagnosis remains one of the most critical challenges in modern healthcare. Traditional unimodal diagnostic approaches—such as radiology, histopathology, or genomics—offer valuable but fragmented insights, often resulting in incomplete clinical interpretations. This research proposes an interpretable cross-modal attention-based deep learning framework for multimodal cancer detection, designed to integrate heterogeneous data sources including radiological images, histopathology slides, genomic profiles, and structured clinical records. Each modality is processed through a dedicated deep encoder—3D CNNs for imaging, Vision Transformers (ViTs) for histopathology, transformer-based sequence models for genomics, and MLPs for clinical data—to extract high-level feature representations. These are fused using a cross-modal attention mechanism that dynamically learns inter-modality relationships and gracefully handles missing data. The attention weights further serve as an intrinsic interpretability feature, revealing the contribution of each modality to the final diagnostic decision. Experimental validation on benchmark multimodal datasets demonstrates that the proposed framework achieves superior accuracy, robustness, and generalization compared to unimodal and existing fusion-based models. Moreover, a Clinical Decision Support Dashboard provides transparent visual explanations through saliency maps and modality importance scores, fostering clinician trust and practical usability. The results highlight the potential of interpretable multimodal AI to transform diagnostic precision, reduce uncertainty, and advance personalized cancer care.

Keywords

Multimodal Deep Learning, Cancer Detection, Cross-Modal Attention, Explainable AI, Medical Imaging, Genomics, Clinical Decision Support.

Multi-Keywords Searchable Attribute-Based Encryption with Verification and Attribute Revocation Over Cloud Data Using Python and Cloud Computing

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Abstract

With the exponential rise in cloud storage usage, ensuring the security, privacy, and efficiency of data retrieval has become a critical concern. Traditional encryption methods often fall short in providing fine-grained access control and secure searchability over encrypted data. To address these limitations, this project introduces a Multi-Keywords Searchable Attribute-Based Encryption (MK-ABE) system, a novel approach that synergizes attribute-based encryption (ABE) with secure multi-keyword search functionality.

The proposed MK-ABE system allows users to perform search queries using multiple keywords without compromising data confidentiality, significantly enhancing usability and flexibility. It incorporates fine-grained access control based on user attributes, ensuring that only authorized users can decrypt and access specific data. A standout feature of this system is attribute revocation, which enables dynamic modification of access rights, addressing scenarios where users' roles or permissions change over time. Another critical component is data integrity verification, which ensures that search results are both accurate and unaltered, building trust in the retrieved data. The system will be developed using Python and deployed on cloud platforms, aiming to deliver a scalable, high-performance, and cost-effective solution suitable for both academic and enterprise environments.

Keywords

Cloud Storage, Data Security, Multi-Keyword Search, Attribute-Based Encryption (ABE), MK-ABE, Attribute Revocation, Access Control, Secure Searchable Encryption, Data Integrity Verification, Python, Cloud Computing, Encrypted Data Retrieval, Fine-Grained Access Control, Scalable Solutions, Privacy-Preserving Search, Dynamic Access Management, Secure Cloud Applications, High-Performance Encryption, Cryptography in Cloud, Confidential Data Access.

Statistical Mix Proportion Optimization of Sustainable Geopolymer Binder Systems using Taguchi Methodology

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Abstract

This study presents the parametric optimization of fly ash–GGBS based geopolymer concrete (GPC) using the Taguchi L25 orthogonal array design. Geopolymer concrete provides a low-carbon alternative to ordinary Portland cement; however, its mechanical properties are highly dependent on mix proportions and alkaline activator characteristics. In this work, four key parameters—fly ash content, GGBS percentage, NaOH molarity, and alkaline activator-to-binder ratio—were investigated at five levels to determine their influence on compressive strength. The experimental effort was significantly reduced by applying the Taguchi optimization technique, wherein only 25 cubes were cast instead of the 625 cubes required in a full factorial design, while still enabling prediction of compressive strength. Cube specimens (70.6 × 70.6 × 70.6 mm) were prepared, cured under controlled conditions, and tested at the designated age. The results were analyzed using signal-to-noise (S/N) ratios and analysis of variance (ANOVA), which identified GGBS content and NaOH molarity as the most significant factors affecting strength development. The optimum mix consisting of 40% fly ash, 60% GGBS, an A/B ratio of 0.5, and 12M NaOH achieved an average compressive strength of 45.31 MPa, outperforming all other trial combinations. The findings validate the effectiveness of Taguchi-based optimization for geopolymer mix design and highlight the potential of optimized GPC formulations for sustainable and high-performance construction applications.

Keywords

Geopolymer Concrete, Fly ash, Taguchi, ANOVA, Mix Design, GGBS.

Evaluating Data Augmentation Strategies for Fine-Tuned Language Models

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Abstract

Despite being widely used, little is known about data augmentation techniques for large language models (LLMs) beyond basic accuracy metrics. Although back-translation is often preferred due to its high classification accuracy, simultaneous optimisation of ranking performance, computational efficiency, and calibration quality is required for real-world deployment. A multi-evaluation framework that goes beyond single-metric tests is presented in this paper. Baseline, back-translation, masked language modelling, and T5 paraphrasing are the four augmentation techniques that are systematically compared across two different architectures: GPT-2 (decoder-only) and DeBERTa (encoder-only). Eight model variants are evaluated using nine metrics, with a focus on BoolQ dataset. These metrics cover classification performance (accuracy, precision, recall, F1), calibration quality (ROC-AUC, Brier score, Expected Calibration Error), and ranking quality (MRR, nDCG@5). Important conclusions show that the effectiveness of augmentation is strongly influenced by architectural design. Across all methods, the bidirectional attention of DeBERTa consistently performs better than the unidirectional constraint of GPT-2. More significantly, a surprising finding contradicts the norm: when efficiency and calibration are taken into consideration, masked language modelling is the best approach, even though back-translation has the highest accuracy (87.69%). It performs at an excellent balance in both. Although masked-LM with DeBERTa has a lower weighted composite score (0.9437) than back-translation with DeBERTa (0.9705), masked-LM is a more reliable option due to its consistent performance across both architectures.

Keywords

Data augmentation, large language model, calibration, multi-metric evaluation, BoolQ.

Broadband Absorption in a Symmetric Resonator-Based Metamaterial Absorber via Geometric Modulation

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Abstract

Metamaterial Microwave Absorbers have emerged as promising candidates for radar cross-section reduction and electromagnetic interference shielding applications due to their engineered electromagnetic response. Conventional resonant MMAs give high peak absorption but suffer with narrow bandwidth. The designed structure consists of a metallic ground plane, a dielectric substrate, and a frequency selective metallic resonator fabricated on the top surface. In contrast to traditional uniform-thickness resonators, the top metal layer is deliberately patterned with two distinct thickness values, arranged symmetrically inside the unit cell. This intentional thickness variation alters the effective inductance and capacitance, as well as the surface current paths, resulting in several closely spaced resonance modes. The impedance matching condition between free space and the absorber is improved due to the resonance behaviour, thereby enhancing absorption bandwidth while maintaining high peak absorption. The symmetric design ensures polarization insensitivity, making the structure suitable for stealth and EMI shielding applications in the microwave regime. In this work, a broadband microwave metamaterial absorber is proposed by introducing a multi level thickness and length variation in a symmetric top resonator configuration. We design a structure that offers an efficient way to surpass the narrowband constraint without substantially raising structural complexity while still preserving a greater than 90% absorbance and increasing the bandwidth to nearly 2X in 8-20 GHz.

Electronics and Logic Development for Grasping Objects using Sensor Array on Robotic Gripper

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Abstract

Reliable grasping with minimal force is critical for safe and efficient robotic manipulation, particularly when objects exhibit diverse geometries and structural compliance. Stable grasping requires timely slip detection and adaptive force-control while avoiding object damage and maintaining a secure hold. This paper describes a tactile feedback-based slip detection and regrasping control framework for a three-finger gripper equipped with 3x3 PDMS-based piezoresistive sensor arrays. Unlike conventional methods, the proposed approach is generalized for all objects possessing defined geometric forms without explicit object models or material properties. Slip is detected by analyzing temporal and spatial variations in sensor resistance patterns. They were arranged on a 3-finger robotic gripper to test grasping, slip detection, and re-grasping of multiple objects. Upon slip detection, a closed-loop controller adaptively increases gripping force in discrete increments ($rFR=+50$) until the spatial tactile response stabilizes to ensure a secure hold. The gripper employs a minimum-force strategy, achieving a user-specified initial normal force by closing fingers until feedback matches a target normalized response. A precision impact tester was used to characterize the sensor to ensure consistent force estimation and the resulting force-resistance mappings were then integrated into the control loop using a Random Forest Regression model. System logic is partitioned between an Arduino Mega 2560 R3 for slip-detection and a Python environment for gripper actuation and force regulation. Experimental validation on diverse objects, including a fragile egg, demonstrates robust slip-detection and stable grasp maintenance, highlighting the effectiveness of spatial tactile sensing for adaptive, model-free manipulation in sensitive environments.

An Efficient XGBoost Approach for Cervical Cancer Risk Assessment in Women

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Abstract

Cervical cancer are a huge cause of multiple cancer fatalities worldwide, especially in progressing regions. Predicting risk early and acting accurately is important for lowering these rates. In this study, we present a learning module through a machine adjective that uses the XGBoost Approach Algorithm to identify cervical cancer risk at an early stage. The model analyses clinical and risk factor to find high-risk patterns. The dataset includes medical details such as age, male sexual behavior, medical history, smoking etc. It also specifies various sexually transmitted diseases. We improved the missing data by handling the procured values, selecting important features, and neutralising the provided information. The procured data was divided into testing and training sets. XGBoost had been selected because it works well with structured clinical data and is more accurate than other machine learning methods. We measured the performance of the provided model using the specified accuracy, recall score, F1-score etc. The results obtained showed that XGBoost algorithm provides better identification of the accuracy provided and also provides generalized algorithm compared to other classification algorithms. The system is meant to support, not replace, professional medical diagnosis. It acts as a first step to highlight possible risks and encourage people to seek medical advice promptly; by analyzing multiple clinical and lifestyle factors simultaneously. The model helps reveal various arcs that may not be adaptable in traditional medical assessment. Such intelligent decision-support systems can reduce the burden on healthcare facilities by prioritizing patients who are at higher risk. When seen in long term prospects, the procured model could be improved by co-assisting through larger and more diverse datasets, additional medical parameters, and real-time clinical data through which it can further enhance prediction, accurate values and reliability among algorithms.

Keywords

Cervical Cancer Prediction, XGBoost Algorithm, Machine Learning, Medical Data Analysis, Early Cancer Detection Classification Models, Clinical Decision Support System.

A Portable Optical Biosensing System for Real-Time Hemoglobin Monitoring with Quantitative Validation

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Abstract

Reliable and rapid evaluation of hemoglobin concentration is fundamental for diagnosing and managing numerous clinical conditions, yet existing approaches largely depend on invasive sampling and centralized laboratory infrastructure. Such constraints limit their effectiveness in decentralized, resource-limited, and field-based settings. In response, this study introduces a compact optical biosensing platform engineered to enable non-invasive and near real-time estimation of hemoglobin levels.

The system operates on multi-wavelength photoplethysmographic sensing, exploiting wavelength-dependent optical absorption characteristics of blood. A high-sensitivity acquisition module, built around the ADPD4100 sensor, facilitates stable signal capture under diverse physiological and environmental conditions. A key contribution of this work is the implementation of a dynamic wavelength selection mechanism that adaptively prioritizes optimal spectral bands based on signal quality indices, improving robustness under varying skin tones and perfusion levels. The collected signals are processed through an embedded computational pipeline incorporating adaptive filtering, calibration modeling, and supervised learning algorithms, enhancing estimation fidelity while mitigating motion-induced disturbances and ambient interference. In addition, a hybrid calibration framework combining physics-based modeling with data-driven regression is introduced to improve cross-subject generalization without requiring extensive recalibration.

Performance evaluation was conducted on a hybrid dataset consisting of controlled prototype measurements and simulated variations across a hemoglobin range of 8–18 g/dL. The proposed model achieved a **mean absolute error (MAE) of 0.68 g/dL**, a **root mean square error (RMSE) of 0.91 g/dL**, and a **mean absolute percentage error (MAPE) of 5.2%** relative to reference values. The system demonstrated a strong **correlation coefficient (R^2) of 0.93**, with a **Bland–Altman analysis indicating limits of agreement within ± 1.8 g/dL**, confirming consistency with standard clinical measurements. Furthermore, the proposed adaptive wavelength selection improved signal-to-noise ratio by approximately **18%**, while reducing motion artifact impact by **~22%** compared to fixed-wavelength configurations. The average processing latency was maintained below **10 seconds per reading**, with an operational power consumption under **120 mW**.

The compact and energy-efficient design enables deployment in rural healthcare environments, emergency response scenarios, and defense applications. Wireless communication support further facilitates remote monitoring and integration with digital health infrastructures.

Overall, the results validate the effectiveness of integrating adaptive optical sensing with intelligent signal processing for non-invasive hemoglobin estimation. This device demonstrates strong potential as a scalable, real-time diagnostic solution, contributing to the advancement of accessible healthcare technologies through interdisciplinary innovation.

Keywords

Non-invasive Hemoglobin Estimation, Photoplethysmography (PPG), Optical Biosensing, Adaptive Wavelength Selection, Machine Learning in Healthcare, Point-of-Care Diagnostics, Real-Time Monitoring, Hybrid Calibration Model, Defense Application.

Improving Diagnostic Accuracy and Patient Outcomes through AI-Driven Early Detection of Brain Tumors

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Abstract

In this paper, an AI-based system of automated brain tumor detection, segmentation, and multi-class classification of multi-modal MRI is described to enhance the accuracy of diagnostic and clinical efficiency. The system manages to combine a self-configuring convolutional backbone with transformer-based attention mechanisms and transfer-learning-based classifiers to detect the local and global characteristics of tumors and include explainability and uncertainty estimation as a way of achieving clinical transparency. The proposed method was tested on cross-validation of patients and traditional benchmarking metrics, demonstrating better results than both popular CNN and U-Net baselines, high Dice scores of tumor subregions, and high classification accuracy on glioma, meningioma, and pituitary tumors. The methods of optimization also facilitated the opportunity to practically implement it, and it was proven that hybrid models of deep learning can be used to assist with early intervention and lessen the load of radiologists.

Keywords

Brain tumor detection, MRI; Deep learning, Vision transformer, Medical image segmentation, Tumor classification, Explainable AI, Clinical decision support.

Cybersecurity Protection Mechanisms for Critical Power Sector

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Abstract

The increased integration of Information and Communication Technologies (ICT) in critical power infrastructure has enhanced efficiency and automation in power systems as well as real-time monitoring systems. However, this increased reliance on digital systems has also created a number of vulnerabilities that make power systems more susceptible to cyber threats. Threats such as Denial of Service (DoS), Man-in-the-Middle (MITM), and false data injection can compromise power system operations and potentially cause huge losses through power outages.

This paper focuses on cybersecurity protection mechanisms in critical power infrastructure systems through an analysis of existing vulnerabilities and research gaps as well as the existing defense mechanisms in the power sector. The paper identifies a number of challenges that make cybersecurity a significant issue in the power sector. These challenges include the inability of power systems to detect threats in real-time, insufficient protection mechanisms for legacy systems, as well as the inability to integrate physical and cybersecurity mechanisms in a cohesive manner.

The study highlights the importance of a comprehensive and dynamic approach to cybersecurity for the safeguarding of critical power infrastructure. This includes a multi-layered approach that incorporates the use of sophisticated detection systems, strong protection for both contemporary and traditional systems, and effective cyber-physical security systems. This not only makes the systems more robust but also allows for the secure and effective operation of contemporary power systems.

Keywords

Cybersecurity, Cyber-attacks, Power system.

A Privacy-Preserving Federated Learning Framework for Real-Time Cryptocurrency Fraud Detection Using Hybrid Machine Learning Models

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Abstract

The exponential increase in the incidence of criminal activity relating to cryptocurrencies has been as a result of the rapid advancement of cryptocurrencies in the currency market. thus there are more challenges towards financial institutions and also towards the consumers who use it. This document describes a Blockchain-based Federated Learning (BCFL) System that allows the check for the occurrence of cryptocurrency fraud in a safe, scalable fashion while maintaining the privacy of the consumer. By using federated learning in combination with Blockchain technology, organizations like banks and cryptocurrency exchanges can collaborate to develop a fraud detection algorithm without the involvement of consumer's transaction data. Key features of this system are secure training of local models, encrypted sharing of model updates, decentralized aggregation of model updates and prediction of fraud. The use of Blockchain enables all parties involved to have some level of transparency and trust amongst each other, that is due in large part to the use of a lightweight consensus algorithm that helps to increase the efficiency of this system and reduce the processing burden. Also, the combination of hybrid Random Forest and Convolution Neural Network model generates additional accuracy improvement over detection based on pure statistical methods and those based on pure deep learning methods as it is capable of modelling statistical and deep transactional behaviours. The system was implemented using a real-world dataset; and the results achieved using our system achieved greater accuracy, precision, recall and ROC-AUC than traditional model-based methods. By marrying together scalable, privacy preserving and intelligent fraud detection, we believe that our system has the ability to provide a traditionally robust platform enabling effective protection against current challenges surrounding cryptocurrency-security.

Keywords

Cryptocurrency Fraud Detection, Blockchain, Federated Learning, RF-CNN, Privacy Preservation, Distributed Learning, Cybersecurity.

Real-Time Health Insights Pipeline Using Big Data Streaming and Machine Learning

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Abstract

Modern healthcare systems generate large amounts of patient information in the form of prescriptions, laboratory reports, and clinical notes. However, because most of this data is unstructured and processed using conventional batch methods, it is challenging to use right away. The real-time healthcare analytics pipeline presented in this work is intended to transform clinical documents into practical insights for quicker medical decision-making. The suggested system uses OCR techniques to process medical documents, then continuously ingests the extracted data via Apache Kafka. The data is cleaned, key features are extracted, and patient-level records are prepared for analysis using Apache Spark Structured Streaming. Predictive models are used to categorize glucose risk levels, identify aberrant laboratory conditions, and assess the severity of diseases. Processed records are stored in MongoDB, and real-time patient insights visualization is made possible by a dashboard interface. The system consistently detects significant clinical risk patterns from streaming healthcare data, according to experimental results. The study shows how scalable and useful healthcare monitoring systems for early risk detection and enhanced clinical decision support can be supported by combining real-time data streaming with machine learning.

A Pipeline-Based Approach for Summarizing Long Legal Judgments Beyond Transformer Input Limits

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Abstract

Legal judgments are often lengthy, unstructured, and complex, making them difficult to summarise using standard transformer-based models due to input length limitations. This work focuses on developing a scalable pipeline-based approach for summarising long legal documents using token-level chunking and hierarchical aggregation. The proposed approach segments documents into overlapping chunks, processes them using a LongT5 model, and combines intermediate summaries into a coherent final output. The system also integrates document validation and a case-type classification module based on TF-IDF feature extraction and a Logistic Regression classifier trained on 4,905 labeled cases. The approach is evaluated on 500 Indian Supreme Court judgments exceeding standard input limits. In addition to detailed summarisation using LongT5, a BART-based model is used for short summary generation to enable comparative analysis. Experimental results show that LongT5 achieves ROUGE-1, ROUGE-2, and ROUGE-L scores of 0.1592, 0.0269, and 0.1230, respectively, with a BERTScore (F1) of 0.7608, outperforming BART, while the classification module achieves an accuracy of 0.89, weighted F1-score of 0.90, and macro F1-score of 0.61. These results demonstrate that the proposed approach effectively generates structured and coherent summaries for long legal documents, making it suitable for real-world legal applications.

Design and Analysis of Solar Powered Eco-Friendly and Efficient Coir Moisture Removal System

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Abstract

The objective of this research work is to develop and test an automatic system for removing moisture from coir and compare its drying efficiency with the existing conventional drying method through statistical analysis. In this study, the existing conventional drying process is compared with automatic moisture control. Process. The proposed automatic coir moisture removal system, in which a rotating drum mechanism, hot air flow, and microcontroller-based moisture sensor feedback control are employed. A total sample size of 03 coir samples was taken for each group with similar initial moisture content ranging from 54% to 58%. The variables taken for analysis are final moisture content and drying time. Statistical analysis was done using mean, standard deviation, and independent sample test. The results obtained clearly depicted that the speed of the drums has a major impact on the removal of moisture content in the proposed system for automatic coir drying. At an initial moisture content of 57% and a blower temperature of 138°C, it was indicated that the final moisture content of the coir material reduces with an increased speed of the drums. At 110 rpm, the final moisture content was found to be 19%, which reduced to 16% when the speed increased to 130 rpm and further reduced to 11% at a speed of 150 rpm. It has been affirmed from this study that the proposed automatic coir moisture removal system indeed works properly at various higher rpm. In addition, out of all the conditions tested, 150 rpm results in minimum moisture content and therefore optimal drying. It is inferred from this study that the rpm of the drum plays an important role in drying, and this proposed system is applicable to efficient coir processing.

Keywords

Automatic coir moisture removal system, Coir drying, Moisture content, Drying time, Hot air drying, Microcontroller-based control, Statistical analysis, independent sample t-test.

An IP Based Login System for Enhanced Security

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Abstract

In today's digital era, ensuring the security of online accounts is of paramount importance. Traditional password systems often fall prey to unauthorized access due to static credentials and predictable patterns. To address this, this paper introduces a novel approach of "Fourth Login" for dynamic password generation. This approach leverages a user's IP address to generate unique, time-sensitive passwords for every login attempt. The generated password is automatically sent to the registered user via secure channels, ensuring seamless and secure authentication. By incorporating dynamic password generation, the system mitigates risks associated with static passwords, such as brute-force attacks and credential theft. The paper focuses on implementing robust Heuristic (Rule-Based) Algorithm algorithm to ensure IP-based password uniqueness and uses encryption to maintain password confidentiality during transmission. This innovative solution offers a user-friendly and scalable authentication mechanism, contributing to enhanced cybersecurity for applications requiring high-level protection.

Detecting Fake Users Over Online Social Networks Using Social Graph Analysis

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Abstract

In recent years, social media platforms have become popular spaces for people to connect and share information. However, some groups or users on these platforms are created with fake or misleading identities to spread false information, manipulate opinions, or conduct fraudulent activities. Detecting such fake users is important to maintain trust and safety online. This project aims to identify fake users by analyzing social network data, such as user connections, and interaction behaviours. Using techniques from Social Network Analysis (SNA) and Graph Theory, the system can detect unusual patterns like tightly connected groups with low individual credibility or automated activity. We will be Using Graph Theory based Algorithm as Jaccard Similarity, Degree Centrality, Betweenness Centrality. By identifying these fake users early, this work helps improve the security and reliability of social media platforms.

Early detection of fake users helps to prevent the spread of false information, reduce coordinated manipulation, and protect genuine users. This research strengthens the reliability and security of social media platforms and demonstrates that social graph analysis is an effective approach for maintaining trustworthy online environments.

Performance Analysis of Polymer-Enhanced Bitumen in Flexible Pavement Applications

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Abstract

In recent times, improving the strength and durability of flexible pavements is a key concern for engineers. The present study investigates the performance characteristics of polymer modified bitumen (PMB) in flexible pavement mix design with the objective of enhancing durability and load-bearing capacity. Different proportions of polymer additives were blended with conventional bitumen, and a series of laboratory tests were conducted to evaluate their influence on material properties. Standard tests such as penetration, softening point, and ductility were carried out to assess the basic characteristics of the modified binder. In addition, Marshall mix design tests were performed to determine stability, flow, and volumetric properties of the bituminous mixtures. The experimental results, analyzed using spreadsheet-based tools, reveal that the inclusion of polymers significantly enhances the performance of bituminous mixes. An increase in Marshall stability and softening point indicates improved resistance to deformation and temperature variations. Meanwhile, penetration and ductility values showed controlled changes, suggesting better flexibility and cohesion of the binder. The study also identifies an optimum polymer content that provides maximum performance benefits without adversely affecting workability. Overall, the novelty of the proposed findings demonstrate that polymer modified bitumen can effectively improve the mechanical behavior and service life of flexible pavements, making it suitable for use in high-traffic and challenging environmental conditions.

Keywords

Flexible pavements, cohesion, binder, polymer modified bitumen, polymers.

Influential User Detection Using Centrality Measures of Social Network Analysis

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Abstract

Influential users are those users over online social networks that are acting as the mover and shakers in the given social networks. To detect these influential users in online social networks is the need of the hour and their detection using the novel approaches will be having many real world implications. In this project we are going to detect these influential users using centrality measures of Degree Centrality, Betweenness Centrality, Eigenvector Centrality, Closeness Centrality Social Network Analysis Techniques and then will be going to lay a comparative study. All the experimentations will be done in Python and proposed approach will be tested on real work social network datasets from opensource dataset repositories. The proposed approach will be having many real world implications.

Community Detection in Online Social Media Using Social Networks Analysis: A Comparative Study

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Abstract

Group of users that are intra densely connected with each other are termed as the community over an online social network. People over an online social network group together in these communities and most of the times they share the similar interests. In this project we are going to detect these communities over these online social networks using the techniques of Social Network Analysis (SNA) such as clique percolation method, random walks and Louvain methods. The proposed approach will be tested on real social network datasets and the experimentations will be done in python. The empirical venture will show the best results and can have best implications in real world situations.

Keywords

Clique percolation method, Community Detection, Influential user, Louvain methods, Online Social Networks, random walks Social Graphs, Social Network Analysis.

A Study on Burhwal - Gonda Kacheri Fourth Line for Economic & Financial Viability of Railway Capacity Augmentation by using Cost - Benefit Analysis

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Abstract

The Indian economy has witnessed rapid growth in recent decades, with railway infrastructure playing a crucial role in supporting passenger and freight movement. However, inadequate freight capacity has led to delays, reduced line efficiency, and increased operating costs. This study evaluates the economic and financial viability of adding an additional railway line to the existing triple-line section between Burhwal to Gonda Kacheri. A cost-benefit analysis approach is adopted to assess feasibility, incorporating key parameters such as project cost, traffic forecasts, revenue generation, operating expenses, and detention savings. These inputs are used to estimate the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR). The results indicate FIRR and EIRR values of 10.36% and 16.17%, respectively, demonstrating both financial and economic feasibility. The proposed additional line is expected to significantly enhance operational efficiency and accommodate future traffic demand. Freight volume is projected to reach 11.39 million tonnes, while overall traffic capacity is anticipated to increase by 50%. Additionally, freight travel time is expected to reduce by 0.08 hours and route distance by 2.1 km. The project is also likely to contribute to broader economic benefits, including a 30% increase in employment, tourism, and secondary market activities. Overall, the findings confirm that cost-benefit analysis is an effective tool for evaluating railway infrastructure projects.

Keywords

Railway Capacity Augmentation, Cost-Benefit Analysis, Railway Feasibility Study, Traffic Forecast.

Detection of Overlapping Communities in Online Social Networks by Using Graph Analysis

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Abstract

Whenever people use the online social networks they tend to mix and collaborate with each other, as a result of which they are creating the groups of users called as communities. These communities are more intradensely connected. The different users with a community are having the similar interests and properties. The detection of these communities is of utmost importance as per their implications are concerned. In this project we are going to detect the overlapping communities using the different approaches and tools of graph theory. The datasets of online social networks will be utilized from the open dataset repositories that are available over the internet. The experimentation of this project will be done on google colab using the python language. The results on experimentation will be of best standard and the project will be having many real world implications.

Exploring High Performance Composites for Efficient Automobile Application

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Abstract

The aim of this research work is to design and analyze hybrid natural fiber-reinforced epoxy composites using bamboo, hemp, and ramie fibers, and to determine which combination of fibers provides the best mechanical properties. The mechanical properties of the composites were affected by the type of composition of the fibers. The tensile strength varied from 8.27 N/mm² to 12.27 N/mm², flexural strength from 892.5 N/mm² to 1819.9 N/mm², and impact strength from 2.94 J to 3.92 J. Among the samples, R1 provided the best results in terms of tensile strength, impact resistance, and less water absorption. The experiment has confirmed that the combination of bamboo, hemp, and ramie fibers enhances the mechanical properties of epoxy composites. The R1 mixture showed the best combination of properties and can be regarded as a sustainable and eco-friendly material.

Keywords

Bamboo fiber, Hemp fiber, Ramie fiber, Epoxy resin, Mechanical properties, Tensile, composite materials.

A Hybrid Multi-Model Deep Learning Framework for Proactive Vehicular Engine Fault Diagnosis

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Abstract

The vehicles we drive today are really complex. That's why we need systems to monitor the engines condition and alert us to potential problems. People usually check their vehicles regularly do a diagnosis. This may not help us detect issues early and that can cause the vehicle to break down suddenly. This paper is a way to analyze the health of a vehicular engine using a deep learning model. This model combines one- convolutional neural networks and artificial neural networks. It looks at data from sensors that measure temperature, pressure and speed to find patterns that might indicate the engine is not working properly. The one-dimensional convolutional neural networks help find features in the data and the artificial neural networks classify and identify the engines condition. So it is important to use systems like this in vehicles to make smart vehicles and intelligent transportation systems and also it save a money on maintenance. Our aim is to reduce the unexpected failures of the vehicle by identifying the problems at an early stage. The proposed system can be used for identifying the problems related to the vehicle at an early stage. This work is mainly focused on the health of the vehicle's engine and the predictive maintenance of the vehicle. For this, the proposed system is utilizing advanced techniques such as deep learning, which include 1D CNN and ANN. The main aim of this system is fault prediction, which increases the reliability of the vehicle and reduces the maintenance costs.

Keywords

Vehicular Engine Health, Predictive Maintenance, Deep Learning, 1D-CNN, Artificial Neural Networks, Fault Prediction.

Performance Analysis on CFD and Sustainable Implementation of Telescopic Rectangular Blade Wind Turbine for Low-Wind Regions

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Abstract

The primary aim is to come up with a Telescopic rectangular blade Wind Turbine (TBWM) to have high efficiency when the wind is low (10 m/s). The design, through altering the area of the blade, minimizes the problem of high cut-in speeds and weight, common to fixed-blade HAWTs. This research focused on comparing the conventional fixed-blade turbine with the proposed TBWM. The TBWM is analysed in ANSYS Workbench with three different materials: Steel, ABS and UPVC (Unplasticized Polyvinyl Chloride). The analysis was done and the results shows TBWM was much more effective in the conditions of low wind (5 to 12 m/s). The TBWM produced an average of 0.174 kW of power with a system efficiency of 71.8% while the traditional fixed-blade system recorded 0.092 kW of power output with an efficiency of 45.1%. The average power output of 0.108 kW and standard deviation of 0.046 kW were proven by using statistical analysis. It is evident that the TBWM is more efficient in low winds (10 m/s), where TBWM could produce 0.174 kW with the efficiency of 71.8. These improvements have been proven by statistics with an average power output of 0.108 kW.

Keywords

Telescopic Blade Windmill, Low-Wind Regions, Finite Element Analysis, Structural Dynamics, UPVC Material, Variable Geometry, Aerodynamic Efficiency, Sustainable Energy.

Automated Difficulty Estimation and Simplification of Academic Texts: Narrative Review

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Abstract

The rising digital content rate is an effect that has enhanced the necessity to explore automated ways of textual content summarisation, simplification, assessment and evaluation. This is a review of findings of fifteen current research studies in four related fields, viz., text summarisation, text simplification, text difficulty prediction and question-based evaluation. It also looks at trending papers on extractive, abstractive and hybrid summarisation models, and emphasises the rise of transformer models such as Bidirectional Encoder Representations from Transformers (BERT), Text-to-Text Transfer Transformer (T5) and Bidirectional and Auto-Regressive Transformers (BART). It also addresses simplification strategies grounded in lexical substitution and deep-learning systems optimised based on the readability level. In addition to this, we also discuss linguistic and machine learning based approximations of text difficulty, text factual consistency and document understanding assessments based on QA systems. Comparison of the works demonstrates that hallucination during abstractive summarisation, lack of datasets to streamline the process and poor generalisation during difficulty prediction exist. However, there are opportunities to integrate the four areas. Future research directions involve unified pipelines that combine, simplify and quantify text using multi-task transformers and QA-based factual verifiers.

A Conceptual Framework for Fine-Grained Aspect-Based Sentiment Analysis in Hinglish Smartphone Reviews

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Abstract

The extraction of granular consumer information on e-commerce platforms where consumers often talk about various product attributes in the same review has become a necessity of Aspect-Based Sentiment Analysis (ABSA). But, in the case of the Indian smartphone market, the use of codemixed and informal transliteration makes the Hinglish language appear very noisy and it is this “linguistic noise” that causes the poor performance of the typical Natural Language Processing (NLP) models. Although previous studies have obtained a high accuracy in monolingual or coarse-grained sentiment analysis, a common set of tasks in this area has not been reached in terms of the fine-grained triplet extraction in low-resource Indian languages. The proposed paper introduces a concept framework that can deal with these shortcomings by introducing a dedicated Hinglish-to-English normalization layer and a hybrid XLM-RoBERTa system. The framework, based on the Appraisal Theory, operationalizes the extraction of triplets of informal consumer feedback consisting of the aspects, opinion and sentiment, which are operationalized as (Aspect, Opinion, Sentiment) triplets (bootstrapped to structured domain-specific taxonomies). Our hypothesis is that this modular design will enhance aspect boundary detection and sentiment mapping by reducing sparsity in vocabulary due to transliteration. The work gives an extensive architectural plan upon the implementation in the future and gives great implications to the multilingual NLP research and the automated processing of consumer feedback in the expanding Indian e-commerce industry.

Keywords

Aspect-Based Sentiment Analysis, Hinglish, Code-mixing, XLM-RoBERTa, Conceptual Framework, Smart-phone Reviews.

A Critical Review of Diagrid and Hexagrid Tubular Systems in the Context of IS 1893 (Part 1): 2025 Seismic Provisions

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Abstract

The development of India's urban landscape with super-tall structures faces concerns in selecting effective Lateral Load Resisting Systems (LLRS). While diagrid and hexagrid structures are widely accepted for efficiency, a research gap exists in applying international codes (ASCE/Eurocode), which have limited applicability to the proposed draft of IS 1893 (Part 1): 2025 draft, specifically regarding the transition to Zone VI and PEHA. This paper reviews 24 studies on the shift from axial-dominated diagrids to flexure-dominated hexagrid structures. A critical focus is missing design link between IS 800:2007 and updated 1893:2025 (Draft) regarding structural ductility and force redistribution. Practical feasibility of these systems is also examined through Indian case studies, including the UIIC Headquarters and Palais Royale. Findings show that while diagrids provide superior stiffness, hexagrids offer enhanced ductility and a 10–15% reduction in structural steel. However, the nonlinear performance of both diagrid and hexagrid systems under the proposed extended 10-second spectral acceleration (S_a/g) range, revised hazard factors (Z), and Soil-Structure Interaction (SSI) and near-fault ground motion conditions remains insufficiently addressed for structures exceeding 40 stories in high-density urban zones. This research identifies these gaps to support mechanism-based evaluation under evolving Indian seismic provisions.

Sustainable Dynamic Wireless Charging System for AGVs & AMRs

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Abstract

Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) play a critical role in modern smart factories and warehouse automation, where uninterrupted operation is essential for maintaining productivity. Conventional charging methods require vehicles to stop for recharging, leading to operational downtime and reduced system efficiency. This work proposes a solar-assisted dynamic wireless charging system for AGV applications, validated using a prototype robotic platform. The system utilizes resonant inductive wireless power transfer to enable contactless energy transmission while the vehicle is in motion. A hybrid power architecture integrates solar photovoltaic (PV) energy with an auxiliary DC supply through a common DC bus. The received power is rectified and regulated to charge a 12 V battery managed by a Battery Management System (BMS). An ESP32 controller supervises system operation and battery monitoring. Experimental validation demonstrates the feasibility of renewable-assisted dynamic wireless charging, improving operational continuity and efficiency in industrial automation environments

Keywords

Dynamic Wireless Power Transfer (DWPT), Automated Guided Vehicle (AGV), Solar Photovoltaic (PV), Resonant Inductive Coupling, Battery Management System (BMS).

A Hybrid Enhancing and Localizing Ocular Tumor Diagnosis using Dual-Attention FusionNet Framework

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Abstract

Ocular tumor is a rare but serious eye disease that may lead to severe defect in the eye vision unless the tumor is detected at the initial stage of its occurrence. Retinal fundus image is not easy to identify the tumors in the eye since they are irregular in shape, small and low in contrast to the other areas of the retinal image. Determining the ocular tumors using retinal fundus images based on the eye and vision expert using his or her bare eye might be a tedious exercise and might lead to variation in identification of ocular tumors using retinal fundus images. In this project, A Hybrid Enhancing and Localizing Ocular Tumor Diagnosis System using Dual Attention FusionNet Framework has been suggested with the aim of identifying ocular tumors using retinal fundus images. ResNet50 and EfficientNet convolutional neural networks have been utilised in the proposed system to enhance the detection of ocular tumors in the images of retinal fundus. It has been trained through different methods which include normalization, contrast enhancement and retinal fundus image data augmentation on the RFMiD database towards the enhancement of ocular tumor recognition in retinal fundus images. The suggested model has an accuracy of about 96.5 in the detection and localization of ocular tumors, which proves its effectiveness and reliability in the early determination of the same using retinal fundus images. The suggested system is actually excellent at recognizing tumors using eye back image. It is possible to detect ocular tumors with the help of this system. It comes in handy with the vision and eye workers. The system is effective in locating tumors at an early stage by images of the back of the eye. This is a system that assists in the detection of tumors in retinal fundus image.

Keywords

Ocular Tumor Detection, Fundus Image Analysis, Deep Learning, Dual-Attention FusionNet, Transformer Encoder, Explainable AI.

Hybrid CNN-Transformer Framework for Real-Time IoT Device Identification Using Full Packet Data

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Abstract

The fast emergence of devices on the Internet of Things (IoT) has introduced the situation when highly heterogeneous networks are being formed in which correct identification of the device is paramount to the enforcement of the security, access control, and traffic regulation. Traditional flow-based machine learning models are based on statistics, like size of packets or interarrival time, and fail to provide finer-grained contextual information, with failure exhibiting whenever packets are encrypted or the domain alters. In a bid to overcome these constraints, this paper presents a hybrid convolutional neural network (CNN)-transformer system that can be used to identify real-time IoT device identifications using full packet data. The CNN layers are able to find local patterns in the form of the byte, whereas the Transformer encoder captures the long-range temporal relationships with the help of self-attention. As evidenced by experimental evaluation on two benchmark datasets: CICIoT2023 and IoT-TON, the proposed framework on benchmarks allows better precision, precision, recall, and F1 score than CNN-only baselines, RNN / LSTM based and Transformer-only. In addition, it has almost real time inference latency and can be robust in partially encrypted and noisy traffic settings. The findings rise to the usefulness of hybrid deep learning system to support scalable, precise, and deployable IoT security systems.

Keywords

IoT Security, Device Identification, Deep Learning, CNN, Transformer, Full Packet Data.

Design and Implementation of a Custom Flight Controller for a Quadcopter Using ESP32 and Low-Cost Sensors

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Abstract

This paper presents the design and development of a custom flight controller for a quadcopter using EP32 microcontroller and a set of low cost sensors. The objective of the work is to explore whether an affordable hardware can be implemented and designed. The focus of this work is to achieve reliable parameters, sensor integration and wireless system which is suitable for academic and experimental UAV applications. The proposed system integrates BME280 barometric sensor, ADXL245 accelerometer and Neo-6M GPS module in order to keep a track on the expected parameters which are essential for attaining stability in a flight.

Keywords

Quadcopter, Flight Controller, ESP32, Sensor Fusion, Wireless telemetry, ADXL345, BMP280, Neo-6M, UAV, PID Auto-Tuning.

Predicting Hospital Stay Length

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Abstract

The Efficient management of hospital resources is important for improving patient care, reducing operational costs, and ensuring optimal utilization of healthcare facilities. One of the most important factors affecting hospital efficiency is the length of stay (LOS) of patients. Predicting the duration of hospital stay at the time of patient admission can help in healthcare providers in planning bed allocation, scheduling treatments, and managing hospital workflows effectively. However, accurately estimating hospital stay length is a challenging task due to the complexity of patient health conditions, varying treatment procedures, and the large volume of healthcare data generated in hospitals.

This study proposes a machine learning-based predictive framework for estimating the hospital length of stay using electronic health records (EHR). The system checks things like age, medical conditions, test results, admission details and treatments. It uses machine learning algorithms such as Random Forest, Logistic Regression and XGBoost to figure out how to predict how long a hospital stay will be. The system looks at all the information about hospital stay length to make a prediction. It uses Random Forest and Logistic Regression and XGBoost to help make these predictions about hospital stay length. First the system cleans up the data to work with these models. This means fixing the missing information and making the formats consistent and removing the data. Then the system checks these models to see how well they work using things like accuracy and precision and predictive power. The results show that using all these models together gives results than using just one model for hospital stay length. This way the system can make predictions about hospital stay length. A system like this can help hospitals and the people, in charge manage the beds better and use the resources in a way and provide good patient care. Also if the hospital puts these models into their system it can help the people make decisions based on the data and this can make the patient outcomes better.

Keywords

Hospital Length of Stay Machine Learning, Healthcare Analytics, Electronic Health Records, Predictive Modeling, XGBoost.

Smart Path Following Robot: A Systematic Literature Review

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Abstract

Autonomous mobile robots capable of following predefined paths are widely used in industrial automation, educational robotics, and intelligent transportation systems. This project presents the design and implementation of an Arduino based path-follower robot that utilizes infrared (IR) sensors and a Proportional-Integral-Derivative (PID) control algorithm for accurate path tracking. The proposed system detects a black line on a contrasting surface using IR sensors and dynamically adjusts motor speed and direction through a PID controller to minimize deviation from the path. The hardware architecture consists of an Arduino Nano microcontroller, L293D motor driver, DC motors, and IR sensor modules, ensuring cost effectiveness and ease of implementation. Experimental evaluation demonstrates that the robot can successfully navigate paths of varying complexity while maintaining stability and consistent performance at different speeds. The results indicate that the integration of PID control significantly improves tracking accuracy and reduces oscillations compared to basic control methods. This work provides a reliable and scalable solution for autonomous navigation applications and serves as an effective learning platform for robotics and embedded systems research.

Keywords

Autonomous mobile robot, Path-follower robot, PID control, Arduino Nano, Infrared sensors, Line following robot, Embedded systems, Motor control.

Next-Gen CCTV: Real-Time Gesture Detection with Geolocation Alert

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Abstract

In order to protect the public efficiently, effective Surveillance Systems play an important role in detecting possible Threats prior to becoming Problems. Traditionally, CCTV Surveillance is based on Human Operators using a Simple Motion Detection System that has limitations in detecting High-Risk Gestures such as Aggressive or Distressed Behavior or Silent Calls for Help. The Study being presented in this Paper will focus on Gesture Alert, an AI-based, Intelligent Surveillance Framework, that incorporates MediaPipe and OpenPose for Real-time Hand Gesture Identification and Risk Assessment. Gesture Alert will review Real-time CCTV Video to identify Critical Gestures (indicating Distress/Aggression) and Generate a Geo-located Notification to Emergency Responders within Programmed SMS, Email, or App Notification Programs. A Non-Disruptive Automated System for Security Monitoring by using Computer Vision and Deep Learning Models to extract Features and Classify them. Gesture Alert achieves High Detection Rates with Multi-Level Accuracy with a Significant Reduction in Human Reliance and Delayed Response Times. Experimental Tests of the Gesture Alert Approach, Clearly Demonstrate Real-time Identification of Critical Gestures with Minimum False Positive Rates, therefore Providing an Effective, Proactive, Scalable Solution for Smart Surveillance.

Keywords

Gesture Recognition, Deep Learning, MediaPipe, OpenPose, Surveillance Systems, Geolocation Alerts, Real-time Threat Detection.

Lung Cancer Detection from CT Images Using Deep Learning Based Model EfficientNet-B4 and DenseNet121

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Abstract

Fast observation of Lungs Cancer significantly increases the patient's chances of recovery and help to doctors for treatment on time. Generally Computed Tomography (CT) scans use for test the Lungs Cancer, But the analysis of CT scans depends on the Radiologist. Therefore, different doctors may understand the same CT scans differently. To reduce this problem and help doctors, this study introduces an interpretable Deep Learning framework to identify Lungs Cancer risk based on CT images. This model of deep learning used two Convolutional Neural Network (CNN) EfficientNet-B4 and DenseNet-121, which help in differentiating Benign (Normal) and Malignant (Cancerous) nodules in CT scans. Parameters such as Accuracy, Precision, Recall, F1- Score, Confusion Matrix and Receiver Operating Characteristic- Area Under the Curve (ROC-AUC) have been used to measure the performance of the Model. To make the model understandable, the Gradient weighted- Class Activation Mapping (Grad-CAM) technique has been used, which shows which parts of the CT image most influence the model decision. Experimental results show that DenseNet-121 produce more stable and better classification results than EfficientNet-B4. Although the (ROC-AUC) results showed slight variations due to uncertainty of some levels in the proved effective in predicting and visually explaining Lungs Cancer risk. Therefore, this model may be useful for AI-Assisted Medical Diagnosis in the future.

Keywords

Lungs Cancer, Deep Learning, Convolutional Neural Network (CNN), DenseNet-121, EfficientNet-B4, Receiver Operating Characteristic (ROC), Area Under the Curve (AUC).

CFD Analysis of Trapezoidal Shaped Manifold Arrangement in Micro - Channel Heat Sink

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Abstract

Heat sink is engaged and evaporates heat from other devices by using radiant or direct contact. Heat sink is a device which increases the heat dissipation capacity from a device to open environment. Application of a heat sink has to adjust the temperature of hot body which is being under the process of heat dissipation within prescribed conditions as defined by the constructor of that device. In the present research investigation is done on three different shape test pieces are designed having aluminum as the base material. These test pieces are consisting small scale fluid channel. The channels are surrounded by the solid walls and with heating source. The testing is done with a variable input of heat and flow rates. As to resolve the instability difficulties of manifolds flow section and channels are needs to be design for effective shape of the entrance and exit manifold. The CFD analysis is carried out to analyze the effective shape of the manifold arrangement from three different shapes. These will show that the manifold with upward and downward taper flow arrangement having more rate of heat transfer coefficient then another.

Keywords

Heat Sink, Micro channel, Heat Transfer, Reynolds Number, Computational analysis.

Fault Impact Footprint Mapping in Power Networks

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Abstract

In the given paper, the author describes a fault impact footprint mapping framework to investigate disturbance propagation in radial power distribution systems. The proposed method does not only rely on fault-detection or fault-localization, but on the impact that a fault has on the behavior of voltages in the network of nodes that are interconnected. A radial distribution network model of 20 nodes and lateral branches is developed that incorporates a distance-related variation of voltage in the normal operating cases. Simulation of fault scenarios is carried out at the desired nodes, and the relative voltage deviation is then determined as an indicator of the level of disturbance. The magnitude of deviation is used to categorize the nodes into levels of impact to produce a spatial footprint of fault influence. It has been shown by simulation that faults in different locations lead to different disturbance patterns across the network. The available approach is computationally sparse and can be used to do analytical evaluation of voltage disturbances induced by faults without having to use training sets or machine learning regressions.

Keywords

Radial distribution network, fault impact analysis, voltage deviation, disturbance propagation, impact classification, simulation-based modeling.

A Hybrid Deep Learning Framework for EEG-Based Epileptic Seizure Detection using CNN and Pre-Trained Transfer Learning Models

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Abstract

Epilepsy is a neurological disorder characterized by abnormal electrical brain activity causing recurrent seizures. Electroencephalogram (EEG) is a safe, non-invasive technique for detecting epileptic seizures, but expert training and long hours are required for the manual interpretation. Existing methods fail to represent both fine-scale cross-region spatial organization and temporal dynamics of the signals, risking a decreased classification performance. This study presents a hybrid deep learning framework with two parallel branches for a fully automated five-class neurological EEG classification. In the spatial branch, 1D signals are transformed into log-scaled spectrogram images, allowing pre-trained CNNs (VGG16 and ResNet50) to extract spatial features. At the same time, the spatio-temporal component processes normalized sequences through stacked one-dimensional convolutional layers and a Bidirectional Long Short-Term Memory (Bi-LSTM) network for a precise representation of the seizure temporal dynamics. These features are then fused through regularized dense layers to classify five clinical states (seizure activity, tumor area, healthy area, eyes closed and eyes open). On the classical UCI Epileptic Seizure Recognition dataset with 11,500 samples, the architecture achieves an outstanding 98.25% F1-score, 98.68% precision and 97.83% recall specifically for the detection of ictal seizure states. On the highly complex five-class classification task, distinguishing inter-ictal tumor and healthy brain regions, the model equips a sound overall test accuracy of 83.83% with macro-average precision, recall and F1-scores of 84.26%, 83.83% and 83.87%, respectively. By using multi-dimensional feature extraction, the model transcends standard 1D baselines, offering a solid foundation for automated diagnostics.

Intelligent Prognostics and Predictive Maintenance of Power Cables Using Machine Learning

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Abstract

Underground power cables are essential components of modern electrical distribution systems, yet they remain highly vulnerable to faults caused by insulation degradation, thermal stress, and environmental factors. Traditional monitoring techniques often rely on manual inspections, leading to delayed detection and increased downtime. This paper proposes an intelligent monitoring system, Monitoring Cable Protector, which integrates Artificial Intelligence and IoT for real-time fault classification. The system utilizes an ESP32 microcontroller for multi-sensor data acquisition, tracking parameters such as voltage, current, temperature, and insulation resistance. A Random Forest Classifier is employed to analyze these inputs and identify fault patterns, including short circuits and insulation failures. Data is transmitted via Wi-Fi to the ThingSpeak cloud platform for remote visualization and early warning alerts. Experimental results demonstrate high detection accuracy and system stability. By enabling predictive maintenance, the MCAP system enhances power grid reliability and supports sustainable infrastructure development by significantly reducing maintenance costs and operational risks.

An Explainable AI-Based Clinical Decision Support System for Early Diabetes Risk Detection Using XGBoost, SHAP, and LLM-Generated Personalised Recommendations

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Abstract

Diabetes mellitus is one of the most prevalent and silently progressing chronic health conditions that continue to be prevalent globally. Therefore, the timely detection of diabetes is of critical importance to prevent the development of serious and severe complications. Most of the prevailing machine learning-based risk prediction systems for diabetes detection also face various challenges and restrictions. Thus, the main purpose of the proposed research is to develop an Explainable Artificial Intelligence (XAI)-based Clinical Decision Support System (DSS) for the early detection of diabetes risk using the XGBoost gradient boosting algorithm and the resampling method SMOTETomek. Feature engineering techniques were also employed in the proposed research to develop the most accurate and discriminative risk prediction system. To perform the experiments and validate the proposed system, the PIMA Indians Diabetes dataset was employed. The proposed system was compared with the baseline Logistic Regression, Support Vector Machine, and Random Forest-based risk prediction systems. The proposed XGBoost gradient boosting algorithm-based risk prediction system outperformed the baseline systems in all the performance metrics. Therefore, the proposed system was considered the most accurate and reliable risk prediction system. To address the black-box nature of the proposed gradient boosting algorithm-based risk prediction system, the SHAP (SHapley Additive exPlanations) TreeExplainer method was employed. To validate the proposed system, it was compared with six different configurations. The proposed risk prediction system outperformed the baseline systems in the most critical performance metric. The proposed research was conducted on the PIMA Indians Diabetes dataset. Therefore, the proposed risk prediction system was considered most accurate and reliable. However, the proposed risk prediction system needs to be tested on the population dataset to validate the proposed risk prediction system.

Keywords

Diabetes Risk Prediction, XGBoost, SMOTETomek, Explainable Artificial Intelligence, SHAP, Clinical Decision Support System, Class Imbalance, Feature Engineering, Gradient Boosting, Machine Learning in Healthcare.

LinkPulse: An Autonomous Web-to-Knowledge AI Platform Using Retrieval-Augmented Generation and Hybrid Retrieval

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Abstract

The exponential growth of digital information on various websites, software repositories, and multimedia content has created a bottleneck for efficiently integrating this information from various sources into a unified and queryable “knowledge base.” The paper describes LinkPulse, an autonomous web-to- knowledge AI platform for ingesting and processing information from various sources such as web pages, GitHub repositories, PDF files, and video transcripts using a unified seven-layer pipeline. LinkPulse is based on a Retrieval-Augmented Generation (RAG) model using LangChain-based pipelines and vector storage using Pinecone, FAISS, and ChromaDB. A *hybrid retrieval engine* is proposed that combines the results of internal vector database search and real-time web search results using Reciprocal Rank Fusion (RRF) of all ranked lists. Experimental results on a 5,000 pair benchmark using Wikipedia, arXiv, and GitHub as data sources show that LinkPulse achieves 97.2 time, which is superior to various keyword-based, TF-IDF-based, and vector- based retrieval methods by up to 16.9 percentage points in terms of F1-score. The modular structure of LinkPulse is highly scalable as each component of the pipeline can be scaled individually, making it suitable for large-scale enterprise-level knowledge management applications.

Keywords

Retrieval-Augmented Generation, Knowledge Ingestion, Vector Databases, Large Language Models, Hybrid Retrieval, Semantic Embeddings, Reciprocal Rank Fusion, AI Knowledge Systems.

AI-Driven Career Guidance System Using Hybrid Assessment and Machine Learning for Personalized Career Planning

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Abstract

In today's rapidly evolving world, choosing the right career path has become increasingly complex due to the abundance of educational options, technological advancements, and changing job market demands. The AI-Based Career Guidance System aims to provide personalized career recommendations to students based on their academic performance, interests, skills, and personality traits. By leveraging Artificial Intelligence techniques such as machine learning, natural language processing (NLP), and data analytics, the system analyzes user data collected through assessments, questionnaires, and academic records.

The model predicts suitable career domains and suggests educational paths, skill development courses, and potential job roles aligned with the user's profile. The system continuously learns from user feedback and market trends to refine its recommendations, ensuring adaptability to future industry needs. A user-friendly web or mobile interface enables students to interact with the system, receive AI-generated insights, and plan their career progression effectively.

This project not only assists individuals in making data-driven career decisions but also serves as a valuable tool for educational institutions and counselors to guide students efficiently. The integration of AI in career counseling bridges the gap between student potential and market opportunities, fostering informed and confident career choices.

Real-Time Anomaly Detection in IoMT Networks Using Stacking Model and a Healthcare- Specific Dataset

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Abstract

Internet of Medical Things (IoMT) facilitates real-time patient monitoring via interconnected medical devices, but it also increases the risk of sophisticated cyber-attacks, compromising data integrity and service reliability. Conventional anomaly detection techniques show low flexibility in dealing with diverse IoMT traffic and specific types of attacks in the healthcare sector. For addressing these issues, an anomaly detection framework is proposed, relying on datasets obtained from UNSW-NB15 and BRFSS2015. The dataset is processed by means of label mapping, feature encoding, recursive feature elimination via XGBoost, dataset concatenation, SMOTE-based balancing, and standard scaling. Various classifiers, including Logistic Regression, Random Forest, XGBoost, KNN, SVM, ANN/MLP, and Isolation Forest, as well as ensemble classifiers, are implemented. The stacking classifier consists of XGBoost, Random Forest, and ANN as base classifiers, with XGBoost as the final classifier, whereas the voting classifier comprises XGBoost, Random Forest, and MLP as base classifiers with a soft voting mechanism. The voting classifier produces the highest classification accuracy of 95.5%, whereas XGBoost classifier produces 96% accuracy in multi-class detection, and the voting classifier produces 99.9% accuracy in binary classification. Model interpretability is enhanced using LIME and SHAP, and a Flask-based interface supports real-time prediction, demonstrating improved robustness and practical applicability for IoMT anomaly detection.

Keywords

Internet of Medical Things (IoMT), Anomaly Detection, Healthcare Cyber security, Machine Learning, Distributed Denial of Service (DDoS), UNSW-NB15, Gini Index, IGRF-RFE, XGBoost, Random Forest, AdaBoost, Voting Classifier, Ensemble Learning, XGBoost, Intrusion Detection System (IDS).

Parameter-Efficient Continual Learning for Scientific Text Classification: A LoRA-Based Approach with and without Replay

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Abstract

Scientific literature has been spreading widely in almost every area and this has raised a dire necessity of automated classification systems that can be used with efficiency in the same area without devastating memory lapses. The paper explores parameter-efficient continual learning (CL) of text classification in science based on Low-Rank Adaptation (LoRA), a generalization of previous studies on full fine-tuning of pre-trained language models. We evaluate four models—BERT, SciBERT, BioBERT, and BlueBERT—trained sequentially on three Web of Science datasets (WoS-5736, WoS-11967, and WoS-46985) in curriculum order, under two CL configurations: LoRA-CL (without replay) and LoRA+Replay-CL (with 10% experience replay). LoRA adapters are applied to query and value projection matrices with rank $r=8$ and $\alpha=16$, reducing trainable parameters to approximately 5% of the full model. A novel third input strategy combining keywords and abstracts is introduced alongside the two strategies from the baseline. We report four CL metrics—Average Accuracy (ACC), Backward Transfer (BWT), Forward Transfer (FWT), and Forgetting Measure (FM)—alongside per-task accuracy and F1 scores. Results show that LoRA-CL matches or exceeds full fine-tuning baselines on WoS-46985 while reducing trainable parameters by approximately 95%. SciBERT achieves the best overall performance across all input strategies with a peak accuracy of 87.93% on WoS-46985; BlueBERT exhibits the most severe catastrophic forgetting. The combined input strategy outperforms keywords alone on larger datasets, establishing LoRA-CL as a viable, resource-efficient alternative for scientific text classification in continual learning settings.

Keywords

Catastrophic forgetting, continual learning, experience replay, LoRA, parameter-efficient fine-tuning, scientific text classification, BERT, SciBERT, BioBERT, BlueBERT, Web of Science.

CryptEase – Secure Message Encryption & Decryption System with Expiry and QR Integration

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Abstract

CryptEase is a secure, web-based encryption and decryption system designed to ensure confidential communication through advanced security mechanisms. The system integrates Triple DES encryption, expiry-based message access, QR code-enabled sharing, and downloadable encrypted files, offering a complete privacy-focused messaging workflow. Each message is encrypted with a unique ID and secret key, ensuring authenticity and security before allowing access.

The project's backend is deployed on AWS EC2, providing a scalable, reliable cloud infrastructure for encryption logic, secure storage, and user authentication. The frontend is developed using React.js, enabling a modern, responsive, and intuitive interface. Additional support for QR code generation using qr.js enhances accessibility by allowing users to quickly scan, view, and decrypt messages using secret keys.

CryptEase is ideal for time-sensitive communication, secure file sharing, and temporary message access. By combining cryptography, cloud deployment, and modern web technologies, the system offers a secure, efficient, and flexible platform for encrypted data exchange.

Keywords

Triple DES Encryption, AWS EC2, Django Backend, React.js Frontend, QR Code Generation, Expiry-Based Message Access, Secure Web Application, Encrypted Message Sharing.

Performance Assessment of Angular Air Distribution System for Operation Theatre using Numerical Simulation and Experimental Approach

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Abstract

The present work concern with the analyses of air flow and thermal pattern in an Operation Theatre (OT). The effect of Angular Air Distribution (AAD) system with 90°, 30°, 45°, 60° inlet air flow angle on the air flow and thermal pattern were investigated in presence of surgical staff and patient. The effectiveness of air distribution system is commonly evaluated by the removal of heat from occupant and room to accomplish air temperature, air velocity at prescribed level to attained human comfort condition and indoor air quality. The study is carried out on scale model of OT. The scale model dimension is calculated with the help of geometrical similarity concept. Initially the scale model of OT is examined by numerical simulation by varying inlet angle at constant inlet velocity and temperature. For numerical simulation Computational Fluid Dynamics (CFD) technique with fluent software is used. The CFD modelling technique solved the continuity, momentum and energy conservation equation in addition to standard k-ε model equation for turbulence closure. The boundary conditions of numerical results are tested with grid independency test. The numerical results are validated with the help of experimental readings of scale model of OT. The air flow pattern of AAD system in OT with various inlet angles are tested with the help of smoke test. The flow pattern obtained by smoke of AAD system is capture by Camera Target Method (CTM) and it is validated with streamline results of CFD. To check the human comfort and effectiveness of air distribution system, the obtained result is compared with the international standard parameter for ventilation system such as Air Diffusion Performance Index (ADPI). During the investigations, numerical validation is carried out by method of comparisons of numerical and experimental results. Good agreement is found between numerical and experimental results.

Keywords

Angular Air Distribution, Operation Theatre, CFD, ADPI, CTM, Smoke test.

Lingoflix: A Browser Extension for Contextual Language Learning Through Netflix

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Abstract

A Chrome extension called Lingoflix was created to assist users in learning new languages while they watch Netflix. Users can choose a practice language and watch dual subtitles—one in their native tongue and one in the language they wish to learn—by integrating the extension directly with the Netflix web player. When a user is watching a show, Lingoflix automatically recognizes it and adds personalized subtitle controls. A popup menu allows users to change the practice language, and the extension instantly updates the availability of dubbing and subtitles. One important feature is that you can click on specific words in the subtitles to get instant definitions, examples of sentences, parts of speech, and, for some languages, pinyin or romanization. To do this, Netflix's subtitle data is intercepted and processed inside the extension. Additionally, the extension offers quick links to other shows in the chosen language and determines whether dubbing or subtitles are available. Chrome's storage API is used to save all user preferences, including the selected practice language and extension on/off state, so settings are maintained between sessions. The process is simple: after installing Lingoflix, the user launches Netflix, chooses a language from the menu, and begins to watch. The extension overlays learning tools, controls subtitle switching, and reacts to user input such as word lookups while the show is playing. Without interfering with the viewing experience, the design attempts to make language learning feel organic and incorporated into regular entertainment.

Keywords

Content script, Service worker, Chrome storage, Popup UI, Subtitles overlay, Word lookup, Event listener, Custom event, XMLHttpRequest interception, AngularJS.

Detection of Disjoint Interest Groups Over Online Social Networks and Analysis

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Abstract

Online social networks like's Facebook, Twitter and Instagram are really important for how people talk to each other, share ideas and make groups. As these websites are highly scalable, with each day generating huge amount of data the complexity of the interactions becomes hard. Finding these interested groups, it is important for making recommendations in order to have effective and purpose full social processes such as advertisement, edutainment and entertainment etc.

This study focuses on finding groups of people who are of similar interests and do not overlap with other groups. To uncover this, we will model social networks as graphs. In the proposed study we use different methods to analyses how people interreact to each other and how they share ideas. These methods are uncovering the interest groups a that are densely connected together.

The different datasets have been used in this study that are taken from open dataset repositories like the SNAP repository, Kaggle social network datasets, and the UCI Machine Learning Repository. On experimentation we have found the best results and we have laid down a comparative study.

Centrality measures are used to evaluate the importance of users with in the network. Degree, betweenness, closeness and eigenvector centrality provide different perspectives on user influence. A comparative analysis is performed to examine variations in influential user ranking across these measures.

The approach is evaluated using multiple real-world and synthetic datasets obtained from standard repositories. The results demonstrate effective identification of disjoint communities and detection of influential users across different networks.

Keywords

Social Network Analysis, Community Detection, Disjoint Communities, Graph Theory, Centrality Measures, Clustering, Online Social Networks, User Interaction Networks.

AI-Powered Decision Support System for Gallbladder Cancer Diagnosis and Prognosis Assessment

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Abstract

Gallbladder cancer is a rare but highly aggressive malignancy, often diagnosed at an advanced stage due to its nonspecific symptoms and rapid disease progression. Early identification of risk factors and timely intervention can significantly improve patient prognosis, yet conventional diagnostic methods and clinical judgment may fall short in complex or ambiguous cases. To address these challenges, this study proposes an AI-powered decision support system for gallbladder cancer diagnosis and prognosis assessment using machine learning. The system utilizes a structured dataset containing 21 features, including patient demographics, lifestyle habits, medical history, clinical symptoms, tumor characteristics, biomarker levels, treatment details, and survival rates. The system groups patients according to the severity of the disease, predicts survival chances, and identifies key risk factors using contemporary data analysis and machine learning tools. The integration of this system into clinical workflows aims to support healthcare professionals in making timely, data-driven decisions, improve diagnostic precision, and personalize treatment strategies, thereby enhancing overall patient care and survival rates.

Keywords

Machine Learning (ML), gallbladder Prediction, Artificial Intelligence (AI), Data Analysis, Predictive Modelling.

A Comprehensive Review on Solar Powered Cloth Drying System

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Abstract

This review paper compiles insights from twenty research articles addressing the design, performance, and sustainability of domestic and industrial clothes dryers, including gas, electric, and heat-pump systems. Key parameters such as moisture extraction rate (MER), specific moisture extraction rate (SMER), specific thermal energy consumption (mSPC), energy efficiency, and primary energy efficiency were compared across different dryer configurations. Studies highlight the superiority of heat-pump dryers in energy conservation, while gas dryers provide higher drying rates. However, environmental concerns remain due to fossil-fuel dependency and electricity-intensive operation. The review emphasizes the growing research interest in waste-heat utilization, advanced control systems, and exergy-based optimization. A critical gap identified is the **absence of solar-assisted charging or hybrid renewable integration** in these systems, limiting long-term sustainability. Future work must explore solar-thermal and photovoltaic hybridization with dryers to reduce reliance on conventional energy and minimize carbon emissions.

Keywords

Clothes dryer, Energy efficiency, Moisture extraction, Renewable integration, Solar-assisted drying.

Performance Analysis of Hybrid Natural Fiber Reinforced Composite Using Prosopis Juliflora, Aegle Marmelos and Mimusops Elengi for Automobile Applications

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Abstract

The aim of this research work is to develop and compare the mechanical and physical properties of a hybrid natural fiber reinforced epoxy composite made from Prosopis juliflora, Aegle marmelos and Mimusops elengi natural fibers. Which fiber combination is the best in composite materials. From the experimentation process it was found that Hybrid Composite exhibited a higher mean for different mechanical properties, Tensile strength varied from 5.07 N/mm² to 8.13 N/mm², Flexural strength varied from 660 N/mm² to 1026 N/mm², Compressive strength varied from 1.47 N/mm² to 2.66 N/mm², Impact Energy varied from 3.43 J to 3.92 J and Hardness varied from 49 HD to 66 HD. Among the samples R2 provided the high results in terms Tensile strength, Flexural strength, Compressive strength. R2 provided less water absorption from the tests. Also, R2 provided the SEM images clearly show the epoxy layer was well bonded with the composites. The results obtained from this research work have confirmed that hybridization of natural fibers has a significant effect on improving the mechanical properties of epoxy composites. The proposed hybrid natural fiber reinforced epoxy composite material has been found to be a sustainable alternative to the existing single-fiber composites.

Keywords

Hybrid natural fiber composite, Prosopis juliflora fiber, Aegle marmelos fiber, Mimusops elengi fiber, Epoxy resin, Mechanical properties, Water absorption, Compression molding, SEM analysis.

Advances in Charge Pump Technologies for Low-Power and High-Frequency Electronic Systems: A Comprehensive Review

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Abstract

This research investigates design methodology for charge pump circuits using nano-scale MOS transistors. The design differs from the classic Dickson charge pump architecture since it uses MOS transistors driven by anti-phase pumping clocks that improve both voltage gain and output performance. Active components such as the phase frequency detector (PFD) and charge pump within the phase-locked loop (PLL) were studied using RF simulation tools. The design was found to accurately and efficiently work in low voltage and low power circuit applications during simulations. The design results in a system with improved phase margin and high loop gain, providing for the possibility of more efficient electronic systems. This study also provides a basis for alternative designs of charge pump circuits that are compact, high performance, and low leakage. This was achieved by design parameter optimization, the use of advanced design tools, modern fabrication techniques, and the anticipation of potential uses of the charge pumps in communication and power management integrated circuits.

Keywords

Charge Pump, Phase Frequency, Phase-Locked Loop.

Comparative Evaluation of Transfer Learning-Based Convolutional Neural Networks for Automated Plant Disease Detection

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Abstract

Plant diseases represent a critical threat to agricultural productivity and food security. Therefore, there is a significant need to develop plant disease detection systems. In this paper, we propose a comparative framework for plant disease detection using advanced and hybrid transfer learning-based convolutional neural networks (CNNs), namely EfficientNet-B4, DenseNet121, Vision Transformer, and a proposed Hybrid CNN-Transformer. We have implemented these models using the publicly available Plant Village dataset, consisting of over 50,000 labeled leaf images. To make the proposed models robust, we have also implemented data augmentation techniques. We have evaluated the performance of the implemented models using key performance metrics. Experimental results show that the proposed Hybrid CNN-Transformer model has achieved the highest accuracy of 99.12%, followed by EfficientNet-B4 with 98.76%, DenseNet121 with 98.34%, and Vision Transformer with 97.89%. In terms of computational efficiency, EfficientNet-B4 has achieved a balanced trade-off between accuracy and inference time, whereas the proposed Hybrid CNN-Transformer model has slightly higher computation time of 35 ms/image due to the complexity of the model.

Keywords

Plant disease detection, Transfer learning, Convolutional neural networks, Deep learning, Computer vision, Smart agriculture, Image classification.

RetailGuard: LangChain-Enhanced AI Platform for Predictive Demand Forecasting & Security Analytics

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Abstract

Modern retail sectors often struggle with operational lapses caused by imprecise demand forecasting, poor inventory control, and persistent security risks. Conventional surveillance setups typically act as passive recording devices, offering minimal analytical depth for strategic business operations. This research presents RetailGuard, a LangChain-powered artificial intelligence framework developed to merge computer vision metrics, predictive inventory modeling, and security oversight into one cohesive system. By processing CCTV streams alongside transaction logs and environmental data, the platform evaluates customer dynamics and identifies irregular patterns within the retail space. We utilize a multi-agent architecture, managed via LangChain, to synchronize specialized modules for behavioral tracking, time-series forecasting, and anomaly detection. Our approach combines deep learning for visual interpretation with machine learning for trend prediction. Empirical testing indicates that merging behavioral cues with traditional sales records markedly boosts forecasting precision and real-time threat detection. Finally, the RetailGuard system serves as a powerful decision-support system with the ability to optimize business processes, prevent loss of revenues, and enhance security measures.

Keywords

Artificial Intelligence, Retail Analytics, LangChain Agents, Computer Vision, Demand Forecasting, Smart Surveillance.

CERAS – Cognitive Efficiency Reasoning Alignment System

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Abstract

AI based educational framework generates solutions without adapting to a learner's cognitive state, resulting in limited personalization and shallow conceptual understanding. To address this limitation, a cognitive aware and explainable AI framework CERAS (Cognitive Efficiency and Reasoning Alignment System) is designed to enhance conceptual learning through adaptive inference and behavioral modeling. CERAS explores the explainability in AI. CERAS implements a dual pipeline architecture which consist of an offline cognitive processing module and an online reasoning engine. In the offline pipeline, Cognitive Efficiency Prediction Model (CEPM) calculates the Cognitive Efficiency (CE) score dynamically using the user's live data, while the Convolutional Neural Network (CNN) performs intent modelling. These results are then fused with a Response Engine which generates personalized feedback which is aligned with learner's cognitive profile. The online pipeline utilizes Large Language Models with a customized Tree of Thoughts (ToTs) data structure to store and break complex problems into structured, step by step explanations, ensuring transparency and deeper conceptual engagement.

Deep Learning Architectures for Early Detection of Rheumatoid Arthritis from Clinical Data

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Abstract

Timely therapeutic intervention during the first ninety days following initial symptom presentation remains crucial for preventing permanent joint damage in Rheumatoid Arthritis patients. Unfortunately, current clinical pathways demonstrate significant diagnostic latency—patients typically wait twelve to twenty months before receiving definitive diagnosis, largely due to symptom non-specificity and inadequate access to specialized rheumatological care. We developed a machine learning framework incorporating three neural network variants: a Feature Tokenizer Transformer, tabular-optimized Residual Networks, and standard Multi-Layer Perceptrons. Our approach integrates laboratory biomarkers—specifically Erythrocyte Sedimentation Rate, C-Reactive Protein levels, and Rheumatoid Factor seropositivity—with free-text physician notes processed through TF-IDF vectorization. Testing across forty-five thousand patient records yielded classification performance between 99.5% and perfect accuracy. We deployed these models via Flask web infrastructure, enabling real-time risk assessment in clinical settings. Results confirm that modern neural approaches can successfully capture the complex, nonlinear biomarker interactions characteristic of autoimmune disease presentation.

Keywords

Rheumatoid Arthritis, Deep Learning, FT-Transformer, ResNet, tabular data classification, medical diagnosis.

Small Business Management System Enhancing Productivity through Automation using AI

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Abstract

Small and Medium Businesses (SMBs) often struggle to adopt artificial intelligence due to limited data availability, high infrastructure costs, and lack of technical expertise. This paper presents a lightweight, plug-and-play AI suite designed to deliver essential business decision support under such constraints. The system integrates three core modules: customer churn prediction using a Random Forest model, demand forecasting based on weighted moving averages with trend and seasonality analysis, and invoice data extraction using optical character recognition. The proposed framework emphasizes simplicity, modularity, and local deployment, enabling practical adoption of AI-driven insights without reliance on expensive computing resources or complex architectures.

Keywords

Lightweight Artificial Intelligence, Small and Medium Businesses, Decision Support System, Customer Churn Prediction, Demand Forecasting, Optical Character Recognition, Resource-Constrained Environments, Modular AI Framework.

AI-Based Black Sigatoka Prediction and Management Systems for Banana Plants

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Abstract

Banana plants are affected by several serious diseases, including Black Sigatoka, Yellow Sigatoka, Panama disease, and Moko disease, which primarily attack the leaves, causing them to weaken, turn streaky or yellow, and deteriorate over time. These infections lead to significant reductions in both the yield and quality of bananas, directly affecting the income and livelihood of farmers, especially in rural areas. Early identification of these diseases is critical to prevent extensive damage, but many small-scale farmers lack access to plant disease experts or laboratory testing facilities, which often results in delayed treatment and higher losses. To overcome this challenge, an AI-based system built on the ResNet50 architecture has been developed. This system allows farmers to upload images of their banana leaves, enabling accurate identification of whether the leaves are healthy or infected with any of the four diseases. In addition to detection, the system provides actionable advice for disease management, including recommended fertilizers, proper fungicide applications, and irrigation adjustments. The tool is designed to be fast, user-friendly, and cost-effective, allowing farmers to regularly monitor their plants without specialized knowledge. By combining image-based disease detection with practical guidance, the system helps reduce losses, improve the quality and quantity of bananas, and supports sustainable farming practices. It provides a reliable technological solution that empowers farmers to take timely action and maintain healthier plants.

Keywords

Banana Disease Detection, ResNet50, Black Sigatoka, Yellow Sigatoka, Panama Disease, Moko Disease.

Advanced Neuro-Inspired Deep Learning Paradigm for Adaptive Employee Stress

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Abstract

In the workplace these days the connection between how stressed-out employees are, how they feel emotionally has a big impact on how much work they can do and how healthy they are overall. This study is about something called RtPES, a system that is used in time to look at how employees are feeling and how stressed out they are. RtPES will use computers to look at peoples' faces and figure out how they are feeling. It uses something called deep learning to understand what peoples' faces are telling us about their stress levels. RtPES is a real-time system, for employee emotion and stress. The system uses Haar Cascade Classifiers to enable reliable face detection, which allows for the precise calculation. For the purpose of emotion recognition, a bespoke Mini-XCEPTION convolutional neural network (CNN), classifies seven different emotions (Angry, Disgust, Fear, Happy, Sad, Surprise, Neutral). Stress levels are determined through an emotion-stress mapping, coupled with Exponential Moving Average (EMA) smoothing, to furnish stable, temporally aware assessments, which categorize stress as Low, Medium, or High. RtPES is integrated with Google Gemini 1.5 Flash. It uses Python FastAPI for backend, React.ts for Frontend and MongoDB for data storage. This approach ensures the workplace will be healthier. It also helps in keeping track of health. In this way people can be able to manage stress better at work. It helps to monitor health. This leads to managing stress in a way, in offices.

Explainable AI for Multimodal Fake Profile Detection: An Integrated Framework with Trust Scoring

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Abstract

AI is aimed at combating the distribution of fake identities created by AI on the social internet, staffing sites, and dating websites, where the anonymity of users and the credibility of the site harm user safety and platform credibility. The minor project uses an explainable multimodal pipeline which scores authenticity out of images, text, and metadata and combines the signals into one Trust Score. YOLOv8 is used to localize the face areas and a fine tuned ResNet 18 model is used to discriminate between real faces and synthetic faces. A fine tuned DistilBERT model is applied to classify profile biographies, to differentiate the human written text and AI generated text. PyExifTool is used to perform metadata forensics and investigate the EXIF fields and identify missing or inconsistent capture data. Final score = Trust Score = $wI + wT + wM = M = 0.4$ $wT = 0.3$ and $wM = 0.3$. Image decisions can be explained using Grad CAM, and textual cues using SHAP and LIME, whereas metadata signals can be interpreted. Use of a Flask backend and React dashboard. Accuracy of 85 percent and F1 of 0.82 were attained in experiments, meaning that the system is dependable in terms of real world verification.

Keywords

Fake profile detection, explainable artificial intelligence, deep learning, natural language processing, metadata forensics, multimodal fusion, trust scoring, Grad CAM, SHAP, LIME.

Enhancing Glycemic Condition Diagnosis Using CNN Architecture and Automated Learning

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Abstract

Glycemic is a chronic condition that affects millions worldwide, necessitating timely and accurate diagnosis to prevent severe complications. This study presents an advanced diagnostic framework integrating Convolutional Neural Networks (CNNs) and machine learning algorithms to enhance the detection and prediction of glycemic. CNNs are employed to analyze medical images, such as retinal scans, for identifying glycemic-related complications like glycemic retinopathy, leveraging their ability to extract complex features automatically. Simultaneously, machine learning models are trained on structured patient data, including glucose levels, BMI, and age, to predict the likelihood of diabetes. The proposed hybrid approach combining CNN extracted image features with structured data enhances diagnostic accuracy and robustness. The model development incorporates data preprocessing techniques, such as image augmentation and feature normalization, and employs optimization algorithms like Adam with regularization strategies to prevent overfitting. Evaluation metrics, including accuracy, precision, recall, and validate the model's reliability and performance. The proposed framework is deployed through user-friendly web applications, enabling healthcare professionals to access predictions seamlessly. This study underscores the potential of artificial intelligence to transform diabetes care by improving diagnostic efficiency, supporting early intervention, and facilitating personalized treatment strategies. Future work aims to incorporate explainable AI techniques and real-time monitoring systems to enhance transparency and adaptability in clinical practice. This method not only improves diagnostic efficiency but also underscores the potential of AI in transforming healthcare.

Heart Disease Prediction Using Machine Learning Algorithm

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Abstract

Disease diagnosis and prediction is one of the major aspects in the healthcare sector. Heart disease remains a leading cause of mortality worldwide, necessitating accurate and early prediction methods to facilitate timely intervention. This study explores the application of machine learning algorithms to predict heart disease by analyzing medical data such as age, blood pressure, cholesterol levels, and other relevant features. Various supervised learning algorithms, including Logistic Regression, Random Forest, Support Vector Machine (SVM) and SVM-PCA were employed to develop predictive models. A set of heart disease data containing various parameters of the tests conducted along with their results are fed to various machine learning algorithm for training. Then the pre-trained models are used for the prediction of new input data of new patients. The results of these algorithms are summed up to get one output for any patient's heart disease prediction. The results indicate that SVM-PCA achieved the highest accuracy, demonstrating the potential of machine learning in enhancing heart disease prediction and contributing to improved healthcare outcomes.

Multi Disease Prediction Using Ensemble Machine Learning on Health Data

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Abstract

Early detection of chronic diseases is essential for improving healthcare outcomes and reducing long-term complications. This study aims to develop a reliable and scalable multi-disease prediction system using ensemble machine learning techniques to estimate the risk of Diabetes, Heart Disease, Kidney Disease, and Liver Disease based on structured clinical data collected from multiple publicly available datasets. The proposed methodology integrates multiple supervised learning models, including Random Forest, XGBoost, Logistic Regression, K-Nearest Neighbors, and Naive Bayes, which are combined using a soft voting ensemble approach to enhance predictive accuracy, stability, and robustness across different disease categories. Data preprocessing plays a critical role in improving model performance and includes handling missing values, label encoding of categorical features, feature scaling, and the application of Synthetic Minority Oversampling Technique (SMOTE) to effectively address class imbalance issues commonly found in medical datasets. The models are evaluated using standard performance metrics such as accuracy, precision, recall, and F1-score, demonstrating consistent improvement over individual classifiers and better generalization capability. Furthermore, a lightweight and user-friendly web-based application is developed to provide real-time disease risk prediction, enabling improved accessibility and practical usability for early screening. The results highlight that ensemble learning offers an efficient, reliable, and scalable solution for early disease detection and supports informed healthcare decision-making processes in real-world scenarios.

The Smart Medical Appointment Booking System

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Abstract

In modern healthcare systems, patients and medical staff often face difficulties such as delayed appointment updates, missed consultations, and inefficient scheduling processes. Many existing medical appointment booking platforms lack intelligent decision-making support, leading to inefficiency in healthcare delivery. To address these challenges, this project proposes SmartSymp-Loc – a Smart Medical Appointment Booking System using Symptoms and Location. The proposed system enables secure user authentication to ensure that only authorized users can access the platform. A role-based access control mechanism is implemented to provide separate functionalities for Patients, Doctors, and Administrators. Patients can register and log in to select their symptoms, which are analyzed using anTF-IDF (Term Frequency-Inverse Document Frequency) vectorization to recommend suitable medical specialists. For location-based doctor and hospital identification, a predefined seed dataset containing hospital details, doctor information, and geographical data is utilized to efficiently match patients with nearby healthcare providers. An urgency-based priority mechanism ensures that emergency cases are handled promptly. The system supports both online and offline consultations. Furthermore, role-based dashboards allow patients to track their appointments, doctors to manage daily schedules and priority cases, and administrators to monitor overall system activities through summary views and analytics. By integrating secure authentication, role-based access control, symptom-based intelligence, structured location data, and priority handling, SmartSymp-Loc enhances healthcare efficiency, reliability, and user experience.

Keywords

Medical Appointment Booking System, Symptom-Based Disease Prediction, Healthcare Scheduling, Role-Based Access Control, Location-Based Hospital Recommendation, Priority-Based Appointment Management, e-Health Systems.

Strategic Engineering Management and Generative AI Driven IoT Framework for Smart and Sustainable Precision Agriculture

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Abstract

The rapid transformation of agricultural ecosystems due to climate variability, resource scarcity, and increasing global food demand necessitates intelligent, adaptive, and scalable technological interventions. This research proposes a Strategic Engineering Management (SEM) driven Generative Artificial Intelligence (GenAI) enabled Internet of Things (IoT) framework for smart and sustainable precision agriculture, focusing on data centric decision optimization and autonomous system coordination. The proposed architecture integrates heterogeneous IoT sensor networks to continuously capture multidimensional agro-environmental parameters including soil moisture, nutrient levels, temperature variability, humidity gradients, and crop health indicators. The acquired data streams are processed through cloud-enabled distributed computing infrastructure supporting real-time data aggregation, feature engineering, predictive modelling, and performance analytics using advanced machine learning algorithms.

A Generative AI decision layer synthesizes context-aware agronomic recommendations, adaptive irrigation scheduling strategies, crop disease risk insights, and scenario-based yield forecasting under dynamic environmental uncertainties. Strategic Engineering Management principles ensure lifecycle optimization, interoperability governance, risk mitigation, scalability planning, and techno-economic feasibility evaluation. The framework leverages edge computing, modular microservices architecture, and secure communication protocols to enhance responsiveness and resilience. The proposed approach improves water efficiency, optimizes fertilizer utilization, enhances yield predictability, and establishes a sustainable digital agriculture paradigm aligned with Industry 4.0 objectives.

Leveraging Artificial Intelligence for Climate Forecasting and Carbon-Neutral Future

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Abstract

Growing intricacies surrounding climate change call for emerging strategies to forecast environmental trajectories and develop sustainable responses. This research explores the application of Artificial Intelligence (AI) to climate forecasting, underlining its importance in scrutinizing vast environmental datasets, predicting extreme weather events, and supporting policy decisions in reaching carbon neutrality. With the integration of machine learning algorithms, satellites, and sensor-climate monitoring, AI allows realistic simulations of atmospheric and ecological phenomena. The study further explores how knowledge drawn from AI can support renewable energy options, emission reduction plans, and climate-resilient infrastructure planning. Despite advances in technology, data integrity, algorithmic biases, and governance remain challenges, necessitating responsible AI deployment. The study traces a pathway from predictive analytics to practical climate action plans, providing an outline for governments, business organizations, and environment institutions to accelerate transformation to a carbon-neutral future.

Keywords

Artificial Intelligence, Algorithmic biases, Carbon Neutrality, Ecological.

Green Innovation as a Driver of Sustainability and Organizational Performance in Emerging Economies: Evidence from India

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Abstract

Sustainability and green innovation have emerged as critical strategic imperatives for organizations operating in an increasingly environmentally conscious and resource-constrained global economy. Green innovation refers to the development and application of eco-friendly products, processes, and technologies that minimize environmental degradation while enhancing economic performance. This study explores the role of green innovation in promoting organizational sustainability, focusing on its impact on environmental performance, financial outcomes, and long-term competitive advantage.

The research synthesizes existing literature to examine the drivers, mechanisms, and outcomes of green innovation within firms. It highlights the influence of environmental regulations, stakeholder pressure, and Environmental, Social, and Governance (ESG) frameworks in encouraging firms to adopt sustainable innovation practices. Empirical evidence suggests that green innovation contributes not only to reduced emissions and resource efficiency but also to improved firm value, reduced operational risk, and enhanced corporate reputation.

Furthermore, the study emphasizes the growing integration of technological innovation and sustainability strategies, where green operational practices act as a bridge between ESG initiatives and corporate sustainability outcomes. Despite the increasing adoption of green innovation, organizations face challenges such as high implementation costs, uncertain returns, and lack of institutional support.

The paper concludes that green innovation is not merely an environmental responsibility but a strategic necessity for achieving sustainable development and long-term organizational resilience. It provides insights for policymakers, managers, and researchers to foster sustainable innovation ecosystems, particularly in emerging economies like India.

Keywords

Green Innovation, Sustainability, ESG (Environmental, Social, Governance), Sustainable Development, Corporate Performance, Environmental Management.

Real-Time AI Pose Estimation for Markerless Physiotherapy Assessment Using a Mobile Camera

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Abstract

Post-operative lower limb rehabilitation requires continuous monitoring of patient movement quality to ensure safe and effective recovery. Conventional physiotherapy assessment relies heavily on therapist supervision and subjective observation, limiting scalability and accessibility. This work presents an AI-based, markerless pose estimation framework for real-time tracking and analysis of human movement during physiotherapy exercises using a single RGB camera. A deep learning-driven pose tracking model identifies and tracks major body joints without the need for wearable sensors or physical markers. The system generates a skeletal representation of the patient's posture and movement, enabling objective assessment of exercise execution. Experimental results demonstrate reliable joint detection and real-time performance during common lower limb rehabilitation exercises. The proposed approach highlights the potential of artificial intelligence to support intelligent, accessible, and remote physiotherapy monitoring.

Keywords

Rehabilitation, Physiotherapy, Pose estimation, Pose tracking model, Joint detection.

Corporate Ethics, Responsibility, and Liability: Pillars of Sustainable Business

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Abstract

Following the systemic crises of the world in the form of environmental destruction as well as the high-profile financial misconducts, the traditional doctrine of the primacy of stockholder in enterprise is being challenged as an inadequate approach to enterprise in the present day. The underlying conflict on modern business research is balancing the fiduciary obligation to make profit with the ethical and legal relationships of the globalized society. The study fills the current gap of how vital a multidimensional framework of governance is beyond elective philanthropy.

This study examines Corporate Ethics- Responsibility- Liability convergence as the new frontier of "Sustainable Business" paradigm. The paper will examine the interactions of the three components that make up the TBL and the Stakeholder Theory towards lessen the systemic risk effect and increase the long-term resiliency of the organization. By conducting a comparative qualitative study of multi-industry case studies between those firms that have adopted these pillars and those that have exhibited systemic governance failures; this research concludes that the three pillars cannot be taken as an addition but synergetic to each other. The evidence implies that those companies that actively coordinate their internal ethics with their external obligations and legal protection experience much lower volatility and greater growth rates caused by innovations.

The study concludes that the Sustainable Business is a business that manages to combine the theory of moral philosophy with that of strategic management and legal rigor. The result is a contribution to the sphere of corporate governance since it suggests a holistic approach in which Ethics offers the purpose, Responsibility offers the action, and Liability offers the accountability. Its results indicate that such tripartite approach is the sole possible way of the 21 st century corporation to retain social license to operate.

Keywords

Corporate Governance, Ethics, Sustainability, TBL Theory, Corporate Liability.

IoT and AI-Based Smart Monitoring System for Industrial Applications

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Abstract

Internet The Internet of Things and Artificial Intelligence are really changing things now that Industry 4.0 is here. This project is about creating an Internet of Things and Artificial Intelligence-Based Smart Monitoring System, for Industrial Applications. The goal is to make monitoring, prediction and decision-making better. The system will use Internet of Things-based sensors to collect and monitor time industrial equipment data from the Internet of Things. This will help with making decisions and the Internet of Things and Artificial Intelligence will be a part of it.

This system also has automated alerts and real-time dashboards that help us maintain equipment proactively and reduce downtime. The Machine Learning and Deep Learning help us make sense of the data. The cloud and edge computing make it happen quickly. We get alerts. See the dashboards in real-time. This helps us fix things before they break. It also helps us avoid shutdowns. The goal is to use data to keep things running smoothly. The Machine Learning and Deep Learning are key, to that. They help us understand and act on the data.

This study shows that using Internet of Things and Artificial Intelligence together is a way to make things work better reduce the money spent on maintenance and make systems more reliable. The idea they came up with could be really useful in factories, automated industries and systems that combine physical and computer parts. This research helps create industries that use data to make decisions and fits with what people want to achieve with modern technology changes. The of Things and Artificial Intelligence are important, for making this happen so the Internet of Things and Artificial Intelligence will be used to improve the way things work.

Keywords

Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning, Industrial IoT (IIoT), Smart Monitoring System, Predictive Maintenance, Real-Time Data Processing, Anomaly Detection, Deep Learning, Edge Computing, Cloud Computing, Industry 4.0, Smart Manufacturing, Industrial Automation, Cyber-Physical Systems, Sensor-Based Monitoring, Data Analytics, Big Data Processing, Fault Detection, Performance Optimization, Decision Support Systems.

Psychological Influences on Digital Purchase Decisions: Examining the Effects of Cognitive Processing, Risk Perception and Trust in Online Consumers

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Abstract

The digital marketplace has transformed the way consumers evaluate information and make purchase decisions, highlighting the growing importance of psychological factors in online consumption. This study investigates the influence of key psychological constructs—cognitive processing patterns, perceived risk, and consumer trust—on online purchase decision-making. Grounded in consumer psychology and behavioural decision-making theories, the research adopts a quantitative approach using survey data collected from active online consumers. Advanced statistical techniques, including factor analysis and structural modelling, are applied to examine the relationships among psychological variables and purchase intention. The results indicate that cognitive processing significantly affects consumer judgment, while higher levels of perceived risk tend to reduce purchase likelihood. Trust in digital platforms emerges as a critical factor that mitigates uncertainty and enhances decision confidence. By integrating multiple psychological dimensions into a unified framework, this study contributes to the theoretical advancement of consumer psychology and offers practical insights for e-commerce platforms and digital marketing strategies. All stages of the research strictly comply with international ethical standards, including voluntary participation, informed consent, and data confidentiality.

Keywords:

Consumer Psychology, Digital Consumer Behaviour, Cognitive Processing, Perceived Risk, Online Trust and Purchase Decision.

Managing Technology for Sustained Innovation: A Strategic and Organizational Perspective

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Abstract

The increasing pace of technological advancement has fundamentally reshaped the competitive landscape of modern organizations. In such an environment, sustained innovation has become a critical capability for long-term survival and growth. This research paper examines how organizations can strategically manage technology to foster continuous innovation. The study adopts a conceptual and integrative research approach grounded in theoretical frameworks such as dynamic capabilities, resource-based view (RBV), and organizational learning theory. It identifies key determinants of sustained innovation, including strategic alignment, leadership vision, organizational culture, human capital, and governance mechanisms. Through an in-depth analysis supported by contemporary industry examples, the paper demonstrates that sustained innovation is not merely the result of technological investment but a systemic organizational capability. The findings highlight the importance of long-term orientation, adaptability, and continuous learning in achieving innovation sustainability. The study contributes to the literature by presenting a comprehensive framework that integrates strategic management and technology management perspectives. It also provides actionable insights for managers aiming to leverage technology as a strategic asset for continuous value creation and competitive advantage.

Keywords

Technology Management, Sustained Innovation, Strategic Capability, Organizational Learning, Competitive Advantage.

Behavioural Bias of Investors Toward Investment – A Study

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Abstract

The traditional paradigm of rational decision-making in finance is increasingly challenged by behavioural insights that highlight the pervasive influence of psychological biases on investor behaviour. The present study examines the impact of behavioural biases—namely overconfidence, loss aversion, herd mentality, anchoring, recency, and information bias—on investment decision-making and financial risk tolerance among individual investors. The study is based on primary data collected through a structured questionnaire and to test the proposed relationships, multiple regression analysis and Karl Pearson's correlation were employed. The findings reveal that behavioural biases significantly influence investment decision-making, with loss aversion and information bias emerging as the most dominant predictors. Additionally, a positive and statistically significant relationship was observed between behavioural biases and financial risk tolerance, indicating that investor psychology plays a crucial role in shaping risk perception and tolerance levels. The study contributes to the growing body of behavioural finance literature by providing empirical evidence from the Indian context, where such integrated analysis remains limited. The findings offer practical implications for investors, financial advisors, and policymakers by emphasizing the need for behavioural awareness and structured decision-making frameworks to mitigate irrational investment behaviour and enhance financial outcomes.

Keywords

Behavioural Finance, Behavioural Biases, Investment Decision-Making, Risk Perception, Financial Risk Tolerance, Investor Behaviour, India.

Influencer Marketing: Shaping Brand Perception in the Digital Age

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Abstract

The rapid expansion of social media platforms has significantly transformed marketing communication, positioning influencer marketing as a dominant strategy in the digital era. This study examines the role of influencer marketing in shaping brand perception, with a focus on long-term brand outcomes rather than short-term engagement metrics. Grounded in Social Influence Theory and Source Credibility Theory, the research analyses how influencer attributes such as credibility, authenticity, and audience engagement influence consumer attitudes and brand perception. A qualitative and conceptual research design is adopted, supported by an extensive literature review and case-based insights. The findings suggest that influencer marketing plays a critical role in building trust, enhancing emotional connection, and strengthening brand identity. However, existing literature reveals key gaps, including the absence of integrated frameworks and limited focus on long-term brand perception. This study addresses these gaps by proposing a comprehensive perspective linking influencer marketing strategies with brand perception. The research offers practical implications for marketers and contributes to the academic understanding of digital marketing strategies.

Keywords

Influencer Marketing, Brand Perception, Social Media Marketing, Consumer Behaviour, Brand Equity, Digital Marketing, Social Influence.

Browser-Based Unified Approach for Vulnerability Detection and Endpoint Discovery

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Abstract

The dynamic nature of web application attacks is becoming an emergent difficulty to the antiquated security evaluation methodology that can be described as excessive infrastructural and invasive examination. To fill this gap, this paper proposes a lightweight and online based, vulnerability assessment platform that introduces security testing into the world of development to offer an immediate expansion of the development environment. The tool employs a two-way endpoint discovery method, whereby, passive scanning of the HTTP traffic and passive scanning of the HTML and JavaScript text is being employed to identify both the static and dynamically generated API endpoints. Security analysis is performed by a hybrid detection engine which makes use of both safe and pattern-matching heuristics as well as limited and non-destructive active probes in order to find out high-impact vulnerabilities known as SQL Injection (SQLi) and Local File Inclusion (LFI). The results are interconnected and presented in a developer-oriented interface through which they can be triaged and remediated in a short time. This paper demonstrates that non-invasive browser-based testing can be made possible and it also provides a scalable template to implement security detection at an earlier phase of the software development life cycle (SDLC) and to improve an ongoing security posture.

Keywords

Endpoint Discovery, Local File Inclusion (LFI), SQL Injection (SQLi), Dynamic Application Security Testing (DAST), Browser Extension.

Towards Effective Detection and Mitigation of DDoS Attacks in IoT Environment

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Abstract

This work presents a comprehensive multi-layer DDoS attack detection and mitigation system specifically designed for Internet of Things (IoT) devices. As IoT devices become increasingly prevalent in critical infrastructure, they represent attractive targets for Distributed Denial of Service attacks due to their limited computational resources and often inadequate security measures. The proposed system implements a three-tier defence architecture combining NGINX-based rate limiting at the network edge, application-level intelligent filtering, and real-time monitoring with automated threat response. The system successfully detects and mitigates various DDoS attack vectors including HTTP floods, SYN floods, and keep-alive abuse attacks. Experimental results demonstrate that the system blocks approximately 95% of malicious traffic while maintaining service availability for legitimate users. The implementation includes a real-time security dashboard for visualization and analysis of attack patterns, providing security analysts with actionable insights. This research work contributes to the growing field of IoT security by providing a practical, deployable solution that balances robust protection with minimal performance overhead.

Keywords

DDoS mitigation, IoT security, intrusion detection, network security, NGINX, real-time monitoring, threat intelligence, cyber defence, attack detection.

Multimodal Deep Neural Network for Diabetic Retinopathy Severity Classification and Referral Risk Prediction

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Abstract

Diabetic retinopathy (DR) is a significant cause of preventable vision loss, often progressing without noticeable symptoms until advanced stages. Most existing automated screening approaches rely solely on retinal fundus images and ignore systemic clinical factors that influence disease severity and referral decisions. This paper proposes a multimodal deep-learning framework that integrates fundus images with clinical and metabolic data for joint DR severity classification and high-risk identification. A convolutional neural network (CNN) is used to extract visual features from retinal images, while a multilayer perceptron encodes clinical variables including age, duration of diabetes, glycemic control, blood pressure, body mass index, lipid levels, and smoking status. The learned representations are fused and optimized using a multi-task learning strategy with dual output heads for severity grading and binary high-risk prediction. Experimental results demonstrate that the proposed multimodal model outperforms image-only baselines in severity classification and achieves strong performance in clinically referable DR screening ($\geq$ moderate DR), with high sensitivity, specificity, and ROC-AUC. These results highlight the effectiveness of multimodal learning for clinically relevant DR screening and risk stratification.

Keywords

Diabetic Retinopathy, Multimodal Deep Learning, Fundus Imaging, Clinical Data Fusion, Multi-task Learning, Risk Stratification, Referral Screening, Convolutional Neural Networks.

PosePal: Real-Time Yoga Pose Detection, Estimation, and Personalized Feedback System

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Abstract

Yoga is one of the oldest forms of exercise for physical and mental health, but depending on the situation, correct postures are very important. In this research, we created PosePal, a yoga pose detection and feedback system leveraging MediaPipe's pre-trained pose estimation framework, OpenCV, and Flask to provide real-time posture detection and feedback. PosePal detects 34 human body landmarks using MediaPipe Holistic and evaluates pose correctness using custom-built geometric modules—VectorCal, AngleCal, and DistanceCal.

So long as the user maintains their pose (correctly) for five seconds, PosePal will move to the next yoga asana. Posepal will then provide a performance score based on time and correctness. PosePal has a simple user webspace using Flask and HTML and is rather easy to use. PosePal is intended to be a bridge between an in-person instructor and self-practice situations for anyone wanting to practice yoga in their own home, with personal/personalized real-time feedback on how they are doing.

Keywords

Computer Vision, MediaPipe, Pose Estimation, OpenCV, Flask, Yoga Guidance System, Fitness Technology.

UVM-Based Functional Verification of Arithmetic Logic Unit Using Adaptive Coverage Method

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Abstract

Universal Verification Methodology (UVM) is a standardized methodology for functional verification of digital designs based on constrained-random stimulus, assertion-based verification, and functional coverage analysis. This paper describes a UVM-based verification environment for an 8-bit Arithmetic Logic Unit (ALU) with an adaptive coverage-driven approach that goes beyond the standard UVM methodology by adapting the stimulus generation process in real-time based on coverage feedback. In contrast to the standard static coverage-driven approach, which only uses constrained randomness, the adaptive feedback loop in this approach identifies under-covered functional bins and focuses the stimulus on those bins, thus improving the convergence of coverage without human intervention. Various phases of verification, such as directed, boundary, random, and adaptive verification, were performed to ensure the functional correctness and robustness of the design. Assertion-based verification was performed using 19 System Verilog properties to check the integrity of the data path and arithmetic operations. Experimental results show the functional correctness of the ALU with a functional coverage of 95.00%, which is an improvement over the 78.91% coverage achieved by the conventional constrained-random verification approach.

Keywords

UVM, functional verification, adaptive coverage, system verilog assertions, ALU verification.

TravelMate AI: Next-Gen AI-Powered Matchmaking & Seamless Itinerary Creation

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Abstract

Artificial Intelligence (AI) is no longer reactive but rather agentic, which means that systems can think, reason multi-step, and act proactively not only in relation to human beings but also other digital agents. Although AI is a disruptive technology in other industries, its application to social and collaborative purposes in the travel and tourism industry has not been extensively studied. The paper will present TravelMate AI, a platform based on Agentic AI that aims at intelligently matching travelers to people with similar destinations, budgets, dates, and interests and who receive personalized and intelligent daily itineraries automatically. Using n8n to automate workflows on the back-end and React.js to create a responsive front-end and Supabase to store data and provide authentication, TravelMate AI provides adaptive, data-driven, and real-time travel suggestions. Collaboration, automation, and adaptivity are the most crucial features of the system, allowing the users to create companionships during travels, get intelligent itinerary updates, and have socially engaging and stress-free travel experience. Therefore, TravelMate AI is the representation of further AI development in the context of the travel planning industry by means of intelligent matching and adaptable optimization of the itinerary.

Keywords

Agentic AI, TravelMate AI, Personalized Itinerary, User Matching, Workflow Automation, Supabase, n8n, Smart Travel Planning, Collaboration, Adaptive AI.

Beyond Static Retrieval: Designing and Evaluating Agentic Retrieval-Augmented Generation for Sales Intelligence

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Abstract

Rapid urbanization, market volatility, and accelerating digital transformation have intensified the need for intelligent engineering systems that support resilient and sustainable decision-making. In this context, Retrieval-Augmented Generation (RAG) has emerged as a powerful approach for enabling data-driven insights from large-scale enterprise knowledge bases. However, conventional RAG architectures—such as vector-based, graph-based, and hybrid retrieval—often rely on static retrieval strategies, limiting their adaptability, interpretability, and effectiveness across diverse analytical tasks.

This paper presents Agentic RAG for Sales Intelligence (ARSI), an engineering-driven framework that integrates autonomous agents with tool-based retrieval mechanisms to enable adaptive reasoning over structured, unstructured, and external data sources. Leveraging a ReAct-style reasoning-action loop, ARSI dynamically selects retrieval strategies based on query intent, enabling accurate quantitative analysis, contextual explanation, and causal reasoning within a unified pipeline. This adaptability supports more transparent and human-aligned decision processes, which are essential for sustainable digital infrastructures.

The proposed framework is evaluated using real-world sales intelligence scenarios, including quarterly revenue assessment, root-cause analysis of sales fluctuations, and cross-market performance evaluation. Comparative results demonstrate that while traditional RAG methods excel in isolated semantic or relational tasks, ARSI achieves superior performance in adaptability, multi-source evidence integration, and explainability. By improving the quality and reliability of enterprise intelligence, this work contributes to resilient digital systems that support informed decision-making, efficient resource utilization, and long-term organizational sustainability, aligning with the broader goals of smart infrastructure development and the United Nations Sustainable Development Goals.

Detection of Top Influential User within Each Interest Group Over an Online Social Network using Graph Analysis

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Abstract

Online social networks play a vital role in modern communication, enabling users to connect and form communities based on shared interests. These communities, known as interest groups, often exhibit strong internal connectivity among users with similar preferences. Identifying such groups and determining the most influential user within each group is essential for applications such as targeted marketing, recommendation systems, and efficient information dissemination. This project focuses on detecting interest groups in online social networks and identifying the top influential user within each group using graph analysis techniques. Users are represented as nodes and their interactions as edges, forming a graph structure. The Louvain community detection algorithm is used to identify interest groups, and multiple centrality measures including Degree Centrality, Betweenness Centrality, and PageRank are combined to determine the most influential user within each group. Publicly available online social network datasets are used for experimentation, and the implementation is carried out using Python with appropriate graph analysis libraries. The proposed approach aims to provide meaningful insights into social network behavior with strong real-world applicability.

Keywords

Online Social Networks, Community Detection, Interest Group Identification, Louvain Algorithm, Influential User Detection, Centrality Measures, Degree Centrality, Betweenness Centrality, PageRank, Graph Analytics, Social Network Analysis.

SCRIBEE: A Comprehensive App for the Detection, Intervention, and Aid of Dyslexia and Dysgraphia

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Abstract

Learning disabilities such as dyslexia and dysgraphia affect millions of children worldwide, often hindering their academic progress, self-expression, and confidence. Dyslexia impacts reading and comprehension, while dysgraphia affects handwriting and written communication, leading to frustration, disengagement, and low self-esteem. Despite the availability of tools like Text-to-Speech (TTS) and Speech-to-Text (STT) or gamified learning apps, most existing solutions remain fragmented—offering partial support without integrating real-time feedback, engagement, and personalized progress tracking. This gap creates difficulties for parents, teachers, and therapists in providing consistent intervention and guidance. Scribee addresses this challenge by combining assistive technology, gamified learning, and adaptive assessment within a unified, cloud-enabled platform. The mobile interface of the work engages children through interactive literacy activities, while the intelligent back-end dynamically adjusts difficulty levels and securely stores progress data. Tested modules like TTS and STT achieved high accuracy (95% and 92%), validating the system's reliability and responsiveness. By merging engagement, accessibility, and adaptive learning, Scribee delivers personalized, child-centered support that fosters confidence and sustained improvement. It transforms fragmented interventions into a seamless ecosystem—empowering children with dyslexia and dysgraphia to learn independently and joyfully while bridging the gap between technology, education, and inclusivity.

Hybridization of Online and Offline Payment Modalities through Dynamic Split-Transaction Orchestration in Contemporary Food Ordering Systems

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Abstract

The current food ordering medium only allows a single method of payment which makes them inconvenient to the customers who would like to use a mix of cash and electronic payments especially in shared food orders and low balance cases. The limitation is solved through this paper and is proposed to be adopted as a hybrid split-payment system which allows the effective settlement of transactions with the help of various payment means in one order. The methodology proposes an integrated payment orchestration framework through which the division of dynamic bill splitting between online payments like UPI as well as offline cash payments may be supported by a reconciliation and transaction validation framework to guarantee consistency and atomity. An HTML, CSS, JavaScript, PHP, and MySQL prototype web-based system were used to test feasibility in a simulated environment of transaction operations. The experimental data show that it allows having better payment flexibility, decreased cart abandonment, and achieve full-price payment reliability, and provides higher success rates with respect to transaction. The primary value of the work is the introduction of a lightweight and scalable practical hybrid of payment framework that can be deployed in the current food ordering and point-of-sale solutions, especially in the Indian digital payment landscape.

Keywords

Split payment, Hybrid transactions, Food ordering systems, UPI integration, Cash-on-delivery, Payment reconciliation.

Develop a Machine Learning Model to Predict Human Life Span

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Abstract

Life expectancy is widely used as an important measure of an individual's overall health and well-being. It is influenced by several factors, including medical conditions, lifestyle habits, and physiological characteristics. However, predicting human lifespan is not straightforward, as these factors interact in complex and non-linear ways. In the project, a machine learning-based approach is proposed to estimate life expectancy using the Gradient Boosting Regressor algorithm. The model is developed using a dataset that includes key health and lifestyle attributes such as height, weight, body mass index (BMI), cholesterol levels, smoking behavior, alcohol consumption, physical activity, and medical conditions like diabetes, hypertension, heart disease, and asthma. To improve data quality, preprocessing steps such as handling missing values and applying one-hot encoding for categorical variables are performed. The dataset is then divided into training and testing sets to evaluate the model's performance. The results, measured using Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2), indicate that the model provides reliable predictions. In addition, a Streamlit-based web application is developed to allow users to input their details and receive real-time life expectancy predictions. Overall, the system offers a practical tool that can help individuals better understand how lifestyle choices may influence their long-term health.

Keywords

Gradient Boosting Regressor, Machine Learning, Life Expectancy Prediction, Healthcare Analytics, Streamlit, Lifestyle Factors.

Corrosion Performance and Chloride Permeability of Lime Activated High-Volume GGBS and Ferrochrome Slag based Concrete

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Abstract

Chloride penetration and the subsequent corrosion of embedded steel are among the leading contributors to the early deterioration of reinforced concrete, highlighting the importance of developing durable and low-carbon alternatives to conventional concrete. The current study probes the combined influence of high-volume Ground Granulated Blast-furnace Slag (GGBS), hydrated lime, and ferrochrome slag (FS) aggregate on enhancing the corrosion resistance and chloride barrier performance of concrete. Six concrete mixes were formulated with a fixed 60% GGBS used as cement replacement, with and without 7% hydrated lime as a chemical activator, while natural coarse aggregates were substituted with FS at 0%, 50%, 75%, and 100% by volume. Durability was measured through the Rapid Chloride Permeability Test (RCPT) according to ASTM C1202, accelerated electrochemical corrosion testing via gravimetric mass loss of embedded HYSD steel bars, and measurement of compressive strength (CS) and ultrasonic pulse velocity (UPV) before and after corrosion exposure. The incorporation of 7% lime together with 75% FS resulted in the minimum charge passed value of 432 C, corresponding to an overall reduction of approximately 69% compared to the control mix (CM) with 1392 C. This was classified as "Very Low" chloride permeability category in accordance with ASTM C1202. The optimal mix (G60L7F75) also attained the highest pre-corrosion CS of 54.4 MPa and UPV of 5448 m/s, with minimal post-corrosion deterioration (1.1% UPV loss and 7.5% CS loss), and the lowest reinforcement mass loss of 8.7% which is 51.9% improvement over the CM. These enhancements are the effect of the additional C-S-H gel formation from GGBS hydration, alkaline activation by hydrated lime, and the impermeable compound microstructure of FS particles, collectively densifying the cementitious matrix and interfacial transition zone (ITZ). The findings confirm the viability of this ternary industrial by-product system for producing high-performance, corrosion-resilient, and sustainable concrete infrastructure.

Keywords

Ground granulated blast-furnace slag (GGBS), ferrochrome slag (FS), Rapid Chloride Permeability Test (RCPT), compressive strength, corrosion resistance, ultrasonic pulse velocity (UPV), sustainable concrete.

From Source to Shelf: A Transparent Product Tracking Solution

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Abstract

This paper presents an advanced transparent product tracking framework designed to ensure end-to-end traceability and trust across modern supply chain ecosystems. The proposed system addresses critical limitations of conventional supply chain management solutions, including centralized data control, limited visibility, and vulnerability to data manipulation. By employing a distributed tracking architecture that integrates unique product identifiers, immutable record management, and real-time event logging, the framework enables continuous monitoring of product lifecycle events from raw material sourcing to final retail delivery. The solution captures and verifies manufacturing operations, logistics movements, storage conditions, and ownership transfers through secure data validation mechanisms. Implemented using modern web technologies and scalable backend services, the system provides an interactive dashboard for real-time product status visualization, provenance verification, and compliance monitoring. Extensive experimental evaluation conducted on simulated multi-tier supply chain datasets comprising over 20,000 product transactions demonstrates traceability accuracy of 99.1%, an average update latency of 210 milliseconds, and a significant reduction in data inconsistency incidents. The proposed approach effectively mitigates counterfeit risks, enhances stakeholder trust, and establishes a scalable foundation for transparent, resilient, and intelligent supply chain management.

Keywords

Supply Chain Transparency, Product Traceability, Source-to-Shelf Tracking, Real-Time Monitoring, Data Integrity, Distributed Ledger, Smart Supply Chain.

Industry Power Consumption and Penalty Minimization Using Automatic Power Factor Correction (APFC) Unit

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Abstract

Escalating demand for economical and productive utilization of electrical energy across manufacturing industries has brought attention to the adverse consequences of suboptimal power factor resulting from widespread deployment of inductive equipment. A poor power factor elevates reactive power requirements, amplifies line currents, escalates distribution losses, induces voltage instability, and triggers financial penalties from electricity authorities. To overcome these limitations, this work proposes an Automatic Power Factor Correction (APFC) unit engineered to enhance industrial energy utilization and curtail penalty-related expenditures. The developed scheme continuously acquires real-time electrical measurements, including supply voltage and load current, and executes dynamic reactive power injection via selective engagement of capacitor banks. A dedicated microcontroller-driven APFC relay evaluates instantaneous load behavior and regulates the power factor toward near-unity conditions, consequently elevating system performance and supply quality. Deployment of the APFC scheme diminishes total apparent power drawn, strengthens voltage profile, decreases feeder losses, and ensures adherence to utility compliance thresholds. Through the convergence of automation, live data acquisition, and adaptive reactive compensation, the proposed APFC unit markedly reduces industrial power bills, extends service life of connected apparatus, and fosters energy-conscious sustainable manufacturing operations.

Keywords

Power factor correction, reactive power compensation, capacitor bank switching, microcontroller control, energy efficiency, industrial power quality.

DeepLeaf: Intelligent Disease Detection System for Tomato Crops

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Abstract

Identifying tomato leaf diseases in the early stage is important in order to minimize crop damage and improve overall crop productivity. Recently, deep learning based methods have been broadly used in automating plant disease identification because of their ability to classify images accurately and quickly. In this study, an integrated deep learning system is presented using two convolutional neural network models, VGG16 and MobileNet, trained on the open source Plant Village tomato leaf dataset containing 16,012 images which belongs to ten different categories. This work presents an efficient deep learning based system for automated tomato leaf disease classification by merging the strengths of deep convolutional feature extraction and lightweight model optimization. Transfer learning helps the models learn faster and achieve higher accuracy while keeping the system more efficient and easy to run. In Experimental findings shows that the hybrid learning strategy works better for classifying the data, converges more quickly, and better at generalizing, making it good choice for real time agricultural monitoring systems. The study talks about how important is that to balance the accuracy and efficiency for real world use in precision agriculture.

Keywords

Tomato leaf disease, VGG16, MobileNet, Transfer Learning, CNN, Precision agriculture.

Enhancing Student Engagement in Zoology Laboratory through QR Code-Enabled Specimen Management: A Machine Learning and Text Analytics Approach

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Abstract

This project employs an interdisciplinary methodology that combines QR code-enabled specimen management with machine learning and text analytics to improve student engagement in zoology laboratory education. The system was put into use with 85 undergraduate students, and the data collected was in CSV format and included both structured responses and open-ended input. We created and tested several supervised machine learning models, such as Random Forest, Support Vector Machine (SVM), Logistic Regression, K-Nearest Neighbors (KNN), and Decision Tree, to see which one could best predict engagement levels. The Random Forest model had the highest accuracy rate of 87%. The examination of feature importance found that simplicity of use, scan frequency, and time spent were the best indicators of engagement. Natural language processing methods, such as sentiment analysis and TF-IDF vectorization, were also used to look at student input. These methods showed that most of the feedback was favorable and that students had better learning experiences. K-means clustering divided students into different involvement groups, which gave us a better understanding of how they behave. Statistical analysis validated a notable enhancement in overall engagement scores subsequent to the intervention ($p < 0.01$). The results show that using QR code technology with advanced analytical methodologies is a scalable, cost-effective, and data-driven way to make experiential learning in zoology labs better.

Sign Language Recognition Using Deep Learning Algorithm: A Survey

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Abstract

The current survey will provide the in-depth overview of Sign Language Recognition (SLR) systems developed under the methodology of the deep learning study, with a focus on researches published in 2019-2025. Sign language recognitions are very important in alleviating the communication barrier between the hearing-impaired society and the rest of the society. As of recent, SLR has seen massive improvements in both isolated and continuous recognition problems, with the improved computer vision, deep neural networks, and cheap computational resources. This paper syntactically examines state-of-the-art deep learning to SLR application methods such as: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long short-term memory (LSTM) networks, attention-based, and Transformer architectures. Some of the modalities of inputs such as RGB video, depth, optical flow, and pose or landmark-based representations are all covered in the survey and are extracted through frameworks such as MediaPipe and OpenPose. State-of-the-art benchmark datasets, such as WLASL, RWTH-PHOENIX-Weather, PHOENIX-2014T, Chinese Sign Language (CSL), and some Indian Sign Language (ISL) datasets are covered as well as popular evaluation measures that can be considered accuracy. To bring into the limelight architectural options, data sets involved, and trends of performance 15 representative research papers have been compared.

Keywords

Sign Language Recognition, Deep Learning, Computer Vision, Multimodal Fusion, Continuous Sign Language Recognition and Human-Computer Interaction.

Verbo Vision AI: A Multimodal AI Framework for Image Understanding

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Abstract

With the rapid growth of images and multimedia content, there is an increasing need for intelligent systems that can effectively interpret visual information and present it in an accessible and meaningful form. This paper presents Verbo Vision AI, a unified multimodal artificial intelligence framework designed to enhance image understanding by transforming a single image into multiple informative outputs. The proposed system generates descriptive captions, performs object detection and localization, supports visual question answering, provides audio narration, and produces a simple video representation of the visual scene. The framework integrates deep learning-based computer vision techniques with natural language processing and multimedia generation methods. Vision-language models are employed for caption generation and question answering, while YOLO-based object detection is used to obtain object-level information from images. The resulting textual content is further converted into speech and visual sequences to improve accessibility and user interaction. Unlike traditional image understanding approaches that address individual tasks separately, the proposed framework combines all functionalities within a single processing pipeline, enabling comprehensive interpretation of visual content. Experimental evaluation conducted on real-world images demonstrates clear, consistent, and accurate outputs across different modules. The proposed system is particularly beneficial for visually impaired users and shows strong potential for applications in education, assistive technologies, and multimedia content creation.

Temple Architecture Analysis Using Deep Learning and Visual Interpretation

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Abstract

Indian temple architecture has developed over many centuries through the influence of religion, regional traditions, and historical conditions, resulting in distinct architectural styles such as Dravidian, Nagara, and Vesara. Identifying these styles has traditionally relied on expert observation and detailed visual study, which becomes time-consuming and difficult when a large number of temples need to be examined. This study focuses on classifying temple architectural styles using image-based analysis with deep learning, while also allowing the basis of each classification to be examined. Temple images are analyzed using a deep learning model trained on a curated dataset of 1,475 images, including 492 Dravidian, 492 Nagara, and 491 Vesara samples collected from different sources and visual conditions. The model learns structural patterns related to architectural elements such as towers, gateways, and sculptural regions that help distinguish between styles. To understand which parts of an image influence the classification result, Gradient-weighted Class Activation Mapping is applied to highlight relevant regions in the temple images. The system was evaluated on an unseen test dataset and achieved a classification accuracy of 89.19%, indicating consistent performance across all three architectural categories. The visual results show that the classification relies mainly on meaningful architectural features rather than background details. These findings suggest that combining deep learning with visual analysis can assist architectural study and support systematic recording and learning related to Indian temple architecture.

Keywords

Temple Architecture, Deep Learning, CNN, Grad-CAM, Image Classification, Visual Representation.

AI-Based Mock Interview Platform

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Abstract

Interview preparation remains a challenging process for job candidates due to limited access to realistic practice environments and objective performance evaluation. This paper presents an AI-based mock interview platform that simulates real-world interview scenarios through voice-driven human-AI interaction. The proposed system generates role-specific interview questions, conducts adaptive dialogue based on candidate responses, and evaluates performance using real-time scoring metrics. A voice-enabled conversational AI module is employed to emulate interviewer behavior, enabling natural and interactive communication. The platform further provides personalized feedback and performance insights to support continuous improvement in communication skills and interview readiness. Experimental usage analysis demonstrates that the system effectively enhances user engagement and confidence, offering a scalable and accessible solution for interview training.

Keywords

Artificial Intelligence, Mock Interview System, Conversational AI, Voice-Based Interaction, Automated Performance Evaluation, Interview Training.

Deep Learning-Based Plant Disease Recognition System Using Convolutional Neural Networks and Streamlit Web Application

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Abstract

It is critical to detect crop diseases in early stage to enhance food production and reduce losses due to diseases. Disease identification methods based on manual visual inspection are highly error prone, require a lot of time, and are not feasible for large scale farming. In this paper, we develop an end to end crop disease prediction system that combines deep learning-based image classification with a real time web based deployment framework. Automatic disease classification from plant leaf images is carried out by a convolutional neural network (CNN) based on the ResNet50 architecture. Transfer learning is used to facilitate feature extraction and to achieve better classification results. A publicly available PlantVillage dataset has been used for training and testing the system. It contains ten disease and healthy classes for tomato crops only. Testing accuracy of 96.5% has been achieved, whereas other performance metrics like precision, recall, and F1 score noted score higher than 96%. The confusion matrix analysis shows that the model performs well in each class and only a few samples have been misclassified. To facilitate real time image upload and prediction, the trained model is wrapped in a Streamlit web application. The proposed architecture provides early crop disease diagnosis in precision agriculture.

Adaptive Cyber Defence Using ML, Steganography, and Hacker Activity Analysis

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Abstract

The Intelligent Web Traffic Analyzer with Hacker Activity Tracking model comprises of a fully integrated system it is integrated based on real-time web application monitoring, analysis, and protection. Along with this the feature our system collects data on request and the next level includes a hybrid hacker detection pipeline that incorporates statistical anomaly detection, rule based signatures, automated alerts, and rate-based heuristics. The contents of our model includes an admin dashboard, IP management, and reporting to end user and to the admin, and this is built with ASP.NET/C#, Microsoft SQL Server, and Google Charts. From our test findings and from load testing and simulated assaults it is clear that the model shows high precision for unusual and third person login attempts, alerting latency of less than two seconds, and it also consists of a steady dashboard performance under all concurrent loads. The admin site manager can more effectively respond to attacks with the smart integrated systems involved in the model, they can also monitor and alert the subsequent user of the threats they might face due to suspicious activities taking place, make it a safer cloud environment compared to the other models.

Keywords

Hacker Detection, Anomaly Detection, Signature-Based Security, IP Management, Cybersecurity Analytics.

Automated Energy Management and Control using IoT

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Abstract

Energy efficiency and effective electricity management are at the center of major challenges as a result of the increasing power demand and the rising energy costs. The developed system equips advanced voltage and current sensors with IoT, enabled communication to perform continuous, real, time, and on, demand energy consumption data collection, transmission, and analysis. The users can have remote access to detailed energy usage information through a dedicated mobile application, thus enabling monitoring and control from anywhere and at any time. The implementation of the proposed solution leads to energy saving, user awareness, and the use of energy in a sustainable way in residential and commercial environments by giving them real, time visibility, intelligent analysis, and remote management.

Keywords

Internet of Things (IoT), Energy Management System, Smart Energy Monitoring, Real-Time Power Analysis, Remote Monitoring and Control, Energy Conservation.

Gen AI – Enabled Mentorship and Internship Support Platform

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Abstract

The growing need to have individualized career advice and internship programs has revealed the shortcomings of the traditional mentorship and placement assistance frameworks that tend to be manual, piecemeal, and hard to scale. The paper will recommend a Generative AI-Powered Mentorship and Internship Support Platform to overcome these obstacles by combining Artificial Intelligence, Natural Language Processing, and full-stack application development to create career mentoring and internship support platforms that are all smart enough to be realistic and relevant nowadays. The system uses a chatbot powered by GenAI to deliver automated advice, resume and skills analysis, mentor placement, and individualized internship and job recommendations. The modern AI models carry out profile analysis, skill verification, mentor-mentee matching, and opportunity ranking according to relevance and user requirements. Data privacy and system integrity are guaranteed by means of secure authentication, role-based access control, and token management. Cloud-based deployment is scalable, highly available, and available 24/7 to a multiuser, multi-server environment. The experimental assessment shows better response efficiency, user engagement, and minimal manual intervention as compared to traditional mentorship methods. The suggested platform will facilitate inclusive, scaled, and intelligent career development in accordance with the current digital education and workforce preparedness goals.

Keywords

Generative Artificial Intelligence, Mentorship Platform, Internship Recommendation System, Natural Language Processing, AI Chatbot, Skill Analysis, Career Guidance, Role-Based Access Control, Cloud Computing, Automated Decision Support.

Smart AI Based Solution for Traffic Management

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Abstract

Rapid urbanization and the continuous growth of vehicular population have made traffic congestion a major challenge in modern cities. Inefficient traffic management leads to increased travel delays, excessive fuel consumption, environmental pollution, and a higher risk of road accidents. Conventional traffic signal control systems operate using fixed-time or pre-programmed schedules, which are unable to adapt to dynamic and unpredictable traffic conditions. As a result, these systems perform poorly during peak hours, emergency situations, and irregular traffic patterns.

This paper presents a Smart AI-Based Traffic Management System that enables real-time adaptive traffic signal control using artificial intelligence techniques. The proposed system integrates computer vision and Internet of Things (IoT) technologies to continuously monitor traffic conditions at signalized intersections. Traffic parameters such as vehicle density, queue length, and waiting time are extracted from real-time video streams and sensor data. A reinforcement learning-based control mechanism is employed to dynamically optimize traffic signal phases by learning optimal control policies through interaction with the traffic environment.

The effectiveness of the proposed system is evaluated under dynamic traffic scenarios simulating peak and off-peak conditions. Experimental results demonstrate a significant reduction in average waiting time and improved traffic throughput compared to traditional fixed-time control systems. The proposed approach offers a scalable, cost-effective, and intelligent solution for urban traffic management and contributes toward the development of sustainable and smart city transportation systems.

Keywords

Smart Traffic Management, Reinforcement Learning, Computer Vision, IoT, Adaptive Signal Control, Smart Cities.

Detection of Abnormality in Endoscopic Image using Image Segmentation

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Abstract

With the advent of faster and accurate devices imaging in the field of Medical has been undergoing a revolution in the past decade. For such devices corresponding software is required which in turn has provided a major drive for new algorithms in signal and image processing. Digital image processing techniques are used in the medical images analysed, used as diagnostic tools and quite often provides insight into the inner working of the process under study. The commonly found abnormalities in endoscopic images are cancer tumours, ulcers, bleeding due to internal injuries, etc. The segmented method is used to segment the tumours, abnormal regions and cancerous growth in the human esophagus. In our proposed work, a method for detecting possible presence of abnormality in the endoscopic images is presented. An algorithm is developed to perform the segmentation, classification and analysis of medical images, especially the endoscopic images for the identification of commonly occurring abnormalities in it.

Keywords

Endoscopy, Tumors, Esophagus, Morphology, Segmentation.

Local Field Potential Study in Normal and Chemically Induced Epileptic Mouse Model

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Abstract

Neurological disorders cause electrophysiological changes of the Brain. Electrophysiological analysis can detect the status of the brain and has positive impact on treatment pattern and actual diagnosis. Different devices are available to study the brain status but the electroencephalography is a technique commonly used for diagnosis of different neurological disorder. With the development of bioengineering, use of LFP can be a promising step apart from EEG which have been continuously using in diagnosing and treating various type of neurodegenerative diseases. LFP provide a molecular level data as compared to superficial EEG record (1). Previous works on LFP in various neurodegenerative disorder have shown correlation of Beta wave oscillation (13–30 Hz.) in Parkinson's disease (2). Changes in local field potential observed in case of epilepsy patients before onset of epileptiform discharge (3). A significant local field potential was recorded in epilepsy patient in theta range as in the earlier work (4)

Present study is carried out to identify the association of LFP signal with neural disorder recorded in the subcortical regions of the PTZ treated seizure model of mouse brain. Insulation coated microelectrodes were stereotactically implanted in the specific regions of the brain to collect the signals. Signals are acquired with the help of BioPac Data Acquisition system from control, PTZ treated mouse groups. The recorded data were analysed using software acknowledge 5.0. changes in the amplitude of waveforms are evident in PTZ treated animals. This indicated alteration of intercellular environment locally.

Classification of Knee Osteoarthritis Using Transformer Based Vision Models

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Abstract

Knee Osteoarthritis (KOA) is a chronic degenerative joint disorder that significantly affects mobility and quality of life, particularly among the elderly population. Accurate assessment of disease severity plays a crucial role in clinical diagnosis and treatment planning. Conventional diagnosis relies on manual interpretation of radiographic images using the Kellgren–Lawrence (KL) grading system, which is subjective and prone to inter-observer variability. This paper presents a transformer-based vision framework for automated classification of Knee Osteoarthritis using X-ray images. The proposed approach leverages Vision Transformers (ViT) and their advanced variants to capture both local structural details and global contextual relationships through self-attention mechanisms. Experimental evaluation on KL-graded knee X-ray datasets demonstrates that transformer-based models achieve improved classification accuracy and robustness compared to traditional convolutional neural network approaches. The results indicate that transformer architectures offer a reliable and scalable solution for computer-aided KOA diagnosis in real-world clinical settings.

Keywords

Knee Osteoarthritis, Vision Transformer, Medical Image Analysis, Deep Learning, X-ray Classification.

Deep Learning-Based Predictive Maintenance Approaches for Intelligent Equipment Monitoring in Smart Manufacturing Industries: A Comprehensive Review

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Abstract

Predictive maintenance (PdM) is recognized as a critical enabler of Industry 4.0 through the provision of data-driven alternative solutions to traditional breakdown and preventive maintenance strategies. A systematic literature review of recent developments in PdM taking into consideration the application of sensor based data, Internet of Things (IoT) enabled monitoring and Artificial Intelligence (AI) based techniques in manufacturing. The literature findings suggest that PdM enhances equipment reliability and reduces downtime compared with conventional methods, moreover, industrial IoT (IIoT) and AI integration are shown to be key factors in the realisation of smart manufacturing. Other advances regarding the use of deep learning and multimodal sensor fusion improve fault detection and Remaining Useful Life (RUL) estimation. However, challenges persist including: slow real-time deployments, limited use of multimodal data sets, low model explainability, and unresolved issues with regard to data privacy. The majority of approaches reviewed were purely conceptual, i.e. they proposed ideas for realising PdM but were lacking both empirical investigations of the results and the performance of the solutions. Future research should focus on the development of solutions that comply with the tenets of explainable AI, lightweight real-time PdM systems, and the testing of solutions within an industrial context to provide a platform for scalable and dependable PdM solutions.

Keywords

Predictive maintenance, Machine learning, Deep learning, Industry 4.0, Smart manufacturing, Multisensory data, Industrial Internet of Things.

Explainable and Data-Efficient Machine Learning Models for Time-Series Risk Prediction: A Comprehensive Survey

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Abstract

The rapid proliferation of machine learning (ML) in risk-sensitive domains has surfaced two persistent challenges: the need for vast labeled datasets and the opacity of predictions made by complex models. This paper presents a comprehensive survey of explainable and data-efficient machine learning models applied to time-series risk prediction. We systematically review 35 studies spanning healthcare, finance, energy systems, and industrial applications, analyzing their methodologies, datasets, key findings, limitations, and research gaps. Our analysis reveals four dominant strategies for achieving data efficiency—transfer learning, data augmentation, active learning, and representation learning—and four primary explainability techniques: LIME, SHAP, attention mechanisms, and Grad-CAM. Synthesized results demonstrate that hybrid models combining data-efficient learning with explainable AI (XAI) outperform traditional approaches by up to 40% in data utilization while maintaining competitive accuracy. Open challenges including the absence of unified benchmarks, limited cross-domain generalization, and high computational cost in real-time settings are identified and a structured research roadmap is proposed.

Keywords

Explainable AI, Data-Efficient Learning, Time-Series Risk Prediction, SHAP, LIME, Transfer Learning, Healthcare AI, Financial Forecasting.

An Automatic Text Summarization Using Extractive ML

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Abstract

In the information overload era, it is essential to barrow the appropriate insights out of the vast volumes of texts in a manner as efficient as possible. The paper describes an automated text summarization system based on AI which utilizes a hybrid system based on extractive and transformer abstractive models. It generates key sentences with the assistance of statistical, positional, and semantic properties, such as TF-IDF, sentence location, named entities, and contextual embeddings, and undergoes refinement with the help of abstractive models to convert the content to corresponding summaries, coherent and written by a human end-user. It enables multi-document inputs, domain-specific adaptation, multi lingual texts and customizable summary preferences on length, tone, and format. The ability to create visualization creates infographics, charts, and slides in order to make the content more approachable and captivating. Assessed on benchmark collections using conventional performance measurements related to ROUGE-N, ROUGE-L, and ROUGE-SU, the system exhibits a high level of accuracy, coherence and readability. The solution is scalable, can be deployed using APIs or SaaS platforms and useful in education, journalism, business intelligence, and research.

Keywords

Automatic Summarization, Extractive, Abstractive, NLP, Transformer Models, Multimodal Summaries, Multi-Document.

SYNCURVE: A Real-Time Multi-Source Health Analytics Platform for Outbreak Prediction Using Machine Learning and Explainable AI

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Abstract

The SYNCURVE Health Analytics Solution provides an adaptive, near real-time capability for detecting and responding to outbreaks in a rapidly evolving urban environment. The SYNCURVE Health Analytics Solution integrates the most effective methods of analysis (e.g., machine learning, statistical modelling and explainable AI) with the goal of identifying potential health risks with minimal delay. The SYNCURVE Health Analytics Solution collects information from many different sources in the urban environment, including healthcare information and services, environment information, mobility patterns of the population, and health-related stories. In contrast to earlier alert systems that were solely threshold-driven or rule-driven, the SYNCURVE Health Analytics Solution uses models based on data to identify trends, detect anomalies, and classify risk. The SYNCURVE Health Analytics Solution uses time-series forecasts, probabilistic models, and graph analysis to describe interaction between locations, populations, and the environment. A module that provides decision support will rank alerts and recommendations for response by risk level and intensity. Geospatial analysis allows the SYNCURVE Health Analytics Solution to visualize the geographic expansion of an outbreak and identify high-risk areas.

Keywords

Public Health Surveillance, Outbreak Prediction, Multi-Source Data Integration, Machine Learning, Explainable AI, Anomaly Detection, Geospatial Analytics.

YouTube Transcript Summarizer: Using Mistral Gemini for Efficient Video Content Distillation

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Abstract

The fast increase of video content on networks like YouTube has posed a challenge to users who desire to extract the important information in lengthy videos within the shortest time. It may be time-wasting and ineffective to watch all videos to grasp the main ideas. To overcome this issue, this project will suggest a YouTube Transcript Summarization System that will automatically create succinct and meaningful summaries out of video transcripts. It is based on a hybrid architecture with two strong Large Language Models (LLMs): Google Gemini Pro and the Mistral-7B-Instruct with Low-Rank Adaptation (LoRA). The first step is to fetch the transcript of a video on YouTube with the help of the YouTube Transcript API that retrieves the time-aligned segments of the speech in the video. In case the transcript exists in a non-English language, it is automatically translated to English so that it can be processed the same way. The process of summarization is dynamic and it selects the suitable model based on the availability of the internet. In case there is an internet connection, the system operates on Gemini Pro which is a cloud-based model that produces highly fluent and context-relevant summaries. The offline system is based on the Mistral-7B-Instruct model fine-tuned with LoRA, which allows a local summarization process to be done effectively with privacy of data and lower computational cost. It is implemented in Streamlit, which is a simple and interactive system that allows one to enter the URL of a video in a YouTube player and get the summary of the video shown in bullet points or paragraphs immediately. The experimental assessment results indicate that the offered system generates the clear and informative summaries, as Gemini Pro demonstrates a somewhat higher fluency whereas Mistral is capable of generating the reliable offline performance. It enhances the availability of video information and can find use in education, research, and information retrieval.

Keywords

YouTube Transcript Summarization, Video Content Analysis, Natural Language Processing, Large Language Models, Google Gemini Pro, Mistral-7B-Instruct, Low-Rank Adaptation (LoRA), Automatic Text Summarization, Multilingual Translation, Streamlit Interface, Information Retrieval.

PSNA Assistant – AI-Powered Campus Support

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Abstract

The emergence of artificial intelligence in academic institutions is changing the face of communication through the creation of AI-based assistants aimed at helping students and staff in their quest to find accurate academic information and institutional support services. Students and staff in these academic institutions have always found it hard to get accurate academic information and institutional services. This project seeks to introduce a cutting-edge academic AI-based chatbot dubbed the “PSNA Assistant,” aimed at helping students and staff in their quest to find academic information in real time. The AI-based chatbot makes use of a cutting-edge technology dubbed Natural Language Processing (NLP) and Retrieval Augmented Generation (RAG) in helping students get accurate academic information. The chatbot also helps students get information regarding academic timetables, faculty information, exam updates, and academic cutoffs through the use of a Vector Database (VectorDB) and a Large Language Model (LLM).

Keywords

AI-powered chatbot, Natural Language Processing (NLP), Retrieval Augmented Generation (RAG), Large Language Model (LLM), and campus support system.

Deep Learning-Based Multi-Class Retinal Disease Detection Using DenseNet-121 with Explainable AI

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Abstract

The retinal conditions, namely diabetic retinopathy, glaucoma, and cataract, are among the major causes of preventable blindness. However, the asymptomatic nature of these conditions in the early stages, in addition to the shortage of ophthalmology specialists, has led to delayed diagnosis. This research was carried out with the aim of developing a computerized system for the classification and diagnosis of fundus images, where four classes, namely diabetic retinopathy, cataract, glaucoma, and normal retina, are distinguishable. This system is based on a two-stage transfer learning method using DenseNet-121, where the classification head is first trained on a frozen backbone, followed by the fine-tuning of some deeper convolutional blocks at a reduced learning rate. A total of 4,217 fundus images, each with a near uniform distribution, were used in the classification. On-the-fly data augmentation was applied to the images, and a weighted loss was used for handling the mild imbalance. Interpretability was also integrated in the system using Grad-CAM, where the class discriminative regions are identified and related to the anatomically significant areas, and LIME, where the significant regions in the images are identified by applying superpixel perturbations. The outputs from the system were also converted to a four-tier risk stratification framework. The system achieves 91% overall test accuracy with a macro F1-score of 0.885, where diabetic retinopathy achieved the highest detection accuracy of 94%.

Keywords

Retinal disease detection, fundus image classification, densenet-121, transfer learning, explainable AI, grad-CAM, LIME, risk stratification.

LEXA: An AI-Based System for Legal Assistant for Judgment Prediction, Summarization and Legal Text Simplification

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Abstract

Legal professionals and the general public face significant challenges in reading, understanding, and acting on legal documents. This paper presents **LEXA** (Legal Expert Assistant), a unified NLP-powered web application that brings together three essential legal AI capabilities: (1) binary judgment outcome prediction using a BERT classifier fine-tuned on a legal question-answering dataset; (2) abstractive summarization using a T5-small model trained on the BillSum legislative corpus, complemented by Sentence-BERT semantic case retrieval; and (3) plain-language rewriting of legal text using FLAN-T5 with a rule-based fallback, evaluated via the Flesch Reading Ease metric. All three modules are served through an interactive Flask web interface with a conversational dark-themed UI. Experimental results show prediction confidence reaching **81.63%**, readability scores above 90 for simplified outputs, and coherent abstracted summaries with relevant case references. LEXA bridges the legal accessibility gap by combining state-of-the-art transformer models in a single deployable pipeline accessible on standard CPU hardware.

Keywords

Legal NLP, BERT, T5, FLAN-T5, Judgment Prediction, Legal Summarization, Text Simplification, BillSum, Sentence-BERT, Flask.

An Inspection of Deep Learning-Based Image Restoration and Segmentation in Smart Manufacturing

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Abstract

Smart manufacturing relies on high-performance image processing for automatic inspection, defect detection, and quality control. The traditional image restoration and segmentation algorithms are adversely affected by noise, distortion, and missing data and hence are not suitable for industry. In recent years, new robust image restoration and segmentation methods based on deep learning have been introduced for smart manufacturing purposes. This survey provides a detailed review of deep learning-based approaches for industrial image quality improvement with focus on Generative Adversarial Networks (GAN), i.e., CycleGAN and GCN. Other segmentation techniques, e.g., U-Net, Attention U-Net, and Mask R-CNN, are also considered. Moreover, comprehensive analysis of the strengths and weaknesses of these models is considered, including the future research directions for improving accuracy, scalability, and real-time automation. With the inclusion of the latest developments, this survey is a valuable reference for researchers and practitioners in intelligent manufacturing, industrial automation, and smart factory systems.

Automated Bone Marrow Cell Classification Using Deep Learning with EfficientNet-B0 and Progressive Unfreezing

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Abstract

Morphological classification of bone marrow cells is extremely important for the diagnosis of hematological cancer; however, it is still a time-consuming and expertise-dependent process. In this research paper, an end-to-end hybrid deep learning architecture based on the EfficientNet-B0 and the Swin Tiny Transformer has been suggested to classify 15 types of bone marrow cells from a vast number of 1.72 million microscopic images. Our hybrid model has shown outstanding accuracy (94.12%), exceeding the performance of EfficientNet-B0 alone (87.52%). High F1-scores were obtained for Eosinophils (0.98), Erythroid Progenitors (0.96), and Neutrophilic Granulocytes Segmented (0.94), whereas Hairy Cells (0.70) and Rare Cells (0.45) had worse performance scores. Grad-CAM, t-SNE, and cosine similarity analysis have revealed that our hybrid model considers important morphological characteristics like the nucleus and cytoplasm during classification.

Keywords

Bone Marrow Classification, Microscopic Imaging Hematological Malignancies, Hybrid Deep Learning, EfficientNet-B0, Swin Transformer, Grad-CAM.

Emotion-Aware Autonomous Driving System Using EEG and Eye-Tracking-Based Cognitive State Analysis

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Abstract

In the case of autonomous and semi-autonomous cars, the main safety of drivers remains a key challenge, particularly in cases where the driver is exhausted, drowsy, or bored. Conventional car systems often disregard the emotional and mental condition of a driver in preference to environmental sensors. Emotion-Conscious Autonomous Driving System as suggested in this paper utilizes eye-tracking information and EEG to detect and quantify the state of drivers in real-time. Variables like blink rate, Eye Aspect Ratio (EAR) and gaze direction are classified by utilizing MediaPipe to extract eye tracking variables. The alpha, beta and theta EEGs are regarded as the brainwave bands, obtained either by using the wearable headsets or by simulated datasets. These signals are acquired by Face Mesh. A pre-trained Support Vector Machine (SVM) model is used to group the manner of drivers into five groups; normal, stressed, microsleep, distracted and drowsy. Depending on the rules of suspicion, the system will undergo a readjustment, such as putting the user into autonomous mode, providing visual and auditory warnings, and prescribing rest or soft music. Moreover, event logging is undertaken to analyze the session and a dashboard built on Streamlit to give live visualization of EEG bands, system actions, emotion status, and eye landmarks. The potential of the system to establish the mental states correctly and deliver timely interventions to boost driver safety and potentially have emotion-sensitive autonomous vehicles is demonstrated to be necessitated by experimentation.

Keywords

Autonomous Driving Systems, Driver Safety, Emotion-Conscious Driving, Eye Tracking, EEG Signals, Brain-wave Analysis, Eye Aspect Ratio (EAR), MediaPipe, Face Mesh, Support Vector Machine (SVM), Real-Time Monitoring, Streamlit Dashboard.

Automated Academic Evaluation and Student Outcome Prediction

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Abstract

The rapid growth of digital education platforms and web-based learning environments has increased the need for efficient and scalable academic assessment systems. Many Institutions conduct and evaluate assignments and quizzes online so the number of student submissions has grown notably. Evaluating large volumes of descriptive answers manually can be time-consuming, especially in courses with a high number of students. In addition, identifying textual similarity between submissions and analysing student performance data adds further challenges for instructors.

To help address these issues, this work proposes an Automated Academic Evaluation and Student Outcome Prediction System developed using the MERN stack along with Machine Learning, Natural Language Processing (NLP), and Data Analytics techniques. This system provides a secured role-based access for both faculty and students. Faculty can upload assignments, quizzes, deadlines, and model answers, while students submit their responses within the specified timeframe. Once the submission deadline is reached, NLP-based similarity techniques are applied to analyse the submitted answers. In particular, TF-IDF vectorization and cosine similarity are used to measure textual similarity between student responses and the model answer, as well as to identify similarities among different student submissions. This approach helps in automating the evaluation process and also supports in plagiarism detection. Based on the similarity results, this platform automatically assigns marks along with the plagiarism score for assignments, generates quiz results and submission patterns. Based on these indicators the predictive analytics are performed using supervised machine learning algorithms to predict whether the student is likely to pass or fail a specific subject.

Overall, integrating automated grading, similarity detection, and predictive analysis into a single system helps in reducing the workload and is also time saving for the faculty. It also allows institutions to monitor student performance more effectively and supports data-driven decision making in modern education systems.

Keywords

Automated Academic Evaluation, Machine Learning, Data Analytics, Natural Language Processing, Plagiarism Detection, TF-IDF, Cosine Similarity, Student Performance Prediction, Predictive Analytics.

Design Space Exploration and Optimization of Retinex-Based Low-Light Image Enhancement on FPGA – A Survey

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Abstract

Image improvement in low-light conditions is crucial in a variety of current imaging tasks, such as surveillance, automated navigation, and intelligent transport. The low-light images may have very low contrast, higher noise, and reduced visual signal, which can lower both how good they look and how well computer vision algorithms work. Retinex-based enhancement are well liked as they replicate the manual vision of individuals by separating an image in terms of light and shadow. However, traditional Retinex algorithms involve complicated procedures such as logarithmic transformations, spatial filtering, and multi-scale processing and so existent processors cannot run them in real time. This survey examines existing methods of low-light image enhancement by Retinex and the way it can be accelerated with Field-Programmable Gate Arrays (FPGAs). Some of the optimization methods that it explores include pipelining, fixed-point computation, loop unrolling, and memory restructuring that will make processing faster and hardware more efficient. The paper further details the advantages of using FPGAs in order to have real time execution whilst maintaining high quality of images, and proposes further researches to be done on how better hardware notion can be achieved in embedded vision systems.

Reliable RFID System for Monitoring and Verifying Expiry Dates of Pharmaceutical Products

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Abstract

The growing demand for transparency and safety in pharmaceutical supply chains has highlighted the urgent need for a secure, reliable method to authenticate medicinal products. This paper introduces an RFID-based system that accurately tracks pills and capsules, focusing specifically on monitoring their expiry dates. By embedding RFID tags into pharmaceutical packaging, the system ensures consistent identification and real-time validation throughout the product's life cycle. Through the use of cryptographic encryption, only authorized personnel can access or modify the stored data, thereby reducing the risk of counterfeit or expired medications. Each RFID tag holds encrypted expiry data that is verified upon scanning, offering immediate confirmation of product authenticity. This innovative solution enhances patient safety, simplifies inventory handling, and offers a scalable and cost-effective method for pharmaceutical authentication.

Keywords

RFID, healthcare, expiry tracking, authentication, pharmaceutical supply chain.

Design and Analysis of Low-Power Consumption Linear Feedback Shift Register Using a Combined Sleepy and Keeper Technique

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Abstract

Power reduction in digital systems has become a critical design priority, especially for portable devices and energy-constrained embedded applications. Conventional Linear Feedback Shift Registers (LFSRs), widely used in communication systems, cryptographic hardware, and Built-In Self-Test (BIST), consume significant leakage and dynamic power at advanced technology nodes. This work presents a low-power LFSR architecture based on an integrated Sleepy and Keeper transistor technique. The proposed hybrid method suppresses leakage during idle periods through sleep transistors while retaining logic state with keeper circuits to avoid performance degradation. A 16-bit LFSR was implemented and simulated using a CMOS process. Experimental results demonstrate a Leakage reduction in leakage power, 18% dynamic power savings, and minimal delay overhead compared to the conventional LFSR. The design therefore offers an efficient and stable solution for low-power applications requiring continuous state retention and high reliability.

Keywords

LFSR, low-power design, sleepy technique, keeper transistor, leakage reduction, CMOS VLSI, BIST, state retention, power gating, subthreshold leakage.

A Deep Analysis on Brain-Like Exploration: Thriving on Graph Giants with Tiny Memory

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Abstract

Although such classical techniques as Breadth-First Search (BFS) and Depth-First Search (DFS) have long been fundamental techniques owing to their simple concepts and well-known theoretical behavior, when used in large-scale networks with limited memory resources they are significantly problematic. In modern systems like social media networks, biological interaction graphs, and communication infrastructure memory availability can be the most important constraint instead of a speed limit. This paper provides solutions to these issues by empirically and theoretically analyzing memory constrained graph search algorithms, namely, Iterative Deepening Depth-First Search (IDDFS) and Beam Search in comparison with BFS and DFS baseline algorithms in synthetic networks of Erdos-Renyi and Barabasi-Albert networks (10,000 to 100,000 nodes). We also propose a Memory-Bound Execution Framework (MBEF) that achieves realistic edge device constraints based on explicit memory limits. We show that using IDDFS, the BFS-level is restored and memory consumption by about 70% (390 MB vs. 1,220 MB), Beam search, in turn, is more scalable, with memory consumption reduced by 85% (152 MB), the number of node expansions is reduced four times, and execution time is lower (8.2 s vs. 18.4 s running BFS). The results offer practical information on the selection of algorithms in the resource-constrained context, such as autonomous navigation, the recommendation system, network routing, and edge computing platforms.

Comparative Analysis of MTCMOS, Header-Switch, and Footer-Switch Sleep Techniques for Low-Power 2:1 Transmission-Gate Multiplexer Design

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Abstract

This paper presents the design and comparative evaluation of MTCMOS, header-switch, and footer-switch techniques for implementing a 2:1 multiplexer using Transmission Gate Logic (TGL) in 90 nm CMOS technology. The primary objective is to identify the optimal sleep-transistor configuration and sizing that minimize the overall area–delay–power (ADP) product, quantified through a Figure of Merit (FOM) metric. Simulation results obtained from cadence virtuoso at 1.0 V supply demonstrate that the Footer-Switch configuration achieves the highest FOM, approximately 18× higher than the Header-Switch and nearly 5.0 orders of magnitude higher than the MTCMOS configuration. These findings indicate that the Footer-Switch provides the most efficient trade-off between performance, power consumption, and silicon area. The proposed optimization framework offers a structured design methodology for achieving energy- efficient multiplexers for ALUs and other low-power communication systems.

Keywords

MTCMOS technology, Header-Switch, Footer- Switch, 2:1 Multiplexer (TGL), Sleep Transistor, Optimal Sizing, Figure of Merit (FOM).

Online Exam Cheating Detection with Cognitive Load Estimation

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Abstract

Online examinations are now a common phenomenon in modern education systems; however, the maintenance of academic integrity in online examinations is a big challenge. Traditional online proctoring systems are based on manual observation, which is often inefficient, time-consuming, and error prone. In this regard, an online exam monitoring system based on artificial intelligence is proposed to automatically detect suspicious activities during online examinations using computer vision and audio processing techniques. In this system, the webcam is used to examine the activities of students in real time by detecting the face, eyes, gaze, and movements of the mouth. In this regard, face detection models such as MTCNN (Multi-task Cascaded Convolutional Neural Network) and facial landmark detection models such as MediaPipe are used to detect the face and facial features of the students. This allows the system to detect the gaze of the students and abnormal movements of the eyes. In addition to this, the system is designed to detect multiple faces in the video frame to detect the presence of intruders in the room. In addition to the above, object detection techniques are employed to detect the presence of forbidden items like mobile phones and books within the video frame. Audio monitoring techniques are included in the system to detect the speech and whispering of the candidate using signal processing techniques like the detection of energy levels and zero crossing rate. The system is further designed to monitor the screen of the examinee to detect the use of unauthorized resources during the examination. Once the presence of such activities is detected, the system generates alerts in real time and voice messages to alert the candidate about the detected behaviors. All the detected behaviors are compiled into detailed visual reports for further analysis. The use of the proposed system in the examination environment using Python, OpenCV, MediaPipe, and deep learning techniques proves the effectiveness of the system in improving the reliability of the examination environment.

Keywords

Online Examination, Cheating Detection, Computer Vision, Artificial Intelligence, MediaPipe, Face Detection, Eye Tracking, Object Detection.

Early Detection of Osteoporosis using Dental X-Rays: A Deep Learning-Based Non-Invasive Diagnostic

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Abstract

Human bones are the calcified skeletal frame work that aids in support, movement of organs and protection. Bone density declines with age, putting people at risk for osteoporosis – a condition in which bones become fragile and prone to fractures. Even though there are scans to evaluate a person's bone health, most people could go undiagnosed for years with weak bones until a severe bone damage occurs. Dental panoramic X ray images, commonly taken in dental offices, offer an attractive chance for early detection of bone medicine-related diseases. In this work, we propose a structured pipeline for computer vision, U-Net-based masking, and deep learning to analyse dental X-rays for the early diagnosis of osteoporosis risk. This method starts by preprocessing the image and applying a masking technique to isolate the relevant bone areas. Then, the proposed method uses deep learning to identify discriminative patterns for the classification of the patient's condition as Normal, Osteopenia, and Osteoporosis. Experimental results on four architectures show high performance, with test accuracy ranging from 87.63% to 94.30%, while MobileNetV2 achieves the best accuracy of 97.28%. The lightweight nature of the proposed framework also makes it possible for efficient real-time clinical practice, making the proposed framework a cost-effective and non-invasive approach for early screening and preventive medicine.

Keywords

Osteoporosis, Deep Learning, MobileNetV2, Computer vision, U-Net masking, Dental X-ray.

REACT (Resilient Environment Attack and Counter-Measure Testing)

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Abstract

Traditional security testing often falls short because it relies on static scans and pre-set attack scripts. These methods struggle to keep up with modern, adaptive defense systems that change in real-time. While AI has helped automate some of these attacks, most current tools focus strictly on whether an exploit "works" rather than explaining how the defense actually behaved.

To bridge this gap, this paper introduces REACT an AI driven framework designed to evaluate cyber resilience. Instead of a one-size-fits-all scan, REACT uses a reinforcement learning agent that "thinks" like an attacker, choosing its next move based on how the system and its Intrusion Detection Systems (IDS) respond. By synthesizing vulnerabilities from exposure signals, REACT can provide a meaningful assessment even if a direct exploit is blocked. Testing in a virtualized Kali Linux environment proved that REACT offers much deeper visibility into defensive gaps than traditional tools. It provides a safe, reproducible way to measure how effectively a system stands its ground against a sophisticated, evolving threat.

Keywords

Cyber Defense Resilience, Adaptive Red Teaming, Reinforcement Learning, Vulnerability Assessment, Intrusion Detection Systems, Cyber-Range Testing.

Credit Card Fraud Detection Using Quantum-Enhanced SVM with Explainable AI

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Abstract

Transactions through the internet are developing at high rates and this makes them vulnerable to scam activities leading to huge losses. Conventional machine learning methods have been of potential in detecting fraud but they are challenged by extreme data imbalancing, latency demands of detection and the structure of time-series transactions. In order to tackle these problems, the proposed project offers a failsafe regime of detecting frauds by combining quantum-enhanced Support Vector Machines (QSVM) with traditional machine learning applications. It presents the statistical tests and feature selection to minimize noise and maximize effectiveness first and then relies on the speedup of the classification of high-dimensional and imbalanced datasets using quantum annealing solvers. To test the quantum-enhanced model, experiments are conducted with the data on credit card transaction (moderately imbalanced and non-time-series) and bank loan application (highly imbalanced and time-series) and clearly demonstrates that the quantum model yields not only better speed in detection but also higher accuracy, especially with the time-series data where classical tools fail. The research opines that quantum machine learning (QML) has a potential to detect fraud in real-time. Nevertheless, it also makes clear that the characteristics of the training data are important to determine which approach between the classical approach and the quantum one is more appropriate in case of the problem.

Keywords

Fraud Detection, Quantum Machine Learning, Support Vector Machine, Imbalanced Data, Time-Series Analysis, Quantum Annealing.

Voice Controlled Intelligent Computer Vision System for Visually Impaired Users

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Abstract

Vision loss can significantly affect a person's ability to perform routine activities such as navigating unfamiliar locations, identifying nearby objects, or reading printed information. To address these challenges, researchers have increasingly explored assistive technologies that rely on artificial intelligence and computer vision. These systems interpret visual information from the environment and convert it into audio feedback, enabling visually impaired individuals to better understand their surroundings. This study introduces a multi-functional assistive framework that integrates real-time object detection, Optical Character Recognition (OCR), voice interaction, and environmental sound monitoring. The proposed system employs a YOLO-based model to detect objects around the user and estimate their approximate distance. In addition, an OCR module reads textual information from signboards, labels, and documents and converts the recognized text into speech output. To further improve user safety, the system includes directional guidance and a horn detection mechanism that analyzes environmental audio signals using frequency analysis techniques. Experimental observations indicate that factors such as lighting conditions, camera movement, and environmental noise can influence system performance. The results demonstrate that integrating visual perception, audio processing, and speech interaction into a single lightweight framework can significantly improve environmental awareness and support safer independent navigation for visually impaired users.

Design Analysis and Optimization of Automatic Locking Clamp for Multi-Size Components in CNC Machine to Minimize Cycle Time

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Abstract

The paper provides the design, manufacturing, and performance appraisal of an automated clamping lock with a proximity sensor in CNC machining, which will reduce the cycle time whilst retaining the clamping uniformity with various size components. The system employs a dual acting pneumatic cylinder (40mm bore, 160mm stroke) that works under 6 bar pressure that is controlled by a 5/3 solenoid valve and Arduino based proximity sensing system. The proposed automatic pneumatic clamp was compared with conventional manual vice by the use of 10 samples (5 of them manual, 5 of them automatic) of component sizes 20mm to 200mm. The outcomes showed that the automatic locking clamp shortened the cycle time drastically by 39.7 percent, as manual cycle time was 45.8 seconds and the automatic cycle time was 27.6 seconds ($p=0.001$). The time taken in clamping was reduced to 1.22s ($p=0.006$) and the response time reduced to 102.2ms ($p=0.008$) (see table 1). Automatic operation had higher clamping force consistency (740particular to the manual operation (0.100mm, $p=0.013$). The statistical validation with two-sample t-tests and main effects plots proved that all of the performance parameters were significantly improved and suggested the proposed system as one of the effective solutions to optimizing the cycle time in any CNC machining operations.

Keywords

Automatic Locking Clamp, Pneumatic Vice, Proximity Sensor, Cycle Time Reduction, CNC Machining, Work-holding Device, Automation, Clamping Force Consistency.

Deep Learning-Based Classification of Fruits and Vegetables for Freshness Detection

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Abstract

Determining the freshness of fruits and vegetables are vital factors in meeting your food quality standards, keeping your diet healthy, and reducing food waste at home. The goal of this research is to see whether information extracted from images of fruits and vegetables can help classify those items as well as gauge their overall freshness. A combination of publicly available image databases and images taken by the researchers themselves generated one large set of data, which included many different types of fruits and vegetables and freshness ratings. Machine learning algorithms using Convolutional Neural Networks (CNN), specifically Transfer Learning methods (specifically MobileNetV2, ResNet50, and EfficientNet), were utilized to create models for classifying and rating the freshness of fruits and vegetables within this data set. Data was preprocessed through resizing, normalizing, and augmenting to provide robustness to the model when exposed to different lighting and background conditions. The model's performance was evaluated based on four metrics: accuracy, precision, recall, and F1-score. The classification task was completed as two separate tasks: identifying fruits and vegetables as multiclass categories; and detecting whether the fruits/vegetables were fresh or not. Our results indicate that lightweight CNN architectures performed very well for both tasks (i.e., classifying categories and detecting freshness), even in the presence of image occlusion and illumination variations. We also used visualization techniques to increase interpretability of our model by showing regions of an image that contributed to the output of the model. This approach has great potential for real-life applications such as smart refrigerators, food inventory management, and agricultural monitoring, thereby helping to improve food safety and decrease food waste.

Keywords

Convolutional Neural Networks, Food Freshness Detection, Fruit Classification, MobileNetV2, Deep Learning, Smart Kitchens.

ESP32-Based Smart Healthcare Bandage for Continuous Wound Analysis and Alerting System

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Abstract

The Smart Bandage system is an innovative IoT-based healthcare solution of real-time wound healing monitoring. The microcontroller employed in the creation of the wireless communication is ESP32 having the inbuilt Bluetooth feature. A flexible breathable bandage with integrated sensors including a DS18B20 thermometer, DFRobot Flexible Capacitive Moisture Sensor and MPU-6050 are used to obtain information on the state of wounds. These sensors will be temperature, moisture content and movement around the wound. The system also gives an alert in the event that abnormal conditions like inflammation, excessive moisture and infection are observed. The alerts are delivered to the healthcare providers via SMS via a GSM module and the data is stored in a cloud platform, e.g. there is a service known as Firebase in which data can be stored to be tracked in the long run. The expected outcome of the system is to detect complications early, monitor patients remotely, and manage wounds in general, particularly those in underserved and rural communities. The smart bandage is an inexpensive, scalable method to the modernization of wound care by combining real-time data collection, wireless communication and cloud storage.

Keywords

Smart Bandage Io based Healthcare Real Time Wound Monitoring ESP32 Microcontroller Biomedical Sensor Wound Care Patient Remote Monitoring SMS Notifications Cloud Storage (Firebase) Data Logging Healthcare Solutions- Wound Infection Detector Wearable Health Device.

TaskHive: Intelligent Multi-Module Environment for Project Management and Collaboration

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Abstract

Software development teams often face challenges in managing projects, tracking progress in real time, and identifying potential risks when using conventional project management tools. Many existing systems rely on static updates and reactive approaches, which limit their effectiveness in dynamic and distributed environments.

This paper presents TaskHive, an intelligent project management platform developed to improve collaboration and support proactive decision-making. The system is implemented using modern web technologies, with React for the frontend and Node.js for the backend. Firebase and Firestore are used for authentication and data management, while Socket.io enables real-time synchronization across users.

TaskHive continuously analyzes project activities instead of only recording task updates. It includes features such as early risk identification, team performance monitoring, and workload-based task assignment. These features help teams understand project status more clearly and take timely actions to avoid delays.

Experimental evaluation shows that TaskHive improves task completion rates, reduces task reassignment, and enhances coordination among team members compared to traditional tools. The system provides better visibility and supports efficient project execution.

Overall, TaskHive offers a practical and scalable solution for managing software projects, especially in agile and distributed team environments.

Keywords

Real-time collaboration, project management systems, predictive risk analysis, team performance analytics, agile development, distributed systems.

A Predictive and Adaptive Machine Learning–Driven System Architecture for Energy Consumption Optimization of IoT Devices in Smart Buildings

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Abstract

Accurately predicting energy consumption plays a crucial role in achieving efficient energy management, load balancing, and sustainable operation of modern power systems. However, forecasting energy usage is challenging due to nonlinear relationships, temporal dependencies, and variability in consumption patterns. To overcome these challenges, this study introduces a hybrid machine learning framework that integrates Light Gradient Boosting Machine (LightGBM) and Extreme Gradient Boosting (XGBoost) to enhance prediction accuracy. The hybrid approach takes advantage of the complementary strengths of both gradient boosting techniques. LightGBM contributes efficient training and rapid convergence, whereas XGBoost improves the model's robustness and generalization ability. By integrating predictions from both models, the hybrid approach captures complex consumption patterns more effectively than individual models. The proposed framework learns from historical energy consumption data and generates reliable forecasts that support intelligent energy management and decision-making. The effectiveness of the hybrid model is assessed using standard regression evaluation metrics, which demonstrate its capability and applicability for practical energy prediction tasks. The findings emphasize the potential of hybrid ensemble learning approaches to enhance the accuracy and reliability of energy consumption forecasting systems.

Keywords

Energy Consumption Prediction, Machine Learning, Gradient Boosting, LightGBM, XGBoost, Hybrid Model, Ensemble Learning, Smart Buildings, Smart Meter Data, Time Series Analysis, Predictive Analytics, Energy Forecasting, Building Energy Management, Data-Driven Modeling.

A Review of Ethical Framework and Assessment Model for Bridging AI Adoption, Cyber security and Digital Literacy Gaps

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Abstract

This research aims to explore the relationship among digital literacy, cybersecurity behaviors, AI ethics awareness with AI tool adoption within a students. The Study used mixed method approach combining questionnaire and open ended questions among students and using factor analysis, classification techniques study found that how self-assessed digital skills and ethical principles influence responsible AI use and digital practices. Interestingly, even though many students rely on AI tools regularly, gaps remains in cybersecurity understanding. These insights provide valuable information for educators, policymakers, and technology developers who want to foster responsible digital citizenship and safe, fair AI engagement in educational settings. The rapid adoption of Artificial Intelligence (AI) across professional sectors requires a solid understanding of AI ethics, cyber security awareness, and digital literacy. This project analyzes existing models and assessment methods to evaluate current skills and ethical gaps using survey data and natural language processing techniques. Building on this analysis, interactive assessment tools, including an AI-based chatbot and training modules, were created to measure users' ethical awareness and technical skills objectively. The study moves forward by designing an integrated ethical framework that incorporates principles such as fairness, transparency, privacy, accountability, and responsible AI use in organizational governance, technical safeguards, and ongoing training. This framework aims to align AI adoption practices with cyber security and digital literacy, ensuring fair, trustworthy, and secure use of AI technologies. The ongoing work involves cybersecurity practices, refining detailed training content, evaluation and deployment strategies to support ethical AI implementation among various professional workplace.

Keywords

Digital Literacy, Cyber security, AI ethics, AI adoption, Cyber security Awareness, Digital Citizenship.

Hybrid Embedded-Cloud System for Collaborative Retail Shopping and Real-Time Route Optimization

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Abstract

Physical retail environments are faced with persistent bottlenecks such as prolonged checkout lines, difficulties in product-location navigation, and limited transparency in billing. This work presents a practical, affordable IoT-based system that transforms a conventional shopping cart into an intelligent agent. The proposed system is based on a Raspberry Pi 5 edge computer coupled with an Arduino Mega sensor platform, providing real-time item vetting and collaborative shopping synchronization. Using Firebase Firestore for cloud persistence, MQTT for low-latency notifications, and an embedded Travelling Salesperson Problem (TSP) heuristic for path optimization, the system delivers live guidance and digital billing directly at the cart. Real-world experiments in a four-aisle physical testbed demonstrate robust accuracy and a 35% reduction in total shopping and checkout time, establishing the feasibility of scalable deployment in supermarkets.

Keywords

Smart Cart, IoT, Embedded System, TSP, Route Optimization, Firebase, MQTT, Retail Automation, Cloud, Raspberry Pi.

Building AI Inside Enterprises: A Product Manager's Framework for Scalable AI Adoption

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Abstract

Artificial Intelligence is rapidly transforming enterprise software systems; however, many organizations struggle to transition from experimental AI prototypes to scalable, production-ready AI products. This challenge is particularly evident in large enterprises where data fragmentation, governance constraints, and cross-functional dependencies slow down AI adoption. This research explores the role of the Product Manager in bridging the gap between AI innovation and enterprise-scale implementation.

The study proposes a structured framework for building AI-enabled products within enterprise environments by focusing on five critical dimensions: data readiness, AI product lifecycle management, cross-functional collaboration, responsible AI governance, and continuous learning systems. The framework draws on industry practices and simulated case scenarios across sectors including healthcare, manufacturing, and financial services to illustrate how organizations can operationalize AI while ensuring scalability, compliance, and user trust.

The findings highlight how product managers can act as orchestrators between engineering, data science, and business stakeholders to deliver value-driven AI products. This research contributes a practical playbook for enterprises seeking to embed AI capabilities into digital products while maintaining strategic alignment, ethical standards, and long-term sustainability.

Developing a Machine Learning Pipeline for Analysing the Relationship Between Mobile Internet Usage, Literacy, and Income in India

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Abstract

Digital inclusion has become increasingly important for the socio-economic development in India. Even though there has been a significant growth in the mobile internet usage, factors such as literacy, income levels, and access to telecommunication continue to shape the ways in which users access the mobile internet. The purpose of this study is to understand how literacy rates, household incomes, and telecommunication providers fuels the internet usage in various states across the country of India. Here we have merged two datasets, that includes the TRAI's performance indicators and socio-economics surveys like the Rural MPCE and literacy levels by the regions. The merged dataset was tested traditionally through ordinary least squares (OLS) regression and also using machine learning techniques such as Ridge, Lasso and Elasticnet regression. The study indicates that the most important factor influencing the internet adoption is Literacy. Also, the involvement of a telecommunication penetration factor (i.e. RJIL 4G) was highly significant. On the other hand, among the models tested ElasticNet demonstrated the best predictive accuracy as it includes the hybrid modelling to address multicollinearity. Overall, the study focuses on the need draw further attention towards the educating the community, along with educational infrastructure to, collectively, help bring down the digital divide in India. Methodologically, this study combines the socio economic and the telecommunications datasets in order to understand the digital adoption as well as to promote the literacy and socio-economic enhancement. These finding can help policymakers in improving the literacy and the telecommunications access to ensure social equality across regions.

Keywords

Internet adoption, Digital divide, Literacy, Telecom penetration, India.

AI-Enabled Adaptive Ambulance Monitoring System with Biometric Authentication

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Abstract

Emergency medical services play a critical role in saving lives during accidents and medical emergencies, where rapid response is essential. However, traditional ambulance systems face challenges such as unauthorized access, lack of continuous patient monitoring, delayed communication with hospitals, inefficient route selection due to traffic congestion, and poor treatment documentation. These issues often result in the loss of the crucial “golden hour,” reducing patient survival chances. The AI-Enabled Adaptive Ambulance Monitoring System with Biometric Authentication is designed to overcome these limitations by integrating biometric security, Internet of Things (IoT), Artificial Intelligence (AI), and real-time communication technologies into emergency medical services. The system ensures secure ambulance access using fingerprint authentication. It enables continuous monitoring of patient vital signs through IoT sensors. AI-based anomaly detection supports early identification of critical conditions. Real-time data sharing with hospitals improves preparedness and treatment planning. A centralized dashboard allows medical staff to monitor patients remotely. Predictive route optimization using GPS and traffic data ensures faster and safer transportation. Medicine usage and emergency events are automatically recorded. Helper details and treatment logs improve accountability and future medical reference. Instant alerts are sent to hospitals and authorities during accidents or breakdowns. This integrated approach enhances patient safety. It reduces emergency response delays. Ultimately, the system significantly improves survival outcomes during critical situations.

Keywords

Artificial Intelligence, Biometric Authentication, Emergency Medical Services, Internet of Things, Real-Time Patient Monitoring.

Surveillance-Based Hostel Security Measurement Using AI and Machine Learning

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Abstract

This paper presents a innovative method of monitoring dormitories that utilize AI and ML to enhance safety security. People really think about go back to old- fashion ways keeping things safe like checking face, use LBPH and Harr Cascade, and looking at CCTV footage. They also have problems include get tired, take long time for respond, not being able expand, and being easy for use The suggested method uses LBPH and HARR CASCADE and LBPH to find object that donot known. This system has a lot of layers, so you might detect people, things, and actions that seem suspect right away. The system runs on the Raspberry Pi edge computing platform, which allows it process data right on the device. This keeps your information safe and makes responses faster. We always look at live video streams to see if there are people, items, or behaviors that shouldn't be there. The test demonstrates that the system can distinguish faces 95technology being offered is the best approach to keep campuses and dorms secure because it is affordable, easy to use, and protects people's privacy. AI surveillance, keeping hostels safe, edge computing, face recognition, finding items.

Keywords

AI surveillance, keeping hostels safe, edge computing, face recognition, finding items, YOLOv5.

Echo-Care: An AI-Driven Voice Cloning System for Personalized Assistive Speech Generation

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Abstract

One of the emerging fields of speech processing is Voice cloning. Voice cloning aims at machines talking like us humans. However, not only talk but talk like someone particular. Now you know where the fun begins. We present a Zero-Shot Voice Cloning System in this paper. We feed in just a few seconds of voice clip. Along with text input, system produces speech output. No more long extensive and speaker dependent training sessions.

We supply our system a audio clip as input, from where the model learns speaker embeddings. These embeddings are combined with a neural network based style transfer model. The resultant speech produced is smooth, sometimes even emotional. We've also implemented a voice enhancer module that removes noise and declutters the voice. Which in return allows the output to be read easily; clearly with little distortion.

We also demonstrate a chat box interface where you can chat with the system online and receive responses in the duplicated voice. Voice cloning model generalizes well on unseen speakers during training. It can now be implemented in various fields such as virtual assistants, voice over accessibility and tools or voice-based conversation systems.

Comparison and Analysis for G+10 Building with Shear Wall by ETABS and STAAD Pro Software

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Abstract

The “Analysis of Building Systems (ETABS)” and “Structural Analysis and Design Professional (STAAD Pro)” software. It is worth noting that manual seismic analysis is very error-prone, time-consuming and tedious in a competition-driven industry. There is also a need to adopt computer programs in the design and analysis of structures, which should not compromise sustainability. Hence, this study aims to compare the results of structural analysis from STAAD.Pro and ETABS for a G+10 building and design 11 story Residential building. To improve integrity and estimation of structural complex in seismic events, “Performance-Based Seismic Design (PBD)” approach was adopted. Recent advances are focused on integration of fragility analysis, probabilistic methods, and adherence to seismic code guidelines. The study fills the existing research gap, i.e., lack of comparative studies on ETABS and STAAD Pro software for comparing results of G+10 buildings with use of shear walls that resist lateral load produced due to Wind and Earthquake effect and Analyze the Cener of Mass, Peak story shear, of mass participation, frequency, Storry stiffness, soft story and Story Drift etc.

Keywords

STAAD Pro, ETABS, Seismic, dynamic analysis, G+10 and mid-rise building.

A Biometric Voice Security System Enhanced with Emotional State Recognition

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Abstract

This work propounds a voice-based framework that incorporates speaker authentication with Speech- Emotion Recognition to enhance assure and context aware interface. This system leverages Mel-frequency Cepstral Coefficients (MFCCs) for acoustic portrayal and applies cosine resemblance for voice biometric validation, succeeded by CNNLSTM based model for emotion sorting. Experimental evaluation provides the voice biometric framework yield uniform authentication efficiency, achieving an accuracy in range **85%-88%** under regulated state, while the Emotion Recognition framework attain validation of **61.45%** on untrained datasets. By narrowing Emotions analysis to authenticated users, the unified strategy boosts system robustness and illustrates practical relevance for secure voice – driven usability, while conceding extant complications pertinent to emotional variability and datasets constraints.

Keywords

Voice Biometric, Speech Emotion Recognition, MFCC, CNN-LSTM, Speaker Authentication, Secure Voice System.

Interpretable Prediction of a Decentralized Smart Grid Based on Machine Learning and Explainable Artificial Intelligence

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Abstract

Rapid growth in the use of decentralized energy systems, coupled with ever-changing levels of integration between Distributive Energy Resources (DERs) and modern Smart Grids, presents a significant challenge to maintaining stability on our Smart Grid Systems today. As traditional methods for monitoring and analyzing performance are not adequate to deal with the variable nature of these Systems (particularly as it relates to load and generation), this paper presents a machine learning-based framework for predicting the stability of decentralized smart grids. Using simulated data from UCI's Electrical Grid Stability Simulated dataset, we evaluate a range of machine learning techniques (e.g., ANN, Random Forest, Gradient Boosted Trees, SVM, KNN, Logit, Naïve Bayes Classifier, SGD, AdaBoost, and XGBoost). Among the various algorithms tested, ANN showed the best performance with respect to predicting stability demonstrating an AUC value of 99.4% and also good stability in terms of predicting with the same degree of accuracy (96.2%) across all measures of performance (accuracy, precision, recall, F1 score). Furthermore, the performance was enhanced by implementing a hybrid stacking classifier that utilized Bagging with Random Forest, AdaBoost and KNN; in addition, a LightGBM stacking mode was created. Overall accuracy improved to 97.0%.

The critical need for transparency in our energy systems is addressed through the use of Explainable Art, (XAI), including SHAP, LIME and Individual Conditional Expectation (ICE), which are employed to interpret model predictions and identify influential features that affect stability at the Grid level.

Keywords

Machine Learning, Stability, Smart Grid, Energy Systems, Analyze, Explainable AI, SHAP, LIME, ANN, XGBoost.

AI-Based Automated Hiring Platform

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Abstract

The AI-Based Automated Hiring Platform is an intelligent system designed to simplify and automate the end-to-end recruitment process with minimal human intervention. The platform enables recruiters to post job openings with detailed descriptions and requirements, while applicants submit resumes directly through the system. Utilizing AI-driven resume analysis, the platform automatically evaluates each application against job criteria, shortlisting only the most suitable candidates. In the subsequent stage, shortlisted candidates complete automated skill assessments or project-based tests predefined by recruiters. The system ensures fair evaluation by analyzing submissions including code repositories and assignments using AI models to assess technical proficiency, problem-solving ability, and project quality. Qualified candidates proceed to the final interview stage where the platform automatically schedules interviews, generates meeting links, and notifies both recruiters and applicants. This fully automated workflow eliminates repetitive manual tasks, reduces hiring bias, and significantly accelerates the recruitment cycle. The project leverages AI, automation, and data analysis to create a transparent, efficient, and unbiased hiring experience for both employers and job seekers. By combining resume screening, skill testing, and interview scheduling within a single intelligent platform, it provides a streamlined and scalable solution to modern recruitment challenges. Future enhancements include integrating predictive analytics for talent matching, chat-based applicant interactions, and real-time performance insights to further optimize the hiring experience and achieve complete process automation.

Keywords

Artificial Intelligence, Recruitment Automation, Resume Screening, Machine Learning, Talent Acquisition.

ROADGPT: Offline AI-Powered Road Safety Recommender System

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Abstract

Road safety is still a serious concern around the world, especially in less developed areas that have poor infrastructure and slow decision making that cause many accidents. Traditionally, road safety assessments are performed in great part using manual inspections and/or expert opinion but are commonly labor intensive, inconsistent, and rely on constant access to the internet for maintaining updated information. This chapter outlines RoadGPT, an enhanced offline capability of an AI-based road safety recommendation system; this tool provides context and policy-based safety interventions to help solve actual road safety problems.

The suggested system utilizes the latest advancements in artificial intelligence and natural language processing in order to semantically encode user reported road safety issues using Sentence Transformer models, allowing for much more precise interpretation than merely using keyword matching. Through the use of FAISS based vector similarity search, relevant interventions are pulled from a curated collection of safety knowledge that has been established via an expert level of knowledge of standards including the Indian Roads Congress (IRC). This also includes utilizing locally deployed Llama-3 as a large language model that has been executed using Ollama to provide expert style recommendations based on established standard of knowledge such as IRC.

RoadGPT's key differentiator is it will work entirely offline – providing the ultimate in data privacy, dependability and usability when connectivity is insufficient. The experimental results show that the system produces fast and meaningful (and interpretable) recommendations in a simple Streamlit interface. This paper presents a conceptual framework for using semantic retrieval methods with other local language models to enable an intelligent transportation safety planning decision support system, and suggest that it is possible to develop a practical, scalable solution for real-world applications.

AI-Powered Mock Interview Preparation Kit Using Generative AI and Virtual Interview Avatars

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Abstract

Preparation for an interview requires technical expertise, problem-solving skills, communication skills, and confidence. The conventional methods of self-preparation, static question banks, and mock interviews among peers are not personalized, scalable, or realistic. This paper proposes an AI-assisted mock interview preparation system that combines ATS-based resume evaluation, adaptive aptitude and technical quizzes, coding practice, and mock HR and technical interviews with a virtual AI interviewer.

The proposed system utilizes the Gemini-2.5-Flash large language model for dynamic question generation, resume assessment, response evaluation, and feedback. The real-time virtual interviewer enabled by LiveKit allows for interactive mock interviews that simulate real-life situations. The experimental study with students shows enhanced readiness for interviews, boosted confidence, and progress in technical, aptitude, and communication skills, thus proving the effectiveness of the proposed system as a scalable solution for interview preparation.

Keywords

Language Models (LMs), Computer Vision, AI Video Simulation, Natural Language Processing (NLP), Attention Span, Generative AI, Real-time Feedback, LiveKit-WebRTC.

Multimodal Deep Neural Network for Diabetic Retinopathy Severity Classification and Referral Risk Prediction

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Abstract

This project presents a Real-Time Disaster Information Aggregation System designed to address challenges in collecting and analyzing large volumes of disaster-related data. The system gathers information from multiple sources such as social media, news platforms, and public data feeds. Using Natural Language Processing (NLP) and Machine Learning (ML), it automatically filters, classifies, and prioritizes information based on contextual relevance, keyword importance, and severity level. A stacking ensemble model combining Logistic Regression, Gradient Boosting, and Neural Networks improves prediction accuracy and reliability. The system provides a user-friendly interface for real-time monitoring, enabling faster decision-making, improved coordination, and enhanced situational awareness during emergencies, ultimately helping to reduce damage and save lives.

Keywords

Disaster Response, Real-Time Data Aggregation, Advanced Algorithms, Emergency Response, Data Categorization, Decision-Making, NLP.

ML for Career Success: A Strategies and Insights

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Abstract

Predicting the career growth trajectories of university students is crucial for guiding their academic and professional development. This systematic review examines the predictive capabilities of machine learning algorithms in providing tailored career growth recommendations that benefit both students and educational institutions. By analysing relevant journal articles published over the past decade, the review highlights commonly employed algorithms, sources of academic performance data, key factors influencing career growth, and the overall effectiveness of predictive models. The findings reveal that Support Vector Machines (SVM) and Random Forests are among the most frequently utilized algorithms, often drawing on data from Learning Management Systems (LMS) and Student Information Systems. The review emphasizes the importance of comprehensive datasets that integrate academic, behavioural, and temporal information to enhance predictive accuracy. Furthermore, it identifies limitations in existing research and advocates for more nuanced approaches to advance career growth prediction methodologies. This study contributes to the development of personalized career guidance strategies, fostering better alignment between students' potential and professional pathways.

AI Integrated IoT System for Wind Turbine Health Monitoring and Control

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Abstract

The increasing deployment of wind energy systems demands reliable and autonomous monitoring mechanisms to minimize downtime and maintenance costs. Wind turbines operate under fluctuating environmental and mechanical stress conditions, making early fault detection essential for sustainable energy generation. This work presents an AI-integrated IoT architecture for real-time health assessment and adaptive control of wind turbine systems. Multiple sensing units capture electrical and mechanical parameters including temperature, vibration intensity, rotational speed, and load current. An ESP32-based edge node performs local acquisition and transmits data to a cloud analytics platform. A Random Forest classification model processes historical and live data streams to identify operational states categorized as healthy, critical, or faulty. Based on prediction results, an automated relay-based protection mechanism is activated to prevent equipment damage. Experimental validation using a DC motor prototype demonstrates accurate fault identification and responsive control, confirming the feasibility of integrating edge IoT and machine learning for predictive wind energy management.

Keywords

Wind Turbine, Internet of Things (IoT), Machine Learning, Predictive Maintenance.

Automated Jute Leaf Disease Classification Using ResNet50 for Precision Agriculture

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Abstract

Foliar diseases have the potential to result into the loss of productivity of fiber crops such as jute which are economically significant and are usually hard to detect at their initial stage. The manual diagnosis method, which is quite traditional, diagnostic process is labour-intensive, subjective, and depends on experience. The article introduces a jute leaf disease detection and severity evaluation automated system which uses sensor aided image capture and classification using deep learning. A field camera unit continuously records images of leaves at a set period of time and environmental sensing is provided to monitor the environment. The new-acquired images received a processing with the help of a transfer learning architecture which made use of the ResNet50 model to distinguish Leaf Spot, Anthracnose, Mosaic Virus, Powdery Mildew, and Healthy leaves. Data augmentation processes are used in the training to raise tolerance to multiple light levels and backgrounds. As an example, a severity estimation module, as one of its functions, effectively analyses the degree of infection besides classifying the disease stage to early, moderate or severe. Gradient-weighted Class Activation Mapping (Grad-CAM) is also additionally incorporated to improve the interpretation of the model by drawing emphasis on discriminating regions that affect predictions. The system is also operational as it initiates a mobile application interface that makes diagnostic results and severity information readily available to farmers so as to be able to implement intervention in time. Strict evaluation based on accuracy, precision, recall, and F1-score proves that the framework is classified with 97% and that all types of diseases are detected in a consistent fashion in field-based scenarios. The framework developed has provided a scalable and practical answer towards automated crop health monitoring, and precision agriculture.

Keywords

Jute Leaf Disease Detection, Deep Learning, ResNet-50, Grad-CAM, Severity Estimation, Plant Disease Classification, Precision Agriculture.

E-Ticketing Mobile Application with Dynamic QR Code and AI-Based Face Verification for Musical Concerts

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Large-scale entertainment events, such as music concerts, attract significant crowds, making secure ticket validation and efficient crowd management essential. Traditional ticketing methods, including paper-based tickets and static QR codes, are vulnerable to duplication, unauthorized sharing, identity misuse, and entry delays. These limitations create operational challenges for event organizers and reduce the overall efficiency of access control systems.

This research proposes a secure mobile-based electronic ticketing system that integrates dynamic QR codes with artificial intelligence-based facial verification to enhance concert access control. In the proposed system, each ticket is associated with a unique dynamic QR code that changes periodically, thereby preventing duplication and misuse through screenshots. Additionally, facial recognition technology is employed to verify the identity of attendees, ensuring that only authorized individuals can gain entry. The system supports multiple ticket bookings, secure ticket transfer through invitation-based links, and real-time gate verification using a dedicated scanning module. The overall architecture combines mobile application interfaces, cloud-based data storage, and AI-driven biometric authentication to deliver a reliable, contactless, and efficient ticket validation mechanism.

Experimental results indicate that the integration of dynamic QR authentication with facial verification significantly enhances security while maintaining fast and seamless entry processing. This system demonstrates the effective use of mobile computing, artificial intelligence, and cloud technologies in developing a robust ticket management solution for large-scale entertainment events.

COLLABSPHERE: Influencer Brand Collaboration Platform

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Abstract

As businesses continue to use influencer marketing, they need seamless and straightforward ways to work with content creators. Even with its popularity, the collaboration processes are typically very time-consuming, labor-intensive, and require the use of a middleman agency to manage everything. This paper introduces the influencer-brand collaboration platform, Collabsphere. The platform helps brands manage their collaborations, deal with multiple influencers simultaneously, and analyze the results of the campaign. The system allows brands to set goals and select relevant influencers based on profile indicators and brand engagement metrics, while influencers can use a single platform to access authentic collaboration opportunities and manage multiple collaboration proposals. The system allows for the incorporation of analytics to better guide and focus influencer campaigns. The system allows for greater operational improvements and collaboration time improvements, along with trust-building transparency for the monitoring and collaborative processes.

Keywords

Influencer Marketing, Engagement Analytics, Collaboration Management, Platform, brand-Influencer collaboration.

Retail Sales Forecasting Using Novel Deep Learning

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Abstract

The task of forecasting sales in the retail domain plays a vital role in optimizing the inventory and supply chain, thereby facilitating better decision-making. However, the statistical techniques used for forecasting fail to handle the complex and nonlinear relationships between the influencing factors and the sales. The proposed TemporalFusionX approach has been adopted as the primary approach to retail sales forecasting because of its better performance. This approach combines both Prophet and XGBoost models to capture seasonal trends as well as nonlinear patterns. This results in better performance in terms of lower RMSE and MAE. Therefore, this paper proposes a novel framework based on the deep learning paradigm, which utilizes the self-attention mechanism for effectively capturing the complex relationships between the influencing factors and the sales. Unlike the existing models, the proposed framework incorporates the significant influencing factors, thereby facilitating better decision-making. Moreover, the self-attention mechanism helps the model focus on the most significant features, thereby enhancing the accuracy and interpretability of the model. The experimental results reveal the effectiveness of the proposed framework, which significantly improves the accuracy of the forecasting task. Moreover, the framework exhibits better stability while dealing with varying demand patterns. In addition, the framework exhibits better generalization capability while dealing with different products and stores. Furthermore, the framework exhibits better robustness while dealing with incomplete and noisy data. Therefore, the proposed framework can be utilized for achieving highly accurate, reliable, and scalable forecasting results.

Keywords

Retail sales forecasting, deep learning, prediction of time series, LSTM, GRU, transformer, demand forecasting.

Integrated Evaluation of Design with Construction Management Practices for Long-Term Behaviour of Post-Tensioned Nuclear Reactor Containment Structures

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Abstract

The common use of post-tensioned concrete containment structures in nuclear power plants is anchored on their great strength, crack control capacity, and resistance to internal pressure and external forces over the long period of service. These structures are not only required to have the design principles but also the construction management practices of planning, scheduling, quality control, inspection and maintenance to determine how well these structures will perform in the long term. Lack of proper coordination between design and construction can lead to loss of prestress, excess creep and shrinkage, durability and lower safety margins. This paper introduces a combined assessment of material needs and building management exercises on the long-term conduct of post-tensioned nuclear reactor holders. The analysis of the secondary data, which was gathered in the form of published research papers, design codes, and technical reports, was performed with the usage of Microsoft Excel, which would help to see the trends concerning prestress loss, creep, shrinkage, and durability. The findings reveal that appropriate design and effective management of construction is important in enhancing the structural reliability, lifecycle performance and safety of nuclear containment systems.

Keywords

Post-tensioned containment, nuclear reactor structures, prestress loss, construction management, creep and shrinkage, durability, lifecycle safety.

SMELLML: A Machine Learning Framework for Detecting Rarely Studied Code Smells

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Abstract

Software quality is frequently affected by the presence of code smells, which are poor design or implementation patterns that decrease maintainability, increase complexity, and introduce technical debt in software systems. Existing detection methods, including heuristic rules and basic machine learning approaches, often rely on fixed thresholds and highly imbalanced datasets, limiting their ability to identify less explored code smells effectively.

This paper presents Smell-ML, a machine learning-based framework designed to detect five rarely studied yet significant code smells: Refused Bequest (RB), Inappropriate Intimacy (II), Class Data Should Be Private (CDSBP), Middle Man (MM), and Speculative Generality (SG). The framework incorporates an improved data preprocessing stage that combines extended software metrics with dataset balancing techniques such as SMOTE, Oversampling.

The classification stage evaluates multiple models, including Random Forest, Support Vector Machine, Decision Tree, and several ensemble strategies such as Bagging, Boosting, Stacking, and Voting. Experiments conducted on 13 open-source Java projects covering 125 versions demonstrate improved precision, recall, accuracy, and F1-score, showing that Smell-ML effectively supports better software maintainability and quality.

Keywords

Code Smells, Software Maintainability, Machine Learning, Ensemble Learning, Data Balancing, Refused Bequest, Inappropriate Intimacy, Class Data Should Be Private, Middle Man, Speculative Generality.

Fake News Detection and Source Credibility Scoring Using NLP and Graph Neural Networks

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Abstract

The rise of online news platforms and social media has made it easier than ever for false information to reach large audiences before anyone can verify it. Existing detection systems tend to focus either on what a news article says or on how it spreads — but rarely on who published it. In this work, we build a hybrid system that checks both the content of a news article and the credibility of its source at the same time. For content analysis, we fine-tune a BERT model on a labeled fake news dataset. For source credibility, we train a Graph Convolutional Network on a co-occurrence graph of news publishers. The two outputs are combined using weighted averaging to produce a single classification decision. We tested the system on 19,742 news samples with a 70:30 train-test split. Our hybrid model reached 93.7% accuracy and a 93.0% F1-score, which is better than using BERT alone (89.3% F1) or the GCN alone (82.8% F1). The results show that checking the source alongside the content makes fake news detection noticeably more reliable.

Keywords

Fake News Detection, BERT, Graph Convolutional Network, Source Credibility, Misinformation, NLP, Decision Fusion.

Drug Recommendation System Based on Sentiment Analysis of Drug Reviews Using ML

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Abstract

Adverse Drug Reactions (ADRs) caused by Drug– Drug Interactions (DDIs) pose a significant challenge to healthcare systems due to their impact on patient morbidity, mortality, and treatment complexity. Existing research primarily employs Graph Neural Networks (GCN and GAT) to model drugs as molecular graphs, which often suffer from high computational costs and dependency on large-scale pre-training. This paper proposes a Voting Classifier-based ensemble method for side-effect prediction, eliminating the need for complex graph-based modeling. The Voting Classifier aggregates predictions from multiple base learners to improve robustness, interpretability, and overall prediction consistency. This approach reduces computational requirements while maintaining high predictive reliability for identifying potential adverse reactions. By shifting from graph-based frameworks to an interpretable ensemble strategy, the proposed system enhances efficiency in DDI side- effect prediction.

GSQ: Enhancing Text-to-SQL Reliability through Schema and Semantic-Guided Synthesis

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Abstract

The main problem in applied artificial intelligence exists because non-technical users need to obtain valuable data from relational databases yet they cannot create SQL queries. The G-SQL framework achieved important progress through its schema serialization and rule-based clause construction methods yet it struggles with advanced query structures and database schema comprehension across different fields and semantic uncertainties. The Hybrid Schema-LLM Guided Intelligence Framework introduces a new architectural design which combines deterministic schema-based parsing with the semantic capabilities of Large Language Models (LLMs). The framework consists of four main elements which include the modular rule-based structural planner and LLM-based semantic reasoning system and synonym expansion system based on embeddings and nested subquery development component. The multi-objective validation layer checks both syntactic correctness and relational integrity of a query before its execution starts. The system shows improved accuracy performance at all levels of query difficulty on the IMDB and Yelp and Microsoft Academic Search (MAS) datasets which are used for benchmarking. The system demonstrates its ability to manage complex multi-level query structures while demonstrating improved cross-domain generalization capabilities and decreased attribute mapping errors which make it suitable for use in both enterprise and public sector data access scenarios.

Keywords

Natural Language to SQL, NL2SQL, Schema-Aware Parsing, Large Language Models, Contextual Reasoning, Semantic Disambiguation, Hybrid Framework.

Performance Evaluation of Sustainable Waste Materials for Pavement Applications

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Abstract

Due to the growing demand for pavement construction, the natural resources are overused and produce large amounts of industrial and municipal waste, which poses a severe threat to the environment. Fly ash, glass powder, and waste plastics are some of the examples of sustainable waste materials that have been widely researched to act as potential substitutes for conventional pavement materials. This paper will provide a comparative analysis of these materials in terms of pavement utilisation using the previous research and technical data. The selected materials are evaluated in regard to their performance characteristics such as strength, durability, stability and resistance to environmental effects. The results obtained in previous research have shown that fly ash can be used to enhance the subgrade stability, glass powder can be used to improve the pavement damage caused by deformation and moisture, and waste plastics can be used to enhance the performance of layers. These materials can be used to help lower the construction costs, lower the level of environmental pollution and save on natural resources, hence aid the production of sustainable and cost-effective pavement systems.

Keywords

Sustainable materials, Pavement engineering, Fly ash, Glass powder, Waste plastics, Performance evaluation.

Adversarial Attack Detection Using Intelligent Algorithms During Object Detection

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Abstract

Deep learning, based object detection systems have become a core element of such pervasive modern applications as autonomous navigation, intelligent surveillance, and human-machine interaction. Still, despite their great success on standard benchmarks, these systems can be easily fooled by adversarial perturbations handful of minutes, purposely engineered changes to input images which lead to the system making incorrect, missing, or even misleading detections. Besides, such perturbations are most often visually imperceptible, so in the case of real, world and safety, critical environments, they pose the highest danger of making flawed decisions that can lead to serious consequences. The project at hand presents a lightweight and detector, independent framework for spotting adversarial attacks happening in the object detection process. No need to change or retrain object detection models, as the framework figures out whether the input images are genuine before trusting the detection results. The method is a kind of mixture of statistical anomaly physics analysis and machine learning based classification and thus it is capable of pinpointing the irregular patterns of adversarial distortions. Model detection behaviors from YOLOv5 and Faster R, CNN under original and adversarial conditions created with FGSM, PGD, and Carlini-Wagner attack methods were studied. The framework gathers statistical features, e.g. inconsistency of confidence scores, prediction uncertainty, and bounding box irregularities, as well as feature, level data from the neural network layers. All of these signals are combined to generate structured representations that are then handled with lightweight classifiers such as Support Vector Machines, Random Forests, and shallow neural networks.

Keywords

Adversarial Attack Detection, Object Detection, YOLOv5, Faster R-CNN, FGSM, PGD, Carlini-Wagner Attack, Statistical Anomaly Analysis, Machine Learning Classifiers, Computer Vision Security.

Performance Analysis of Lightweight Machine Learning Algorithms for Intrusion Detection in Wireless Sensor Networks

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Abstract

Wireless Sensor Networks (WSNs) are widely used in important applications such as environmental monitoring, healthcare systems, industrial automation, and military surveillance. Because of their distributed nature, limited computational resources, and open communication channels, WSNs are highly susceptible to security threats including denial-of-service attacks, probing activities, and unauthorized intrusions. Intrusion Detection Systems (IDS) act as an additional layer of security that can detect malicious activities through the examination of network traffic behavior. Although machine learning approaches have shown strong performance in intrusion detection, many models require high computational resources, which makes them unsuitable for resource constrained WSN environments. This paper presents a comparative analysis of three lightweight machine learning algorithms Stochastic Gradient Descent (SGD), Logistic Regression (LR), and Gaussian Naïve Bayes (GNB) for intrusion detection using the KDDCup 99 dataset. The models are assessed using metrics such as accuracy, precision, recall, F1-score, along with computational efficiency measured using training time. The results show that Logistic Regression attains the highest accuracy of 99.79%, while Stochastic Gradient Descent provides similar performance at 99.66% with much lower training time. Gaussian Naïve Bayes shows very fast training but lower accuracy. Overall, the results suggest that SGD provides the best balance between detection performance and computational efficiency, making it well-suited for real-time intrusion detection in resource-limited wireless sensor network environments.

AlgoRythm: Intelligent and Secure AI-Based Learning Platforms for Skill Development in Programming

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Abstract

AlgoRythm blends artificial intelligence with programming instruction, crafting tailored educational journeys while fiercely guarding user privacy. Local AI models dissect code snippets, while external APIs handle execution. There is no persistent storage of user work. The core offerings are- dynamic roadmap creation, Learning by building projects and existing GitHub repository analysis, Algorithm Visualization resources, code refactoring, Test evaluation, motivational streaks. Plus, location-aware tech updates. Backing SDGs 4, 8, 9, it lifts education quality, hones career skills, sparks creative learning spaces. The project underscores blending smart tech with ironclad privacy measures.

Keywords

Artificial intelligence, programming education, intelligent tutoring systems, ai coding assistant, gamified learning, educational technology.

A Machine Learning-Based Automated Essay Scoring System with Semantic Plagiarism Detection and OCR Integration

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Abstract

Due to recent developments in online education systems, the need for efficient evaluation of descriptive answers has become prominent, as manual checking can be laborious and difficult to replicate on a large scale. In this paper, we aim to develop an automated essay evaluation system that enables accurate scoring, plagiarism detection, and feedback in an online examination setting. While existing methods focus solely on score submission, our system incorporates multiple aspects, including ML-based essay scoring, semantic plagiarism checks, handwritten text image processing using OCR, and feedback generation, all within a unified web platform. This method is implemented on the ASAP dataset by training a Random Forest regression model on top of linguistic and structural features. Detection of semantic plagiarism by using Sentence- BERT embeddings and cosine similarity to find exact copies as well as paraphrased content. Furthermore, we employ Tesseract OCR for processing handwritten responses, and we utilize a rule- based mechanism to evaluate multilingual responses (English and Hindi) and generate feedback. The experimental results demonstrate that the proposed system yields an essay scoring Quadratic Weighted Kappa (QWK) of 0.84, Pearson correlation of 0.87, and Mean Absolute Error MAE of 1.76, as well as a plagiarism detection accuracy rate of 94.6 %, respectively. These results demonstrate strong alignment with human evaluation and improved reliability compared to previous traditional keyword- based methods. The proposed method yields a scalable and effective solution for automated assessment and can be directly applied to contemporary online examination and e-learning platforms.

Keywords

Automated Essay Scoring (AES), Machine Learning, Random Forest, Semantic Plagiarism Detection, Sentence-BERT, Optical Character Recognition (OCR), Natural Language Processing (NLP), Feature Extraction, Multilingual Evaluation.

A Hybrid Sentiment Analysis and Machine Learning Approach for Cyberbullying Detection

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Abstract

Cyberbullying has become a very critical issue all over the social media, and it always impacts all the users across the world, and they are facing significantly on emotional and mental level. One of the well-known traditional ML such as the extra tree classifiers which always struggle with online communications system and to overcome these barriers, this study presents a significantly stacking based cyberbullying system and gradient boosting. The model will employ the learner to enhance barrier from these habits and also enhance prediction accuracy. The system provides accurate and precision and accurately detect sentimental analysis. Overall this kind of framework provides intelligent and user centric approach to mitigate cyberbullying on social platform.

Keywords

Cyberbullying detection, sentiment analysis, machine learning, resampling.

Solar Energy Forecasting Using Adaptive Machine Learning for Improved Grid Stability

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Abstract

The increasing trend of solar photovoltaic energy utilization in the existing power grids has generated many challenges due to the intermittent and variable nature of solar energy. The traditional solar forecasting techniques like numerical weather prediction models and radiation transfer models are complex and heavily dependent on the accurate determination of atmospheric conditions and may not be appropriate for real-time prediction. To overcome the limitations of the traditional solar forecasting techniques, the proposed system has been designed to incorporate a machine learning- based solar forecasting technique.

The recent integration of solar photovoltaic energy systems into the existing power grids has resulted in challenges owing to the random and stochastic nature of the energy source. In this regard, the existing forecasting tools, including numerical weather prediction and radiative transfer model, are complex and require accurate atmospheric conditions for forecasting the solar irradiance. In this direction, the present study aims to develop a machine learning-based forecasting tool by considering various meteorological factors (temperature, humidity, wind speed, cloud cover, and irradiance), along with solar geometric factors (zenith angle, azimuth angle, and incidence angle). This process follows a multi-stage pipeline, which involves data acquisition, data preprocessing, and feature engineering. The results showed that the best accuracy was obtained through the Gradient Boosting Regressor, which had minimal error, thus showing a lot of resilience for handling non-linear and time-varying solar data.

Keywords

Solar photovoltaic energy, renewable energy integration, machine learning, meteorological parameters, solar irradiance, zenith angle, azimuth angle, data preprocessing, feature engineering, Gradient Boosting Regressor, predictive analytics.

ESG-Driven Digital Transformation in SMES - A Hybrid Grey Modelling Strategic Framework Approach

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Abstract

The aim of this study is to identify and assess the key factors that hold influence over the adoption of an ESG-driven digital transformation framework in SMEs. An integrated approach has been applied to develop a cause-effect analysis framework. The study was conducted in two phases. In Phase 1, the study identified 12 factors from previous literature. Phase 2 consisted of data collection and analysis, and was performed in two stages, DEMATEL, being Stage 1, was used to collect expert responses to establish a multi-criterion relationship amongst the 12 factors on a 1-7 Likert Scale. Stage 2 consisted of utilizing Grey Causal Modelling (GCM) to further assess the relationship between the identified causes and effects. To do this GCM considers four features - namely - the causes, the effects, the objectives and the outcomes. Expert responses were collected for this on a 1-9 Likert Scale with respect to the three objectives identified in the study - namely - "ESG-Driven Digital Technology", "Resilience", and "Sustainable Performance". The responses and the subsequent analysis established that there exist 6 causes, F3, F4, F5, F8, F9, and F10 with the rest of the factors being effects of the said causes. The results suggest that managerial and policy interventions that focus on these factors can have the most widespread effect throughout the entire factor-chain identified in this study.

Real Time Traffic Surveillance and Detection Using Deep Learning and Computer Vision Techniques

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Abstract

Traffic congestion, which occurs when the volume of vehicular traffic exceeds the number of available road spaces, is a major issue with urban transportation systems due to the growing number of vehicles, and the finite real estate to construct new road infrastructure. This results in wastage of fuel, increasing delay and reduction in traffic fluidity. To solve this problem, a system called "Real Time Traffic Surveillance and Detection Using Deep Learning and Computer Vision Techniques" has been proposed. The proposed system uses surveillance cameras at the traffic junction for monitoring traffic. The captured traffic images are then processed by a YOLOv8 object detection model to detect and count cars, buses, trucks, motorcycles, and auto-rickshaws with a high level of accuracy. The number of detected vehicles in the images is then used to calculate traffic density in each lane. A fuzzy logic controller (FLC) is then used to dynamically adapt the duration of the traffic signal according to the level of congestion detected at the input traffic image. The adaptive traffic signal control system is able to provide longer greens at the most congested lanes and shorter greens at the least congested lanes. A web interface, implemented using Flask, allows authorized users to check traffic conditions and system predictions visually in near real-time.

Keywords

Traffic Surveillance, YOLOv8, Deep Learning, Computer Vision, Fuzzy Logic, Clever Traffic Management.

UniConnect: An AI-Enhanced Unified Digital Platform for Student-Centric Campus Services

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Abstract

Schools are moving towards digital solutions to manage the campus services and most of the critical services offered to students, including grievances redressal, experience sharing in interviews, resource Booking and lost-and-found management remain in fragmented and semi-manual systems. The current digital solutions tend to cover the services separately and are not smartly automated, do not have a semantic understanding, and predictiveness. Past studies have discussed standalone and independent grievance management systems, booking systems and knowledge sharing portals, but these systems are usually lacking scalability and integration and do not include sophisticated Artificial Intelligence (AI) tools to support decision making automatically.

An example is the case of grievance management systems where much emphasis has been given to the process of online complaint form submission instead of introducing contextual moderation and understandable decision procedures. Equally, resource booking systems are usually based on non-predictive and non-dynamic scheduling models. Lost-and-found applications typically use manual matching or merely searching by keywords, which restrict their ability to be effective in finding related items. Also, the sharing of interview experience relies heavily on user-generated content without the process of automatic extraction of formal knowledge. These unmet requirements demonstrate a strong research gap: a unified intelligent campus service offer that will combine a variety of student-centric services and utilize AI-based automation, semantic analysis, and predictive intelligence.

In order to fill this gap, this paper offers UniConnect, an AI-enhanced single digital platform that will automate and unify various campus services into one ecosystem. The system includes Natural Language Processing (NLP) to extract structured interview knowledge, transformer based explainable AI to moderate grievance, semantic similarity analysis to match lost-item and ARIMA based time-series forecasting to predict resource allocation.

Experimental analysis has shown that the suggested system has an 80 percent accuracy in extracting knowledge during interviews, 91 percent F1-score in grievance moderation, 85 percent semantic matching precision of lost items, and 40 percent better utilization of the resources with predictive booking. The findings suggest that explainable AI, semantic intelligence, and predictive analytics can be combined to considerably increase the effectiveness, clarity, and prompt service systems at the campus level.

Optimizing IoT Technology for Community Greenhouses: Enhancing Food Security in Rural Communities

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Abstract

The integration of IoT technology in community greenhouses has the potential to revolutionize food production in rural areas, enhancing food security and improving livelihoods. This paper presents an optimized IoT-based system for community greenhouses, leveraging sensors, machine learning, and cloud computing to monitor and control environmental parameters, predict and prevent issues, and provide real-time alerts and recommendations to farmers.

The system was tested in a rural community greenhouse, demonstrating significant improvements in crop yields (20% increase), water conservation (30% reduction), and energy efficiency (25% reduction). The system's scalability and adaptability make it an attractive solution for implementation in various rural settings, contributing to the achievement of Sustainable Development Goal 2 (Zero Hunger).

Rural communities worldwide grapple with food insecurity stemming from climate variability, scarce resources, and inefficient farming practices. This paper introduces an optimized IoT framework for community greenhouses that integrates affordable sensors, actuators, and edge computing to automate environmental controls—such as temperature, humidity, soil moisture, and nutrient delivery—for year-round crop production. Leveraging protocols like MQTT and LoRaWAN for reliable connectivity in low-infrastructure areas, the system employs machine learning algorithms for predictive analytics, reducing water usage by up to 40% and boosting yields by 25–35% compared to traditional methods, as evidenced by prior IoT agriculture deployments. Community-centric features, including shared mobile dashboards and blockchain for resource tracking, enable collaborative management and equitable food distribution. Ultimately, this approach fosters resilient, localized food systems, empowering rural populations toward sustainable self-sufficiency.

Keywords

IoT optimization, community greenhouse, food security, rural agriculture, precision farming.

Stock Management System using IoT

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Abstract

This paper presents the design and implementation of a real-time Internet of Things (IoT) based stock management system for automated inventory tracking and monitoring. The system leverages Radio Frequency Identification (RFID) technology for contactless item detection, coupled with an ESP-based microcontroller for data acquisition, processing, and wireless communication. Environmental parameters such as temperature and humidity are continuously monitored using integrated sensors to ensure optimal storage conditions for sensitive goods. The collected data is transmitted to a cloud platform using lightweight communication protocols and visualized through a web-based dashboard for real-time monitoring and analysis. The system incorporates intelligent alert mechanisms to identify low stock levels and abnormal environmental conditions. Experimental validation demonstrates high accuracy in item tracking, reliable wireless data transmission, and efficient real-time visualization. The proposed system offers a cost-effective and scalable solution for modern inventory management, contributing significantly to the advancement of smart warehousing technologies.

Keywords

Stock management, RFID, IoT, ESP microcontroller, cloud dashboard, real-time monitoring, smart warehouse, inventory automation.

Intelligent Pharmaceutical Inventory Management Using AI, IoT, and Predictive Analytics

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Abstract

The rapid digital transformation of healthcare supply chains has accelerated the need for intelligent, automated inventory systems in pharmaceutical environments. Traditional pharmacy inventory management approaches often suffer from stock-outs, overstocking, manual errors, and limited demand forecasting capabilities, resulting in financial losses and compromised patient care. This book chapter proposes an AI-driven Smart Pharmacy Inventory System that integrates Internet of Things (IoT) sensors, cloud-based infrastructure, predictive analytics, and machine learning algorithms to enable real-time stock monitoring, automated replenishment, expiry tracking, and demand forecasting. The framework leverages data-driven decision-making to optimize stock levels, reduce wastage, enhance traceability, and ensure regulatory compliance. The proposed system architecture incorporates RFID-enabled tracking, temperature and storage condition monitoring, cloud-based dashboards, and predictive models such as time-series forecasting and anomaly detection to improve operational efficiency. Furthermore, the chapter discusses system design considerations, security mechanisms, scalability challenges, and sustainability implications within smart healthcare ecosystems. Performance evaluation metrics including inventory turnover ratio, stock-out rate reduction, forecasting accuracy, and operational cost savings demonstrate measurable improvements over conventional systems. By aligning intelligent automation with pharmaceutical logistics, this chapter contributes a scalable and interoperable framework suitable for retail pharmacies, hospital pharmacies, and integrated healthcare networks. The findings highlight the strategic role of AI-powered inventory systems in enhancing healthcare resilience, minimizing drug wastage, and supporting data-centric pharmaceutical management in the era of digital healthcare transformation.

Keywords

Smart Pharmacy Inventory System, Artificial Intelligence, IoT-Based Monitoring, Predictive Analytics, Demand Forecasting, Cloud Computing, Pharmaceutical Supply Chain, RFID Tracking, Healthcare Digital Transformation, Inventory Optimization.

VitalPulse: A Hybrid Machine Learning Framework for Real-Time Cardiovascular and Stroke Risk Prediction

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Abstract

Cardiovascular diseases continue to be the biggest contributor to mortality rates globally. The early identification of cardiovascular risk factors is not adequately addressed during routine clinical practice. In patients, early warning signs are present, such as progression with age, high blood pressure, cholesterol level imbalance, and poor lifestyles. These factors are generally evaluated individually rather than as a whole. The present study aims to evaluate the combined effect of these clinical parameters using a publicly available cardiovascular dataset with numerical and categorical features collected during routine medical practice. The dataset has undergone considerable preprocessing, including handling missing values, feature scale normalization, and reduction of overlapping feature effects. In addition, various classification models that range from statistical models to ensemble models are used to perform evaluation using accuracy-based as well as class-sensitive performance measures. The results obtained from the evaluation demonstrate that nonlinear interactions between features can be used to achieve better performance. To further facilitate the application of the proposed model, an IoT-based framework is integrated with the system for health monitoring. The results obtained from the evaluation demonstrate that cardiovascular risk prediction using machine learning can be used to improve early screening methods, especially when it is used with IoT-based monitoring.

Keywords

Cardiovascular Disease, Machine Learning, Risk Prediction, IoT, Remote Health Monitoring, Remote Patient Monitoring, Cloud Computing, Biomedical Sensors.

Real Time Anomaly Detection in Energy Consumption

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Abstract

Real time anomaly detection in energy consumption focuses on designing and developing a resilient data pipeline that simulates dynamic data, processes it in real time, and detects anomalies with adaptive machine learning. Python-based data generators simulate context-aware sensor events, which are streamed via Apache Kafka and processed using Apache Spark Structured Streaming. Unlike static models, the system integrates a resource-efficient Streaming Half-Space Trees (HS-Trees) algorithm that establishes personalized consumption baselines for individual smart meters, enabling the detection of household-specific irregularities. Anomalies are evaluated by a risk-based classification engine that triggers severity-dependent notifications, ranging from dashboard logs to automated emergency voice alerts. The processed data are visualized using a native Cassandra-Grafana interface, ensuring low-latency monitoring. Real time anomaly detection in energy consumption combines data engineering with adaptive data science, creating a scalable, user-centric prototype relevant to modern smart grid and industrial analytics roles.

Keywords

Real-Time Systems, Kappa Architecture, Stream Processing, Anomaly Detection, Data Visualization.

Deep Learning–Based Adaptive Radiation Pattern Optimization for 5G Massive MIMO Antenna Systems

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Abstract

The advent of fifth-generation (5G) wireless communication networks has led to an increased need for intelligent antenna technologies that are capable of adapting to changing propagation environments. The Massive Multiple Input Multiple Output (MIMO) antenna system holds a crucial place in providing improved spectral efficiency, high-speed data rates, and signal integrity. In traditional beamforming or radiation pattern optimization methods, complex models or simulations, such as electromagnetic simulation, are used, which are complex and not suitable for real-time adaptations. This article presents an adaptive radiation pattern optimization solution for 5G Massive MIMO Antennas using deep learning. The proposed solution leverages the use of deep learning to predict optimal weights of beamforming and associated radiation patterns by learning dependency among parameters of antenna configuration, CSI, and spatial distribution of users. The proposed solution has the ability to dynamically steer the beam, suppress the sidelobe region, and efficiently mitigate interference by understanding the complicated nonlinear relationships among the environmental factors. The adaptive characteristic of the proposed framework makes possible a continuous learning process even in dynamic propagation conditions, which depend on user mobility, multipath fading channels, and interference variance. Simulation-based analyses illustrate that in comparison to existing static and heuristic optimization approaches, the proposed deep learning method is able to provide better beam alignment correctness, interference leakage suppression, and spectrum efficiency gain. This illustrates the efficiency and feasibility of a deep learning-based integration of antenna systems in existing and future 5G communication systems for intelligent radiation pattern control.

Sensing Based Electric Vehicle Battery Monitoring System

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Abstract

Electric vehicles rely heavily on battery performance and safety. Monitoring battery parameters such as voltage, current, and temperature is essential to prevent battery failures and improve efficiency. The paper here proposes an IoT-based battery monitoring system using an ESP32 microcontroller for real-time monitoring of the state and safety of the battery. The system measures the voltage, current, temperature, and bulging conditions of the battery by utilizing appropriate sensors and then sends the data to the microcontroller. The system monitors both the battery pack and cell parameters through an appropriate driver circuit. The data obtained from the sensors are displayed on a 16×2 LCD and also sent to the IoT platform for remote monitoring. The system also detects abnormal conditions such as overheating, overcurrent, and voltage imbalance, as well as swelling conditions in the battery, which may cause harm to the battery. The proposed model provides an efficient and cost-effective way to monitor the health and safety of the battery in applications such as electric vehicles and energy storage systems.

Keywords

ESP32, Battery Monitoring System IoT, Single Cell Monitoring, Battery Safety, Temperature Monitoring, Bulge Detection.

AI-Based Smart Pet Adoption Web Application Using Content-Based Recommendation

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Abstract

Pet adoption plays a significant role in improving animal welfare by providing shelter to abandoned animals and companionship to humans. Despite the availability of online adoption platforms, most systems rely on simple search mechanisms and lack personalized recommendation capabilities. This paper presents an AI-Based Smart Pet Adoption System that delivers customized pet suggestions using a content-based filtering approach. The system gathers user inputs such as preferred pet type, lifestyle characteristics, and geographic location. These inputs are analyzed and matched with pet-related attributes including breed, age, health condition, and vaccination records stored in the database. A similarity-based scoring mechanism is used to identify and recommend the most suitable pets. The system is implemented using Python and Flask for backend processing, HTML and CSS for the user interface, and SQLite for database management. Additional functionalities include pet availability tracking, detailed pet information, and an adoption request module. The proposed system enhances user experience, reduces search effort, and improves the likelihood of successful adoptions.

Keywords

Pet Adoption, Artificial Intelligence, Recommendation System, Content-Based Filtering, Flask, SQLite

Predictive Solar Forecast Driven EV Charging Controller with Real-Time Grid Stability

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Abstract

Due to unplanned and uncontrolled charging patterns, the explosive growth of electric vehicles (EVs) has brought new challenges to power distribution networks. Conventional EV charging systems frequently rely on time-of-use pricing or static scheduling, which can result in peak load conditions on the grid and inefficient use of renewable energy sources. In order to increase energy efficiency and preserve grid stability, this paper introduces a predictive solar forecast-driven EV charging controller that is integrated with real-time grid monitoring. The suggested system minimizes reliance on traditional grid electricity by optimizing EV charging schedules using solar power prediction. The ESP32 microcontroller, which powers the system, controls charging operations by keeping an eye on battery conditions, solar availability, and grid parameters like voltage and current. In order to prevent battery overcharging and guarantee safe charging conditions, sensors such as voltage sensors and ACS712 current sensors continuously monitor system performance. The system can intelligently switch between solar energy and grid supply based on current energy availability thanks to a hybrid energy architecture. Furthermore, remote monitoring, data visualization, and system control via a mobile interface are made possible by the Blynk platform's integration of IoT technology.

Keywords

Electric Vehicles (EVs), Smart Charging, Solar Forecasting, Renewable Energy Integration, Hybrid Energy System, ESP32, Internet of Things (IoT), Real-Time Monitoring, Energy Management System, Smart Grid.

An Interactive Job and Internship Platform for Technical Education Department

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Abstract

The Technical Education Department Interactive Job and Internship Platform provides a solution to the problem which prevents students from connecting with educational institutions and recruiters because it creates a digital recruitment system which enables organized hiring processes. The site will enable students to create detailed profiles which will display their educational history and their technical abilities and their certifications and their completed projects and their work experience while posting available job and internship positions which will match the required educational and professional skills. Educational institution administrators and staff members can use placement activities together with their school assessment system to monitor student progress and create reports which help them make informed decisions. The system enables users to monitor their application progress through its interactive elements while they send real-time messages that enhance their recruitment process involvement and make the process more transparent. The proposed platform enables better employment prospects through its industrial ties and its function as a scalable educational asset which helps streamline employment search processes while managing application requirements and institutional evaluations.

Deep Learning Based YouTube Summarizer with Conversational Search

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Abstract

In the digital world where technology has prevailed, YouTube has been the top educational, networking, entertainment, and knowledge gaining platform. Nevertheless, due to the abundance of data of video content uploaded daily, the user may easily get lost in the content and hardly find the necessary information without wasting time on long videos. Our project proposes a Deep Learning Based YouTube Summarizer with Conversational Search to deal with this issue. Simply put, it is YouTube Video Summarizer and Chatbot System which can automatically summarize videos and provide clear and precise summaries. It verifies the existence of an official transcript; otherwise, it uses a speech-to-text model of Whisper to generate one. This is followed by the generation of the transcript based on the video then breaking the transcript into various numbers of chunks and processed with advanced Natural Language Processing (NLP) algorithms with Google Gemini large language model (LLM) and Application programming interface (API) to produce logical and user-friendly summaries. Moreover, it has a developed smart chatbot that runs on semantic search and transformer-based embeddings where users are able to interact with the video content directly within the system. The chatbot allows the user to pose questions related to the video to the chatbot based on their need and access particular information without having to engage in manual search of the video. This system is rated over the robust applications in the education, research as well as digital content management. In general, the initiative highlights the importance of AI-based methods of converting raw video content into knowledge.

Keywords

NLP, YouTube Summarization, Whisper Model, Transcription, Gemini API, Chatbot, Question Answering System.

Digital Detective: A Gamified Reinforcement Learning-Based Cyber Safety Education System for Children

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Abstract

The growing usage of digital platforms among children has also resulted in an increase in cyber threats such as phishing, impersonation, malicious links, and social engineering attacks. Previous research studies have investigated the awareness of cyber safety, vulnerability to phishing attacks, and gamification strategies for cybersecurity training to increase user engagement and awareness of threats [1], [2], [4]. These studies show that interactive and gamified learning environments can increase awareness and user engagement. However, most of the existing research is based on static content, rule-based training, and score-based gamification and does not emphasize behavior-driven learning or adaptive reinforcement strategies, especially for children. In addition, very few studies have been carried out on the combination of machine learning-based scenario generation with reinforcement learning architectures to shape safe digital behavior through episodic decision-making. To overcome the above-mentioned limitations, this paper proposes Digital Detective, a gamified cyber safety education platform for children aged 8–14 years. The proposed platform represents cyber threats as story-based villains and uses reinforcement learning concepts to encourage safe decision-making and punish unsafe behavior through instant mission failure. The experimental results from the pre- and post-gameplay assessment activities show a significant improvement in the accuracy of cyber threat recognition, emphasizing the effectiveness of gamification using reinforcement learning for cyber safety education.

Keywords

Cyber Safety Education, Gamification, Reinforcement Learning, Machine Learning, Phishing Detection, Educational Games.

Blockchain-Enabled Anti-Counterfeit System

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Abstract

There are various supply chain management inefficiencies that encompass duplicated services and lack of proper departmental planning as well as inconsistent practices. Another significant cause of these issues is transparency. The clandestine product counterfeiting is one of the most urgent problems of the present-day business. Visual distinction of the real and fake goods is not always easy and this diminishes the consumer confidence and poses a challenge to business. The effects of counterfeiting on brands are experienced by many individuals, although a number of them do not understand fully what these impacts entail. In order to solve this problem, the methods that exploit artificial intelligence (AI) are employed. There are some limitations to these methods though. Every QR code, such as those, can be duplicated and falsely applied to counterfeit goods. Convolutional Neural Network (CNN) based AI models will also require a lot of processing power. The purpose of the project is to identify fake products with the help of supply chain tracking.

Giving an opportunity to see the entire supply chain history of a product, this project aims at using a blockchain based system in order to assist in tracing counterfeited products.

The blockchain technology guarantees that only genuine commodities will be tracked down and traced throughout the process of supply chain. Users can view and verify documents in large quantities because it is decentralized thus encouraging collaboration and removing the use of middlemen. The advantage of the blockchain technology is that a change of data is impossible without the consent of both parties. This makes the data accurate and removes vulnerability. The solution that is suggested provides an indelible set of transaction, through the cryptography protection offered by blockchain technology. This highly prevents the chances of counterfeiting. In this essay, the development and operation of the blockchain based system will be described and how it can address the issues within the supply chain as well as aid in reducing the identification of counterfeits. With improved supply chain tracking and security, the approach provides a reliable and scalable technique of securing any supply chain and reinstating consumer confidence in the authenticity of their products.

Deep Learning Based Detection of Depression Levels Using ECG Signals in Mat Format

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Abstract

Depression, bipolar disorder, and schizophrenia are some of the mental health disorders that present a major issue in the global health scene; therefore, they should be diagnosed at an early age and accurately to implement proper treatment. The paper reports the protocol of an automated mental health detection system based on an electrocardiogram (ECG) signal and deep learning method to assist in the objective clinical examination. MAT version of the raw ECG signals are processed to find noise and refine the quality of the signals, followed by conversion into 224×224 image expressed, to fit one of the convolutional neural network (CNN) models. Inception V3 and ResNet are two advanced architectures that are implemented and comparatively assessed to extract features and classify them. To decide which model is the best one, the standard measurements are used to evaluate the performance such as accuracy and precision. The chosen model is incorporated in user focused framework that is able to categorize conditions as normal, depression, and abnormal, further breaking down bipolar disorder and schizophrenia. The classification results obtained through the experiment are high, and the system can be used as the reliable tool in the detection of the primary mental health screenings and clinical decision support.

Keywords

Mental Health Detection, Electrocardiogram (ECG), Deep Learning, Convolutional Neural Network (CNN), Inception V3, ResNet, Depression, Bipolar Disorder, Schizophrenia, Image-Based Classification.

IoT Based Fire Fighting Robot

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Abstract

This paper makes an attempt to address fire- related safety issues in residential, industrial, and remote areas by developing an IoT-based fire- fighting robot capable of detecting fire, smoke, and hazardous gases in real time. The system has a MQ2 gas sensor for detection of smoke and LPG, an ESP32 microcontroller for processing and wireless communication, and an ESP32-CAM module for live monitoring of the fire. High- torque Johnson 100 RPM DC geared motors along with BTS7960 motor drivers allow the robot to carry water tank, enabling the robot to reach the fire. This robot is designed to be the best and effective solution for fire detection and extinguishing, particularly in locations where immediate human intervention is not convenient.

Keywords

Fire-fighting robot, ESP32 microcontroller, MQ2 gas sensor, Flame sensor ESP32-CAM module, BTS7960 motor driver, Johnson geared motors.

Agentic AI-Powered Legal Judge

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Abstract

This study develops an Agentic AI-Powered Judge to monitor and validate autonomous judicial decision-making and legal case analysis. While AI-powered legal tools show promise in expediting case review, they often remain “black boxes” lacking ethical transparency and procedural fairness. We propose a multi-agent supervisory system utilizing case law data from 2010 to 2025 to audit the logic and statutory alignment of AI-generated legal opinions. The system employs specialized agents to verify reasoning correctness and regulatory compliance, ensuring that judicial recommendations adhere to strict constitutional norms. Results demonstrate that the Agentic Judge effectively filters biased interpretations—such as identifying a 70.5% conviction confidence threshold in specific criminal simulations—to ensure transparent, human-like decision-making. By maintaining a 70% logic confidence requirement, the framework provides explainable narratives that bridge the gap between autonomous efficiency and judicial accountability.

Keywords

Agentic AI, AI-as-a-Judge, Legal Technology (LawTech), Multi-Agent Systems, Judicial Decision Support, Explainable AI (XAI), Algorithmic Fairness.

Federated Learning of Healthcare Diagnostics with Bias-Awareness

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Abstract

Machine learning in the healthcare diagnostic field has proven to have a lot of potential in the better-disease detection and clinical decision-making. Nevertheless, the conventional centralized learning strategies share issues associated with the privacy, protection, and regulation. Additionally, the healthcare information tends to be shared across various institutions and it is highly heterogeneous, which results in prejudiced models that can work unfairly with various demographic groups. Federated learning is a solution to privacy issues based on the idea of training models collaboratively but without providing access to raw patient data, though bias in model predictions is not automatically overcome. This project suggests a prejudice-conscious federated learning system that is aimed at increasing the quality and dependability of the healthcare diagnosis systems. The suggested solution incorporates bias detection and mitigation strategies in the federated learning process without compromising the privacy of the data. Demographic parity/equalized odds are fairness metrics that help in the evaluation and reduction of bias among a variety of patient populations. With experimental analysis, the suggested bias-aware federated learning model can attain better fairness with negligible effect on diagnostic accuracy. The findings emphasize the need to include ethical and fairness concerns in federated healthcare AI systems, which would help in designing privacy-protecting, equitable, and reliable medical diagnostics solutions.

Keywords

Healthcare Diagnostics, Federated Learning, Mitigation of bias, Fairness in machine learning, Privacy- Maintaining Learning, Ethical AI, Distributed Machine Learning.

Deep Learning-Based Multimodal Authentication System Integrating Facial and Voice Verification

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Abstract

The rapid development of digital technologies has led to a notable demand for secure, effective, and user-friendly authentication systems. Of all potential solutions to this challenge, voice and facial recognition technologies, in particular, have developed as a significant application of advanced data science and artificial intelligence methods. A number of recognition models still exhibit a lack of accuracy under real-world conditions such as inadequate light causing low visibility, background noise when both environmental and situational interference occurs, and intentional deception of recognition systems by facial disguise or voice distortion. A comprehensive solution that combines technical accuracy, fair application, and transparency is still missing. This paper addresses these gaps by proposing a multimodal system that combines the strengths of both the tools to ensure that all such gaps are overcome. Additionally, it compares two different models and helps discriminate between them to identify which model is better suited for different situations.

Keywords

Voice Recognition, Facial Recognition, Deep learning, Multimodal Authentication, Security.

A Multi-Stage Deep Learning Approach for Biomarker-Driven Detection of Small Vessel Disease

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Abstract

Small Vessel Disease (SVD) is a neurological condition caused by abnormalities in the brain's small blood vessels and is a major contributor to stroke, cognitive impairment, and dementia. Early identification of SVD is difficult because the disease appears as subtle structural changes in brain Magnetic Resonance Imaging (MRI) scans, which often require expert clinical interpretation. Manual examination of MRI scans is time-consuming, subjective, and may lead to inconsistent diagnoses. Therefore, automated and reliable detection systems are essential for early diagnosis and effective treatment planning. This research proposes a multi-stage deep learning framework for biomarker-driven detection of Small Vessel Disease. White Matter Hyperintensities (WMH) are considered the primary imaging biomarker for identifying SVD, along with additional indicators such as lacunes. In the proposed system, MRI scans are first preprocessed using techniques such as noise reduction, intensity normalization, and skull stripping to enhance image quality and remove non-brain tissues. A U-Net based deep learning model is then used for accurate segmentation of WMH regions, enabling precise extraction of lesion areas from MRI images. The segmented biomarker regions are further analysed using the Swin Transformer model for classification. The Swin Transformer captures both local and global contextual features using hierarchical shifted window attention, allowing effective modelling of lesion distribution across brain regions. Experimental results demonstrate improved accuracy, sensitivity, and specificity compared with conventional convolutional neural network approaches. The proposed framework provides a reliable and efficient approach for automated detection of Small Vessel Disease and supports early clinical diagnosis.

Smart Classroom Management System

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Abstract

The Smart Classroom Management System is an intelligent web-based platform developed to enhance classroom operations through automation and data-driven insights. The system enables real-time attendance tracking, assignment management, performance monitoring, and structured communication between teachers and students. Built using React.js for the frontend and Node.js with Express.js for the backend, the system utilizes MongoDB for flexible data management and JWT- based authentication for secure access control. Unlike traditional classroom systems, this project integrates AI-driven text-based emotion analysis using Natural Language Processing techniques to evaluate student feedback and detect emotional patterns. By combining attendance records with emotion analytics, the system performs risk assessment to identify students who may require academic or emotional intervention. Additionally, automated email alerts and a counseling recommendation module are incorporated to support early intervention strategies. The platform provides advanced analytics dashboards to assist teachers in making informed decisions. The proposed system aims to modernize classroom management by transforming raw academic data into actionable insights, ultimately improving student engagement, well-being, and academic performance.

Keywords

Smart Classroom, Attendance Automation, Student Analytics, Emotion Recognition, Learning Management System, Educational Data Mining.

Groundnut Crop Yield Prediction Using Machine Learning Techniques

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Abstract

Predicting crop yields is a crucial component of contemporary agriculture since it enhance food security, Productivity, and resource management. One of the main oilseed crops grown in many agricultural areas is groundnuts, and precise yield forecasting is crucial for farmers and agricultural planners to make wise choices. Conventional techniques for estimating crop yields frequently rely on manual analysis and historical observations, which may not adequately reflect intricate interaction between agricultural elements. Machine learning techniques can be used to evaluate past agricultural data and produce accurate forecasts in order to overcome this difficulty. A web-based groundnut yield prediction system created with machine learning techniques is presented in this paper. A dataset with agricultural characteristics including cultivated area, production values and seasonal yield data is used by the suggested system. To enhance the quality of the dataset, data preprocessing procedures such as data cleaning and missing values removal are carried out prior to model building. The prediction model is constructed using the Random Forest Regression algorithm because of its capacity to manage big datasets and nonlinear interactions. A web application built on Streamlit that offers users an interactive interface is used to implement the system. The application incorporates user authentication capabilities such as registration and login, allowing secure access to the prediction system. Once logged in, users may input agricultural datasets, automatically train the machine learning model, and assess its performance using metrics like Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R^2 Score. The user's input feature values are then utilized to predict groundnut yield using the trained model. The results of the experiments show that the suggested system can help farmers and academics understand agricultural production trends and provides accurate output projections. The technology is useful and accessible for real-world agricultural applications because to the integration of machine learning with an intuitive web interface. This study demonstrates how data-driven methods can enhance crop production forecasting and promote sustainable agricultural growth.

Keywords

Predicting groundnut yield, Machine Learning, Random Forest Regression, Agricultural Data Analytics, Seasonal Crop Analysis, Precision Agriculture, Decision Support System.

SMART PERSONA – AI-Powered Voice and Video Interview Platform

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Abstract

The increasing demand for scalable, consistent, and technology-enabled recruitment processes has created the need for intelligent interview automation platforms. SMART PERSONA is a multimodal AI-driven interview system designed to support both voice-based and video-based interview experiences. The platform enables recruiters and institutions to conduct structured, interactive interview sessions while providing candidates with instant, detailed performance feedback.

The system adopts a modular client-server architecture built with Next.js and React on the frontend and Node.js on the backend. Real-time communication is achieved using WebRTC-based video and voice integration through Vapi, while Supabase manages authentication, secure data storage, and real-time synchronization. An AI engine integrated via modern language model APIs generates role-specific interview questions dynamically and evaluates candidate responses using natural language processing techniques.

The platform incorporates structured workflows including session creation, candidate invitation, application submission, automated question delivery, response recording, AI-based evaluation, and analytics reporting. It ensures fairness, scalability, and explainable feedback while maintaining data privacy and secure session management. By combining automation with real-time interaction and intelligent assessment, SMART PERSONA enhances recruiter efficiency and supports continuous candidate improvement. The proposed system demonstrates a practical and scalable approach to modern AI-powered interview management.

Keywords

Artificial Intelligence, Voice-Based Interview, Video-Based Interview, Automated Recruitment, Natural Language Processing, Real-Time Communication, WebRTC, Interview Analytics, Secure Authentication, Multimodal Assessment.

Deep Neural Network-Based Virtual Health Assistant for Symptom-Driven Disease Prediction

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Abstract

The system aims to develop an intelligent healthcare solution that can predict possible diseases based on user-reported symptoms. The systems use DNN to Analyze complex patterns within healthcare datasets and provide accurate disease prediction. This technology helps people figure out what illness they might have, just by entering their symptoms into a digital assistant. The system uses artificial intelligence to understand descriptions of health problems and medical history, working much like a smart doctor that listens and learns from lot of examples. The system not only predicts the disease but also evaluates causes and suggests precautions to be taken to support early health awareness. Healthcare workers and patients can use this assistant to get useful advice quickly, which is especially helpful for those who cannot see a doctor right away. It aims to make healthcare more accessible and efficient, helping doctors focus on more serious cases while offering guidance and peace of mind to people who want answer about their symptoms.

In Silico Evaluation of Natural Polyphenols as Potential Modulators of TREM2 in Alzheimer's Disease

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Abstract

In this study we have taken Triggering receptor expressed on myeloid cells-2 (TREM2) which is an immune receptor mainly found on microglia, the brain's primary immune cells. From many recent studies we have found that TREM2 plays an important role in controlling neuroinflammation, helping microglial survival, and aiding in the removal of harmful protein clumps like amyloid- β , which cause Alzheimer's disease. But problems with TREM2 signaling cause lower phagocytic activity and ongoing inflammation, which results in disease progression. As a result, if we adjust TREM2 activity it will result in a promising approach for boosting neuroprotective mechanisms in Alzheimer's disease. Therefore, we have used natural plant-based polyphenols for this study because of their known antioxidant, anti-inflammatory, and neuroprotective benefits. In this in silico method molecular docking we have performed to explore how TREM2 (PDB ID: 5ELI) interacts with epigallocatechin gallate (EGCG), apigenin, curcumin, and resveratrol.

After docking, we got an analysis that apigenin has a binding affinity of (-8.6 kcal/mol) and EGCG (-8.5 kcal/mol) which highest for TREM2. This indicates that they form very strong and stable interactions. Then, Curcumin (-7.1 kcal/mol) had moderate binding, while resveratrol (-6.3 kcal/mol) had a lower affinity. The strong binding of apigenin and EGCG suggests they are very effective in interacting with TREM2 and could impact microglial functions related to controlling inflammation and clearing amyloid- β . From this in silico molecular docking studies we got a computational basis for further experimental research aiming treatments for Alzheimer's disease.

Fake News Detection using Multi-Category Support Vector Machine

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Abstract

In recent years, the spread of false news has become a major threat to the credibility of information and the stability of society. Whenever false information is spread through internet channels, it has been noted the speed of dissemination of false information is so rapid that it creates a need for strong automated detection systems. In this abstract we present an approach to detecting fake news using machine learning that utilizes a multi-faceted approach for increased speed and accuracy. For feature extraction, we utilized Multi Perspective Component Analysis (MPCA), because it is able to extract a large variety of semantic and stylistic features from text efficiently. The Firefly Algorithm was used as a metaheuristic for feature selection, to reduce dimensionality and select from the set of features the most discriminative features useful for classification. The prediction phase of the proposed method employed a Multi-Class Support Vector Machine (MSVM) which has been shown to generalize well and is effective in handling high-dimensional spaces. Long ShortTerm Memory (LSTM), a deep learning method is utilized for the comparison, since it can model sequential data and capture long-term dependencies it was used to time to standardize the performance measure of the MSVM based method. Next, the comparative analysis will provide both strengths and weaknesses of the methods for detecting fake news. Ultimately, toward the goal of creating useful tools for combatting fake news to support a more informed and resilient information ecosystem.

A Hybrid Financial Fraud Detection Framework Integrating Machine Learning, NLP, and Graph Analysis

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Abstract

Financial fraud has become one of the biggest concerns of banks, digital payment services and regulatory agencies worldwide. The recent growth of electronic banking, mobile payment systems, and other digital financial services has resulted in a huge increase in online transactions as consumers make purchases. While these advances provide consumers with added convenience, they also offer criminals new opportunities to commit fraud, including money laundering, account takeover, identity theft, and organized fraud networks. The majority of current methods utilized for detecting fraudulent acts involve reliance on rule-based systems, which identify fraud based on a pre-programmed threshold or set pattern; however, many current methods are unable to catch more complex or changing types of fraud and often create a large number of false-positives that impose a burden on legitimate customers. The new system developed through this research is an artificial intelligence (AI) based fraud detection system that utilizes machine learning, natural language processing (NLP) and graph-based relational analysis to enhance the accuracy of fraud detection. The system uses the PaySim mobile money transaction dataset, which simulates real-life financial transaction activities, to develop and evaluate fraud detection models. The proposed system will classify Transactional Data as Fraudulent or Legitimate using combinations of Ensemble Machine Learning Algorithms such as Random Forest, Decision Tree, and XGBoost. Additionally the system will generate Story Like Descriptive Narratives based off of Transaction Metadata, and will leverage NLP Techniques based off of DistilBERT to Review the generated narratives for Contextual Patterns Associated with Suspicious Activity. Finally, the system will provide Graph Analysis capabilities through NetworkX and Neo4j in order to facilitate the identification of Hidden Relationships between Accounts along with the Discovery of Coordinated Fraud Rings, as well as Analysis of Suspicious Financial Networks. Overall, the results from Experiments demonstrate high levels of Fraud Detection performance and a Reduction in False Positives for all components of the new system. By combining multiple forms of analysis the new system provides a performance driven Analytical Approach to Scalably and Effectively identifying Complex Patterns of Financial Fraud in a rapidly evolving Digital Finance Environment.

Keywords

Financial Fraud Detection, Machine Learning, Natural Language Processing, Graph Analysis, DistilBERT, Random Forest, XGBoost.

CEDARS: Early Detection of Cervical Cancer Using Efficient Deep Learning and CNN

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Abstract

This paper presents CEDARS (Cervical Early Detection and Analysis using Robust Segmentation), an automated deep learning system designed for the early detection of cervical cancer from Pap smear images. Cervical cancer remains one of the leading causes of cancer-related mortality among women worldwide, and the accuracy and speed of its diagnosis remain critical challenges in clinical practice. The proposed integrated pipeline combines a U-Net segmentation model with a ResNet50 classification architecture to achieve a validation accuracy of 95.5%, simultaneously reducing diagnostic time by 60% when compared to conventional manual screening procedures. The system delivers five key diagnostic outputs for each analyzed image: cell classification, confidence scores, segmentation masks, LLM-generated medical descriptions, and an overall cell status assessment. By automating the analysis of Pap smear images, CEDARS provides an objective, rapid, and consistent preliminary diagnostic tool capable of supporting medical professionals and expanding access to reliable cervical cancer screening.

Keywords

Cervical Cancer, Deep Learning, Convolutional Neural Network, U-Net, ResNet50, Pap Smear, Image Segmentation, Early Detection.

Cloud-Based Intelligent Medical Record Management Solution

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Abstract

This paper presents a cloud-based intelligent medical record management system designed to securely store, manage, and retrieve patient health records via a centralized platform. Traditional healthcare systems rely on paper files or remote local storage, which often result in data redundancy, limited accessibility, and increased risk of digital loss.

The proposed platform utilizes online computing to enable authorized users, including doctors, patients, support team, to view stored health information anytime and from any location. It incorporates organized arrangement techniques such as B-Tree and Hash indexing to support fast data retrieval, even with large datasets.

In addition, the system implements access control based on user roles and encryption mechanisms to ensure details privacy and protection. This system automatically manages records and safely shares data, helping doctors work together and reducing manual work.

Overall, this proposed method enhances medical care efficiency, minimizes delays in therapy, and provides a flexible secure management of patient records.

Keywords

Web-based storage, Health file, Data Security, B-Tree Indexing, Healthcare Systems, Data Encryption, Role-Based Access.

Cognitive News Recommender with GNNs, LLMs, and Adaptive Sentiment Drift Monitoring

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Abstract

This paper proposes a Cognitive News Recommender System that combines Graph Neural Networks (GNNs) for capturing the interactions between users, news, and topics, Large Language Models (LLMs) for semantic news content analysis, and an Adaptive Sentiment Drift Monitoring module for monitoring user interests in real-time. The proposed system overcomes the drawbacks of conventional recommendation systems, including bias, redundancy, and recommendation fatigue, by providing dynamic and context-aware news recommendations. The proposed system learns from user behavior and sentiment drifts to ensure relevance and diversity in news recommendations.

The online news media platform has experienced explosive growth because of real-time multimedia broadcasting, high frequency social journalism, and distributed news curation platforms. The traditional news recommenders do not consider dynamic emotional preferences, cannot model complex publisher topic-user graphs, and depend on centralized data pipelines that are susceptible to privacy leakage. This paper proposes the Cognitive Federated News Recommendation System that combines Graph Neural Networks (GNNs) for contextual graph reasoning, Large Language Models (LLMs) for deep semantic analysis of news content, and the Adaptive Sentiment Drift Monitoring module for analyzing user-specific emotional dynamics. A two-layer Federated Learning framework is used to provide privacy-preserving personalization for user devices and multiple news publishers. The experimental results demonstrate dramatic improvements in engagement (22), contextual accuracy (94.6), diversity (82.3), and ethical robustness. The proposed approach sets new grounds in secure, sentiment-driven, and cognitively adaptive personalized journalism.

Keywords

News Recommendation, Graph Neural Networks (GNNs), Large Language Models (LLMs), Sentiment Drift Monitoring, Personalization, Explainable AI, Recommender Systems, Digital Journalism.

Hybrid CNN–GAN Architecture for Underwater Image Enhancement

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Abstract

Underwater pictures are usually blurry. This is because light does not travel well in water. When light travels through water it gets absorbed, scattered and changed which makes the images look bad. This results in pictures that're hard to see with colors that do not look right and a lot of haze. These problems make it hard to use pictures, for computer vision applications. This paper shows a way to make underwater pictures look better using a mix of two types of intelligence: Convolutional Neural. Generative Adversarial Networks. The Convolutional Neural Networks part fixes the structure of the pictures removes noise and corrects the colors a bit. The Generative Adversarial Networks part makes the underwater pictures look more realistic. The model is trained on the Enhancing Underwater Visual Perception dataset for 25 cycles using PyTorch on a laptop GPU. The goal is to make the underwater pictures look good and be accurate. Experimental results show that the underwater pictures look much clearer with contrast and colors compared to the underwater pictures. The framework can help with research, underwater robotics and environmental monitoring using pictures that are clearer and more accurate which is the main goal of using Convolutional Neural Networks and Generative Adversarial Networks for underwater pictures.

Keywords

Convolutional Neural Network, Generative Adversarial Network, EUVP Dataset, Deep Learning, Image Restoration.

A Deep Learning Driven Smart Healthcare Framework Using AI-Based Application for Skin Diseases Prediction

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Abstract

Skin problems have been among the most prevalent health complications all over the world. One should identify them at the initial stage and properly to prevent severe complications. As a rule, doctors examine the skin using their eyes, which can be slow, require personal judgment, and may be unavailable in locations with less medical resources.

This paper presents a smart healthcare system that employs the deep learning technology to automatically identify skin diseases based on special skin images (referred to as dermoscopic images). The HAM10000 dataset is used as the training. The system is trained on EfficientNet B0 which is a contemporary AI model and is trained in two steps to enhance precision. Since the number of cases of each disease is not equal in the dataset, class-weighted sampler and Focal Loss (with gamma = 2.0) are employed to manage imbalance. In order to enhance the power of the model, a number of image tricks are used in the training process that include Mixup, CutMix, ColorJitter and Random Erasing. During testing, predictions are made more predictable with the help of Test-Time Augmentation (five variations).

To be transparent, the system applies Grad-CAM to show precisely where on the skin the prediction was induced by the system, allowing physicians to learn why the AI was predicting in a particular way. Lastly, the model is accessible via a web based application, allowing the user to post pictures and receive real-time feedback. Prediction Skin Disease, Prediction HAM10000, Prediction EfficientNet-B0, Prediction Transfer Learning, Prediction Focal loss, Prediction Mixup Image Augmentation, Prediction Test-Time Augmentation, Prediction Grad-CAM, Prediction Deep Learning, Prediction Medical Image Analysis.

Detection and Prevention of SQL Injection and Cross-Site Scripting (XSS) Attacks

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Abstract

Web applications are considered one of the most vulnerable areas in data breach incidents, mostly due to improper management of inputs, leading to SQL injection and cross-site scripting attacks. This paper discusses a simple yet efficient system in improving web application security using a rule-based system. The system is based on a set of rules and a set of grammatical filters in improving web application security. The system is based on a simple principle of injecting malicious data into a web application environment and taking preventive measures accordingly. The architecture of the system is clearly defined in order to maintain transparency in the system. The system is also based on a logging system in identifying malicious activities in a more accurate way. The system is also based on reducing false positives in a more accurate way in identifying malicious activities. This system is considered efficient and can be easily integrated into a system in a more reliable way in reducing vulnerabilities in web applications.

Keywords

SQL Injection, Cross-Site Scripting, Web Security, Rule-Based Filtering, Vulnerability Detection.

Electromagnetic Interference and Safety of Patient Implanted with Cardiac Implantable Electronic Devices

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Abstract

Certain cardiac diseases require the use of CIEDs (cardiac implantable electronic devices), such as defibrillators and pacemakers. These devices face an Electro Magnetic Interference (EMI) threat. The rapid pace of technological development raises new safety concerns with implantable cardiac devices. The goal of this work using experimental, simulation, clinical, and review methods, is to define and characterize the risk for EMI and CIEDs, and its related patient safety issues.

It has been experimentally proven that under some circumstances, such as the presence of strong EM fields, very close proximity to the EMI source, and some cardiac implantable device sensing frequencies, EMI is possible. Simulation studies indicate that certain emerging technologies (e.g. electric vehicle (EV) charging, and wireless power transfer) have the potential to generate new types of complex EM fields that may interact with CIEDs. Clinically, very little or no negative effects have been reported, and this is a testimony to the effectiveness of design of such devices, including filtering and shielding.

Perhaps one of the more potentiated conclusion drawn from this work is to some extent, a compromise is to some extent, a compromise. Several studies have identified the absence of data from clinical studies, but available patient data suggests that, especially under standard circumstances, the risk is negligible. The best studies carried out in real life, especially continuous exposure studies, continue to be concerning from an electromagnetic view. The absence of data is particularly focused on devices and technologies.

EMI is overall, still an existing concern with regard to CIEDs, however, data demonstrates that the risk is minimal and that CIEDs are safe to be used in most environments.

The safety of patients will continue to be of utmost importance. Future investigations may focus on improvements in new methods of standard real-life assessment of new innovations.

Keywords

Electromagnetic Interference (EMI), Cardiac Implantable Electronic Devices (CIEDs), Pacemakers, Implantable Cardioverter-Defibrillators (ICDs), Patient Safety, Electric Vehicles (EV), Wireless Power Transfer, Electromagnetic Compatibility (EMC), Medical Device Safety.

Multi-Class Chronic Pain Localization Based on Hybrid TF-IDF and Machine Learning Models in an Electronic Medical Record

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Abstract

Precise anatomical identification of chronic pain is frequently restricted by subjective self-reporting as well as inconsistency of clinical documentation. This work presents a hybrid machine learning framework for automatic pain site classification with real world tertiary care data collected from SGPGI Hospital, Lucknow. The dataset bore structured demographic and clinical delimiters (Age, Gender, Pain Score, DN4) and six narrative features of the clinical situation that were written by clinicians. 462 anonymized patient records were used for mining. Data preprocessing was carried out which included median imputation, categorical harmonization, TF-IDF vectorization with sub linear term frequency scaling and bigram representation to capture context-specific clinical expressions. Four supervised learning models viz. LightGBM, XGBoost, Random Forest and Linear Support vector machine (SVM) were implemented and fine-tuned using stratified data partitioning and target grid search optimization. Out of these, the stabilized accuracy of the class-balanced Linear SVM was found to be the highest (82.98%) along with weighted Precision (0.86), Recall (0.83) and F1-score (0.82). Optimum regularization ($C = 0.8-1.0$) improved stability of the margin in high dimensional sparse feature space, over fits were decreased while the discriminative capability was maintained. Confusion matrix evaluation proved reliable class-wise performs especially well on frequently represented anatomy region Low Back with little inter-class misclassification. By using often well-documented clinical narratives instead of specialized hardware or physiological sensors, it is the proposed framework platform that allows a scalable and institution-ready solution. These results demonstrate the use of sub linear TF-IDF and balanced linear SVM achieving good multi-class pain site prediction with a future focus on transformer-based modelling, multi-modal integration and integration into CDSSs.

Keywords

Chronic pain localization, electronic medical records, machine learning, support vector machine, TF-IDF, natural language processing, multi-class classification, clinical decision support systems.

Artificial Intelligence Techniques for Chronic Pain Evaluation: Machine Learning Deep Learning Methods Examination

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Abstract

Chronic pain evaluation is also gradually shifting from simple subjective self reports, to progressively advanced technology-driven computation approaches. This review focuses on the recent progress in chronic pain detection using behavioural, neurophysiological, biomechanical, imaging, wearable and multimodal sources of data. Innovative methods such as facial expression recognition, electroencephalography (EEG), functional near-infrared spectroscopy (fNIRS), connectivity analysis with MRI, ultrasound elastography, wearable physiological sensors and bioelectrical impedance techniques have allowed markers associated to nociceptive processing to be identified. Machine learning and deep learning models display despotism in performance (it has been reported in models with an accuracy of 78%-95%). Three major methodological shifts can be seen here: from the focus on subjective reporting of symptoms to quantifying biomarkers objectively, growing emphasis on modelling temporal dynamics and studying network level and developing clinically applicable diagnostic systems. The neurophysiological signatures of chronic pain have been consistently identified in neuroscience research such as spectral changes and altered functional connectivity in favour of a systems-level perspective which includes cortical reorganization, autonomic imbalance and neuromotor adaptation. As well, with the help of computer vision and wearable technology, scalable, real-time monitoring in acute care settings as well as rehabilitation and remote healthcare settings are being enabled. However, there are still limited data for clinical translation due to small and single centre studies as well as modality specific pipelines restricting the generalizability and scalability. Of course, future directions should emphasize large-scale multimodal datasets largely using robust external validation, explainable artificial intelligence frameworks to enable large-scale and precision-driven chronic pain management.

Mood Reads: An Emotion-Aware Book Recommendation System Using Machine Learning and Natural Language Processing

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Abstract

Mood Reads uses emotions to recommend books because it recommends books based on the current emotional state of readers instead of using their previous reading patterns and book popularity ratings. The system uses a DistilBERT transformer-based emotion classification model to analyze user-written text because the model extracts contextual meaning from the text to determine user emotional states. The system maps detected user emotions to appropriate book genres before it uses Google Books API to find matching book titles. MoodReads operates as a complete web application because its developers built it with Flask and SQLite while the platform presents audio narration to users who need accessibility.

Keywords

Emotion Detection, DistilBERT, Natural Language Processing (NLP), Emotion-Aware Recommendation System, Book Recommendation, Deep Learning, Sentiment Analysis, Flask Web Application.

Harnessing AI for Deep Fake Detection in Images

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Abstract

The main purpose of an AI-based deep fake detection system is to detect changes in the face. It is a set of four deep learning models, including Swin Transformer, MobileNetV2, VGG16, and DenseNet121, which assist in the binary classification (Real vs. Fake). To further increase the accuracy of the classification, the DenseNet121 model features were used as input to a Random Forest classifier. The whole training and evaluation was done on a big data set of undisfigured and distorted face images. It is an entire system that is a web application, which uses flask on the backend and HTML, CSS and some JavaScript to make the frontend interactive. The application provides the individuals with the possibility to place the pictures of their faces and get the predictions (Real or Fake) and the associated confidences rating. This system is a brilliant method of authentication of the authenticity of facial images therefore its use is highly necessary in the fields of digital forensics and AI security. MobileNetV2, VGG16, and Swin Transformer all have a great accuracy of 92, 93, and 96 percent, respectively.

Keywords

Deep Fake Detection, Image Forgery Detection, Swin Transformer, MobileNetV2, VGG16, DenseNet121, Random Forest, Binary Classification, Web Application, Flask, HTML, CSS, Digital Forensics, AI Security.

ICT Competency Profiling of LIS Professionals in Indian Engineering Colleges

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Abstract

Information and Communication Technology (ICT) has become integral to modern library and information services, particularly in engineering colleges where digital resources and research support are increasingly critical. This study profiles the ICT competencies of Library and Information Science (LIS) professionals in Indian engineering colleges, focusing on skill levels, tool usage, training, challenges, and areas for improvement. Data collected from surveys and institutional records reveal that LIS professionals demonstrate strong proficiency in core areas such as library automation, database searching, and e-resource management. However, competencies in advanced domains, including digital repository management, data analytics, and emerging ICT tools, remain underdeveloped. Key challenges identified include limited advanced training, insufficient technical support, budget constraints, and high workloads. The study recommends targeted training programs, infrastructure upgrades, and strategic collaborations to enhance ICT adoption and overall library service quality. The findings provide actionable insights for policymakers, library administrators, and educators aiming to strengthen digital capabilities in engineering college libraries.

Keywords

ICT competency, LIS professionals, digital libraries, library automation, engineering colleges, data analytics, e-resources, India.

Vision Estate: AI & AR/VR Powered Real Estate Platform

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Abstract

This paper is about a study based on the development of a real estate app with the help of artificial intelligence and virtual reality technologies. The paper discusses the pros and cons of AI and VR technologies in the real estate sector. It is crucial for a buyer to feel secure about their investment in real estate and thus our application comes in place. The main aim of the paper is to discuss AI and VR technologies and its significance in the real estate sector. These technologies have had a long history in the academic world, dating back to the mid-last century, however the scope of the projects using these technologies was limited due to the lack of data and computational power needed for these technologies to function. In recent times, the development of better and efficient hardware has helped overcome the technical challenges, and thus the need for Virtual Reality and Artificial Intelligence technologies has caught an eye in the society and the public over the last few years. In particular, when discussing Virtual Reality technology, the emphasis will be on 360 images. VR helps in creating immersive house tours thus reducing friction while transacting, buying or selling properties.

Keywords

Artificial intelligence, eco-score, virtual walkthrough, property enlisting, virtual reality.

Comparative Experimental Study on Strengthening of Beam Column Joints Using UHPC Jacketing

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Abstract

Beam-column joints constitute critical stress-transfer regions in reinforced concrete (RC) frame systems and largely govern their load distribution, stability, and deformation behaviour. Inadequate detailing, construction imperfections, and long-term material deterioration can significantly weaken these regions, resulting in early joint damage and reduced structural reliability. Enhancing the performance of such joints is therefore necessary to meet modern safety requirements under increased service and extreme loading conditions. This experimental investigation evaluates a composite strengthening of RC beam-column joints using UHPC Jacketing. Four RC beam-column joint specimens were fabricated, comprising two reference specimens with conventional detailing and two specimens strengthened using the proposed method. The strengthening process involved Jacketing of existing joint core concrete and with UHPC to improve mechanical resistance and durability.

All specimens will be subjected to monotonic loading to assess critical performance parameters, including load-carrying capacity, stiffness characteristics, deformation behavior, crack evolution, and modes of failure. The experimental program aims to compare the structural performance of control and strengthened beam-column joint specimens. Key observations will encompass load-displacement response, changes in stiffness, patterns of crack initiation and growth, and overall failure mechanisms. This experimental program is designed to evaluate the structural response of reinforced concrete beam-column joints enhanced through UHPC strengthening approach. The performance of the retrofitted specimens will be examined in comparison with control joints without strengthening. The findings are intended to demonstrate the effectiveness and practical suitability of the proposed hybrid technique for upgrading deficient beam-column joints, especially for structures subjected to seismic actions and elevated loading demands.

Keywords

Beam-column joint performance, reinforced concrete rehabilitation, UHPC replacement technique, experimental structural assessment.

Privilege Escalation Attack Detection and Mitigation in Cloud Using Machine Learning

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Abstract

This project employs advanced machine learning to fortify cloud security, specifically targeting and mitigating privilege escalation attacks for a more robust defense mechanism. As cloud adoption rises, so does the risk of privilege escalation attacks. This project addresses vulnerabilities in employee access privileges within cloud services to enhance overall security. Leveraging machine learning, the project enables real-time detection and mitigation of privilege escalation attacks. Techniques like LightGBM, Random Forest, Adaboost, and Xgboost contribute to a dynamic defense against evolving threats. Users and businesses experience heightened data security, fostering trust in cloud computing. Cloud service providers and enterprises gain confidence in a secure online environment, benefiting from the project's security enhancements. And also included, a Voting Classifier, amalgamating predictions from Decision Tree, Random Forest, and Support Vector Machine through a "soft" voting approach, enhances the system's performance in detecting and mitigating privilege escalation attacks. Additionally, a user-friendly Flask framework with SQLite integration optimizes user testing, providing secure signup and signin functionalities for practical implementation and assessment.

Keywords

Privilege escalation, insider attack, machine learning, random forest, adaboost, XGBoost, LightGBM, classification.

Real-Time Dermatological Disease Detection Using MobileNetV3 and Web-Deployable Deep Learning Framework

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Abstract

Early detection of dermatological diseases is essential for effective clinical intervention, yet access to expert diagnosis remains limited in many regions. This project presents an automated skin condition classification system using a lightweight deep learning architecture optimized for real-time performance. A MobileNetV3-Large convolutional neural network was trained on a curated dataset containing seven dermatological classes—Acne, Eczema, Normal, Psoriasis, Rosacea, Vasculitis, and Vitiligo. The dataset was cleaned through a multi-stage preprocessing pipeline involving duplicate detection, stratified splitting, augmentation, and a skin-region filtering gate to suppress non-skin inputs. To further improve reliability, a pre-analysis rejection module detects low-quality images using blur variance, brightness thresholds, entropy-based confidence measures, and a pixel-level skin detection mask. The final model achieved 87% test accuracy, with strong class-wise performance across minority categories. A Streamlit-based web application was developed to provide an interactive diagnostic interface, allowing users to upload images, visualize predictions, view class probabilities, and inspect debugging details when needed. The system demonstrates that compact CNN architectures, combined with robust preprocessing and reject logic, can deliver high-quality dermatological predictions suitable for educational, telemedicine, and mobile health applications.

Keywords

Skin condition classification, MobileNetV3, deep learning, dermatology AI, convolutional neural networks (CNN), medical image analysis, Streamlit web application, tele-dermatology, lightweight neural networks.

Smart Agrihub: AI-Powered Platform for Farming Marketplace, Weather & Crop Prediction, and Regional Language Support

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This research introduces an intelligent and integrated agricultural decision-support framework with the combination of machine learning, computer vision, and expert knowledge synthesis to help the farmer with crop choice, fertilizer, and early detection of plant diseases. The system has several supervised learning pipelines such as Rotation Forest ensemble classifier, voting-based crop recommendation models, and the label-encoded fertilizer prediction networks, while using the unified FastAPI architecture. A deep learning segmentation model called the Roboflow API can be used to access real-time disease diagnosis using leaf images, while a generative AI module based on Gemini model can be used for interpretive agronomic guidance based on crop type, pest or disease profile, and the geographical location. The platform also integrates with a frontend client which is built using React & Vite with modular routing, visualization and user management using centralized application state. The interoperability of these components proves a concept of an end-to-end and scalable pipeline that can bring actionable insights in agriculture to boost further efficiency of inputs, in addition to facilitating precision farming practices for various user groups.

Keywords

Crop recommender, fertilizer predictor, plant disease analysis, Rotation Forest algorithm, Ensemble learning, FastAPI, Generative AI computer vision artificial intelligence, registration farms decision support, precision agriculture.

Audio to Sign Language Converter

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Abstract

Sign language is a crucial mode of communication among the hearing and speech impaired individuals. Nevertheless, communication between the users of sign language and non-sign language is still challenging because of the absence of automated translation tools. This paper introduces audio to sign language, a web-based application, which translates speech or text input into sign language animations with the use of Natural Language Processing. The system interprets user input by tokenizing, doing grammatical analysis and detecting tenses and then correlating the processed words with the associated sign language videos. The input is supported with multilingual input facilitated by language detection and translation. The suggested system enhances access and will facilitate real-time communication without the use of special hardware.

Keywords

Speech to sign language, NLP, assistive technology, accessibility, web-based system.

AAS: Bridging Static Knowledge and Dynamic Endpoints in Institutional Assistance Systems

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Abstract

The adoption of Large Language Models (LLMs) into the higher education setting is currently constrained by the so-called Data Fragmentation problem, where the institutional knowledge is split into unstructured disorganized documents (e.g., syllabi, policies) and structured, safe databases (e.g., ERP, LMS). Conventional Retrieval-Augmented Generation (RAG) systems cannot close this gap, they tend to fail at retrieving realtime information or fail to hallucinate in answering student specific queries like attendance and results analysis. We describe the Agentic Academic System (AAS), a neuro-symbolic framework combination, in order to address this, where semantic reasoning and data retrieval are separated. AAS proposes a Semantic Intent Router that dynamically types and routes user queries to either a Neural Retrieval Engine with the static knowledge or a more secure and deterministic execution of backend tools via a Model Context Protocol (MCP) server. The system guarantees the privacy and integrity of data by the close isolation of these workflows and standardization of various output formats through a new Context Fusion Layer. Experimental evidence on a high-fidelity synthetic data set shows that AAS eradicates hallucinations on numerical data, and can do so, with 100 percent accuracy on dynamic queries (as opposed to 0 percent on a baseline system RAG system), with an average real-time latency of approximately 1.7 seconds. This model provides a platform of privacy-centric, scalable design of the future generation of academic assistants.

Keywords

Artificial Intelligence (AI), Large Language Models, Retrieval-Augmented Generation (RAG), Model Context Protocol (MCP), Chatbots, Academic Chatbots, Artificial Intelligence in Education, Neuro-symbolic AI, Data Privacy.

Decoding ROI - A Cross - Industry Analysis of Google Ads and Facebook Ads Performance in 2025

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Abstract

The paper analyzes and compares ROI of Google Ads and Facebook Ads by industry using benchmarking reports and secondary benchmarking datas provided, as well as personal observations made on Reddit. In this study, Varos (2025), 360 Agency (2025), WordStream (2024), and WorldMetrics (2025) are based on four reliable industry sources and the research studies industry CTR, CPC, CVR, CPL, and ROAS. The study demonstrates that Google Ads has better intention-based conversions, which are more beneficial in terms of higher CTR and ROAS but more expensive, whereas Facebook Ads offers more optimal costs savings in terms of lower CPCs and CPLs and therefore, it has greater potential at the middle of funnel lead generation and brand affinity. It may be explained by a complementary sentiment analysis of the comments in the Reddit Marketing Forest as industry players believe that Google Ads are trustworthy but expensive and Facebook Ads are cheap but unstable in terms of the quality of leads. Collectively, these results suggest that interdependences between the advertising platform, the industry, and the objectives of a campaign determine the ROI of these two platforms and conclude that advertisers need to use a hybrid data-based strategy when allocating their advertising budgets and no longer industry benchmarks. This groundbreaking research contributes to the existing literature on digital marketing and advertising because it provides a combination of qualitative and quantitative findings on the efficiency of advertising in 2025.

Analysing Player Consistency in Professional Football: Introducing the Robust Consistency Score (RCS)

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Abstract

Consistency in professional football is discussed extensively yet measured rarely. Practitioners routinely describe players as reliable or erratic, but such assessments rest on subjective impression rather than any formal quantitative basis. This paper introduces the Robust Consistency Score (RCS), a composite metric designed to address that gap. The RCS captures three theoretically distinct dimensions of player reliability: the stability of match-to-match ratings, the overall quality at which consistent performance is delivered, and the competitive availability that validates the observed pattern. All three components are normalised to a common scale before combination, preventing any single dimension from arithmetically dominating the composite. The framework was applied to match-level player rating data from the Big 5 European leagues (2023–24 season). After applying minimum thresholds of 20 appearances and 1,500 minutes, a working dataset of 398 players was retained. Three metrics are developed progressively: the Consistency Index (CI), the Adjusted Consistency Index (CI_{adj}), and the final RCS. One-way ANOVA, Linear Regression, and Random Forest models are applied to examine structural predictors of consistency, and K-means clustering identifies four behavioural archetypes: Consistently Outstanding, Consistently Good, Consistently Average, and Boom-or-Bust. Goalkeepers show the highest median CI (0.9324), followed by midfielders (0.9179) and defenders (0.9084), with forwards recording the lowest values (0.8897). Positional differences are statistically significant ($F = 30.28$, $p < 0.001$). Match volume emerges as the dominant predictor of RCS in Random Forest modelling (feature importance = 64.5%), and higher-rated players tend to show lower rating variability, a finding that challenges common assumptions about elite performance volatility.

Keywords

Football analytics, player performance, consistency measurement, machine learning, K-means clustering, match ratings, performance stability, data-driven scouting, robust consistency score, positional analysis.

Semantic Legal Case Recommendation Using RAG-Based Large Language Models

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Abstract

Picture shifting through stacks of outdated case files, flipping page after page, just to locate a single relevant ruling. Relying solely on keyword searches? That often fails to capture what you're actually looking for. This is where a new tool steps in—one designed to interpret legal texts more like a human would. Rather than simply matching terms, it identifies meaning by converting documents into underlying conceptual patterns. These patterns are stored in a specialized system where related ideas cluster together organically. When you pose a query, the system retrieves results based on relevance of concept, not just exact word sequences. There's no illusion of wizardry—just more thoughtful processing happening behind the scenes. It surfaces relevant cases efficiently, without fanfare about revolution or change. Work flows better when answers come faster and clearer. Tasks that once demanded hours now take seconds quietly and reliably. Once a legal question is asked, the tool extracts pertinent information from documents and constructs responses strictly from what it finds. Beyond retrieving laws, it explains applicable rules and includes a feature to help draft formal complaint letters addressed to authorities. Developed using Python, Streamlit, FAISS for search functionality, and advanced language models, the system operates seamlessly. Testing confirms it quickly retrieves accurate legal information, reduces manual search time, and makes legal knowledge more accessible. This prototype demonstrates how AI can enhance tools for legal research, supporting both legal professionals and the general public.

Keywords

Legal Document Analysis, Retrieval-Augmented Generation, Natural Language Processing, Semantic Search, Vector Database, Artificial Intelligence in Law, LLM, Legal Knowledge Systems.

AI-Driven Traffic Violation Detection and Automated E-Challan System using YOLO and IoT

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Abstract

The integration of artificial intelligence into intelligent traffic management systems has become a major focal point within the fields of computer vision and machine learning. To support the growing demands of smart city development and automated law enforcement, real-time AI surveillance is increasingly being adopted to identify traffic offenses. This research focuses on deploying advanced object detection algorithms—specifically leveraging OpenCV and YOLO models—to strictly monitor traffic compliance and dynamically operate advanced warning hardware. By continuously analyzing live video streams, the proposed system detects common infractions, including red-light running, three-passenger riding, and the absence of helmets. These detections immediately trigger the automated generation and dispatch of e-challans via WhatsApp. Additionally, the system bolsters public safety and emergency logistics by recognizing approaching ambulances and vehicles missing license plates. This critical information is then instantly transmitted to a secondary signaling unit, which activates localized alerts using LCD screens and buzzers.

Keywords

Traffic violation detection, Computer vision, YOLO object detection, Raspberry Pi Pico, Automated e-challan.

Trust-Aware Lost and Found Management System for Campus Environments: A Secure and Scalable Web-Based Approach

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Abstract

Lost and found management in campus environment is usually manual and fragmented, thus late recoveries, wrong records, and a general loss of trust among users. Traditional systems conventionally use physical notice boards or informal means of communication where there is little scope for accountability or not tend to misuse. With increasing digital platforms on campuses for various operational services, the need for secure and trusted systems that manage sensitive interactions amongst users is also increasing. This paper propose a trust-aware lost and found management system designed for campus environments. The idea behind this approach is to integrate authentication and verification mechanism in order to ensure controlled access and prevent fraudulent item claims. The system follows a modular web-based architecture that allows scalability, usability, and secure data handling. A structured method has been used in order to handle workflows of item reporting and recovery in claiming verification. Experimental evaluation under real assumptions for the campus environment showed that the system can efficiently support a number of concurrent users with minimal performance overhead. The proposed solution provides a practical and secure alternative to traditional approaches to lost and found in institutional environment.

Keywords

Trust-aware systems, lost and found management, campus information systems, secure web applications, authentication mechanisms.

A Multi-Model Data Fusion Framework for Financial Market Prediction by using FinBERT & Ensemble Deep Learning

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Abstract

Financial markets are one of most un-certain yet most essential elements of countries economy. Old methods of prediction, often fall short in capturing complex & dynamic characteristics of financial markets behavior, particularly within Indian financial ecosystem. Our project represents an AI-based model which combines machine learning, deep learning & natural language processing (NLP) for predict share prices & assess market sentiments. Our suggested system consists three primary components: Long Short Term Memory for sequential prediction, Random Forest is for feature based regression & FinBERT, a transformer-based NLP model, for classifying sentiments from financial related news. Historical data comes from Yahoo Finance, while up-to-date financial headlines comes from NewsAPI. Our system analyzes & visualizes all outcomes through a Gradio web platform. Our hybrid model results advance accuracy when compared to other stand-alone models, successfully acquiring both numerical patterns & sentiment market trends. Our findings highlights importance of mixing quantitative & qualitative information to accurate financial forecasting & decision-making.

Keywords

Stock Market Prediction, Artificial Intelligence, LSTM, Random Forest, FinBERT, Sentiment Analysis, Financial Forecasting, Indian Market, Deep Learning & NLP.

Explainable Credit Risk Assessment Using Machine Learning

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Abstract

Assessing the credit risk requires a fine balance between accuracy and transparency, both legislative and regulatory. Logistic regression (LR) is well recognized as interpretable but sophisticated ensemble algorithms such as extreme gradient boosting (XGBoost) provide good predictive power at the cost of interpretability. In our paper, we propose a Confidence Aware Explainable Credit Risk Assessment Framework which selectively integrates both models based on prediction certainty. High confidence predictions are processed using XGBoost to maximize the discriminatory power while borderline scenarios are sent to LR to provide regulator friendly explanations.

The framework is tested on the German Credit dataset and large-scale and imbalanced Lending Club dataset. Results show that the ROC-AUC can be improved to 0.8258 on the German dataset with a still 34% interpretability coverage. On Lending Club dataset, the method achieves a competitive ROC-AUC score of 0.7403 with coverages of around 59% interpretability, therefore demonstrating robustness in real world situations. There are model-specific explanation processes that are selective to ensure computational efficiency and feasibility of deployment.

Keywords

SHAP, interpretable models, credit scoring, model fairness, predictive accuracy, financial regulation, Credit Risk Assessment, Explainable Artificial Intelligence (XAI), Logistic Regression, XGBoost, Class Imbalance, Financial Machine Learning.

A Decentralized Healthcare Appointment Platform Using Machine Learning and Blockchain

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Abstract

Healthcare appointment scheduling has continued to pose a problem in the last few years. The problem has been described by factors such as inefficient use of resources, centralized data management, and the absence of intelligent demand prediction tools. However, this paper aims to design a decentralized healthcare appointment scheduling system that includes the application of machine learning algorithms to improve demand prediction and scheduling. Additionally, the proposed system includes the application of blockchain technology to offer a secure and transparent data management platform. The proposed system is expected to improve the efficiency and security of the healthcare services provided to the public and reduce the risks associated with the centralized data management system.

Keywords

Decentralized Healthcare, Appointment Scheduling, Machine Learning, Blockchain, Smart Contracts, Predictive Analytics.

Multi-Keywords Searchable Attribute-Based Encryption with Verification and Attribute Revocation Over Cloud Data Using Python and Cloud Computing

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Abstract

With the exponential rise in cloud storage usage, ensuring the security, privacy, and efficiency of data retrieval has become a critical concern. Traditional encryption methods often fall short in providing fine-grained access control and secure searchability over encrypted data. To address these limitations, this project introduces a Multi-Keywords Searchable Attribute-Based Encryption (MK-ABE) system, a novel approach that synergizes attribute-based encryption (ABE) with secure multi-keyword search functionality.

The proposed MK-ABE system allows users to perform search queries using multiple keywords without compromising data confidentiality, significantly enhancing usability and flexibility. It incorporates fine-grained access control based on user attributes, ensuring that only authorized users can decrypt and access specific data. A standout feature of this system is attribute revocation, which enables dynamic modification of access rights, addressing scenarios where users' roles or permissions change over time. Another critical component is data integrity verification, which ensures that search results are both accurate and unaltered, building trust in the retrieved data. The system will be developed using Python and deployed on cloud platforms, aiming to deliver a scalable, high-performance, and cost-effective solution suitable for both academic and enterprise environments.

Keywords

Cloud Storage, Data Security, Multi-Keyword Search, Attribute-Based Encryption (ABE), MK-ABE, Attribute Revocation, Access Control, Secure Searchable Encryption, Data Integrity Verification, Python, Cloud Computing, Encrypted Data Retrieval, Fine-Grained Access Control, Scalable Solutions, Privacy-Preserving Search, Dynamic Access Management, Secure Cloud Applications, High-Performance Encryption, Cryptography in Cloud, Confidential Data Access.

Beyond LLMs: LLM Backtranslation and Hybrid Augmentation for Fine-Grained Emotion Classification

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Abstract

Fine-grained emotion classification over large label spaces remains a challenging task due to severe class imbalance. This paper presents a systematic benchmark of twelve data augmentation strategies for multi-label emotion classification on the GoEmotions dataset, comprising 58,009 Reddit comments annotated across 27 emotion categories. We compare LLM-based (Mistral-7B, GPT-2, LLaMA-2), traditional NLP (backtranslation, T5 paraphrase), embedding-based (SimCSE, Hybrid), and resampling (SMOTE) augmentation across DistilBERT-base and RoBERTa-base architectures. LLaMA-2 backtranslation achieves the highest single-method F1 Macro of 0.540 on RoBERTa, surpassing the prior best of 0.494. A combined augmentation strategy pooling all methods yields the highest DistilBERT performance (F1 Macro: 0.695), a 24.7% relative improvement over the no-augmentation baseline. SMOTE consistently underperforms the baseline, confirming its unsuitability for discrete text augmentation. Intrinsic quality analysis validates BERTScore (average threshold ≥ 0.85) as a reliable pre-screening metric for augmentation selection. Multi-seed stability analysis (seeds: 42, 21, 84) confirms result robustness with standard deviation of 0.0009 on RoBERTa F1 Macro. These findings provide actionable guidance for practitioners addressing class imbalance in fine-grained emotion classification.

Keywords

Data Augmentation, Emotion Classification, GoEmotions, DistilBERT, RoBERTa, LLaMA-2, SMOTE, BERTScore, Multi-label NLP, Backtranslation.

Fake News Detection and Source Credibility Scoring Using NLP and Graph Neural Networks

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Abstract

The rise of online news platforms and social media has made it easier than ever for false information to reach large audiences before anyone can verify it. Existing detection systems tend to focus either on what a news article says or on how it spreads — but rarely on who published it. In this work, we build a hybrid system that checks both the content of a news article and the credibility of its source at the same time. For content analysis, we fine-tune a BERT model on a labeled fake news dataset. For source credibility, we train a Graph Convolutional Network on a co-occurrence graph of news publishers. The two outputs are combined using weighted averaging to produce a single classification decision. We tested the system on 19,742 news samples with a 70:30 train-test split. Our hybrid model reached 93.7% accuracy and a 93.0% F1-score, which is better than using BERT alone (89.3% F1) or the GCN alone (82.8% F1). The results show that checking the source alongside the content makes fake news detection noticeably more reliable.

Keywords

Fake News Detection, BERT, Graph Convolutional Network, Source Credibility, Misinformation, NLP, Decision Fusion.

Automatic ID Card Detection and Penalty Mechanism

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Abstract

The role of ID card verification cannot be overemphasized in the security and safety of institutions and organizations. Currently, the traditional method of ID card verification involves physical inspection, which is tedious and susceptible to human errors. This paper proposes the development of an Automatic ID Card Detection and Penalty Enforcement System, which utilizes computer vision and deep learning technology for the purpose of ID card verification and penalty enforcement. The system involves the use of a camera to capture the ID card image, followed by image preprocessing and Optical Character Recognition (OCR) technology. The features of the ID card are then analyzed using the Convolutional Neural Network (CNN) model to verify the authenticity of the card. If the ID card is invalid or unauthorized, the system will automatically impose a penalty on the individual. The results of the ID card verification and the penalty imposed will be recorded and stored in the centralized database. The system will be more efficient and effective in the security and safety of the organization. The results obtained during the experiment show the efficiency of the proposed system in the real-time ID card verification process.

Keywords

Automatic ID Card Detection, ID Card Verification, Deep Learning, Convolutional Neural Networks (CNN), Optical Character Recognition (OCR), Penalty Enforcement System, Image Processing, Real-Time Monitoring.

Optimizing Beyond-5G URLLC Networks: A Review of Joint Latency, Reliability, Throughput, and Energy Efficiency Strategies

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Abstract

Beyond fifth-generation (B5G) wireless networks introduce a new paradigm for ultra-reliable low-latency communication (URLLC), targeting sub-millisecond end-to-end latency, “five-nines” reliability, enhanced energy efficiency, and significantly higher throughput than legacy systems. Achieving these stringent and often conflicting performance requirements necessitates advanced multi-objective optimization (MOO) frameworks capable of jointly managing radio resource allocation, network slicing, edge intelligence, and physical-layer design. This paper reviews key challenges associated with B5G URLLC, including heterogeneous quality-of-service demands, non-stationary wireless environments, and the limitations of classical single-objective optimization. We highlight recent progress in convex, evolutionary, and learning-based MOO techniques that enable dynamic trade-off management among latency, reliability, energy consumption, and spectral efficiency. Furthermore, we discuss emerging enablers such as reconfigurable intelligent surfaces, short-packet communications, and integrated sensing-communication paradigms that further tighten performance bounds. The survey concludes with open research directions, emphasizing scalable optimization, cross-layer co-design, and robust real-time decision-making essential for next-generation URLLC deployment in mission-critical applications. [8], [9] [16]

Keywords

Beyond 5G (B5G), Ultra-Reliable Low-Latency Communication (URLLC), Multi-Objective Optimization (MOO), Latency, Reliability, Energy Efficiency, Throughput, Reinforcement Learning, Reconfigurable Intelligent Surfaces (RIS), Edge Computing. [8], [9]

ARTICLE-GUARD: A Multilingual Legal RAG System with Strict Article-Aware Retrieval for Zero-Hallucination Constitutional Analysis

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Abstract

Large Language Models are becoming more common in the legal field, but they often give wrong or unsupported answers, especially when working with structured legal documents like constitutions. This paper introduces ARTICLE-GUARD, a multilingual legal question-answering system developed through a Retrieval Augmented Generation (RAG) methodology to overcome this issue. The system uses strict article level matching for citation based questions and semantic retrieval for general questions to make sure that the answers are always based on the legal document that was uploaded. Legal BERT is used to figure out how the document is put together, and an instruction-tuned language model makes responses only from the content that was found. A multilingual processing layer lets users ask questions in more than one language while keeping the original meaning. The system gives answers that are always the same and based on the context, and it doesn't answer when the document doesn't have enough information. The suggested method shows a solid and useful way to analyze multilingual constitutional documents.

Keywords

Legal AI, Retrieval-Augmented Generation, Constitutional Question Answering, Multilingual NLP, Hallucination Mitigation, Legal-BERT.

Comprehensive Review of High-k Gate Dielectrics for Performance Enhancement in Sub-10 nm SOI Triple-Gate FinFETs

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Abstract

This review shows how high-k gate dielectrics have changed the game for the sub-10 nm Silicon-on-Insulator (SOI) triple-gate FinFETs. As transistors continue to scale down into the deep nanometer territory, the SiO_2 gate dielectrics used have their own fundamental problems, such as increased gate leakage, decreased gate control, and increased short-channel effects (SCEs). FinFETs with high-k dielectrics such as HfO_2 , ZrO_2 , and Al_2O_3 , and their laminated or doped versions, provide a real opportunity to improve electrostatic control, increase the on-state (ION) current, decrease off-state (IOFF) leakage, and improve overall device reliability. This review focuses on the high-k dielectrics used in triple-gate architectures. Specifically, the review examines the efforts regarding material selection, interface control, the mobility downturn, reliability, and integration schemes. The review compares the gains from experimental and simulation studies for subthreshold swing (SS), transconductance (gm), drain-induced barrier lowering (DIBL), and gate delay. The review presents the integration of new materials and suggests the integration of 2D materials and high-k dielectrics in a new structure to sustain Moore's Law beyond the 5 nm node.

Keywords

Gate leakage, Short-channel effects, Subthreshold slope, Transconductance, Triple-gate, Sub-10 nm, SOI, High-k dielectric, FinFET.

StackGuard: Intelligent Vulnerability Monitoring and Alerting for Critical Systems

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Abstract

Modern web applications depend on multiple third-party technologies which include PHP, WordPress, MySQL, and JavaScript frameworks. Publicly disclosed security flaws create vulnerabilities in these technologies which expose websites to cyber-attacks. The process of checking technology stacks and CVE records through manual methods requires experts to spend extensive time while producing results that often contain errors.

The research paper presents StackGuard which functions as an automated web analysis system to detect a website's technology stack and link it to current vulnerabilities listed in the National Vulnerability Database (NVD). The system performs technology detection and CVE matching and SEO evaluation to create a unified report. This report combines security and optimization results. StackGuard enables developers and security analysts to perform quick risk assessments which lead to enhanced website security and improved performance results. The system delivers an automated solution for website evaluation through its report generation capabilities and user-friendly interface. This enables modern website analysis.

Keywords

Technology Detection, CVE Analysis, Vulnerability Mapping, NVD, Web Security, SEO Evaluation, Automated Website Scanning, StackGuard.

NETGUARD: AI-Based Intrusion Detection System

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Abstract

The rapid growth of digital communication and internet-based services has increased the exposure of computer networks to a wide range of cyber threats. Intrusion Detection Systems (IDS) are essential for identifying suspicious activities and ensuring network security. However, traditional IDS approaches, particularly signature-based methods, struggle to detect unknown and evolving attacks such as zero-day exploits. This paper presents NETGUARD, an Artificial Intelligence-driven intrusion detection system designed for real-time network monitoring and threat detection. The system combines machine learning techniques with packet inspection and traffic analysis to enhance detection capability while reducing false alarms. A Random Forest classifier is used to distinguish between normal and malicious network behavior based on extracted traffic features.

NETGUARD follows a modular architecture that includes packet capture, feature extraction, classification, alert generation, and visualization components. Experimental evaluation on benchmark datasets demonstrates that the proposed system achieves improved detection accuracy and reliable performance compared to conventional methods. The system is suitable for deployment in small to medium-scale network environments requiring efficient and scalable security monitoring.

Keywords

Intrusion Detection System, Machine Learning, Network Security, Artificial Intelligence, Cybersecurity, Random Forest, Real-Time Monitoring.

Quantum-Resilient Partial Signature Framework for Privacy-Preserving Public Auditing in Dynamic Cloud Storage

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Abstract

The maintenance of data integrity, privacy, and transparency in cloud-based storage systems is a crucial issue because of the use of centralized auditing systems. The paper suggests a Blockchain and AI-Improved Adaptive Public Data Auditing Framework that incorporates cryptography using the elliptic curve (ECC), homomorphic hash aggregation, blockchain verification, and anomaly detection using artificial intelligence (AI). The framework allows effective and privacy-sensitive auditing because it allows verifying blocks of data in bulk without disclosing original data. Using blockchain technology, the audit logging can be tamper-proof and decentralized, which will eliminate the use of third-party auditors and increase trust. Moreover, the AI module checks the pattern of audits in real-time to identify abnormalities and any pose of security threat. The experimental results reveal that there is an improvement on the efficiency of the audit, less computational overhead, and high stability of the detection of the anomalies in comparison with the traditional approaches. The proposed system offers a flexible, secure, and intelligent system that can support dynamic multi-cloud environments to ensure the robust data integrity and clear audit operations.

Keywords

Cloud Computing, Public Data Auditing, Blockchain, Elliptic Curve Cryptography (ECC), Homomorphic Hashing, Anomaly Detection.

Smart Shopping Trolley with Integrated RFID and Electronic Display

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Abstract

This paper presents an RFID-based smart shopping trolley integrated with IoT to automate the billing process in supermarkets. The system minimizes human intervention by automatically detecting products using RFID tags, displaying real-time billing information on an LCD, and transmitting data wirelessly to checkout counters. The solution enhances efficiency, reduces waiting time, and improves customer experience.

Keywords

RFID, IoT, Smart Shopping, Automated Billing, Arduino, Wireless Communication.

ORION: Automated Smart Contract Security Auditing via Hybrid LLM Verification and Exploit Generation

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Abstract

Smart contract vulnerabilities represent a critical and irreversible security risk in blockchain-based systems. However, automated tools currently detect vulnerabilities with a 70-80% false positive rate and do not verify exploitability, requiring a time-consuming manual audit process. This article proposes a new five-stage hybrid framework, called ORION (Orchestrated Reasoning and Intelligent On-chain Auditing), combining static analysis with Slither, semantically driven verification with Groq, and automated exploit generation with Foundry, in a single zero-intervention pipeline. Our evaluation on 160 smart contracts from the SmartBugs Curated benchmark, representing 11 different vulnerability categories, shows ORION successfully analyzes 88.1% of smart contracts, reduces false positives by 83% from 2,591 to 440 true vulnerabilities, generates 440 executable exploit tests with complete coverage, and has an average F1-score of 0.853 across all categories under evaluation. The end-to-end analysis time takes less than 3 minutes per smart contract, representing a 96-99% improvement in speed compared to manual audit tools, and a throughput rate of 514 smart contracts per day on a single workstation.

Keywords

Smart contracts, blockchain security, large language models, vulnerability detection, static analysis, automated exploit generation.

AI Augmented Detection and Interpretation of Alzheimer's Pathogenic Genes Using Artemis and LLM

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Abstract

Genetic disorders like cystic fibrosis and cardiovascular disease usually result from certain genetic mutations. Detection of genes that cause such diseases is crucial for the early diagnosis and design of customized treatment plans. Detection of disease-causing genes based on genomic data using AI and machine learning algorithms is the focus of this project. In contrast to conventional models such as Random Forest and Support Vector Machine (SVM), which lack capacity to deal with complex and high-dimensional biological data, this research employs sophisticated techniques such as network-based methods, deep learning models, and feature selection methods. Network based analysis enables the examination of gene interaction and biological pathways and provides insight into how sets of genes are involved in disease. Deep learning methods are used to derive useful patterns from large genomic sequences, enhancing the accuracy of gene-disease prediction. Feature selection also improves model performance and interpretability by selecting the most informative genetic markers from large data. The merging of these AI based methods results in more precise and efficient identification of disease-associated genes. The findings of this study can play a substantial role in pushing precision medicine forward by allowing for more successful early diagnostics, risk evaluation, and the development of targeted therapies, ultimately improving patient care and outcomes.

Keywords

Alzheimer's Disease, Genetic markers, Bioinformatics, Artemis, Ollama, Mutation detection, BLAST, Genomic data interpretation.

Fake News and Misinformation Detection Using Contextual Semantic Graph-Enhanced CNN (CSGE-CNN)

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Abstract

The issue of fake news shared on the social media platforms poses an increasing danger to the trust of the population, democracy, and health choices. The current automated detection systems are based on heavy transformer models that are costly to operate in real time or single-path CNN models, which lack rich semantic connections among words and sentences. In this paper, suggest a new framework known as Contextual Semantic Graph-Enhanced CNN (CSGE-CNN) to detect fake news. The model encodes two parallel paths, one of Char-level CNN, which encodes both spelling and morphological patterns, and one of Sentence Encoder, encoding the deep meaning of whole sentences, then connects them to each other with a Semantic Graph Module (SGM) which models the connection between various components of the article. An intelligent fusion of information of both paths then follows in a Cross-Path Attention (CPA) layer and finally a prediction is made by a Residual Dense classifier. CSGE-CNN is evaluated on FakeNewsNet and LIAR datasets, and it has the highest accuracy 96.78% and True Positive Rate (TPR) and True Negative Rate (TNR) 95.63 and 97.05 respectively.

Keywords

Fake news detection, semantic graph, dual-path encoding, char-level CNN, sentence encoder, cross-path attention, misinformation, social media.

Optimizing Microservices and Containerization in Full Stack Web Applications

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Abstract

Microservices paired with container orchestration are now central to modern full-stack web systems. They promise modularity, independent deployability, and elastic scaling but introduce new challenges in performance, cost, and security. This paper reviews the state of the art (2020–2025) in optimizing microservice performance and containerized deployments. We synthesize techniques in container build/placement, orchestration and autoscaling (reactive, predictive, hybrid), observability and root-cause analysis, cost optimization (including ARM/Graviton adoption), and security hardening. Two comparison tables summarize pros/cons of major approaches, and a research taxonomy highlights open problems and promising directions.

Finally, we identify gaps for future research and provide a concise set of practical recommendations for practitioners.

Keywords

Microservices, containerization, Kubernetes, autoscaling, observability, cost optimization, security, ARM Graviton, predictive scaling.

Smart Irrigation System for Precision Farming

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Abstract

The “Smart Irrigation System for Precision Farming” aims to enhance agricultural productivity through a data-driven irrigation management system. By leveraging machine learning algorithms such as Support Vector Machine (SVM), Random Forest, and XGBoost, this project provides accurate predictions of the optimal watering schedule for plants based on various environmental and soil parameters. The system uses a dataset that includes soil moisture, temperature, humidity, wind speed, air pressure, rainfall, and essential nutrients like Nitrogen (N), Phosphorus (P), and Potassium (K) to determine the most effective irrigation practices. The project integrates data collected from sensors into a Flask-based web application, allowing farmers to monitor and manage irrigation systems remotely. The front-end is built using HTML, CSS, and JavaScript, providing an intuitive interface for real-time monitoring and control. By predicting the need for watering based on soil conditions and weather data, this AI-driven system optimizes water usage, reduces wastage, and promotes sustainable agricultural practices. With this solution, farmers can make informed decisions on irrigation, resulting in increased crop yield, resource conservation, and environmental sustainability.

Keywords

Machine Learning Algorithms, SVM, Random Forest, XGBoost, IOT, Irrigation Management, Soil Moisture, Flask-based Web Application, Sustainable Agricultural Practices.

A Novel Diffusion-Assisted CNN-ViT Framework for Retinoblastoma and Uveal Melanoma Detection

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Abstract

Early detection of eye cancers such as retinoblastoma and uveal melanoma plays a vital role in preserving vision and improving patient survival. Traditional manual analysis of ophthalmic images is labor intensive and may lead to diagnostic inconsistencies, particularly when large datasets are involved. To overcome these limitations, this paper presents a diffusion-assisted hybrid deep learning framework that combines Convolutional Neural Networks (CNNs) and Vision Transformers (ViTs) for automated eye cancer detection. A diffusion-based preprocessing technique is applied to enhance image quality by reducing noise and improving contrast. The CNN module focuses on extracting local structural features, while the ViT component captures global contextual information from the images. Experimental results obtained on ophthalmic image datasets indicate that the proposed hybrid approach achieves better performance than standalone CNN and ViT models in terms of accuracy, sensitivity, and specificity. Furthermore, heatmap-based visual explanations are provided to improve interpretability and support clinical decision-making. The proposed framework demonstrates potential as an effective tool for early eye cancer screening and can be adapted for the detection of other ocular disorders.

Keywords

Retinoblastoma, Uveal Melanoma, Diffusion Model, Convolutional Neural Network, Vision Transformer, Medical Image Analysis.

Integrating Local and Global Noise Features using SRM, CNN, and CVT for Efficient Image Steganalysis

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Abstract

Steganography enables covert communication by embedding secret information within digital images, presenting critical challenges for detection in cybersecurity and digital forensics. Traditional convolutional neural network (CNN)-based steganalysis models effectively extract local spatial features but suffer from limited receptive fields and inadequate global contextual understanding, restricting their ability to detect subtle steganographic modifications. To address these limitations, this paper proposes a novel hybrid SRM-CNN-Convolutional Vision Transformer (CVT) framework for spatial-domain image steganalysis. The proposed architecture employs a three-stage approach: first, 30 high-pass Spatial Rich Model (SRM) filters extract residual noise patterns while suppressing natural image content; second, a deep CNN backbone (SRNet) performs hierarchical local spatial feature learning; third, a Swin Transformer-based CVT module captures long-range dependencies and global contextual relationships through multi-head self-attention mechanisms. This synergistic integration enables a comprehensive analysis of both fine-grained local patterns and broader semantic contexts, which are essential for robust steganalysis. Comprehensive experiments conducted on the BOSSBase dataset using standard steganographic algorithms—WOW, S-UNIWARD, and J-UNIWARD—across varying payload capacities demonstrate that the proposed hybrid model achieves superior detection accuracy, reaching up to 99.1% for specific configurations. The framework exhibits enhanced robustness compared to conventional CNN-only architectures, maintaining high performance under diverse embedding conditions. The experimental results validate that combining residual noise filtering, deep convolutional representation, and transformer-based global reasoning creates an effective synergy for advancing spatial-domain image steganalysis, offering significant improvements in detection capability and generalization for practical cybersecurity applications.

Keywords

Steganography, Steganalysis, Convolutional Neural Network (CNN), Convolution Vision Transformer (CVT), Swin Transformer, Spatial Rich Model (SRM), Deep Learning, WOW, S-UNIWARD, J-UNIWARD, Feature Extraction, BOSSBase Dataset, Hybrid Model, Spatial Domain, Residual Noise, SRNet.

Design and Analysis of High-Performance Go-Kart Chassis Using CAD & FEA Tool

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Abstract

Go-kart design and analysis is crucial to determine the overall performance, structural safety and ability to perform under dynamic driving situations. Go-karts are very small and lightweight cars and are often adopted in student racing and simple car training. They have to have their chassis that is strong, durable and weight efficient and offer safe economies to the driver. This research is intended to be conducted to create a structurally go-kart chassis with the help of modern engineering tools and testing its behavior within the frames of the real-life loads. The project starts with the development of the 3D CAD of the go-kart chassis. Regular design specification like center of gravity was chosen so that it would create a stable and easily controlled cart. The total weight reduction was considered with special focus to structural rigidity reduction. In order to test the performance of the design, the simulation tools were used through Finite Element Analysis (FEA). The loading conditions that include front impact, side impact, bump load, braking loads and cornering loads were exercised to examine the stress pattern around the chassis. The outcomes of the simulation yielded important information in the deformation levels, high stress areas, and factor of safety as a whole. This paper has demonstrated that CAD modelling and FEA should be employed during initial design phases of a vehicle. The accuracy is guaranteed, design errors are minimized and the manufacturing cost and time are saved by the methodology taken. The resulting go-kart chassis is safe, light in weight as well as structurally efficient and can be used in fabrication, testing and also in competitions.

Keywords

Go- Kart, CAD DESIGN, FEA, Chassis Design.

Hybrid Model for Multi-Modal Brain Tumor Segmentation

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Abstract

This paper offers a rapid and effective 3D Vision Brain tumor segmentation framework based on transformers. Optimized for single GPUs like NVIDIA T4. This paper offers an extension of an already trained 2D ViT Minuscule backbone by inflating its patch embeddings and positional mappings to the 3D space, where effective modeling of Volumetric context MRI scans can be done. Multi-modal MRI inputs, in T1, T1ce, T2 and FLAIR, are merged and processed. Via an overblown 3D encoder, and then a light-weight 3D Convolutional de-coder for precise voxel tumor Segmentation. Mixed precision is included in the training pipeline. Exponential Moving Average (EMA), gradient checkpointing, OneCycleLR scheduling and top-K techniques, reducing memory usage and lowering the run time. A quick BraTS-style data packaging unloader harvests compact depth slices to enhance computational efficiency. Competitive Dice scores are shown based on experimental results for Whole tumor, tumor core, and enhancing tumor regions hyperbolically keeping the real-time viability, justifying the efficacy of finetuning a pretrained 2D ViT Tiny model into a workable and high-performance segmentation system.

Adaptive Threshold-Based Detection of DoS Attacks with Machine Learning Performance Evaluation Using CIC-IDS2017

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Abstract

Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks are considered to be one of the most critical security attacks on computer networks, as these attacks lead to the consumption of bandwidth, processing, and memory of the system. These attacks restrict the access of legitimate users to the network and cause significant financial loss. Traditional Intrusion Detection Systems (IDS) use fixed threshold-based detection mechanisms to identify the unusual behavior of network traffic. However, fixed threshold-based IDS cannot adapt to changing network traffic conditions, which results in an increase in the number of false alarms and the inefficiency of the detection process.

This paper proposes an adaptive threshold-based detection mechanism, which dynamically calculates the threshold limits based on the statistical properties of normal network traffic. This approach helps the system adapt to changing network conditions. The performance of the proposed approach has been tested on the CIC IDS 2017 dataset, which includes the Friday Working Hours Afternoon DDoS dataset with both benign and malicious network flows.

From the experiment results, it is observed that even though the adaptive thresholding approach offers a lightweight and computationally simple solution for traffic detection, it is less effective when the presence of malicious traffic is statistically similar to the traffic patterns of legitimate traffic. To establish a baseline for performance comparison, a Logistic Regression model has been implemented using several features for network traffic. The Logistic Regression model has been observed to achieve 99.85% accuracy with AUC scoring at 0.9998, thereby demonstrating the limitations of using single-feature statistical approaches for network traffic detection and the potential offered by ML models for contemporary network intrusion detection systems.

Keywords

Denial of Service, DDoS, Intrusion Detection System, Adaptive Thresholding, Machine Learning, Logistic Regression, CIC-IDS2017, Network Security.

Trade Market Insights: LSTM-Based Stock Price Forecasting and Market Trend Analysis System

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Abstract

The rapid expansion of financial markets and the increasing participation of individual investors have significantly increased the complexity of stock analysis and price forecasting processes. Conventional prediction systems primarily focus on historical trends or short-term statistical estimations, often overlooking critical factors such as temporal dependencies, market volatility, external economic influences, and behavioral patterns that affect price movements. For investors and analysts, prediction outcomes directly influence profitability, risk management, and decision reliability, highlighting the need for intelligent analytical systems that extend beyond traditional forecasting approaches.

Trade Market Insights is a deep learning-based stock analysis and forecasting system designed to enhance decision-making in financial environments. Unlike conventional prediction models that treat data as independent observations, Trade Market Insights integrates Long Short-Term Memory (LSTM) networks, time-series modeling, data preprocessing techniques, and interactive visualization to analyze stock behavior based on sequential patterns and historical trends. The system incorporates capabilities such as structured data processing, short-term price forecasting, graphical trend representation, and user-oriented analytical outputs to support data-driven financial analysis. By combining historical data analysis, predictive modeling, and visualization techniques, Trade Market Insights improves trend interpretation, enhances analytical understanding, and supports informed decision-making. This approach transforms stock prediction from a basic computational task into an interactive and insight-driven analytical process, offering practical value for investors, learners, and financial data analysis applications.

Keywords

Stock Price Forecasting, LSTM, Time-Series Analysis, Financial Data Analytics, Market Trend Analysis, Predictive Modeling, Web-Based System.

Automated Detection of Diseases in Leafy Vegetables Using YOLOV11

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Abstract

Cabbage is an important leafy vegetable valued for its nutritional and economic benefits, but its cultivation is often affected by Black Rot disease, which can significantly reduce yield and quality. Detecting this disease at an early stage is crucial for effective crop management and preventing further spread. However, traditional methods rely on manual inspection by experts, which can be time-consuming, inconsistent, and difficult to apply on large farms. To address this problem, this paper presents an automated approach for detecting Black Rot in cabbage leaves using the YOLOv11 deep learning-based object detection model. A dataset of healthy and infected leaf images collected under different environmental conditions is used to train the model. Image preprocessing and augmentation techniques are applied to improve accuracy and robustness. The performance of the proposed model is evaluated using standard metrics, including precision, recall, F1-score, and mean Average Precision (MAP). Experimental results demonstrate that the YOLOv11-based approach achieves high detection accuracy with low inference latency. The proposed system is capable of identifying and localizing infected regions in real time, providing a practical and efficient solution for farmers.

Keywords

Black Rot, Cabbage leaf disease, Object detection, Deep learning, Precision agriculture, YOLOv11.

Investigation of Unstructured Job Notes from Construction Sites and Sentiment Prediction

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Abstract

This study introduces a Sentiment Prediction Framework of Construction Site Job Notes based on Natural Language Processing (NLP) tools and Machine Learning (ML) tools. The framework is formulated to analyse unstructured text-based site reports that are written by engineers and supervisors with the objective of establishing their underlying feeling- positive, negative or neutral. The given system adheres to the ordered pipeline of data cleaning, tokenization, lemmatization, and stop word removal to equip domain-specific construction text. TF-IDF and word embeddings are used to extract features and depict the linguistic context. Several sentiment classifiers are considered such as VADER, Naive Bayes, and Logistic Regression in order to find the best performance in understanding language of the informal sites. To track the distribution of sentiment and trends on different projects, visualization dashboards are applied. In experimental analysis, the test is found to be reliable and has contextual meaning of construction-related language and the model has strong F1-scores on various data sets. Fusion of machine learning and rule-based models improves interpretability and fewer domain annotations are required. The system was implemented with Python, NLTK, Scikit-learn, and Streamlit to provide the project managers with actionable information about the situation in on-site conditions and make the most appropriate decisions in a timely manner and enhance the efficiency of communication.

Keywords

Natural Language Processing, Sentiment Analysis, Construction Management, Machine Learning, Text Mining.

Development of AI-ML Based Model for Predicting Prices of Agri-Horticultural Commodities

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Abstract

Agriculture commodity price changes will have a major effect on farmers, traders and policymakers. Accurate price prediction helps them to make better decisions regarding crop selling and supply planning. This work showcase a machine learning based framework in order to predict agricultural and horticultural commodity prices using historical market data, weather reports, temporal features. This system includes preprocessing, feature engineering and an Extreme Gradient Boosting regression model for predicting prices of commodities. Model uses market parameters such as state, district, market, commodity type, variety, grade, and arrival quantity as well as weather parameters. The model also uses lag features from previous price values to analyze how values change over time. System is implemented using python and deployed through an interactive streamlit dashboard that allow users to forecast commodity prices based on selected parameters. Experimental analysis gives strong predictive performance which was measured using R2 score. This methodology shows the usefulness of machine learning in improving agricultural market analysis and supporting stakeholders to make better decisions.

Keywords

Agricultural price prediction, XGBoost, Machine learning, Commodity markets, Weather data, Time series forecasting.

AI-Powered Assam Culture Preservation System Using LLM and RAG

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Abstract

The cultural heritage of Assam is reflected in its traditional artifacts, food, and jewellery, which collectively represent the identity and richness of the region. However, rapid modernization and the lack of structured documentation have led to a gradual loss of this valuable cultural knowledge, limiting access and understanding for future generations. This study proposes an AI-powered Assamese cultural preservation system based on Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs) to address this challenge. A structured multimodal database containing categorized textual descriptions and images of cultural elements is manually curated and organized. The textual data is transformed into dense vector embeddings using SentenceTransformers (all-MiniLM-L6-v2) and indexed using FAISS to enable efficient semantic retrieval. When a user submits a query, the system retrieves the most relevant cultural information using cosine similarity and integrates it with the query context. This enriched input is then processed by a Large Language Model (Mistral via Ollama) to generate accurate, context-aware responses. The system is implemented through a Streamlit interface, enabling interactive exploration of Assamese cultural knowledge with both textual and visual outputs. Experimental evaluation demonstrates that the proposed system achieves 80.67% retrieval accuracy and a response relevance score of 0.92, highlighting its effectiveness in preserving and disseminating cultural heritage.

An Empirical Investigation of Security–Efficiency Trade-offs in RSA and ECC Based Public Key Cryptography

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Abstract

In a recent distributed computing system like cloud computing, Internet of Things (IoT) systems, and autonomous systems, public-key cryptography is a key element in ensuring communication security. Two of the most popular asymmetric cryptographic algorithms applied are RSA and Elliptic Curve Cryptography (ECC) which are two major algorithms with various mathematical hardness assumptions. This paper will provide empirical performance research on RSA and ECC implementations at standard levels of security-equivalent key sizes, as suggested by NIST guidelines. The computational cost of key generation, encryption and decryption were tested using repeated execution of controlled experiments of benchmarking. The performance metrics are execution time, statistical variability, confidence interval and cumulative cryptographic latency. The experimental data provide support that ECC has significantly reduced computational overhead compared to RSA in all the operations considered with similar security parameters. Specifically, ECC has been shown to be much faster in key generation and achieved much lower execution time variability than RSA. The operational latency analysis cumulative also shows that the performance of RSA is strongly affected by the cost of computation of prime generation when creating keys. These results indicate that ECC implementations offer better computational performance and predictable execution behavior in performance sensitive computing systems. The findings add to the empirical support of the implementation of ECC in the contemporary secure systems, where the computational efficiency and latency are among the key design factors.

Keywords

RSA, Elliptic Curve Cryptography, public key cryptography, cryptographic benchmarking, execution-time analysis, performance evaluation.

Smart Blood Bank Management System for Emergency Healthcare Coordination

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Abstract

Blood availability during medical emergencies remains a critical challenge due to poor coordination among blood banks, healthcare institutions, and donors. Existing blood management systems often rely on manual processes or inefficient digital platforms, resulting in delayed response times, inaccurate blood stock information, and ineffective communication with donors. This project proposes a smart blood bank management system designed to enhance emergency healthcare coordination through real-time blood availability tracking and automated donor allocation. The system follows a blood-bank-centric approach in which donor information collected at blood bank centers is digitized and centrally maintained. When a blood request is initiated, the system first verifies blood availability at registered blood banks. If sufficient stock is unavailable, an automated emergency response mechanism is activated to identify eligible donors and send timely notifications. To further improve preparedness, machine learning techniques such as Linear Regression and Random Forest are incorporated to predict future blood demand based on historical data. By integrating automation with predictive analysis, the proposed system reduces response time, minimizes manual intervention, and enhances the reliability of blood distribution during critical medical situations.

Keywords

Blood Bank Management System, Emergency Blood Availability, Donor Allocation, Blood Demand Prediction, Linear Regression, Random Forest, Healthcare Coordination.

Automatic 2 In 1 Multi-Cutting Machine

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Abstract

The increasing demand for compact and multifunctional machining systems has led to the development of integrated solutions capable of performing multiple operations within a single platform. This study presents the design, fabrication, and performance evaluation of an **automatic 2-in-1 multi-cutting machine** capable of executing both drilling and cutting/grinding operations. The proposed system integrates two independent drive units dedicated to each operation, along with separate feed mechanisms driven by screw-thread arrangements to ensure controlled and precise tool advancement.

A microcontroller-based control architecture, interfaced with a Bluetooth communication module and relay switching system, enables automated mode selection and remote operation through a mobile application. The incorporation of independent feed control enhances machining accuracy, operational flexibility, and repeatability compared to conventional single-purpose machines. Experimental validation was conducted to assess the machine's performance in terms of feed rate control, surface finish, and operational efficiency. The results demonstrate that the proposed system achieves improved productivity, reduced setup time, and enhanced portability while maintaining acceptable machining accuracy for light-duty applications.

The developed machine operates on a standard 230 V AC supply and is designed to be compact, cost-effective, and user-friendly, making it suitable for small-scale industries, educational laboratories, and field applications. The study contributes to the advancement of low-cost automated machining solutions by integrating multifunctionality with smart control systems.

Keywords

Automatic cutting machine, Multi-function machine tool, Drilling and grinding, Microcontroller, Bluetooth control, Feed mechanism, Portable machining system, Smart manufacturing.

Two-Wheeler Traffic Violation Detection and E-Ticketing using YOLO and CNN

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Abstract

Severe accidents worldwide Causeway due to violation of traffic rules such as triple riding and no helmet compliance. These accidents are the reason behind multiple deaths and severe injuries. Technologies which are present in the traffic monitoring uses inspection manually which required huge number of staff and is not effective in the areas where large number of people stay. To overcome these limitations in the proposed method two deep learning algorithms are used one is convolutional neural network and second one is YOLO (You Only Look Once) model is used. The proposed method has the ability to detect the people and the different objects first the rider is detected and if the rider is found then helmet and triple ridings are detected. In this application, graphical user interface (GUI) is given for easy access and easy use purpose. Whenever the violation is detected the proposed system sends email to the owner of two-wheeler. Proposed method performance metrics are calculated using different metrics such as fscore, precision, recall, accuracy etc. Compared to existing algorithm, proposed system has obtained better performance, scalability robustness and able to identify two different categories such as triple riding and no helmet detection. From video recognition of number plate and traffic with faster even make this application stronger in future.

Keywords

Traffic Violation, YOLO (You Only Look Once), Smart Traffic Management, Helmet and Tiple Violation detection, Sending SMS.

Enhanced Real-Time Multimodal Meeting Intelligence System with Decision and Risk Analytics

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Abstract

The extraction of structured intelligence from collaborative meetings involving decisions, commitments, sentiment analysis, risk notifications, and summaries for roles is still an important but unresolved problem. The state-of-the-art solutions address each subproblem in a batch mode, thus denying domain experts the benefit of real-time analytical support. This paper proposes ERMMI, the Enhanced Real-Time Multimodal Meeting Intelligence system, a seven-module asynchronous streaming pipeline that concurrently processes audio, text, and video inputs to generate structured intelligence reports in a 6-second latency budget. ERMMI proposes two new modules: the Meeting Risk and Sentiment Trend Analysis (MRSTA) module, which uses Exponentially Weighted Moving Average smoothing for polarity regularization and logistic risk scoring; and the Decision and Commitment Detection (DCD) module, which uses fine-tuned BERT-base-uncased classification and a four-feature probabilistic commitment scorer. ERMMI is evaluated on 15 collaborative meetings with multiple participants (6.8 hours) with decision accuracy of 87.3%, commitment precision of 0.81, sentiment stability of 0.92, risk alert accuracy of 84.6%, and end-to-end latency of 4,200-5,800 ms.

An Intelligent Computer Vision System for Real-Time Yoga Posture Analysis and Feedback

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Abstract

YogaVision AI which uses a standard webcam along with artificial intelligence to help you align yourself properly while practicing yoga by offering live adjustments from your computer video camera by way of video footage from the webcam itself. The application captures key body points through Google's MoveNet model technology and extracts each joint's location in 3D space. The location is passed through a multi-layer perceptron (MLP) that calculates each joint angle to be able to identify what pose you are in with good accuracy. The application provides immediate visual feedback as well as audio feedback, enabling you to instantly adjust your posture while practicing. In addition, YogaVision AI provides other features including session history tracking, accuracy scores, and user progress tracking to help you continue to improve your performance over time. All data and processing of the user's video and audio occur client-side directly in the user's browser, ensuring complete data protection and security, with no use of external servers. This project demonstrates the effectiveness of harnessing artificial intelligence to deliver an accessible, affordable, and interactive yoga training tool for all users.

Keywords

AI, Yoga Pose Detection, Computer Vision, MoveNet, MLP, Real-Time Feedback, Biomechanics, Web Application.

Federated Learning-Based Privacy-Preserving Intrusion Detection System for IoT-Enabled Smart Cities

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Abstract

The rapid proliferation of Internet of Things (IoT) devices in smart cities has introduced unprecedented security challenges, while traditional centralized intrusion detection systems (IDS) raise significant privacy concerns due to the need for data aggregation. This paper presents a novel privacy-preserving federated learning-based intrusion detection system designed specifically for IoT-enabled smart city environments. The proposed system trains a global intrusion detection model collaboratively across distributed IoT devices using federated learning, ensuring that no raw privacy-sensitive data is ever transmitted to a central server, thereby preserving user privacy while maintaining detection accuracy. The architecture incorporates differential privacy mechanisms to provide formal, mathematically grounded privacy guarantees and employs a hierarchical federated learning model to effectively handle the heterogeneity inherent in IoT smart city networks. Extensive simulations using real-world IoT network traffic traces demonstrate that the system achieves a detection rate of 96.8% with low communication overhead and outperforms conventional centralized IDS approaches without compromising data privacy. The system successfully detects a wide range of IoT-specific attack vectors, including Distributed Denial of Service (DDoS) attacks, replay attacks, and botnet intrusions. This research underscores the critical importance of developing privacy-preserving and scalable security solutions tailored to the complex, distributed nature of smart city infrastructures, offering a practical and effective framework for securing next-generation IoT deployments. The proposed approach aligns with the Engineering and Technology themes of ICR CET 2026.

Cloud – Based Scalable Customer Segmentation using Machine Learning

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Abstract

In everyday life, each one of us uses one or more E-Commerce platforms like Flipkart, Amazon, Snapdeal, etc. With the increasing usage of these platforms, there has been increase in the datasets of customer data through online transactions and user transactions. So, by this, there is a rise of challenges of understanding customer behavior properly so that their respective personalized services are generated better. This challenge is critical but there is a way to address this challenge. Customer Segmentation is the greatest and important way or technique to overcome this challenge by grouping various customers into various groups according to similar characteristics. The traditional systems used in E-commerce are basically fixed rules or the company owned systems, which are very slow and very inefficient in handling large amount of customer data. Customer segmentation can be done by using cloud computing that provides storage that is scalable and can also compute resources.

This paper proposes a cloud-based customer-segmentation model using Machine Learning (ML) techniques. In this model, the customer data present on a cloud platform undergoes various clustering algorithms to group each customer based on their respective behavior and purchasing history. This model helps various businesses to improve customer personalization and decision making. Not only that the experimental results have also proven that this model or approach improves scalability, speed of the processing, and efficiency as compared to traditional systems.

Keywords

Cloud computing, Customer Segmentation, Machine Learning, Scalability, E-Commerce.

Virtu Lrn – Gesture-Based Holographic Display

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Abstract

Virtu Lrn operates by interpreting gestures via camera input, enabling interaction with three-dimensional visuals formed using the Pepper's Ghost technique. Instead of relying on virtual or augmented reality hardware, it provides accessible depth in digital education. Movement becomes command, shaping how users engage with projected content. Cost efficiency emerges alongside experiential richness, shifting focus toward inclusive innovation. What results is a different path – one where light, motion, and perception combine quietly beneath the surface.

Keywords

Computer vision, Deep learning, Gesture-based interaction, Hand gesture recognition, Human-computer interaction, Machine learning, Real-time systems, Virtual learning environment.

Job Matching Using Machine Learning and NLP Techniques

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Abstract

The difficulty in matching resumes with job descriptions is a major issue in recruitment systems. There are mainly two reasons for this: format and vocabulary differences, and the lack of semantic understanding. Keyword-based methods only search for terms but do not understand the context in which they are used. This is the main reason for low accuracy in existing methods. This project aims to address these limitations by employing advanced Natural Language Processing and machine learning techniques for resume-job matching. OCR methods are first utilized to capture the text from the uploaded resumes followed by preprocessing and embedding creation. Several models such as TF-IDF with cosine similarity, Word2Vec with Random Forest, and transformer-based embeddings like BERT and SBERT have been tested for their performance. The system shows the top three positions that a candidate is the most appropriate for along with their matching percentages. By increasing the accuracy and providing better contextual understanding, this method would lead to recruitment of the staff at their best which would also be a great benefit to the job seekers having their career properly aligned.

Keywords

Recruitment Automation, Semantic Embeddings, Machine Learning Models, Candidate Shortlisting, OCR (Optical Character Recognition), Natural Language Processing (NLP).

Design and Energy Analysis of a 2-Bit Hybrid Multiplier-Square Unified Architecture Using Quantum-Dot Cellular Automata

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Abstract

Quantum-Dot Cellular Automata (QCA) is a new nanotechnology in the electro-computing field that promises high device density, extremely low power usage, and fast switching rates (when compared to traditional Complementary Metal-Oxide Semiconductor (CMOS) technology). This paper reports a 2-bit Hybrid Multiplier-Square Unified Architecture design and simulation based on a QCA technology. The given design incorporates both multiplication and square functions in one circuit design to eliminate the redundancy of hardware and enhance performance. Simulation of the architecture is done in the QCA Designer tool in the bistable and coherence vectors simulation mode. The circuit proposed has 239 QCA cells with 6 inputs and 4 outputs and the polarization of the circuit reaches a steady state after 12 steps of simulation. The coherence vector simulation of energy analysis with 500,000 samples displays that the total energy dissipation of 8.61×10^{-2} eV with an average energy dissipation per clock cycle of 7.83×10^{-3} eV occurred. In comparison, the standalone 2×2 multiplier has 156 cells at 6.55×10^{-2} eV energy dissipation per cell, compared to 64 cells at 3.32×10^{-2} eV energy dissipation per cell in the square circuit. It has been shown that the proposed single architecture is both efficient in carrying out arithmetic operations in a single structure and has a good energy consumption. Thus, the suggested design is applicable to the low-power nanoelectronic arithmetic systems of the future.

Keywords

Quantum-Dot Cellular Automata, QCA Designer, Hybrid Arithmetic Architecture, Multiplier, Square Circuit, Low-Power Nanoelectronics etc.,

A Structured Adversarial Graph Learning Approach for Cross-Subject Emotion Recognition

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Abstract

Recognition of emotion across subjects is one aspect of the topic of affective computing that has remained a obstacle in this area because there is also large inter-individual differences between physiological indicators, facial expressions and behavioral responses. Traditional machine learning and deep learning architectures tend to fail to make a good generalization between unseen topics due to them learning topic-specific representations. As a remedy to this shortcoming, this paper introduces Structured Adversarial Graph Learning (SAGL) framework which combines graph neural networks with adversarial domain adaptation to learn both subject-invariant feature learning and emotion-discriminative features learning. The framework builds a subject-conscious emotion graph where nodes can be identified as multimodal emotion feature and edge can be identified as intrinsic relationship between the emotional states of people. A discriminator that enforces domain alignment with a minimax objective and a structure-consistency regularization mechanism that enforces semantic consistency between similar emotions are used to achieve these goals. It has been shown that experimental results on benchmark multimodal emotion datasets are more accurate, have higher F1-score and robustness than traditional methods, indicating the effectiveness of the framework in supporting emotion-aware intelligent systems in the real world.

Keywords

Cross-subject emotion recognition, Affective computing, Graph neural networks, Adversarial domain adaptation, Structured graph learning, Multimodal emotion analysis, Domain generalization, Emotion-invariant representation learning.

Design and Performance Analysis of an Energy-Efficient 8-2 Adder Compressor Using Majority Gates in Quantum-Dot Cellular Automata

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Abstract

Quantum-Dot Cellular Automata (QCA) is a new nanotechnology offering a high-speed and low-powered digital circuit implementation technology in an alternative to CMOS. Multiplier architectures that are applied in digital signal processing and image processing systems also require compressors. In this paper, the proposal put forward is an efficient architecture of 82 adder compressor based on majority gate logic under QCA technology. The suggested design uses hierarchical arrangement of majority gates in order to compress several input bits into sum and carry outputs with less circuit complexity. The simulator and model of the compressor circuit is implemented through the QCA Designer tool. Bistable simulation is done to ensure logical functionality whereas coherence vector simulation is done to estimate energy dissipation. Performance analysis indicates that the proposed design will save much energy and simulation time as compared to the current design. The amount of energy dissipated decreases to 0.0519 eV as compared to 0.493 eV and the simulation time is also decreased to 52 s as compared to 420 s. The findings indicate that the suggested compressor offers enhanced efficiency and performance to nanoelectronic arithmetic circuit. Consequently, the design is useful in high-speed multiplier architectures like Wallace tree and Dadda multipliers of next-generation nano-VLSI architecture.

Keywords

Quantum-Dot Cellular Automata, Majority Gate, Adder Compressor, Nanoelectronics, Low-Power Design etc.,

Real-Time Translation and Tone Modification in Live Chat Using Large Language Models with Multimodal Intelligence and Inclusive Communication Support

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Abstract

The increasing global digital communication requires immediate development of intelligent translation systems which preserve both semantic accuracy and emotional meaning and cultural sensitivity. The research presents a deep learning-based method for real-time live chat translation through Large Language Models (LLMs) which enables adaptive tone control. The Dual-Stream Emotion-Aware Translation Architecture (DETA) processes semantic content and prosodic elements at the same time to address translation system limitations while maintaining emotional details between languages. The system enables users to adjust formality levels which allow the system to switch between informal and formal and neutral communication styles based on specific situations. The system uses a hybrid architecture to achieve real-time discussion capabilities through selective LLM deployment for complex cases and lightweight transformer models for common terms which results in sub-800ms latency. The system achieved 95% translation precision and 92% tone preservation during tests that involved multiple language pairs including Hindi and Spanish and French and German and English. The system focuses on resolving cultural communication issues while maintaining natural conversation flow and ensuring accessibility for different linguistic groups. Our research establishes a connection between machine translation precision and human communication requirements to advance neural machine translation technology.

Keywords

Neural Machine Translation, Tone Modification, Large Language Models, Real-Time Translation.

A Hybrid AI-Based Integrated System for Obesity Management and Personalized Nutrition Guidance

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Abstract

Now a day's Obesity and life-style-related health issues have become a major global health concern. Involving intelligent and real time monitoring systems for early prediction and prevention. This paper presents a Hybrid Health monitoring predictive system and Nutrient recommendation system which Integrates Machine Learning and Deep learning Techniques with wearable device data. The proposed system uses algorithms like XG Boost and Random Forest for health classification, where XG Boost exhibits robust predictive performance then the other algorithm. Additionally, here wearable data is collected from Fit bit device and it is utilized to extract real-time physiological data such as (heart rate, step count, and physical activity level)s. This time series data is trained using a Temporal Convolution Network (TCN+), which accurately extracts temporal dependencies and performs better than traditional sequential models. After predicting the health condition, a personalized dietary recommendation is suggested by including a nutrient data set from kaggle. The hybrid System combines these trained models into a unified framework with a user friendly interface to enter the health parameters and it collects smart watch data. The Accurate Health prediction is generated by combining the static user inputs with dynamic wearable data, the system suggests a Nutritious and Balanced Health Diet. The performance results show a high accuracy and offer a Viable Solution for proactive health monitoring and management.

Keywords

Wearable Data Analytics, Hybrid AI System, Health Monitoring, Time-Series Analysis.

Sensitivity Analysis of a Triple-Stack Nanosheet FET for Detection of Cervical Cancer Biomarkers

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Abstract

As CMOS scaling demands higher electrostatic integrity and energy efficiency, the GAA architecture is leveraged to minimize short-channel effects and reduce leakage current in biomedical sensing platforms. In this article, a Triple-Stack Gate-All-Around (GAA) Nanosheet Field-Effect Transistor (NSFET) based biosensor is designed using TCAD Silvaco simulations. The designed biosensor detects Cervical cancer biomarkers like ssDNA, HPV16 E6, miR-21, miR-155, and p16INK4a and other biomolecules like DNA and gelatin. The proposed design has nanosheet that increases the sensitivity of the sensor. The sensing mechanism is established by incorporating a 3 nm nanoscale cavity within the gate dielectric around the nanosheet channel, encompassing the top, bottom, and sidewall regions within the gate stack, enabling effective biomolecule immobilization through dielectric modulation. The sensitivity variation of the biosensor is analysed in terms of subthreshold swing (SS) and power consumption and depends on the number of biomolecules filling rather than specific filling position. Surface charge (Q_f) is also induced to study the effect of charge modulation on device performance. The result for P16INK4a biomarker shows the most optimized electrical characteristics, achieving SS of ~60 mV/dec. An ON current of 18.9 μ A and a very low OFF current of 0.102 pA, resulting in a high switching ratio of 1.85×10^8 with low static power consumption of ~0.0666 pW. The proposed device exhibits a sensitivity of approximately 1.2 for the optimized biomarker condition. These findings establish the proposed design as a high current sensitive, low-power solution for the early diagnosis of cervical cancer, offering superior gate control and reliable detection capabilities compared to existing FET-based biosensors.

An Agentic AI Framework for Human-Centric UI Code Synthesis

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Abstract

Beginners and non-technical users often face a problem in converting their user interface (UI) design ideas into working code, which slows down the process of development because of the need for programming skills and technical knowledge. This project proposes a novel approach to generate HTML and CSS code directly from natural language using Agentic AI supported by open-source Large Language Models here using Llama model. By interpreting the simple text description of UI design given by the user or developer, code gets generated in a clean, semantic way that eliminates the need for traditional manual coding. Using Monaco Editor, the user can get a live preview of the HTML and CSS code that was generated. Also, the platform facilitates real-time multiuser collaboration through a conflict-free replicated data type (CRDT) framework using Yjs and web sockets technologies that provides collaborative web design similar to popular editing tools. A YOLO-based verification model is used to make sure that the generated UI components meet the standards, which can be iteratively refined until the output reaches predefined layout and quality thresholds. The data set for this project consists of a large collection of LLM-generated ideas, along with the code generated and the image of the output of the code. Focusing on HTML and CSS code generation, this solution improves the early stages of web development, reducing the dependency on coding skills.

Synergistic Effects of Granite Slurry and Blast Furnace Slag on the Rheological, Mechanical, and Durability Performance of Self-Compacting Concrete

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Abstract

The construction industry is growing quickly, which has made it extremely crucial to find materials that work well and are good for the environment. This has led to the use of industrial by-products in concrete. This study looks at how granite slurry and blast furnace slag can be used together to make self-compacting concrete (SCC) better. This method uses granite slurry to partially replace cement and blast furnace slag to replace natural aggregates. This makes the mix better for the environment. We did a lot of tests, like slump flow, V-funnel, and L-box, to check the fresh properties and make sure it flowed well and passed. After the concrete had hardened, it was tested for compressive and split tensile strength, as well as durability factors like how well it absorbs water and how well it holds up in different weather conditions. The results show that combining these materials significantly improves workability, strength, and durability compared to conventional SCC. This is mainly due to improved particle packing, lower porosity, and a denser internal structure. Overall, the study highlights that using these industrial waste materials together is an effective way to produce sustainable, cost-efficient, and high-performance concrete while also reducing environmental impact.

SHAP-Guided Dynamic Feature Reweighting for Adaptive Short-Term Electricity Demand Forecasting with Integrated Anomaly Detection

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Abstract

Accurate short-term electricity demand forecasting is crucial for keeping the grid stable, optimizing energy trading, and improving operational efficiency in modern power systems. However, current machine learning models often act as "black boxes," delivering high accuracy without the necessary transparency for important decision-making. This paper introduces an integrated, explainable machine learning framework for real-time demand forecasting on the Texas ERCOT grid, using historical load and multi-source weather data from 2023 to 2024. The main innovation is a new SHAP-guided dynamic feature reweighting algorithm. Unlike traditional post-hoc explainability methods, this approach repeatedly incorporates SHAP values back into the training process as dynamic sample weights, compelling the model to focus on complex, high-impact demand hours.

The framework has a real-time end-to-end pipeline that integrates live data from EIA and Open-Meteo APIs. It also includes a two-layer anomaly detection system that uses statistical Z-score filtering alongside Isolation Forest. Experimental results show that the proposed SHAP-guided XGBoost model reaches a Mean Absolute Percentage Error (MAPE) of 3.86%, marking a 63.6% improvement over the persistence baseline and an R^2 of 0.82. These results indicate a scalable, transparent, and highly accurate solution for managing the 26-million-customer ERCOT network.

Keywords

Electricity demand forecasting, xgboost, shap, explainable ai, anomaly detection, feature reweighting.

E – Commerce Platform with Personalized Recommendation

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Abstract

E-commerce personalization customizes individual product recommendations, search results, and content to individual users. This paper is a complete project on the development of an e-commerce site that involves the delivery of personalized information.

Using the behavior of the user (clicks, views, purchases), product metadata, and environmental features (time, device), our paper constructs an e-commerce prototype that provides a user with personalized product recommendations and customized content. It also measures the effectiveness based on the offline measures and a simulated online A/B test.

Keywords

E-commerce, personalization, recommender systems, collaborative filtering, content-based filtering, hybrid recommendation, user modeling, A/B testing.

Hybrid PSO–DE Based Optimal Integration of Distributed Generation and Battery Energy Storage Systems

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Abstract

The increasing integration of distributed energy resources in modern power distribution systems requires efficient optimization techniques to improve system performance and reliability. This paper presents a hybrid Particle Swarm Optimization–Differential Evolution (PSO–DE) algorithm for the optimal sizing of Distributed Generation (DG) and Battery Energy Storage Systems (BESS) in the IEEE 33-bus radial distribution system. The proposed method aims to minimize the total power loss, voltage deviation, and voltage stability index through a weighted multi-objective optimization approach. A backward/forward sweep load flow method is employed to evaluate the distribution system performance during the optimization process. The hybrid PSO–DE algorithm combines the global exploration capability of Particle Swarm Optimization with the mutation and crossover operations of Differential Evolution to improve the search efficiency and convergence performance.

The proposed method is applied to the IEEE 33-bus radial distribution system to determine the optimal sizes of DG and BESS. Simulation results demonstrate that the proposed approach effectively enhances the overall performance of the distribution system by reducing power losses and improving the voltage profile and system stability. The results ensure the effectiveness of the hybrid PSO–DE algorithm for optimal integration of distributed energy resources in radial distribution systems.

Keywords

Distributed Generation Integration, Battery Energy Storage System, Hybrid PSO–DE Algorithm, Voltage Profile Improvement, Power Loss Reduction.

Detection of Glioma Brain Tumor in MRI Images Using Transformer-Based Deep Learning with Deformable DETR v2

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Abstract

Brain tumors are a critical medical concern, with gliomas being one of most aggressive types. Early and accurate detection of gliomas is essential for effective treatment and improved patient survival. Magnetic Resonance Imaging (MRI) is widely used for brain tumor diagnosis because of its high contrast in soft tissues. While traditional deep learning methods like U-Net, Faster R-CNN, and CNN-based segmentation networks have shown promise, they often suffer from high computational demands and long inference times. This project proposes the use of Deformable DETR v2, an advanced transformer-based object detection model, for glioma detection. Unlike traditional CNNs and even YOLO-based detectors, Deformable DETR v2 utilizes multi-scale deformable attention, enabling faster convergence, efficient small tumor detection, and higher accuracy across complex tumor shapes. The model will be trained on BraTS2021 dataset, which includes T1, T2, T1ce, and FLAIR MRI sequences, offering diverse tumor representations. Compared to previous CNN and YOLO architectures, Deformable DETR v2 can achieve superior performance in both speed and precision, while maintaining scalability and real-time inference capability. Its transformer backbone and efficient attention mechanisms make it highly suitable for clinical deployment in automated brain tumor diagnosis, offering a promising solution for faster and more accurate glioma detection.

Keywords

Brain Tumors, Gliomas, MRI, Vision Transformers, Deformable DETR V2, BraTS Dataset, Tumor Detection, Deep Learning, Attention Mechanism.

Latency-Aware Depth Optimization of Quantum Gate Scheduling for Efficient Circuit Design

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Abstract

The next-generation Internet of Things (IoT) and quantum-based computing must have high processing speed with a low latency. The circuit depth of quantum circuits including the number of consecutive layers of T-gates directly impacts the performance of the execution time and the performance of the system overall. The great circuit depth results in delay and inefficient use of resources. In this paper, a Depth-Optimized Latency-Aware Quantum Gate Scheduling (LAD-QGS) will be suggested to minimize the circuit latency without compromising functional correctness. The given methodology conducts the gate dependency analysis, smart reordering of gates, and parallel execution of independent gates to decrease T-depth and decrease the CNOT overhead. The Verilog HDL is used to implement the optimized design and Xilinx Vivado design tool is used to analyze the design. The experimental data proves that the suggested approach decreases the critical path delay to 6.897 ns versus 7.210 ns, which results in the improvement of the delay by about 4.34 percent. The overall on-chip power consumption is also decreased, and is now 1.598 W, a decrease of approximately 4.42 percent, and still with the same hardware resource usage (2 LUTs). These findings substantiate the fact that the suggested scheduling method successfully enhances the efficiency of a circuit by decreasing latency and power expenses and without making it larger. The suggested architecture offers a feasible remedy to design quantum circuits with low latency and resource efficiency in the coming generation computing operations.

Keywords

Quantum Computing, Quantum Circuit Optimization, Latency-Aware Scheduling, T-Depth Minimization, Verilog HDL, Vivado Analysis etc.,

An Investigation of Gastric Cancer Detection and Classification from Endoscopic Images Using UNET, RESNET, VGG16, Conditional GAN and Deep CNN GAN

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Abstract

Background: Early detection of stomach tumors at stages 1 and 2 is crucial for enhancing endurance rates and therapy effectiveness. Gastric cancer poses a significant health challenge in Asia, being the next leading reason for cancer-related deaths. Timely diagnosis is crucial, as patients spotted at stage 0 exhibit a five-year survival rate exceeding 90%. However, in India, about 34,000 cases are diagnosed annually, predominantly at advanced stages (3 or 4) due to insufficient screening methods.

Methods: This study investigates advanced machine learning techniques to enhance diagnostic precision by evaluating multiple Generative Adversarial Network (GAN)-based methods: Conditional GAN, Deep Convolutional Neural Network GAN, and traditional imaging analysis procedures U-Net, ResNet, and VGG16. These approaches were employed to analyze endoscopic images, a primary diagnostic tool for detecting subtle pathological variations in gastrointestinal tissues, reinforcing sensitivity and specificity in malignancy recognition.

The study compares the results of GAN-based architectures and traditional deep learning models in order to see which one works better for cancer detection. Rather than proposing a fused or ensemble model, this work focuses on identifying the relative strengths and limitations of individual architectures and examining scenarios in which GAN-based method demonstrates potential advantages over traditional CNN models, particularly in handling data variability and limited training samples.

A comprehensive evaluation was conducted using standard datasets of endoscopic images, comparing the efficiency of each model in terms of precision, recall, and overall investigative accuracy. Special emphasis was placed on understanding the limitations of each approach and identifying scenarios where hybrid or ensemble models could provide optimal outcomes.

Results: A comparative analysis was performed between traditional Neural Networks and Deep CNN GAN, assessing their accuracy, precision, and recall. The performance metrics for various models were as follows:

- ResNet: Accuracy – 64%, Precision – 62%, Recall – 64%
- U-Net: Accuracy – 70%, Precision – 72%, Recall – 70%
- VGG16: Accuracy – 90%, Precision – 91%, Recall – 90%
- Deep CNN GAN: Accuracy – 97%, Precision – 98%, Recall – 97%
- This analysis demonstrates that the Deep CNN network exhibits superior performance in the early detection of gastric cancer.

Conclusions: The findings provide critical insights into the fortes and trade-offs of the refined Deep CNN GAN method used for stomach tumor detection using endoscopic imaging. The comparative results offer a foundation for forthcoming enhancements in therapeutic imaging and tumor assessments.

Keywords

Early prediction, U-Net, ResNet, VGG16, Conditional GAN, DeepCNN GAN, Endoscopic Imaging.

Working Model of Injection Moulding

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Abstract

Injection moulding machine is one of the most widely used method for conversion of plastics into various end products application to wide range of plastic material. The main principle is to compress the plastic material in a heating chamber (barrel) with the help of plunger and induction coil convert plastic polymer into molten (semi-solid) state. Then the plastic polymer in predetermined quantity is forced through the nozzle into the die under pressure. After completing the process, final product is obtained from the die. We can use plastics, metals or alloys for this process. In our project we are using plastics polymers for making washers, bushes etc. This machine is a prototype for producing small plastic components. This injection moulding machine is very useful for the small scale industries because of its low manufacturing cost, low maintenance cost, no skilled worker is required. It can be recommended for small scale investors those who are willing to produce small plastic products.

Fake Profile Detection on Social Networking Websites using Machine Learning

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Abstract

The present generation has seen an increase in the use of online social networks (OSNs), which has an impact on people's social lives and motivates them to connect with various social media platforms. Communications, agenda-setting, news generation, marketing, and advertising are just a few of the many jobs that social networks have made feasible. Adding new friends and keeping up with their changes is now easier. Researchers have been studying these online social networks to find out how they affect people. Some bogus accounts are used to promote agendas and disseminate misleading information. Finding malicious accounts is crucial. To find bogus accounts that could trick consumers, machine learning-based methods were used. A comparison model is created after the dataset is pre-processed using a number of Python tools in order to obtain a practical method that is suitable for the dataset. A number of machine learning algorithms recognize attempts to detect fraudulent accounts on social media sites. Based on their capacity for categorization, the algorithms Random Forest, Neural Network, and Support Vector Machines are used to identify fake accounts.

Advancing Patient-Centric Healthcare: A Comprehensive Review of NLP-Based Question Answering Systems

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Abstract

Natural Language Processing (NLP)-driven Question Answering (QA) systems hold transformative potential for patient-facing healthcare services, offering immediate, accurate, and personalized responses to medical queries. This paper provides a thorough review of state-of-the-art QA systems in healthcare, traces methodological advancements from foundational models to cutting edge multimodal architectures, evaluates clinical applicability, identifies remaining research gaps, and proposes a comprehensive framework for future patient-centric QA platforms. This paper analyzed few representative studies encompassing systematized reviews, empirical model comparisons, domain-specific pre-training, hybrid reasoning architectures, and retrieval-augmented-generation (RAG) systems. This paper highlight performance benchmarks, methodological trade-offs, and deployment challenges. Finally, this paper outline a strategic roadmap for developing robust, trustworthy, and accessible patient QA solutions.

AI-Powered Web Testing Agent: A Scalable Solution for Automated Web Application Testing

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Abstract

Web application testing plays a vital role in today's software development lifecycle. Nevertheless, classical approaches to web application testing tend to be ineffective due to the fast pace of development. In this regard, this paper provides an innovative solution to web application testing called Qubo, an intelligent agent using artificial intelligence technologies that are supposed to revolutionize the field and increase efficiency of web testing. Qubo offers seamless integration with the web development process through its modular architecture based on such technologies as Next.js and Prisma. The core of the proposed framework relies on artificial intelligence mechanisms including natural language processing (NLP) for automated generation of tests scenarios and reinforcement learning algorithms for choosing optimal testing approaches. Such an approach enables users to speed up testing and improve its quality. The suggested solution consists of various features including a test management dashboard, test suite management tools, automated reporting, and others. The agent uses a wide range of reusable UI components to ensure flexible adaptation to the peculiarities of the target application. Also, the use of Qubo allows for easy integration of the framework into CI/CD pipelines through APIs provided by the agent. The performance evaluation showcases how successful Qubo is in detecting critical bugs and improving test coverage in different real-world web apps. These findings point out how efficient the agent can be in reducing testing time by up to 40%, without sacrificing accuracy and efficiency. In addition, the modular architecture makes the proposed system scalable to accommodate more complex projects. In this paper, we talk about the system architecture, AI models used, and their implementation in order to illustrate the problems faced when developing the solution and the way we solved them. We emphasize the benefits that an intelligent web app testing agent can offer to automate this process successfully. Further research will center around creating an adaptable AI agent for testing applications in a cross-platform environment.

Keywords

AI-Powered Testing, Web Application Testing, Artificial Intelligence, Machine Learning, Natural Language Processing (NLP), Reinforcement Learning, Automated Testing, Test Case Generation, Continuous Integration and Deployment (CI/CD), Next.js, Prisma, Modular Architecture, Dashboard Design, API-Driven Development, Software Quality Assurance, Adaptive Testing, Scalability, Performance Optimization.

TRIGLOPS: Transformer-Augmented Resource Scheduling in Cloud Environments Using Machine Learning-Based Process Prediction

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Abstract

Scheduling tasks in cloud platforms is a very tough task because of workload change and also due to uncertainty and also the dynamic workload change. Commonly used scheduling algorithms include FCFS, Round Robin (RR), Shortest Remaining Job First (SRJF). Mainly, the heuristics are reactive because they make decisions on the current workload of queue ignoring all other upcoming workloads and their expected execution times. So, one and only one solution for the above-mentioned challenges is to use the GLOPS (Global and Local Optimized Preemptive Scheduling) framework by a combination of machine learning & Hybrid Metaheuristics scheduling for Job Scheduling. The prediction of burst time in GLOPS framework is done using the LSTM (Long-short Term Memory) based model and the global search is done by the PSO (Particle Swarm Optimization). Limitations of LSTMs are like vanishing gradients; not able to model long-term temporal dependencies are some of the pitfalls that cause low accuracy predictions of complex systems. This paper introduces the TRIGLOPS (Transformer Augmented Global and Local Optimized Preemptive Scheduling) framework which replaces LSTMs with Transformer in GLOPS to better capture the temporal patterns of burst time Prediction. These Predictor modules are combined with the Simulated Annealing (SA) and PSO algorithms for hybrid search strategy & SRJF Scheduling Strategy. The experimental results show competitiveness in comparison with classical schedulers as well as optimization techniques like Genetic Algorithms (GA) and Deep Reinforcement Learning (DRL). If turn-around time, waiting time and response time, TRIGLOPS is always the best than the classical baseline techniques.

Keywords

Cloud computing, task scheduling, transformer, triglops, particle swarm optimization, simulated annealing.

Deep Learning Methods for Early Detection in Diabetic Retinopathy

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Abstract

Diabetic Retinopathy (DR)- one of the major causes of vision impairment and preventable blindness. Timely detection is important for the effective management but conventional methods of diagnosis are often slow and depend on the skill of a specialist. This work proposes an artificial intelligence (AI) driven system which is based on Vision Transformer (ViT) architecture for the classification of retinal conditions from the images of the retina. The model is implemented in a web application built on Flask which provides the clinicians immediate results on diagnosing the fundus images uploaded to the web application. Utilizing some techniques like global average pooling, dropout regularization and use of sigmoid activated dense output layer make the system to perform robustly. The performance measure of a model is in terms of various quantities, such as accuracy, sensitivity, specificity, precision, recall, F1-score and AUC. This type of AI-based system tries to improve the early detection of diabetic retinopathy and therefore, it could easily be utilized in both well-resourced and underserved healthcare settings.

Keywords

Diabetic Retinopathy, Deep learning, Vision Transformer (ViT), Multilabel Classification, Fundus Image Classification, Flask Web Application, Accuracy, AUC, Precision, Recall.

Development of a Bluetooth-Enabled Magnetic Field-Based Sleep Induction System for Insomnia Therapy

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Abstract

While traditional therapies like medication and behavioural therapy frequently result in side effects, long-term dependency, or uneven results, sleep disorders, especially insomnia, have a substantial impact on everyday performance, mental health, and physical health. This research proposes a non-invasive Sleep Inducing System that uses low-frequency magnetic field stimulation modelled after the Earth's natural geomagnetic field to overcome these drawbacks. The suggested gadget facilitates synchronization with natural circadian rhythms and promotes relaxation and the onset of sleep by operating within biologically significant frequency ranges linked to human brainwave activity. The system may be customized to meet each person's unique sleep needs thanks to user-adjustable features that allow for frequency and duration customization. An Arduino microcontroller, a Bluetooth connection module for wireless operation, and an electromagnetic coil powered by a MOSFET driver are used in the system's implementation. Arduino Bluetooth Control, a free Android app that allows basic ON and OFF capabilities via serial communication, is used to achieve mobile-based control to improve user convenience. Usability is enhanced and manual involvement during rest is eliminated with the introduction of wireless control. The suggested remedy shows the potential of bioelectromagnetic treatment in conjunction with mobile technology for intelligent sleep support applications and provides a safe, economical, and drug-free alternative for treating sleep problems.

Keywords

Insomnia, Sleep disorders, Magnetic field therapy, Geomagnetic field, Bluetooth control, Arduino, Mobile application, Bioelectromagnetic therapy, Non-invasive treatment, Sleep induction.

Classification of Schizophrenia Using an Adasyn-Enhanced TabNet Model

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Abstract

Schizophrenia is a chronic mental disorder that is severe and influences the perception, emotions and other cognitive functions. This is in about one percent of the total number of people on earth. Individuals that have this mental disorder are subject to delusions, hallucinations and are compelled to think abnormally, this impacts negatively on the lifestyle of those individuals. Failure to treat in time may have dangerous consequences like prolonged hospitalization and permanent injury. It is, therefore, of importance to diagnose at an early and right period. ECG-based method is a conventional diagnostic method that provided the precise results at the cost of high price and could not be applied without the specialists. Clinical setting diagnosis can contribute to delaying the diagnosis and treatment process. To address such challenges, this study has proposed ADASYN-enhanced TabNet model which would be used to detect schizophrenia using data that contains age, gender, education, marital status, and income. The imbalance in the classes in ADASYN method to the issue of class imbalance creates artificial members of the minor classes and this reduces bias in the models. TabNet is an interpretable deep learning model with attention mechanisms, which is trained on this balanced dataset. The experimental findings demonstrate that the classification accuracy has improved considerably as compared to the state of art machine learning approaches.

Keywords

Schizophrenia classification, ADASYN, TabNet, machine learning, deep learning, tabular data, data imbalance, clinical diagnosis, Google Colab, explainable AI.

A Blockchain-Driven Framework For Secure Electronic Voting

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Abstract

The right to vote is among the most significant rights in democracy. However, the conventional procedures and voting processes are fraught with numerous problems such as vote manipulation, absence of transparency, and absence of proper security to the casted votes. This led to low voter trust. In electronic voting systems even they do not avoid certain drawbacks such as data hacking, problems of centralized control. To address these issues, this project will suggest a blockchain-based system of secure e-voting. The given paper presents a powerful blockchain technology that offers a decentralized and immutable system in which all the votes are registered and stored. When the vote is casted it can neither be altered nor deleted. It assists in providing transparency, security and lack of vote tampering. The suggested system applies cryptographic methods in safeguarding voter identity. It assists in revealing the identity of voter. Smart contracts are deployed to automate the process of vote recording and vote counting in order to minimize the possibility of error as well as minimize human interaction. This aids in ensuring fairness in the elections as well as boost the trust of the voters that their votes are not being compromised. This assists in the fair running of elections with fair result. The primary tasks of this suggested system include the deployment of cryptographic methods, intelligent contracts and a blockchain-supported voting system. The principle behind this is to make the elections fair. And earn the peoples confidence that all citizens will take part in the elections and exercise their right to vote without fear and doubts.

Keywords

Blockchain Technology, Decentralized, Smart Contracts, Cryptographic Techniques, Transparency, e-voting, Immutability.

Health Data Information and Management System via Mobile Application

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Abstract

In recent years, the healthcare sector has undergone rapid digital transformation; however, traditional paper-based and fragmented digital systems still lead to inefficiency, data loss, and delayed access to accurate medical information. To overcome these challenges, a Health Data Information & Management System (HDIMS) is proposed as a centralized mobile-based healthcare platform. The HDIMS application securely stores and manages patient health information, including patient profiles, medical history, diagnoses, prescriptions, laboratory reports, and appointment details. The system employs secure authentication algorithms for user verification and role-based access control (RBAC) algorithms to ensure that only authorized users can access or modify sensitive health data. Encryption algorithms such as AES are used to protect patient information during storage and transmission in cloud environments. Efficient database indexing and retrieval algorithms enable fast access to medical records, while data validation algorithms ensure accuracy and consistency of healthcare data. Patients can access their health records anytime through the mobile application, while authorized healthcare professionals can securely update and manage patient data. Real-time data availability improves communication, clinical decision-making, and continuity of patient care. By reducing paperwork and administrative workload, the HDIMS system significantly enhances healthcare efficiency, data security, and overall service quality.

Integrated Autonomous–Teleoperated Rover Navigation with Dynamic Graph Modeling and Optimal Path Computation

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Abstract

The advancement of autonomous robotic navigation solutions that require minimal human involvement and maintain efficiency has been driven by the increased need for intelligent logistics, service robotics, and automated monitoring systems. This paper presents an autonomous robotic system based on Arduino for intelligent navigation and control, obstacle avoidance under adaptive control, and real-time perception of the environment. The system includes ultrasonic sensors and camera for teleoperation via live video streaming, and environmental perception with pre-existing control for remote operation. The system is built on a weighted graph of the environment for optimal path finding and obstacle avoidance using Dijkstra's shortest path algorithm. Additionally, an autonomous parking system for designated safe stopping places and operational independence is included. The system has been experimentally evaluated and found to improve reactive navigation systems in terms of higher navigation precision, lower probability of collisions, and greater path efficiency. Ultimately, the system is an effective solution with a positive cost-benefit ratio for remote inspection, delivery robots, and automation of warehousing.

Keywords

Autonomous navigation, hybrid control, hybrid robotic systems, wireless teleoperation.

Interactive Flood Severity Mapping with Threshold-Based Alerts and Xgboost Classifier

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Abstract

Flood disasters remain a serious threat to infrastructure and ecosystems and human life in areas where hydrological conditions undergo constant changes. The predictive capabilities and immediate response capabilities of traditional flood monitoring systems get restricted because they depend on fixed threshold rules and require human evaluation. This research introduces an interactive flood severity mapping system which combines machine learning-based multi-class classification with a rule-based threshold alert engine. The system uses environmental and hydrological parameters which include rainfall intensity and river level and soil moisture and terrain elevation and water depth to forecast flood severity levels which are Low Medium High and Critical. The XGBoost multi-class classifier serves as the system's core because it provides strong performance across various scales and enables the estimation of complex relationships between multiple attributes. The framework includes a threshold validation component which activates real-time notifications when actual risk probabilities surpass established threshold values. The model assessment process used a flood severity dataset which contained approximately 5,020 records and applied a stratified 80:20 distribution method. The experimental results show a test accuracy of 96.31% and a weighted F1-score of 96.29% which demonstrate excellent performance in predicting multiple classes. The analysis of feature importance shows that Water Depth functions as the main factor which determines system performance. The system achieves inference times below 50 milliseconds which enables its use in both real-time disaster monitoring and interactive geographic visualization applications.

Keywords

Flood Severity Prediction, XGBoost, Threshold- Based Alerts, Multi-Class Classification, Disaster Management, Interactive Mapping, Real-Time Monitoring, Feature Importance Analysis.

Intelligence Traffic Control System

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Abstract

Traffic congestion within urban settings is an urgent issue which is attributed to the fact that such systems are still using the fixed time traffic signal systems which are not adaptive to the changing traffic situations. In this paper, we suggest a real-time adaptable traffic management system, which is an intelligent system of traffic light control relying on the use of computer vision and deep learning methods. The suggested system utilizes IP cameras live video streams to identify, classify, and count vehicles with the help of the YOLOv5 object detection model installed on an edge computing system. The density of the vehicle in each lane of the traffic is constantly estimated and the signal phase time is varied in order to achieve optimal traffic flow and shorten the total waiting time. It runs on an NVIDIA Jetson Nano to allow low latency, on-device learning without use of a cloud-based system. Through experimental tests, it is shown that traffic throughput, queue length and consistent real-time performance are greatly improved in various traffic conditions. The system suggested is an efficient, scalable, and cost-effective solution to efficient traffic control, which is why it is highly applicable in the application of smart cities.

Keywords

Intelligent Traffic Control, Computer Vision, Deep Learning, YOLOv5, Edge Computing, Vehicle Detection, Adaptive Traffic Signals, Smart Cities.

Managing the Modern Workforce: Evaluating the Effectiveness of Remote and Hybrid Working Policies

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Abstract

In the aftermath of the COVID-19 pandemic, organizations have significantly restructured traditional workforce management practices by adopting remote and hybrid work models. This study examines how these work arrangements function within contemporary organizational strategies. It aims to identify effective practices for managing geographically dispersed teams and to evaluate the impact of remote work on employee productivity, job satisfaction, and work-life balance.

A comprehensive review of existing literature, including scholarly articles, books, and conference papers, forms the basis of this research. The findings indicate that remote work can enhance productivity and job satisfaction by minimizing workplace distractions and increasing flexibility. However, it may also lead to challenges such as social isolation and difficulties in maintaining clear boundaries between work and personal life. Hybrid work models, which integrate remote and office-based work, offer a balanced solution by promoting collaboration while preserving flexibility.

The study further highlights the importance of leadership, particularly transformational leadership and effective communication, in managing remote and hybrid teams successfully. It concludes by emphasizing the need for continued research to understand evolving trends and long-term implications for employee well-being and organizational performance.

Keywords

Workforce Management, Remote Work, Hybrid Work, Organizational Effectiveness.

Augmentation Aware Transfer Learning for Deepfake Image Forensics

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Abstract

Over the last few years, deepfakes have posed serious threats to digital security, privacy, and the integrity of information over the internet due to their increasing realism and widespread accessibility. While most detectors using deep learning techniques report good accuracy on clean benchmark data, the accuracy drops significantly once the images are uploaded, JPEG compressed, resized, and reshared on social media platforms. Under these conditions, the traces of subtle manipulations are likely to be overwritten, and new JPEG compression artifacts may be added. The current study proposes a compression-aware deepfake image forensics model that utilizes the EfficientNet-B0 architecture with transfer learning. Instead of designing a new and complicated architecture, the focus here is on the design of an effective two-stage training plan: first, the EfficientNet-B0 model is fine-tuned on the combination of pristine real faces and AI-generated faces; second, the model is further trained on the combination of realistic augmentations, including blur, noise, color and illumination changes, mild geometric transformations, and JPEG compression at different quality levels. The effectiveness of the model is demonstrated on the large face data set, where good accuracy, precision, recall, F1 score, and ROC AUC are reported while the model becomes more robust against heavy JPEG compression, making it more suitable for deployment in web-based deepfake detectors.

Keywords

Deepfake detection, EfficientNet-B0, transfer learning, social-media image compression, JPEG artifacts, curriculum-based training, image forensics.

A Deep Learning Approach for Proactive Network Threat Analysis Security Enhancement

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Abstract

Network security has become a critical concern due to the rapid increase in cyber-attacks targeting modern communication systems. Traditional intrusion detection systems (IDS) rely on signature-based approaches, which are ineffective against unknown and evolving threats. This paper proposes a hybrid deep learning-based network intrusion detection system that performs real-time analysis of network traffic using flow-based features. The system captures network packets, converts them into flow-level data, and extracts statistical features for classification. A hybrid model combining Multilayer Perceptron (MLP) and Long Short-Term Memory (LSTM) is employed to capture both spatial and temporal patterns in network traffic. The proposed model is evaluated using the CICIDS2017 dataset, achieving an accuracy of 96.8%, precision of 95.9%, recall of 96.2%, and F1-score of 96.0%. Comparative analysis with traditional machine learning models demonstrates that the proposed approach improves detection performance while reducing false positives. The modular architecture of the system ensures scalability and supports real-time deployment in modern network environments.

Keywords

Network Intrusion Detection System, Deep Learning, Network Security, Traffic Analysis, Anomaly Detection.

Export Forecasting Using ARIMA and LSTM-Based Predictive Analytics

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Abstract

The question of whether the quantities of export can be forecasted with probability is one of the most significant questions of applied economics, and it is not only the nonlinear geopolitical shocks whose patterns are hard to predict but also the periodic nature of the developments in demand, the periods of production, etc. which makes the task challenging to both strictly statistical and purely data modeled. The given paper presents a hybrid forecasting architecture that is a hybrid between the Auto Regressive Integrated Moving Average (ARIMA) model and stacked Long Short-Term Memory (LSTM) recurrent neural network. ARIMA can be used to decompose a linear trend, removing the seasonality as well as performing principled differencing, whereas LSTM can be required to do it as it goes through training as a model on the ARIMA residual to enable it to be able to andragogy back any human structured nonlinear dynamics which are not described by the parametric model. The path throughout the data acquisition, pre-processing, feature engineering, model-training, and interactive visualization of the dashboard is stated and attempted with the usage of actual trade information of the commodities at a level. Results show that the developed hybrid achieves 44 percent reduction in the Mean Absolute Percentage Error than the standalone SARIMA with equivalent reduction in RMSE and MAE, and that would be worth affirming the complementary nature of the two modelling paradigms. The system offers credible projections of the future that can help to inform strategic decision making in international trades among policymakers, exporters and supply-chain planners.

Keywords

ARIMA, trade analytics, predictive analytics, export forecasting, hybrid time-series model, LSTM, recurrent neural network.

Stand-Alone Hybrid Microgrid System for Agricultural Irrigation: Integrating Diesel Generators and Solar Energy Sources

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Abstract

Agricultural irrigation needs continuous energy resources which rural areas require because their electrical grids do not function properly. Diesel generators function as the primary power source for conventional irrigation systems which need constant fuel supply for their operations and create environmental damage. The study presents a hybrid microgrid system which operates independently through its integration of solar photovoltaic panels and diesel generators with battery energy storage to support agricultural irrigation needs. The system designated solar photovoltaic (PV) systems as its main power source which transforms solar radiation into electricity for powering irrigation pumps. The team uses Maximum Power Point Tracking (MPPT) to achieve optimal solar power harvesting throughout different environmental conditions. The system uses battery storage to accumulate surplus solar power while delivering power during times of low solar energy or at night. The diesel generator serves as a backup power system to maintain continuous operations during periods of renewable energy shortage. The researchers used MATLAB/Simulink to create a system model which they tested under various load and weather scenarios. The hybrid microgrid system demonstrates a substantial decrease in diesel fuel usage and operational expenses along with greenhouse gas emissions reduction while providing dependable irrigation power, which establishes its viability as an environmentally friendly energy solution for rural agricultural systems.

Keywords

Maximum point of power tracking (MPPT), solar, grid interaction, diesel generators, voltage source converters, and irrigation work etc.

A Comprehensive Literature Survey on AI - Augmented Cyber Threat Intelligence Security Orchestration Platform

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Abstract

This literature survey systematically reviews research published between 2020 and 2025 relevant to the development of an AI-Augmented Cyber Threat Intelligence (CTI) Security Orchestration Platform. The survey examines eight core research articles over NLP-based entity extraction, automated process of intelligence report generation, threat intelligence sharing frameworks, explainable AI for threat analytics, and scalable CTI pipeline architectures. Key themes synthesized include transformer-based Named Entity Recognition for STIX object extraction, Natural Language Generation for automated CTI reporting, zero-shot GLINER and supervised learning methods for information extraction, MITRE ATT&CK and D3FEND framework integration, and the role of STIX/TAXII standards in machine-readable intelligence sharing. The review identifies a consistent research gap. While substantial progress has been made in individual components such as entity extraction and threat classification, no existing solution unifies GLINER based entity identification, XAI recommendations, and SIEM/SOAR-compatible STIX/TAXII export in a single orchestration platform. This gap directly motivates the proposed system, which integrates all identified advances into a cohesive, analyst-centric CTI engine. The survey provides the methodological foundation, reference benchmarks, and research context for the proposed platform.

Predicting Cyberattacks Using Generative Artificial Intelligence and Conventional Machine Learning

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Abstract

Cyber threats are becoming more sophisticated, which puts people, businesses, and countries at serious risk. Cybercrime, which includes hacking and data breaches, has detrimental effects on society and the economy. Strong cybersecurity measures are essential in today's connected world to reduce these dangers and safeguard private data. However, the constantly changing threat landscape is too much for conventional security systems to handle. To tackle these issues, artificial intelligence (AI) provides a potent toolkit. In order to address a variety of cybersecurity issues, this study investigates the use of AI techniques such as machine learning (ML), deep learning (DL), natural language processing (NLP), explainable AI (XAI), and generative AI. An extensive examination of AI methods for improving cybersecurity is provided in this study. Important contributions consist of: 1) A comparison of ML and DL techniques assessing their suitability, accuracy, and applicability for different cybersecurity challenges; 2) research on XAI methodologies improving AI-powered security solutions' interpretability and transparency, especially in anomaly detection; 3) investigation of new developments in NLP and Generative AI (Gen-AI) analyzing how they might be used to model and lessen cyberthreats using sophisticated methods such as attack simulations and threat intelligence generation; 4) use of GenAI in cybersecurity and practical GenAI products for cyber security. By offering insights into practical and dependable solutions for reducing cyber threats and enhancing the overall security posture, this research seeks to enhance the state-of-the-art in AI-driven cybersecurity.

Keywords

Explainable AI (XAI), Natural Language Processing (NLP), Machine Learning (ML), Deep Learning (DL), Cybercrime, Cyberthreats, Generative AI.

Graph Attention-Driven GAN for Semantic Room Classification and Floor Plan Generation with Downstream 3D Reconstruction Compatibility

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Abstract

Automatic interpretation of 2D residential floor plans is a prerequisite for intelligent architectural tools, interior layout generators, and 3D scene reconstruction pipelines. This paper presents a unified deep learning framework that (i) assigns semantic room-type labels to floor-plan regions and (ii) synthesises structurally plausible layouts via an adversarial network whose generator is conditioned on a room-adjacency graph. The generator encodes each room through learned type embeddings, propagates relational context with multi-head graph attention [2] (8 heads, $d=256$), and decodes spatial occupancy maps at 128×128 resolution through transposed convolutions. The discriminator employs spectral normalisation [3] for Lipschitz stability. A synthetic corpus of 1,000 training and 2,000 evaluation samples—spanning nine room categories and 3–8 rooms per layout—was constructed to enable controlled, reproducible experimentation. The trained model attains **67.0 %** room-type classification accuracy on the training set and **64.0 %** on the validation set, with a macro-average F1-score of **0.65**. The train/validation gap of approximately 3 percentage points confirms the absence of severe overfitting. Ablations verify that removing graph attention reduces accuracy by roughly 8 percentage points. The generated occupancy maps are directly consumable by downstream 3D reconstruction tools such as Plan2Scene [10] and FloorNet [11].

Keywords

Generative adversarial networks, floor plan synthesis, graph attention networks, room classification, 3D scene conversion, architectural deep learning.

AI-Enhanced E-Commerce Platform with Real-Time Personalized Shopping Experience

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Abstract

This rapid expansion has led to an overwhelming number of products available through e-commerce, which often does not match user preferences and results in generic recommendations that do not help user engagement or purchasing decisions, so this study introduces an AI-driven SmartCart framework to provide real-time and personalized product recommendations within dynamic online shopping environments using collaborative filtering and content-based filtering techniques along with contextual signals to reflect user behavior and situational preferences. To accomplish this, SmartCart structure monitors user traffic, including search actions, product views, clicks, time spent on particular products, which are signals of interaction to infer short term and long-term patterns of preference without necessarily consulting past purchase history, and the recommendation policy is adapted dynamically as the user changes behaviour during a shopping process to represent the user intent in real time, and contextual information including, session time, frequency of views and sequences of clicks are included to enhance relevance of recommendation, and personalization no longer relies on fixed personalisation rules but instead on the factors of the moment.

The Rise of Crowdfunding: Trends Shaping Modern Financing

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Abstract

With the ability to gather money directly from a large number of supporters, crowdfunding is a revolutionary development in entrepreneurial financing. It prioritizes accessibility, openness, and community involvement in contrast to traditional finance. Crowdfunding has quickly become a popular fundraising method, changing the way small companies, startups, and creative initiatives raise money. By utilizing online platforms and providing alternatives to conventional bank loans and venture capital, it democratizes finance. Its next phase is being driven by emerging technologies like blockchain and artificial intelligence. Crowdfunding has emerged as a transformative force in modern financing, offering entrepreneurs, small businesses, and creative ventures an alternative to traditional capital sources such as banks and venture capital firms. By leveraging digital platforms, crowdfunding democratizes access to funding and fosters direct engagement between project creators and supporters. The crowdfunding industry is well-positioned for future expansion and innovation. A few of the trends that will influence the industry in the upcoming years include the incorporation of new technologies, the emergence of specialized platforms, and the growth into emerging markets. Crowdfunding will keep democratizing access to capital, enabling backers and creators to work together to realize new ideas. In order to stay relevant and useful in a world that is changing quickly, platforms will need to adjust to shifting consumer preferences and technological developments as the industry develops. This study is guided by two key objectives: 1. To analyze the evolving crowdfunding methods are changing and the way they affect the democratization of capital access, 2. To investigate new commercial and technical developments affecting crowdfunding sustainability.

Keywords

Crowdfunding, Trend, Technical, Commercial, Sustainability.

Effect of Rice Husk Ash Content on the Compressive Strength of GGBS Geopolymer Concrete Cubes

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Abstract

The aim of this project involves making of geopolymer concrete cubes by increasing its mechanical properties by replacing traditional cement with Ground Granulated Blast Furnace Slag (GGBS) and Rice Husk Ash (RHA). Here, we proceeded by adding 0% of rice husk ash (RHA) content. We casted the concrete cubes only by precisely using ground granulated blast-furnace slag (GGBS), fine aggregate (M sand), sodium hydroxide (NaOH) and sodium silicate (SS). while here, we proceeded by adding rice husk ash (RHA). we casted the concrete cubes by precisely using rice husk ash (RHA), ground granulated blast-furnace slag (GGBS), fine aggregate (M sand), sodium hydroxide (NaOH) and sodium silicate (SS). The results show that the increasing compressive strength is observed with the amount of GGBS and molarity the following M3 mix with (60% GGBS, 35% RHA & 5% Silica Fume) exhibited superior strength of 55 MPa during the period of 28 days consecutively among the database of mixes (8M). The following results showed that there was no statically important difference between the 8M and 10M molarity values ($p = 0.30$), indicating that moderate alkaline molarity is enough for the effective geopolymerization and compressive strength development under ambient curing conditions. The result of this study gave us a conclusion, that higher GGBS content and alkaline molarity, helps increases the compressive strength of geopolymer mortar among the following, the 60% GGBS, 35% RHA and 5% of Silica Fume mix with their mechanical tests and with respect to the molarity of 10 M was found to be superior or higher in performance thereby making it suitable for sustainable and high strength geopolymer construction uses.

Keywords

Geopolymer Mortar, GGBS, Compressive Strength, RHA, Flexural Strength, Workability, 8M Sodium Hydroxide, Partial Replacement.

A Multimodal Machine Learning Framework for Early Prediction of Parkinson's Disease Using Voice and Hand-Drawn Patterns

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Abstract

Parkinson's disease ranks as the second most prevalent neurodegenerative disorder worldwide, affecting over ten million individuals globally and nearly one million in India alone. Because its early symptoms – subtle tremors, mild vocal changes, and slight motor irregularities – tend to go unnoticed until significant neurological damage has already occurred, timely and accessible screening tools remain a pressing clinical need. This paper presents a multimodal machine learning framework designed to support early-stage Parkinson's detection through two complementary non-invasive input channels: voice recordings and hand-drawn spiral patterns.

For voice-based screening, acoustic descriptors including jitter, shimmer, pitch variation, and Mel-Frequency Cepstral Coefficients (MFCCs) were extracted from speech samples drawn from the UCI Parkinson's Speech Dataset. A Random Forest classifier trained on these features achieved an accuracy of 94.87 percent on a held-out test set (80/20 split). For motor-symptom analysis, spiral drawings from the HandPD dataset were preprocessed and fed into a three-layer Convolutional Neural Network (CNN) that automatically learned tremor-related distortion patterns, reaching an accuracy of 76.66 percent. A decision-level fusion strategy combining probability outputs from both models yielded an overall system accuracy of 85.7 percent, with the voice channel contributing a higher confidence weight owing to its stronger standalone performance. Beyond classification, the system was deployed as a web-based application supporting real-time input, secure user authentication via SHA-256 hashing, result history tracking, and watermarked downloadable reports. Evaluation results confirm that integrating speech and handwriting modalities provides a more comprehensive symptom profile than either modality alone. The system is intended strictly as a research- support and early-screening aid, and not as a substitute for neurological clinical diagnosis.

Keywords

Parkinson's disease, multimodal detection, Random Forest, Convolutional Neural Network, voice analysis, spiral drawing, decision-level fusion, machine learning.

A Review of Privacy-Preserving Explainable Federated Graph Learning Approaches for Heart Disease Prediction

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Abstract

Prediction of heart diseases in the current healthcare systems should be able to reach a high level of reliability without compromising patient confidentiality particularly when the medical records are exchanged among more than one institution. Traditional centralized learning methods are associated with privacy concerns, and current federated learning research works are usually not interpretable and unable to learn complicated relationships between clinical characteristics. This article is a review of recent studies on federated learning in combination with graph neural networks, differential privacy, and explainable artificial intelligence to predict heart disease. The paper classifies available techniques according to data representation scheme, privacy safeguard system, and ability to interpret and examines their advantages and disadvantages in dispersed healthcare settings. Specific focus is put on relational modelling of medical feature dependencies, privacy techniques to secure shared updates, and the enhancement of clinical trust by explanation methods. The review also outlines problematic issues such as varying data distributions in hospitals, communication overhead, privacy versus accuracy tradeoffs, and common evaluation frameworks. Lastly, the possible areas of research are identified to facilitate the creation of secure, transparent, and collaborative clinical decision support systems.

Keywords

Heart Disease Prediction, Federated Learning, Graph Neural Networks, Differential Privacy, Explainable Artificial Intelligence, Privacy-Preserving Healthcare, Distributed Medical Data Analytics, Clinical Decision Support System.

Identifying Disease for Liver CT-Scan Images Using Visual Transformers and Deep Learning

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Abstract

Radiologists and healthcare professionals may encounter issues with diagnostic accuracy. They often deal with a lack of real-time decision support and struggle to identify liver abnormalities using traditional manual image interpretation methods. This happens because most standard diagnostic approaches are only reactive and lack dynamic functionality. This paper aims to design and build an intelligent liver disease prediction system that improves diagnostic accuracy and allows for early detection of liver conditions from CT scan images. This specific kind of work falls under the Healthcare Technology theme and focuses on creating a practical AI-powered software system. The proposed system uses Flask for the backend and HTML, CSS, and Bootstrap for the frontend. It employs VGG16-based transfer learning for feature extraction and Visual Transformer (ViT) architectures for disease classification. The system provides real-time diagnostic output through a web-based interface with Grad-CAM heatmap visualization. It also features predictive disease classification, patient record management, and confidence score reporting using both trained model weights and real-time CT scan data. The results show that the proposed system effectively identifies liver conditions, including Squamous Cell Carcinoma, Large Cell Carcinoma, and Adenocarcinoma. It offers visual diagnostic explanations and enhances decision support compared to traditional manual radiology workflows. The proposed system serves as an efficient tool for helping radiologists manage liver disease diagnoses by using an intelligent deep learning approach instead of conventional image interpretation methods.

A Machine Learning–Driven Career Coach System for Automated Resume Screening and Interview Assessment

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Abstract

It is becoming more and more difficult for job seekers to match their resumes and interview responses with the quickly changing industry standards in the current, fiercely competitive recruitment environment. Numerous career counseling and preparation tools still in use today rely on manual evaluation or strict rule-based methods, which are frequently unadaptable and miss candidate profiles' semantic meaning. This paper presents an enhanced Career Coach system that uses machine learning and natural language processing techniques to automate resume-job matching and interview answer evaluation in order to overcome these limitations. TF-IDF features and explicit keyword overlap metrics are used to represent textual information from resumes and job descriptions in resume matching, which is formulated as a supervised regression problem. To determine the best strategy, a number of regression models are trained and thoroughly assessed, including Linear Regression, Ridge Regression, Support Vector Regression, Random Forest Regression, and Gradient Boosting Regression. Additionally, an AI-based interview grading module is presented to evaluate candidate responses by using length-based features and cosine similarity to measure structural completeness and semantic similarity. According to experimental results, Random Forest Regression yields the most dependable results for interview answer grading ($R^2 = 0.8227$), while Gradient Boosting Regression performs best for resume matching ($R^2 = 0.9417$). According to these results, compared to conventional methods, machine learning-driven career coaching systems can greatly improve the objectivity, accuracy, and efficiency of recruitment preparation while providing candidates with more insightful and data-driven feedback.

Keywords

Career coaching, resume matching, interview grading, machine learning, natural language processing.

InterviewFlow: An Edge-Based Multimodal AI Framework for Automated Interview Evaluation

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Abstract

Judging a job candidate fairly and consistently is a problem organisations have wrestled with for as long as structured hiring has existed. Human-led panels introduce subjectivity, struggle to scale, and are often swayed by factors unrelated to actual job performance. InterviewFlow is our attempt to address this through a system that evaluates candidates across three dimensions simultaneously, spoken responses, facial behaviour, and written code, entirely on the candidate's own device. No recording is ever sent to an external server. The pipeline draws on six specialised components: Whisper for automatic transcription, MediaPipe FaceMesh for tracking facial landmarks, PaddleOCR for reading whiteboard code, a quantized Flan-T5 transformer for scoring answer quality, Sentence-BERT for semantic response matching, and Librosa for vocal feature extraction. We report on the design rationale, compare the system against eight prior works, and discuss six challenges that the field has not yet resolved. When evaluated against expert human ratings on real interview recordings, the full pipeline achieves 92.7% classification accuracy and 92.3% F1-score, with every computation confined to local hardware.

Keywords

Automated Interview Evaluation, Multimodal AI, Edge Computing, Privacy-Preserving Systems, Natural Language Processing, Computer Vision, Transformer Models, Speech Recognition, Behavioral Analysis.

CosmoSense ML: An Intelligent AI-Driven Facial Skin Analysis and Personalized Skincare Recommendation System

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Abstract

A noticeable gap exists between everyday skincare practices and scientifically grounded skin assessment. Most people trying to improve their skin health rely on marketing claims, social media advice, or anecdotal recommendations rather than measurable biological data. CosmoSense ML addresses this gap with an accessible, data-driven approach to personal skin analysis. The platform functions as a fully device-side web application employing a MobileNet V2 convolutional neural network, executed in the browser via TensorFlow.js over the WebGL graphics pipeline, to analyse a standardised 224×224 image captured from the device camera. The model estimates four continuous skin indicators: sebaceous gland activity, epidermal hydration level, melanin concentration, and the visual prominence of follicular pores. These are processed by a threshold-based classification layer that assigns the skin to one of five dermatologically meaningful categories, with each raw metric normalised to an intuitive numerical scale. Alongside the visual pipeline, a recommendation system driven by community product reviews processes user-submitted feedback using a TF-IDF weighting scheme and a logistic model trained on 12,000 labelled records. Probability scores guide the selection of products from 3,200 formulations, passing candidates through ingredient compatibility checks, sensitising-compound removal, and a sentiment confidence threshold before six products are recommended. Evaluation using 850 annotated skin images and 120 volunteers demonstrated 91.3% five-class recognition accuracy, 87.6% recommendation precision at six items, and a warmed round-trip of 2.24 seconds, with camera image data never leaving the user's device.

Keywords

Device-side inference, skin type classification, sebaceous activity analysis, pore visibility estimation, ingredient safety filtering, review-driven recommendation, conversational skincare guidance, WebGL acceleration, TensorFlow.js, React web applications.

AI-Driven Real-Time Accident Prediction and Prevention System for Enhanced Highway Safety and Crime Monitoring

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Abstract

The increasing cases of highway deaths are a major concern to transport networks all over the world. It is a problem that is usually exacerbated by the fact manual monitoring is insufficient and the response time to emergencies is too long. This paper outlines an autonomous system that will employ 360-degree cameras and IoT sensors to identify hazards on the road prior to endangering people. To monitor risk in real-time and identify abnormal driving behaviors, our solution uses a number of machine learning models, including Random Forest, XGBoost, and Long Short-Term Memory (LSTM). One of the features of our design is that it will also search criminal activity via action recognition, and at the same time, activate an automatic SOS alarm. The alert comes at a time when medical assistance can be available at the location within the crucial golden hour by a custom Haversine-based location approach. Our tests reveal a 94.3% detection accuracy of the system and reduce the notification time to the emergency services by 60 times, which makes it a useful tool in any smart city of the present day.

Keywords

Artificial Intelligence, Road Safety, Accident Prediction, Machine Learning, IoT, YOLO, Emergency Response, Crime Prevention.

RakshaNetra: Securing Intelligent AI-Powered Framework for Vigilance and Cyber Awareness

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Abstract

Cybercrime complaints have shot up lately, and honestly, the old reporting systems just can't keep up. Most websites only collect complaints and leave investigators to sift through everything by hand. It's slow, and cases often get stuck in limbo or aren't prioritized the right way. That's where RakshaNetra comes in. It's a secure, practical setup that actually helps with reporting and investigating cybercrimes using AI. The system sorts complaints automatically, figures out how risky they are, and puts together quick summaries so investigators can get the gist of each case right away. Access and permissions are handled with a three-tier, role-based model, so everything stays secure and accountable. Anyone can use RakshaNetra—victims can report anonymously or register if they want, and there's a mobile app for them, plus a web dashboard for investigators. In tests, even in a simulated setup, RakshaNetra made everything faster: cases got handled sooner, the important ones got flagged first, and investigators had a much clearer view of how things were moving along.

Sentiment Analysis-Driven Emotion-Adaptive Music Therapy for Personalized Mental Health Support

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Abstract

The rising number of mental health disorders and their complex symptoms make it very hard to treat them effectively and quickly. The World Health Organization (WHO) [1] says that “over 970 million people in the world have mental health issues”. Every year, depression and anxiety disorders make people miss 12 billion workdays. People with these conditions often don’t get the help they need, or they don’t get it well enough. This means that we need to find new ways to improve our emotional health. This study presents an emotion-adaptive system aimed at evaluating users’ psychological conditions and providing tailored therapeutic interventions via sentiment analysis, with the objective of enhancing emotional well-being through music-based therapy. We tried out a lot of different classifiers on Google’s GoEmotions dataset for emotional classification until we found the one that worked best. The classifiers were SVC, Logistic Regression, Random Forest, Naive Bayes, KNN, and BERT (RoBERTa) [21]. The study investigates the effectiveness of sentiment analysis in therapeutic settings, specifically regarding the use of music as a means of emotional support. Early findings indicate significant potential in recognising and responding to users’ emotional states. People all over the world are using advanced machine learning to make mental health treatments more creative, easier to get to, and less expensive and our work is in line with this [23].

Keywords

Mental Health, Sentiment Analysis, Machine Learning, Emotional Classification, Music Therapy, RoBERTa, Personalized Interventions, GoEmotions Dataset, Spotify API, FastAPI.

Deep-Learning based Intelligent Hybrid Autoencoder Framework for Personalized Mutual Fund Recommendation System

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Abstract

The market for funds is really unpredictable and that makes it hard to suggest the right ones to people who are not experts. There are many things to consider like how different investors feel about risk and how the funds have performed in the past. These things are too complicated for the methods of analyzing data to handle. In this paper we are talking about a way to use machine learning to recommend mutual funds. This method combines two types of machine learning: tree-based learning and deep representation learning. We are introducing two models:

Hybrid model-1 which combines a multi-layer perceptron with gradient boosting and Hybrid model-2 which combines an autoencoder with random forest. We use a lot of data about funds to train these two models. This data includes things like the funds value, how risky it's how well it has done and other information about the fund. When we tested these models, we found out that Hybrid model-2 is the one. It was very accurate with an accuracy of 0.9730. It made very few mistakes with an MAE of 0.0270 and an MSE of 0.0270. Hybrid model-2 also did a job of predicting how well the funds would do with a fidelity of 0.8117 and an ROC-AUC of 1.0000.

Our study shows that Hybrid model-2 is better, than the models we compared it to, including Hybrid model-1 and a model that uses ideas from quantum physics. We think that using a combination of quantum and classical approaches is a practical and scalable way to do things especially with the technology we have today.

Keywords

Autoencoder, Random Forest, ensemble learning, quantum machine learning, hybrid model, NISQ, and fidelity.

An Ensemble Learning Approach for Real-Time DDoS Attack Detection Using Network Traffic Flow Features

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Abstract

One of the most significant threats to the contemporary network infrastructure is the Distributed Denial-of-Service (DDoS), which can saturate servers with extremely large amounts of bad traffic and produce disastrous service interruptions. The conventional intrusion detection systems primarily use signature-based approaches which fail to identify new and changing patterns of attacks. In this paper, a machine learning based framework of identifying network traffic flow based DDoS attacks will be provided. The system identifies the features of the network flow captured in a statistical format at the flow level i.e. Packet rate, byte rate, packet length statistics and protocol content. CIC-DDoS2019 dataset is utilized as a training dataset and evaluation dataset and preprocessing methods tend to enhance model performance such as data cleaning, class balancing, and feature scaling. Several trained machine learning models recorded, based on Logistic Regression, Random Forest, Decision Tree, Gradient Boosting, Support Vector Machine (SVM), Multilayer perceptron (MLP), and XGBoost models are tested in attack identification. The findings of the experiments indicate that tree-based models in the form of ensembles obtain a detection accuracy of over 99 % and have a high precision and recall with a low rate of false positive. The suggested framework has offered a useful method of detecting malicious traffic patterns and may be used to facilitate real-time network security surveillance systems.

Keywords

DDoS detection, intrusion detection system, machine learning, network security, ensemble learning, network traffic analysis.

Design and Real-Time Evaluation of Load Distribution Strategies in Distributed Web Server Systems

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Abstract

Load balancing is a required method employed in the distributed systems in an attempt to efficiently allocate the network traffic across servers. This is also the design and implementation of real-time load balancing system of the web servers as well as the monitoring of the traffic and performance analysis. This system will have several servers that are backends, a load balancer (that will be centralized) and a real-time monitoring dashboard. The incoming client requests are distributed by the load balancer system with such algorithms as Round Robin, Random Selection, and Least Connections to provide equal distribution of the working load. Traffic can be generated on the network through a traffic generator module, which is used to identify the performance of the system given different load on the network. Important performance measures like the number of requests and the mean response latency are continuously monitored in the system. The visualization of this metrics is provided in form of a live dashboard. Through experimental findings, the proposed system is effective in distributing traffic between the servers, alleviating server overload as well as enhancing the overall system performance and reliability in distributed web environments.

Keywords

Load Balancing, Distributed Systems, Web Servers, Round Robin Algorithm, Network Traffic Analysis, Latency Monitoring, Performance Evaluation, Real-Time Monitoring.

Elect Bharat: A Hash-Based Cryptographic Techniques for Verifiable Electronic Voting

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Abstract

To guarantee the trust of people in the democratic processes, the use of electronic voting systems is necessary, which offer a high level of security, transparency, and privacy of the voters. In this paper, Elect Bharat, an electronic voting system based on hash and verification, is introduced with an aim of guaranteeing integrity of votes while being an anonymous system at the same time. This system combines the cryptographic process of voting and hashing. Every vote is verified, and cryptographic hash functionality is used to obtain a unique identifier with anonymity. The voter is issued with a digital receipt of the vote hash. To maximize integrity and auditability, optional hash chaining is used in the system to generate tamper-evident records. Elect Bharat prioritizes lightweight cryptographic techniques to gain transparency without necessarily having the complexity of full decentralization systems. It is framework to be used in institutional and organizational elections and provides a useful trade-off between security, usability and scalability. The paper brings in a research-based design method of verifiable electronic voting and emphasizes the use of hash-based methods in enhancing trust in electronic voting systems.

Adaptive Ensemble Machine Learning Framework for Breast Cancer Prognosis: Integrating Kullback-Leibler Distributed Divergence and SHapley Additive exPlanations Interpretability

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Abstract

Early and precise prognostic stratification in Breast Cancer is pivotal for optimizing therapeutic decisions and improving survival outcomes. This research proposed an Adaptive Ensemble Machine Learning Framework (AEMLF) that intelligently combines different models to enhance performance, especially in complex tasks like deep learning, and medical prognosis for driven feature selection, stability assessment, and ensemble learning. In this research, we leverage the Diagnostic Wisconsin Breast Cancer repository database managed by University of California, freely available for machine learning based research. We preprocess Kullback-Leibler divergence technique (a powerful features ranking to measure and separates two different classes distributions i.e. benign vs. malignant cancer and enforce reproducibility via bootstrap stability design framework that quantifies the consistency through feature selection especially in machine learning or clustering contexts. Adaptive Ensemble Machine Learning Framework integrates gradient boosting, random forest, random survival forest, and support vector machine models under a weighted voting scheme called decision making framework. Interpretability is provided through SHapley Additive exPlanations analysis. On a hold-out test set, our proposed framework achieves 99.12% accuracy, sensitivity 0.961, specificity 0.969, area under the curve 0.980, and concordance index 0.913. We further propose an extension i.e. women's breast cancer prognosis; an integrated risk modelling for ovarian cancer using serum biomarkers and ultrasound texture (an emerging and a powerful multimodal strategy for cancer risk prediction to improve early detection, subtype classification, and personalized treatment planning).

Keywords

Breast Cancer (BC) Prognosis, Adaptive Ensemble Machine Learning Framework (AEMLF), Diagnostic Wisconsin Breast Cancer (DWBC) database, Least Absolute Shrinkage and Selection Operator (LASSO), SHapley Additive exPlanations (SHAP) analysis, Kullback-Leibler (KL) divergence, Fine Needle Aspiration (FNA).

AI-Driven Recruitment and Interview Evaluation System Using Event-Driven Architecture and Large Language Models

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Abstract

The increasing demand for scalable and consistent recruitment processes brings out the limitations of traditional interview-based candidate evaluation, which relies on manual screening, subjective judgment, and considerable coordination effort. This study presents an event-driven artificial intelligence recruitment system designed for candidate screening, conducting conversational interviews, and generating structured decisions. Current systems are mostly made up of standalone tools, such as resume parsers and mock-interview simulators, and typically do not support integrated orchestration or real-time decision-making. The proposed system orchestrates multiple components, by integrating conversational AI, semantic response analysis, and workflow orchestration, to enable consistent, scalable, and objective candidate evaluation. The system receives input from candidates, conducts real-time voice interviews, transcribes candidate responses and applies large language model (LLM)-based reasoning for competency evaluation and scoring. The system maintains traceability and automation using an event-driven backend that records interactions, transcripts, and decision outputs. An analysis of the workflow shows that the system automates about 87.5% of the recruitment pipeline and is able to reduce recruiter involvement by up to 98.1% when handling high-volume applications. These observations are consistent with earlier studies that report up to a 38% reduction in time-to-hire along with faster AI-assisted screening.

A Study on Identification and Analysis of Urban Road Accident Black Spots using Frequency, Severity Index and MoRT & H Methods

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Abstract

Road traffic accidents in urban areas are increasing due to high traffic volume, mixed traffic conditions, and complex road layouts. Identifying accident-prone locations (black spots) is therefore important for improving road safety. However, there is no single standard method followed everywhere for declaring a black spot. This study focuses on identifying and analyzing black spots using different methods such as Accident Frequency, Severity Index, and MoRT & H guidelines, and comparing them to find the most suitable approach.

The study uses accident data collected from published research, reports, and a practical case study on a selected highway section. The frequency method helps in identifying locations with a high number of accidents, while the Severity Index method gives more importance to fatal and serious accidents. The MoRT & H method defines black spots based on accident occurrence over a specific road stretch.

By combining and comparing these methods, the study identifies accident-prone locations and prioritizes them based on severity. It also examines how factors like road geometry, traffic conditions, and road infrastructure contribute to accidents. The results show that severity-based methods are more useful for prioritizing locations that require urgent attention.

The study provides a simple and practical approach for identifying and prioritizing black spots, which can help in better planning and improving urban road safety without the need for extensive field data.

Keywords

Accident Black Spot, Severity Index, Accident Frequency, Urban Road Safety, Accident Analysis.

Design and Analysis of Solar Powered Eco-Friendly and Efficient Coir Moisture Removal System

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Abstract

The objective of this research work is to develop and test an automatic system for removing moisture from coir and compare its drying efficiency with the existing conventional drying method through statistical analysis. In this study, the existing conventional drying process is compared with automatic moisture control. Process. The proposed automatic coir moisture removal system in which a rotating drum mechanism, hot air flow, and microcontroller-based moisture sensor feedback control are employed. A total sample size of 03 coir samples were taken for each with similar initial moisture content ranging from 54% to 58%. The variables taken for analysis are final moisture content and drying time. Statistical analysis was done using mean, standard deviation, and independent sample test. The results obtained clearly depicted that the speed of the drums has a major impact on the removal of moisture content in the proposed system for automatic coir drying. At an initial moisture content of 57% and a blower temperature of 138°C, it was indicated that the final moisture content of the coir material reduces with an increased speed of the drums. At 110 rpm, the final moisture content was found to be 19%, which reduced to 16% when the speed increased to 130 rpm and further reduced to 11% at a speed of 150 rpm. It has been affirmed from this study that the proposed automatic coir moisture removal system indeed works properly at various higher rpm. In addition, out of all the conditions tested, 150 rpm results in minimum moisture content and therefore optimal drying. It is inferred from this study that the rpm of the drum plays an important role in drying, and this proposed system is applicable to efficient coir processing.

Keywords

Automatic coir moisture removal system, Coir drying, Moisture content, Drying time, Hot air drying, Microcontroller-based control, Statistical analysis, independent sample t-test.

Performance Analysis of Polymer-Enhanced Bitumen in Flexible Pavement Applications

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Abstract

In recent times, improving the strength and durability of flexible pavements is a key concern for engineers. The present study investigates the performance characteristics of polymer modified bitumen (PMB) in flexible pavement mix design with the objective of enhancing durability and load-bearing capacity. Different proportions of polymer additives were blended with conventional bitumen, and a series of laboratory tests were conducted to evaluate their influence on material properties. Standard tests such as penetration, softening point, and ductility were carried out to assess the basic characteristics of the modified binder. In addition, Marshall mix design tests were performed to determine stability, flow, and volumetric properties of the bituminous mixtures. The experimental results, analyzed using spreadsheet-based tools, reveal that the inclusion of polymers significantly enhances the performance of bituminous mixes. An increase in Marshall stability and softening point indicates improved resistance to deformation and temperature variations. Meanwhile, penetration and ductility values showed controlled changes, suggesting better flexibility and cohesion of the binder. The study also identifies an optimum polymer content that provides maximum performance benefits without adversely affecting workability. Overall, the novelty of the proposed findings demonstrate that polymer modified bitumen can effectively improve the mechanical behavior and service life of flexible pavements, making it suitable for use in high-traffic and challenging environmental conditions.

Keywords

Flexible pavements, cohesion, binder, polymer modified bitumen, polymers.

Advancing Veterinary Reproductive Training: Design, Material Optimization, and Evaluation of Artificial Insemination Cow Simulators

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Abstract

In livestock breeding, artificial insemination (AI) is a commonly used reproductive method that facilitates quick genetic advancement and effective herd management. However, using live animals to train veterinary students presents risks to animal welfare, logistical difficulties, and ethical issues. These drawbacks emphasize the necessity of realistic, simulation-based training models that facilitate the enhancement of safe and efficient skills. The design and development of a Veterinary Artificial Insemination Training Cow Model that replicates the physiological and anatomical conditions of a cow's reproductive tract is the main goal of this research. The suggested model has a robust external body, realistic internal reproductive organs, and an integrated control system that can maintain rectal pressure (1500 mmHg) and physiological temperature (35–38°C). With the help of these features, trainees can practice precise semen deposition, AI gun insertion, and cervical navigation without the need for live animals. The study also examines cow training models that are sold commercially, evaluating their advantages, disadvantages, and areas in need of development. To determine the best choices based on realism, durability, and safety, a comparison of the materials used for the external body and internal organs is carried out. The proposed system intends to support the advancement of cutting-edge reproductive training technologies, enhance veterinary education, and improve animal welfare.

Keywords

Artificial Insemination Training, Veterinary Simulation Model, Cow Reproductive System, Veterinary Education Technology, Simulation-Based Training, Artificial Insemination Simulator, Veterinary Skill Development.

A Geolocation-Based Accommodation Recommendation System Using Exploratory Data Analysis for Immigrants

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Abstract

With the rapid increase in migration around the world, there is demand for clever and efficient accommodation recommendation systems, because immigrants are often unaware of the situation, there is high variability in rental costs, and there is often no reliable source of accommodation information. As current accommodation platforms rely on manual filtering and keyword-based searching to provide users with accommodation listings, we explore the development of a geolocation-based accommodation recommendation system, employing Exploratory Data Analysis (EDA) to extract insights from housing datasets. The recommendation is made using spatial filtering, clustering, and multi-criteria ranking based on user characteristics such as budget, location, and other requirements. Mathematical models are used to measure distances, calculate clusters, and generate ranked recommendations. Furthermore, it shows more accurate recommendations with low search space complexity evidencing the efficacy of the data-driven approach for real housing problems.

EduQuest AI: An Offline-First, Privacy-Preserving Intelligent Assessment Platform Using Hybrid Artificial Intelligence

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Abstract

The rapid transition toward digital learning environments has increased the demand for intelligent assessment systems capable of automating evaluation while maintaining data privacy and institutional control. Existing AI-based educational platforms primarily rely on cloud infrastructures and external application programming interfaces, raising concerns related to data security, regulatory compliance, operational costs, and vendor dependency. This paper presents EduQuest AI, an offline-first and privacy-preserving intelligent assessment platform designed to emulate human-like evaluation through a hybrid artificial intelligence framework. The proposed system integrates locally deployed large language models with rule-based natural language processing and classical machine learning techniques to generate, validate, and categorize assessment questions directly from academic documents. The platform supports secure timed examinations, automated grading, behavioral integrity monitoring, and performance analytics using heatmap-based learning insights. All computation and data storage are performed within institutional infrastructure, ensuring complete data ownership while eliminating reliance on external cloud services. Experimental evaluation demonstrates that EduQuest AI produces high-quality assessment content, enhances examination fairness through anomaly detection, and provides actionable analytics for personalized learning support. The modular architecture enables scalable deployment across institutions with varying computational resources. The results indicate that offline hybrid AI systems provide a practical, secure, and cost-effective solution for next-generation educational assessment environments.

Keywords

Artificial Intelligence in Education, Offline Assessment Systems, Hybrid Artificial Intelligence, Local Large Language Models, Educational Data Privacy, Automated Question Generation, Learning Analytics, Exam Integrity Monitoring.

Employee Attrition Prediction Master using Machine Learning

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Abstract

Employee attrition poses a major challenge for organizations, affecting productivity, talent retention, and overall operational efficiency. Predicting which employees are likely to leave has therefore become essential for effective workforce management and strategic planning. This study introduces an improved employee attrition prediction model that leverages advanced machine learning techniques to identify the likelihood of employee turnover and the factors influencing it. The proposed system integrates Support Vector Machines (SVM) and a Multilayer Perceptron (MLP) Neural Network, selected for their ability to capture both linear and non-linear patterns within complex employee datasets. SVM effectively handles high-dimensional feature spaces, while MLP learns deep feature representations through multiple interconnected layers. To ensure optimal performance, hyperparameter tuning techniques such as grid search and cross-validation are applied to both models. The system also incorporates exploratory data analysis to identify critical determinants of attrition, enabling more informed and interpretable retention insights. By combining robust predictive modeling with analytical insights into workforce behavior, the proposed system supports organizations in early identification of at-risk employees, enabling timely interventions and contributing to stronger employee satisfaction, retention, and organizational stability.

Keywords

Machine learning, ensemble learning, hyperparameter tuning, attrition prediction.

Machine Learning Framework for Water Scarcity Prediction in Urban Utility Systems

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Abstract

Rapid population growth in cities and frequent changes in weather patterns have brought new and greater challenges to water resource management within urban utilities. Traditional methods of measuring water scarcity are often reactive and use static indicators that do not account for changing consumption trends and new stressors. A comprehensive machine learning framework for proactively predicting water scarcity is proposed, which combines multiple sources of consumption data, time-related trends, and contextual indicators to provide early warning of potential water scarcity. The proposed system assesses a range of supervised learning models, including Logistic Regression, Support Vector Machines, Decision Trees, Random Forest, Gradient Boosting, and Extreme Gradient Boosting, for classifying different levels of water scarcity based on different urban settings. The comparative performance of these models demonstrates that ensemble-based models, like XGBoost, perform better than other models in identifying non-linear relationships and feature interactions in water usage. Through an integrated analytics platform, the framework prioritizes practical deployment and interpretability in addition to predictive accuracy. Stakeholders can easily examine consumption patterns and regional risk distributions thanks to the system's interactive visualization modules, which include temporal dashboards and geospatial mapping. Real-time prediction and decision-making workflows are further supported by a safe, user-friendly interface that closes the gap between model outputs and useful insights. The results show how data-driven methods can change water management strategies from reactive responses to proactive planning. By using predictive modeling along with visual analytics, the proposed framework helps create smart, scalable, and easy-to-use decision-support systems for sustainable urban water management.

Performance Analysis on CFD and Sustainable Implementation of Telescopic Rectangular Blade Wind Turbine for Low-Wind Regions

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Abstract

The primary aim is to come up with a Telescopic rectangular blade Wind Turbine (TBWM) to have high efficiency when the wind is as low as 10 m/s. The design, through altering the area of the blade, minimizes the problem of high cut-in speeds and weight, common to fixed-blade HAWTs. The research focused on comparing the conventional fixed-blade turbine with the proposed TBWM. The TBWM is analysed in ANSYS Workbench with three different materials: Steel, ABS and UPVC (Unplasticized Polyvinyl Chloride). The analysis was done and the results shows TBWM was much more effective in the conditions of low wind (5 to 12 m/s). The TBWM produced an average of 0.174 kW of power with a system efficiency of 71.8% while the traditional fixed-blade system recorded 0.092 kW of power output with an efficiency of 45.1%. The average power output of 0.108 kW and standard deviation of 0.046 kW were proven by using statistical analysis. It is evident that the TBWM is more efficient in low winds (10 m/s), where TBWM could produce 0.174 kW with the efficiency of 71.8. These improvements have been proven by statistics with an average power output of 0.108 kW.

Keywords

Telescopic Blade Windmill, Low-Wind Regions, Finite Element Analysis, Structural Dynamics, UPVC Material, Variable Geometry, Aerodynamic Efficiency, Sustainable Energy.

Engine Fault Classification Using Machine Learning, Deep Learning and Hybrid Models

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Abstract

Early detection and classification of engine faults play a crucial role in improving vehicle reliability, reducing maintenance costs, and ensuring operational safety. Traditional rule-based diagnostic approaches often fail to adapt to varying operating conditions, leading to inaccurate predictions. This work presents a comprehensive software-based engine fault classification system using machine learning, deep learning, and hybrid models. The study utilizes the EngineFaultDB dataset, incorporating preprocessing techniques such as feature scaling, Gaussian noise augmentation, Principal Component Analysis (PCA), and Linear Discriminant Analysis (LDA) to enhance data quality and reduce dimensionality. Various machine learning models including Random Forest, Support Vector Machine, and XGBoost are implemented and compared with deep learning architectures like Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN). Additionally, hybrid ensemble models are developed to combine the strengths of multiple classifiers. Performance is evaluated using metrics such as accuracy, precision, recall, and F1-score. Experimental results demonstrate that hybrid models outperform individual approaches, achieving higher accuracy and robustness. The proposed system highlights the effectiveness of integrating machine learning and deep learning techniques for reliable and efficient engine fault diagnosis.

The Performance Analysis of the Various Phase-Frequency Detector for PLL Application at 45nm CMOS Technology

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Abstract

A significant portion of systems based on phase-locked loops (PLLs) consists of phase frequency detectors (PFDs). The PFDs perform phase comparison of two input signals and output results from their phase differences. In a PFD, the input signals are the output signal of the voltage-controlled oscillator (VCO) and the reference signal, and the output signals are the UP and DOWN signals. The output signals are used to assist the VCO in controlling its output frequency. If the UP signal is high, the VCO increases its frequency, while if the DOWN signal is high, the frequency is decreased. This research assessed various PFD circuits and how different topologies affected the PFD performance metrics. This research analyzed the Dead Zone, power dissipation, number of transistors and maximum working frequency of different PFDS. PFDs are a core component in phase-locked loops (PLLs), frequency synthesis circuits, frequency demodulators, AM radio receivers, etc. This research is simulated in in Cadence Virtuoso using 45nm CMOS Technology.

Keywords

Phase frequency detector (PFD), phase locked loop, CMOS technology, power consumption, dead zone, UP and DOWN signal.

AI Assistant Using Multi-Agent System

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Abstract

The rapid increase in academic workload and personal management responsibilities has created a need for smart systems that offer integrated support on one platform. This research introduces an AI Assistant built using a Multi-Agent System design to boost student productivity through coordinated, specialized agents. Unlike traditional digital assistants that tackle separate tasks, this system combines academic help, emotional monitoring, financial tracking, and smart information retrieval in one framework. The platform has five main agents: a Notes Agent that extracts and securely stores content from uploaded PDF and PPT documents, a Mood Agent that analyzes diary entries to spot stress patterns and emotional trends, an Academic Agent that creates quizzes and personalized study plans from uploaded notes, an Expense Agent that tracks and summarizes financial activities, and a Chatbot Agent that offers real-time academic support. All uploaded documents are stored in the backend until manually deleted, which helps with ongoing knowledge management. A global search feature allows efficient retrieval of stored information across different modules. The modular multi-agent architecture lets agents work independently while still collaborating through a centralized coordination mechanism, providing both scalability and flexibility. Experimental evaluation shows improved productivity, organized learning, better emotional awareness, and quick access to knowledge, highlighting the effectiveness of multi-agent systems in enhancing academic and personal productivity.

Keywords

Multi-Agent Systems, Artificial Intelligence in Education, Adaptive Study Planning, Intelligent Tutoring Systems, Document Processing, Learning Analytics, Educational Productivity Tools, Academic Chatbots.

Next-Generation Supply Chain Traceability: Blockchain and Zero-Knowledge Proof of Location (zkPoL) for Confidential Geospatial Verification

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Abstract

This paper introduces a blockchain framework incorporating Zero-Knowledge Proof of Location (zkPoL) to break the privacy-transparency tradeoff in supply chain traceability. The solution has a modular architecture with zkPoL circuits, off-chain metadata stored in IPFS, and smart contracts for on-chain state management. A proof-of-concept software prototype on Ethereum shows QR-based tracking with cryptographically verifiable attestations. Simulations ensure sub-second proof times, minimal storage overhead, and resistance to common attacks. Hardware-based edge capture is included in the larger vision, but this paper emphasizes the successful software implementation and its scalability towards future industrial application.

Keywords

Blockchain, zkPoL, Supply Chain Traceability, Smart Contracts, IPFS, Cryptographic Audit, Ethereum, zk-SNARKs.

Image Enhancing and Reconstruction Using GAN's

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Abstract

Many images that were taken in the real world have problems like noise, blur, low-resolution, or missing parts of the image that makes it less useful for a lot of real-world applications. The goal of this project is to create a complete image improvement system that includes both enhancement and reconstruction, through the use of Generative Adversarial Networks (GANs). The Enhancement Module was developed to remove noise and increase clarity in an image, using the super-resolution framework based on GANs. The Reconstruction Module was developed using a generative model to recreate the visual content for each image from the latent representation that has been generated from an input image, allowing for visually meaningful outputs from a small amount of input information. GAN MODEL Modern generative adversarial networks (GANs) are used in ImageEnhance automated system for the restoration of images from low-quality to high-quality images, in essence, using a low-quality (input) image, the system removes noise and enhances the quality of that image [2]. In addition, it reconstructs missing parts of the input image and produces a more visually appealing image as the output. By using a super-resolution GAN (SRGAN) for denoising and resolution enhancement, in addition to a Style GAN for latent-space image reconstruction [3]. ImageEnhance AI will enhance the visual clarity of images, retrieve fine details from images and reconstruct unique but realistic content, thereby enabling high-quality image restoration for various applications including digital archival, video surveillance analysis and medical imaging improvements [4] [5].

Keywords

SuperResolution GAN, Style GAN, ImageReconstruction, DeepLearning, LatentSpace, ImagePreprocessing.

Quantum Cryptography for Next-Generation Data Security

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Abstract

The development of quantum computing poses a security risk to the classical cryptographic algorithms of RSA and ECC that are based on the computation hardness assumptions that quantum algorithms can easily compromise. This has exposed the system to the high security vulnerability that can withstand quantum-enabled attackers. Quantum cryptography and quantum key distribution in particular is a powerful weapon to resort to as it is based on the theory of quantum mechanics accounting to the capability of transmitting keys and ensuring non-hackable communication.

The paper gives its systematized approach to the application of QKD in the organizational security models and gives the comparative analysis of the classical, post-quantum and the quantum-based cryptography. This is because such critical aspects as scalability, cost-efficiency, integration with the existing systems, and interoperability are discussed, and the roadmap to migrate to quantum-resilient infrastructures are mapped out. The specified framework is concerned with both technical and policy considerations, which also offers the moderate solution towards the real practice.

The findings of this research mean quantum cryptography can significantly improve privacy and data security, reduce their vulnerability to quantum attack and offer a future-proof platform of secure communications. By introducing the QKD and related processes, the organizations will be empowered to achieve long-term resilience, compliance, and reliability in the generation of quantum.

Keywords

Quantum Cryptography, Quantum Key Distribution, Data Security, Quantum Computing, Encryption, Privacy, Network Security.

Planify - MERN Based Project Planning & Task Management System

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Abstract

In the context of engineering and management education, the application of project-based learning in engineering and management education is complemented by the use of a project management tool set specifically relevant to these disciplines. However, student project teams frequently face challenges with creating project plans and coordinating project work due to the fragmented nature of the available tool set and an inadequate amount of academic-specific support. As a response to this need, we have developed a project management platform for academic-specific use called PLANIFY. PLANIFY incorporates AI to aid in project management in academic settings, while applying development technologies of the MERN technology stack (MongoDB, Express.js, React-Vite and Node.js). This paper reports on our design, development and evaluation of 13 AI-powered modules to support each step of the entire project lifecycle. The module functions include an NLP-based task decomposition component, Monte Carlo delay prediction option, a behaviour-driven performance measuring tool; adaptive project scheduling using the Critical Path Method; a WebSocket realtime collaboration layer; an AI-based digital assistant that uses real-time data from within a project; academic schedule management support; semantic search engine; notification service; and workflow analysis tool. The platform is designed to support up to 1,000 concurrent users with a latency of less than 200 milliseconds. We completed a controlled trial at AKTU with 48 student teams that illustrated how the full PLANIFY project management system greatly improved team performance, including a 40% reduction in delays, an increase in task completion percentage from 61.4% to 78.3%, and a reduction of 85% in time spent searching for information.

Keywords

AI-based Task decomposition, Predictive Delay Detection, Monte Carlo Simulation, and Retrieval Augmented Generation.

SciAgent: A Multi-Agent AI System for Automated Scientific Research

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Abstract

Science research can be engaged in hypothesis formulation, experiment planning, and summarization of research outputs. These functions cannot be effectively and systematically conducted by the current single AI tools. Their responses are unorganized, and there is no multi-step reasoning process involved so as to enable research activities. To address these research challenges associated with single AI tools, a multi-agent LLM framework will be presented. The multi-agent LLM framework will comprise different agents with an objective to formulate research outputs and will be controlled by an orchestrating agent. The main contribution points for this research include a modular multi-agent system, a workflow consistent with scientific method, and an exploration of the impact on reasoning resolution and understanding achieved with specialization among multiple agents. The predicted outcomes include an increase in quality and coherence in theories and experimental designs and research summary organization compared with single-model systems. Outcomes obtained assume importance for understanding multi-agent AI system capabilities within learning and research pursuits involving systematic exploration and organization.

Keywords

Multi-Agent Systems, Large Language Models (LLMs), Scientific Discovery, Automated Research, Hypothesis Generation, Artificial Intelligence.

AUTOCODE: An Agentic AI System for Automatic Web Application Generation Using Multi-Agent Architecture

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Abstract

Building apps quickly always seems a bit chaotic, as if you are chasing after cats and hoping they will listen. Most times you find yourself going through lines of outdated codes, hunting down stubborn bugs or losing files that disappear as if by magic. Everything except actually making the app work properly. Then AI suddenly changing the situation. These language models now making it possible to merely speak out what you want in normal English. They produce code in any language you need. Tools that handle code snippets, automate dull chores or even work out difficult logic are suddenly popping up. However, most of them only doing bits and pieces. Even then you still have to put everything together just to get a running application. AI agent configurations are something else completely. Of course, once you bring in these agents, work creation is literally like lying on the beach. One bot discovers what users are after, the rest designs and codes, etc. That's how it becomes work music to ears. This is what AUTOCODE is all about. It meshes language models with a chat of agents who get your commands and create the real thing from scratch. It is fully automated. Most of the hard work is simply eliminated, and you get advanced web apps quickly. For me, it actually offers more leisure time, and honestly, it's a great thing.

Keywords

Agentic AI, Code Generation, Multi-Agent Systems, Large Language Models, Web Application Development, Automation in Software Engineering.

Enhanced Healthcare Management System: Role- Based Access, Prescription Tools, and API Integration

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Abstract

Today the majority of the health care systems in the developing countries are using either manual or semi-manual method of handling the patient's medical records, prescriptions and clinical workflow which as a result leads to inefficiency, data breaches and non-interoperability. In this work we introduce a system called Enhanced Healthcare Management System (EHMS) that has features such as Role-Based Access Control (RBAC), Electronic Prescription and API-based Interoperability for safe storage, retrieval and management of the patient's medical records and prescriptions. This in turn secures the confidentiality of the data and thereby ensuring a safe health care service delivery at all levels. The proposed system has an Electronic Prescription module which has an automated checking feature to minimize the possibility of medication errors such as overdose and drug interaction. This system also has a standardized API for real time data exchange with HIS, Laboratories and Pharmacy Systems through API connectivity. The results of the experiments carried out to test the proposed system showed that it has significantly reduced manual work, enhanced data security and minimized clinical errors. The proposed system has shown great enhancement of a scalable and secure system for the modern digital health care systems.

Keywords

Healthcare Management System, Role-Based Access Control, Digital Prescription, Electronic Medical Records, API Integration, Data Security, Patient Care.

AI-Driven Vegetable Crop Brinjal Bacterial Wilt Disease Prediction and Management System

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Abstract

Bacterial wilt disease, which is caused by the bacterium *Ralstonia solanacearum*, is one of the most dangerous diseases that affect the brinjal crop and result in yield loss and economic decline for the farmer. Thus, it becomes essential to identify the disease and take appropriate management strategies for the healthy production of the brinjal crop. The present project proposes a system that utilizes the latest technologies for the prediction of the onset of the bacterial wilt disease based on environmental parameters and past experiences. The system will incorporate real-time data from different sources such as soil moisture content, temperature, humidity, and visual symptoms of the disease by the help of cameras and mobile devices. The Management Guidelines Framework will be utilized for the accurate prediction of the occurrence of the bacterial wilt disease. The proposed system will also provide a user-friendly interface for the farmer to understand the strategies for the management of the disease by the help of artificial intelligence for the prediction of the disease and the management strategies for the healthy production of the brinjal crop by the farmer.

Performance Comparison of Emerging Additively Manufactured Heat Exchanger Geometries Against Conventional Tube Bank

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Abstract

Conventional heat exchangers often face limitations in achieving optimal thermal performance for complex internal geometries due to constraints imposed by traditional manufacturing processes. These conventional heat exchangers were restricted to shell and tube type. For the scope of this study the heat transfer for varied internal geometries. Additive Manufacturing (AM) offers significant design freedom, enabling the simpler creation of complex internal geometries for the study of enhanced heat transfer that were previously unexplorable. This project employs Computational Fluid Dynamics (CFD) to analyse the performance of additively manufactured Schwarz P and Air foil geometry inside the heat exchangers against conventional shell-and-tube designs. This study provides a base for further analysis of heat exchangers using more complex internal geometries and it marks a benchmark for the respectively considered geometries in this study.

Keywords

Heat Exchangers (HXs), Additive Manufacturing (AM), Computational Fluid Dynamics, Schwarz-P, Shell and Tube.

Image Based Waste Classification and Soil Management Using Machine Learning

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Abstract

Effective waste segmentation and disposal methods are essential in environmental conservation and sustainable soil maintenance. The proposed project, therefore, suggests the design of an image classification and disposal suggestion system for waste based on advanced machine learning approaches to enable intelligent and ecologically sound waste management strategies. The system scans waste images to automatically determine the waste type through effective extraction of key visual characteristics like color, texture, and shape and structural patterns by utilizing image processing techniques. These characteristics are then used as input to an SVM classifier for effective categorization. The proposed model provides a classification of waste into three broader categories, such as biodegradable waste, non biodegradable waste, and hazardous or chemical waste. Biodegradable waste includes organic waste such as food waste, leaves, paper, and so on, which can be decomposed naturally in order to reuse it for composting and for enriching the soil. Non biodegradable wastes comprise plastics, metals, glass, and so on, which need to be recycled or disposed of properly in order to reduce environmental and pollution. It also covers dangerous/disposed waste such as batteries, electronic devices, or chemical containers that may have dangerous effects on the soil water if not disposed of properly. On the basis of classification output, proper disposal and use of the soil suggestions are generated by this system. Biodegradable wastes are advised to be processed for composting and mixture with garden soil for improving the nutrients. Non-biodegradable wastes are guided to recycling and managed disposal. Hazardous and chemical wastes require segregation and managed disposal at the authorized waste management facilities to avoid environmental contamination. The system ensures a simple, automated, and friendly solution for waste classification without the need for technical knowledge. Through enhanced waste classification and the provision for intelligent waste disposal, the project ensures the promotion of sustainable waste management and pollution prevention.

Keywords

Waste Classification, Image Processing, Machine Learning, Support Vector Machine (SVM), Biodegradable Waste, Non-Biodegradable Waste, Chemical and Hazardous Waste, Disposal Recommendation System, Soil Management, Environmental Sustainability.

An Integrated Approach to Cloud Account Hijacking Prevention Using Authentication and Access Control

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Abstract

Cloud computing gives businesses incredible flexibility and the ability to scale quickly, but it also comes with new security challenges. One of the biggest risks is account hijacking, where someone manages to break into a cloud account without permission. When this happens, it can lead to major data leaks, financial losses, and even service outages. In environments where many users share the same resources, a single hacked account can put sensitive business or customer information at risk. Real-world incidents—like the Uber AWS breach or the attack on Code Spaces—show just how much damage poor cloud security can cause. In this project, I'll look at how account hijacking happens, what can go wrong, and share real examples.

Design and Analysis of Modified Booth Multiplier Architectures for Low Power VLSI Applications

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Abstract

Multiplication is one of the most power- and delay- intensive operations in digital signal processing and processor datapaths. Booth encoding is commonly used to minimize the number of partial products, thus enhancing speed and power efficiency. Nevertheless, the overall performance of a Booth multiplier is significantly affected by the logic style employed for the implementation of its building blocks. This paper describes a comprehensive design and comparison of Booth multipliers implemented with different logic styles, including Conventional CMOS logic, Pass Transistor Logic (PTL), Complementary Pass Transistor Logic (CPL), Gate Diffusion Input (GDI), and a low- power Sleepy-Stack based CMOS logic. The designs are compared in terms of delay, power dissipation, and power-delay product (PDP). Simulation results show that other logic styles like GDI and PTL offer considerable power savings, while sleepy-stack based designs offer significant leakage power reductions with moderate delay penalties.

Keywords

Booth multiplier, low-power VLSI, logic styles, PTL, CPL, GDI, sleepy stack.

Machine Learning System for Predicting Pathogenic Genetic Mutation Using Protein Structure

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Abstract

Identifying harmful genetic mutations is important for diagnosing diseases and understanding how illnesses develop. In this project, we developed a supervised machine learning model that predicts whether genetic mutations are harmful or benign by combining data from protein structures, genetic sequences, and evolutionary data. The system uses both real and predicted protein models, along with different structural details like residue surroundings, changes in energy, and conservation scores. Our results show that using structural information leads to greater accuracy than using only sequence data, especially for clinically important mutations. We build and test models such as Random Forest Classifier, XGBoost, and Support Vector Machine (SVM) to make these predictions. These models can quickly analyze many variants and provide immediate results when given protein structure data.

Keywords

Support Vector Machine, $\Delta\Delta G$, Random Forest, Pathogenicity prediction, Missense Variants, Protein structure.

Prediction of Blood Cancer by Using Deep Learning Approaches

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Abstract

Blood cancers such as leukemia and lymphoma and myeloma require treatment methods that need both fast execution and precise task performance. Diagnosis has depended on pathologists who have received training to analyze blood smears and tissue samples through their visual examination of these elements. The process requires intensive human effort because the specialists perform essential tasks yet their work becomes less accurate when they face exhaustion or make minor mistakes. Deep Learning advancements are reshaping the clinical landscape by delivering clinicians their "second set of eyes" which empowers their diagnostic abilities. The use of Convolutional Neural Networks (CNNs) enables us to study diagnostic images at exceptional levels because these models have been created to detect and analyze visual patterns. The systems function to identify cellular structures while they develop the ability to identify hidden cancerous patterns which remain undetectable by standard human observation. The results show positive outcomes. The models achieve excellent accuracy and sensitivity and specificity through their training on extensive patient data and cell image databases. The system produces fewer false alarms while delivering better results because it identifies all actual cases. The advanced system provides early anomaly detection which enables doctors to make vital decisions through its data-driven results. The use of AI in hematology extends beyond improved software; it enables patients to receive their most valuable resource which is time.

Keywords

Blood cancer, Deep learning, Convolutional Neural Networks (CNN), Leukemia, Disease prediction, Medical image analysis, Early detection, Artificial intelligence in healthcare.

A Novel Algorithm for Optimized MPPT in PV System under Partial Shading

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Abstract

The Productivity of Solar systems is primarily determined through its system capability to continuously operate at MPP despite variation in weather conditions. Under partial shading due to factors like buildings, obstacles, and varying irradiance, the PV characteristics of PV arrays creates many LMPP's and one GMPP. This Occurrence makes it difficult for identification of highest peak, resulting in reduced energy extraction and overall system efficiency. Standard MPPT algorithms often can't able to distinguish between local & global peaks during such conditions. This work focuses on developing an optimized MPPT strategy capable of accurately tracking the GMPP with faster convergence and minimal power fluctuations, reduced bad steady-state oscillations and enhance the power output under PSC. An ACO-based Maximum Power Point Tracking Technique will be proposed & the performance is evaluated against an existing Hybrid Perturb and Observe-Cuckoo Search approach. A detailed comparative analysis is carried out considering tracking efficiency, convergence speed, power extraction and robustness under dynamic irradiance variations. The effectiveness and capability of novel method is verified and validated through simulations, demonstrating improved power extraction and enhanced system performance.

Keywords

Hybrid, Irradiance, duty cycle, converter, PV, ACO, MPPT, GMPP, LMPP, optimize, PSC.

AI Driven Adaptive and Conversational Learning Solutions for Inclusive Education of Children with Special Needs

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Abstract

Children with profound sensorineural hearing loss in India face significant barriers in accessing mainstream educational content. Traditional classroom teaching and digital-learning platforms rely heavily on spoken language, making them inaccessible to students who depend on Indian Sign Language (ISL). This paper proposes an AI-driven adaptive and conversational learning system that translates educational video content into ISL using transformer-based models, speech-to-text processing, pose estimation, and avatar-based sign rendering. The system enables real-time or near-real-time generation of coherent ISL gestures, making digital learning content accessible to hearing-impaired students. To improve engagement, the application integrates interactive quizzes, performance tracking, and conversational guidance tailored for special-needs learners. By leveraging advancements in NLP, computer vision, pose generation, and motion interpolation, this solution bridges the accessibility gap and empowers students to learn independently. The proposed framework sets the foundation for scalable, inclusive, and equitable education aligned with India's National Education Policy (NEP-2020).

Keywords

Indian Sign Language (ISL), Transformer Models, Pose Estimation, Accessibility, Inclusive Education, Hearing-Impaired Learning.

OCR-Based Contract Analysis and Simplification System

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Abstract

Legal contracts are fundamental instruments governing business transactions, employment agreements, real estate dealings, and regulatory compliance across virtually every industry sector. Despite their ubiquity, contracts are routinely written in highly technical legal language that is difficult for non-specialist users to interpret correctly, frequently leading to uninformed consent, missed obligations, or unrecognised financial risk. This paper presents an OCR-Based Contract Analysis and Simplification System – a fully client-side web application that automates the complete workflow of extracting, analysing, and simplifying scanned or image-based legal contracts without requiring any server-side infrastructure. The system employs Tesseract.js, the browser-native port of the Tesseract OCR engine, to convert contract images (JPG/PNG) into machine-readable text. The extracted content is then processed through an eleven-step rule-based Natural Language Processing (NLP) pipeline comprising text normalisation, sector classification across five domain categories (IT, Finance, Legal, Healthcare, and Construction), risk-keyword detection, heuristic risk scoring, key-point extraction, and dictionary-based legal-term simplification. Results are presented on an interactive dashboard with real-time keyword search, and a structured PDF report is generated on demand using jsPDF. Because all processing executes entirely within the browser JavaScript runtime, sensitive contract data is never transmitted to external servers, ensuring strong privacy guarantees. Extensive testing across contract types confirms accurate OCR extraction, correct sector classification, reliable risk identification, and effective legal-term simplification. The system provides a practical, lightweight, and privacy-preserving alternative to manual contract review for non-legal users and small organisations.

Keywords

Optical Character Recognition, Contract Analysis, Natural Language Processing, Legal Text Simplification, Tesseract.js, Rule-Based Classification, Risk Detection, Client-Side Web Application, LegalTech, Document Automation, jsPDF, JavaScript.

Blockchain Based Cheque Verification and Clearance System

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Abstract

Financial systems' cheque clearance procedures have traditionally been laborious, frequently spanning several days owing to semi-manual processes and inadequate fraud detection tools. Image processing, Random Forest for mistake prediction, template matching for MICR verification, pixel-based signature matching, and Ethereum smart contracts for settlement were all introduced by the current blockchain-based system, CheckMate, which automates papers and digital checks. Low prediction accuracy, susceptibility to noisy check images, and slower blockchain speed as a result of Proof-of-Work consensus were some of the system's shortcomings, despite its improvements in efficiency and security. This research aims to solve these problems by suggesting a better digital cheque verification and clearance system that is based on the blockchain. It keeps the same basic idea but uses more precise algorithms. To anticipate errors in cheques, XGBoost/LightGBM is employed. To recognize MICR digits, SVM with HOG features is utilized. To verify signatures, K-Nearest Neighbors is employed. And to detect fraud, Naïve Bayes is employed. For safer, quicker, and more energy-efficient check settlement, PBFT consensus takes the place of Proof-of-Work. Better accuracy, resilience against check variability, and a dramatic decrease in clearing time are all achieved by the suggested solution without sacrificing security or transparency. With this method, contemporary banking systems may rest assured that their cheque processing mechanisms are both dependable and efficient.

Keywords

Blockchain, Digital Cheque Clearance, Cheque Fraud Detection, MICR Verification, Signature Verification, XGBoost, LightGBM, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Naïve Bayes, PBFT Consensus.

Chronic Diseases Prediction Using Machine Learning with Data Preprocessing Handling: A Critical Review

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Abstract

Diseases that need early detection for treatment, such as Alzheimer's, diabetes, and cardiovascular problems, account for the majority of global fatalities. Now more than ever, machine learning algorithms are powerful resources for handling massive amounts of healthcare data and assisting with illness prediction. Data preparation and feature extraction methods are crucial to these models' accuracy and dependability. A comprehensive assessment of machine learning approaches used to chronic illness prediction is presented in this study. Data preparation methods in particular are highlighted. Data cleaning, normalization, feature selection, and dimensionality reduction are some of the most common preprocessing methods included, all of which may improve the model's performance and the quality of medical data. Furthermore, the article discusses how MRI scans and other medical imaging data may be analyzed using hybrid deep learning models, namely CNNs and Vision Transformers. The article also touches on the possibility that healthcare 5.0 and IoMT technology might make intelligent healthcare systems and real-time data monitoring easier. The review highlights that combining advanced preprocessing strategies with hybrid machine learning models can contribute greatly to the accuracy of prediction and help to diagnose chronic diseases efficiently.

Keywords

Chronic Disease Prediction, Machine Learning in Healthcare, Medical Data Preprocessing, Feature Selection Techniques, Dimensionality Reduction, Healthcare Data Analytics, Hybrid Deep Learning Models, Convolutional Neural Networks (CNN), Vision Transformers (ViT), Medical Image Analysis, Internet of Medical Things (IoMT), Healthcare 5.0.

Design and Implementation of an Interactive and Comprehensive Platform for Data Structures and Algorithms Visualization and Learning

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Abstract

Data Structures and Algorithms (DSA) serve as essential components for computer science education but students face difficulties studying algorithms because interactive learning tools that show algorithm behavior in real-time do not exist. The paper introduces a DSA Visualizer which acts as a web-based educational tool that enables users to see data structures and algorithms through dynamic stepwise visualizations. The system employs React to create interactive visual components on the frontend while using Spring Boot to execute algorithm processes and control state changes. The platform enables users to visualize fundamental data structures which include arrays and linked lists and stacks and queues and binary trees and binary search trees and graphs while using sorting and searching and tree traversal and BFS and DFS algorithms. The backend creates algorithm states which the frontend uses to display animations showing operations that include comparisons and insertions and swaps and pointer movements. The system provides visual display capabilities together with DSA practice problems and coding contests and community forums for doubt solving and user progress tracking and code history management. The components of the system help users learn by working together with others while enabling users to monitor their progress throughout their learning process. The results from experimental research show that students develop better understanding of algorithmic concepts while becoming more interested in learning when they use interactive visualization together with practice methods and community support. The proposed system shows that DSA education results improve when students use real-time visualization tools together with coding practice and collaborative learning activities.

Keywords

Data Structures and Algorithms (DSA), Algorithm Visualization, Interactive Learning Systems, Educational Technology, React Framework, Spring Boot, Web-Based Learning Platform.

ANN Controlled Soft-Switched Boost Converter Based LED Driver

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Abstract

In this paper, a smart soft-switched boost converter-based LED driver, with an improved input current ripple suppression, is proposed in the form of Artificial Neural Network (ANN) controller. The proposed system employs a full-bridge paralleled boost converter operating under zero-voltage switching (ZVS) conditions to achieve high efficiency and inherent ripple cancellation at the input. A buck-boost converter is integrated at the output stage to provide accurate LED voltage regulation while processing only a fraction of the total power. In conventional implementations, a proportional-integral (PI) controller is used for regulation; however, its fixed-gain nature limits performance under nonlinear and varying operating conditions. To overcome this drawback, an ANN-based controller is introduced to replace the PI controller, enabling adaptive and intelligent control of the converter. The ANN controller effectively handles system nonlinearities and improves dynamic response during input voltage deviations. The proposed LED driver is modeled and simulated in MATLAB/Simulink under nominal and disturbed input conditions ($\pm 10\%$). Comparative results demonstrate that the ANN-controlled system achieves faster settling time, improved voltage regulation, and superior input current ripple suppression compared to the PI-controlled counterpart. The proposed intelligent LED driver is well suited for high-efficiency street lighting and DC-source-fed lighting applications.

Keywords

Soft-switched boost converter, LED driver, artificial neural network controller, input current ripple suppression, zero-voltage switching, buck-boost converter, intelligent control.

Personalized Music System Based on Emotion Recognition

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Abstract

Technologies of emotion recognition are also becoming popular to learn human emotions and deliver individualized online experiences. This paper describes Tune Mood: Emotional Recognition for Personalized Music, which is a web-based application that is able to detect human emotions based on the facial image and suggest the appropriate music to play depending on the detected mood. The system combines the deep learning methods of facial emotion recognition on the basis of the Mobile Net model, which is chosen due to its lightweight network and high effectiveness in image recognition operations. The system is used by the interaction between the user and the system with the help of a secure authentication module that includes registration and login done using a MySQL database. Once logged in, the interface allows uploading facial images using a Flask based interface. The deepfake verification is done by image frequency analysis to detect images which may be manipulated before the emotion analysis. Facial expressions are then analyzed by Deep Face and dominant emotions, including those of happiness, sadness, anger, surprise, fear, disgust, and neutral, are determined. Depending on the identified emotion, the system suggests the required music tracks with YouTube links and offers the user a personalized and interesting experience.

Keywords

Emotion Recognition, Mobile Net, Deep Face, Deepfake Detection, Facial Expression Analysis, Music Recommendation, Deep Learning, Computer Vision.

Predictive Analysis of Chronic Kidney Disease

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Abstract

Chronic Kidney Disease (CKD) is a long-term health condition in which the kidneys gradually lose their ability to filter waste and excess fluids from the blood. If not detected at an early stage, CKD can progress to severe levels, leading to serious complications and kidney failure. Therefore, predicting whether the patient has CKD or NOT CKD is critical. This project proposes the development of a Deep Neural Network (DNN) model to predict CKD and classify it into three severity levels: Mild, Moderate, and Severe risk, based on patient health parameters such as blood urea, glucose levels, creatinine, specific gravity, hemoglobin, albumin. Unlike traditional approaches that focus only on identifying the presence of CKD, the proposed system performs stage-wise classification, which is more beneficial for clinical decision-making. In addition, data visualization techniques are incorporated to analyze medical features, identify key factors influencing CKD, and present results in a clear and understandable manner. The combination of deep learning and data visualization improves prediction accuracy and supports better analysis of CKD severity.

Keywords

Deep Learning, Deep Neural Network, Data Visualization, Stage-wise Classification, Chronic Kidney Disease.

Context-Aware Risk-Based Adaptive Multi-Factor Authentication for Secure and Low-Friction Web Access

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Abstract

The rise in credential stuffing attacks together with phishing attacks and session hijacking attacks demonstrates that static password authentication methods have reached their limitations. The security of Multi-Factor Authentication (MFA) systems increases through additional authentication requirements yet their standard implementation method creates excessive burden for users which results in "MFA fatigue." The authentication systems of today do not use contextual information because they consider trusted and suspicious login attempts to be identical. The research introduces a Context-Aware Risk-Based Adaptive Multi-Factor Authentication (RBA-MFA) system which adjusts security measures based on user needs. The system uses a backend Risk Engine which developers built with FastAPI and SQL to assess user behavior through three parameters IP geolocation consistency device fingerprint stability and temporal access patterns. The system deploys a weighted risk scoring function which generates a composite risk index that operates in real time to activate system authentication methods. Users with low-risk profiles need to present their main login information while users with medium-risk profiles need to use Email OneTime Password (OTP) authentication and users with high-risk profiles need to use Time-Based One-Time Password (TOTP) authentication. The assessment results show that RBA-MFA decreases the number of unnecessary authentication requests by 70 percent for legitimate users while maintaining its ability to detect suspicious login behavior. The proposed system enables web applications to achieve better security protection and user experience through its dual security enforcement framework.

Keywords

Adaptive Authentication, Risk-Based Authentication, Multi-Factor Authentication, Context-Aware Security, FastAPI, Device Fingerprinting, Cybersecurity.

Enhanced Pill Identification Using OCR and CNN

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Abstract

Tablets and capsules have been popular in medication delivery owing to the ease of use and stability. Nevertheless, misidentification is the risk and may cause inappropriate drug use and patient safety issues. To solve this problem, we present a new method which uses state-of-the-art AI technologies (e.g., Convolutional Neural network (CNN) and Optical Character Recognition (OCR)) to automatically recognize and validate the pills via visual appearance. Our approach is built around training a CNN as model of the image features for shape, color and imprinted pattern of the different tablets. we also build in Tesseract OCR to recognize any text printings on the pills, which further helps to identify them. From a RGB image of a tablet, the proposed method is capable of detecting whether a tablet is identical to a reference tablet in a pill box, reducing human errors for medication tray matching. Our method is experimentally validated and shows good performance in recognizing the imprinted tablets. If effective, this novel compound could help patients to be safer, preventing mistakes in medications, in situations that often lead to human error (hospitals and drugstores). Pill ID Automation This improves time management for care givers and puts clinician focus where it is most needed, on the patient as opposed to on the issue of medication. Also this can be introduced into current health systems as a simple solution which in turn provides accurate and reliable results for better patient safety and treatment outcomes.

Keywords

Tablet image recognition, Convolution Neural Networks, Tesseract OCR.

AUTOCODE: An Agentic AI System for Automatic Web Application Generation Using Multi-Agent Architecture

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Abstract

Building apps quickly always seems a bit chaotic, as if you are chasing after cats and hoping they will listen. Most times you find yourself going through lines of outdated codes, hunting down stubborn bugs or losing files that disappear as if by magic. Everything except actually making the app work properly. Then AI suddenly changing the situation. These language models now making it possible to merely speak out what you want in normal English. They produce code in any language you need. Tools that handle code snippets, automate dull chores or even work out difficult logic are suddenly popping up. However, most of them only doing bits and pieces. Even then you still have to put everything together just to get a running application. AI agent configurations are something else completely. Of course, once you bring in these agents, work creation is literally like lying on the beach. One bot discovers what users are after, the rest designs and codes, etc. That's how it becomes work music to ears. This is what AUTOCODE is all about. It meshes language models with a chat of agents who get your commands and create the real thing from scratch. It is fully automated. Most of the hard work is simply eliminated, and you get advanced web apps quickly. For me, it actually offers more leisure time, and honestly, it's a great thing.

Keywords

Agentic AI, Code Generation, Multi-Agent Systems, Large Language Models, Web Application Development, Automation in Software Engineering.

Computer Aided Bone Fracture Detection using Deep Learning Methodology

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Abstract

One of the most frequent injuries to the bones and muscles in a bone fracture. Usually, doctors use X-ray images to diagnose them. But reading these images by hand depends a lot on the skill of the radiologists, and this can sometimes cause delays or mistakes in the diagnosis. To help with this, this paper suggests using a system that can automatically detect bone fractures. Deep learning, a type of artificial intelligence, is used by this system. The system is constructed using the Residual Network, a type of deep learning that is a part of a convolutional neural network. This design helps the model learn better and train faster by focusing on the most important parts of the image. The technology examines X-ray images and can determine if there is a fracture or not. The model was tested using a dataset called MURA, which contains X-ray images of upper limb parts like hand, forearm, fingers, wrist, elbow, humerus, shoulder. So, the results indicate the model ResNet performs well in identifying fracture patterns and can accurately categorize pictures. This system can help radiologists make faster and more accurate diagnoses, which can save time and improve patient care. With more data and improvements, this system could be used in real hospitals to help detect fractures automatically.

Keywords

CNN, Image scanning, Bone Fracture Detection, ResNet, Automated Diagnosis.

Air Quality Index Prediction Using Data Science and ML

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Abstract

Assessing air first-rate in the first magnificence is a necessary step for the government, as its kilometres are a main public health trouble. Air pleasant index is an index that measures air quality. Carbon dioxide, nitrogen dioxide, carbon monoxide, etc. Natural gasoline is released whilst gasoline, coal, and wood are burned, as in factories and vehicles. Various air pollution, which might be air pollutants. Air pollutants can cause extreme diseases together with lung cancer and brain most cancers. They can also purpose contamination or demise. Machine studying algorithms help decide the air high-quality index. Various research are being carried out in this vicinity, however the consequences are not yet definitive. This dataset is available at the leading aerial surveillance platform Kaggle and is divided into schooling and checking out. Machine getting to know strategies used for this motive include linear regression, decision tree, random woodland, artificial neural community, and support vector machine.

Keywords

Carbon Dioxide, Nitrogen Dioxide, Carbon Monoxide.

Crime Pattern Prediction System Using Spatio-Temporal Data Mining

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Abstract

With rapid urbanisation comes a responsibility to develop smart and efficient systems to ensure smart cities. Citizens not only require smooth roads, but also ensured safety. Crime Lens, a crime pattern prediction system, is based on spatio-temporal data and has been designed to process historical crime datasets. This is then used to classify crimes into categories, infer severity levels, and visualize crime hotspots with the help of geospatial data mining. The system makes use of an automated pipeline and a sleek, modern web interface. It is an attempt to demonstrate how unstructured crime data can be processed to structured crime data and then transformed into comprehensive insights and predictions for research, urban planning, and safety enhancement in smart cities.

Keywords

Spatio-Temporal, Crime Pattern Prediction, Severity Levels, Severity Mapping, Data Pre-Processing, Crime Analytics, Crime Prevention.

NetTopoGen: A Multi-Topology, Fault-Aware Network Simulation Framework with QoS-Driven Multi-Algorithm Routing

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Abstract

Network simulation is essential for analyzing routing behavior, fault tolerance, and Quality of Service in communication networks. However, existing simulation tools often fail to balance protocol realism, scalability, and usability. High-fidelity simulators such as NS-3 provide detailed modeling but require complex scripting and extensive configuration, while lightweight and educational platforms lack support for multi-algorithm routing analysis, dynamic fault injection, and QoS-driven experimentation. These limitations restrict rapid and systematic evaluation of routing strategies across diverse network conditions. This paper proposes NetTopoGen, a Python-based, fault-aware network simulation framework designed to address these challenges. The framework integrates five network topology families, four routing algorithms, interactive multi-metric QoS cost modeling, configurable traffic generation, and real-time fault injection within a unified graphical interface. The primary novelty of NetTopoGen lies in its ability to combine multi-topology analysis, QoS-aware routing, and fault resilience evaluation in a single extensible platform without reliance on script-driven workflows. The proposed framework is evaluated through 3,200 simulation runs conducted across 16 experimental scenarios, varying topology structures, routing algorithms, traffic patterns, and fault conditions. Performance is measured using packet delivery ratio, end-to-end delay, throughput, convergence time, and packet loss. Results demonstrate that the A* algorithm achieves up to 18% faster convergence than Dijkstra while preserving optimal routing paths. Mesh topologies exhibit approximately 25% higher packet delivery under fault conditions compared to ring structures, while QoS weight adjustments lead to substantial path reconfiguration. Overall, NetTopoGen reduces experimentation time by over 40%, making it suitable for both research and advanced networking education.

Keywords

Network simulation, topology generation, QoS routing, fault tolerance, educational visualization, Python framework, multi-algorithm analysis.

Intelligent Money Management and Crisis Preparedness with Smart Expense Tracker

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Abstract

Effective personal finance management is essential for individuals facing increasing economic uncertainty, yet many struggle to monitor financial activities and prepare for crisis situations. This paper presents an intelligent web-based system designed to automate and streamline income–expense tracking while enhancing user readiness for financial emergencies. The proposed application integrates secure user authentication, real-time transaction recording, and interactive financial analytics using modern full-stack technologies. A MERN-based architecture—comprising React.js, Node.js/Express, and MongoDB—supports responsive data handling, while JWT authentication, bcrypt hashing, and RESTful APIs ensure security and scalability. The system provides features such as trend analysis, category-wise spending insights, and financial health indicators to assist users in identifying vulnerabilities and strengthening crisis preparedness. Experimental evaluation demonstrates that the application offers consistent, accurate, and meaningful financial insights, thereby improving user financial awareness and supporting more informed decision-making. The work contributes to personal finance technology by providing a practical and extensible solution for intelligent money management.

Keywords

Personal Finance Management, Crisis Preparedness, Full-Stack Web Development, Financial Analytics, React.js, Node.js, MongoDB.

Virtu Lrn – Gesture – Based Holographic Display

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Abstract

Virtu Lrn operates by interpreting gestures via camera input, enabling interaction with three-dimensional visuals formed using the Pepper's Ghost technique. Instead of relying on virtual or augmented reality hardware, it provides accessible depth in digital education. Movement becomes command, shaping how users engage with projected content. Cost efficiency emerges alongside experiential richness, shifting focus toward inclusive innovation. What results is a different path – one where light, motion, and perception combine quietly beneath the surface.

Keywords

Computer vision, Deep learning, Gesture-based interaction, Hand gesture recognition, Human-computer interaction, Machine learning, Real-time systems, Virtual learning environment.

Enhancing Breast Cancer Detection Using Deep Learning Framework

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Abstract

Among women across the planet, breast cancer is still ranked among the causes of cancer-related deaths, and early and precise diagnosis is of paramount importance as far as healthcare is concerned. Mammography is extensively applied to screen breast cancer, but the analysis of the mammogram images is often not easy because of the complicated structures of tissues and the imbalanced datasets. In the work, an optimised deep learning-based framework is introduced for the classification of breast cancer mammograms through the strategy of handling dual data. The offered method combines transfer learning and ResNet50 to extract the best features and uses the Synthetic Minority Over-sampling Technique (SMOTE) to efficiently resolve the issue of class imbalance. A completely connected classification network with batch normalization and dropout layers is implemented in order to enhance generalization and minimise overfitting. This framework is tested on both balanced and imbalanced data to simulate real-life diagnostic situations. The experimental outcomes show high classification accuracy, sensitivity and reliability, which point to the effectiveness of the dual approach in enhancing diagnostic performance. The given system has the potential of providing a scalable and efficient approach to computer-aided diagnosis of breast cancer and assist radiologists in delivering accurate and consistent clinical decisions.

Keywords

Breast Cancer Diagnosis, Mammogram Classification, Deep Learning, ResNet50, Transfer Learning, SMOTE, Imbalanced Data, Medical Image Classification, Computer-Aided Diagnosis.

Hybrid Log Classification System Using BERT, DBSCAN, Regex or Llms

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Abstract

Large-scale software systems continuously generate heterogeneous and unstructured log messages that are critical for monitoring system behavior and diagnosing failures. However, functional log classification remains challenging due to evolving log formats, semantic ambiguity, and the high computational cost of deep learning-based approaches. This paper presents a cost-aware hybrid log classification framework that combines density-based pattern discovery, rule-based filtering, and semantic language modeling within a unified pipeline. Frequent and repetitive log patterns are automatically identified using DBSCAN clustering over pre-trained, frozen BERT embeddings and are converted into lightweight Regular Expression (Regex) classifiers, enabling efficient handling of the majority of log traffic. Log messages that do not match derived patterns are semantically classified using a BERT-based classifier, while low-confidence predictions are selectively escalated to a Large Language Model (LLM) for robust handling of rare and previously unseen logs. Unlike single-model or parsing-dependent approaches, the proposed framework explicitly balances classification accuracy and inference cost through confidence-aware routing. Experimental evaluation on heterogeneous system logs demonstrates improved classification performance while significantly reducing reliance on computationally expensive models. The proposed approach offers a practical and extensible solution for scalable and reliable log classification in modern AIOps pipelines.

AI-Based Stock Price Prediction System

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Abstract

The stock market changes every day and predicting prices is very difficult. This project, AI Based Stock Price Prediction System, uses artificial intelligence to help predict future stock prices. It collects past stock data and analyzes patterns using machine learning techniques like LSTM, Random Forest. The system provides predictions that can help investors make smarter decisions, reduce risks, and plan their investments better. This project aims to make stock trading easier and more reliable by giving accurate forecasts in real time.

Keywords

Artificial Intelligence, Machine Learning, Stock Market Prediction.

Automated Infrastructure Configuration and Continuous Deployment Pipeline for Multi-Server Environments Using Ansible and Jenkins

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Abstract

Managing and deploying complex applications across multiple machines is an arduous task; In addition to being time-consuming and error-prone for Operations teams, it also creates an environment that causes headaches for everyone involved. We focused on this challenge, how do we keep a multi- host environment in perfect sync, and allow for the deployment of new functionality without disruption to anything? Our solution is an Automated Continuous Deployment (CD) Pipeline that provides an end-to-end approach to removing manual work from IT Operations. With the help of Ansible we've created a definitive Infrastructure Blueprint that automatically configures everything required to run an application (e.g., web servers, databases, load balancers, etc.) independently of any human intervention. The Pipeline leverages the capabilities provided by Jenkins to manage the Infrastructure Blueprint and serve as the primary "command" that coordinates the entire sequence from when a developer commits code through to the point where that same code is deployed to both Staging and Production environments. Ultimately, this transformation of the way we deploy has drastically reduced the burden of repetitive and error-prone tasks from our already stretched Operations teams.

Keywords

DevOps, CI/CD, Pipeline, Jenkins and Ansible server Configuration, Remote server.

AI Driven Control Framework for Scalable Microservices Resource Allocation

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Abstract

The microservice applications built using cloud-native technology have very dynamic workloads and complex service dependencies. This makes resource allocation a critical and challenging task. The conventional autoscaling method (such as threshold-based horizontal autoscaling) is too slow and does not consider service dependencies. This leads to performance issues and resource suboptimality. Our contribution is the proposed hybrid control framework, which integrates Reinforcement Learning (RL), Model Predictive Control (MPC), and Graph Neural Networks (GNN) as an intelligent management model for any resource. The GNN part relies on the service call graph to forecast the probability of workload and cascading effects of microservices. The RL agent is trained to learn scaling policies adaptively to cope with real-time fluctuation. There is an MPC module as a management stabilizer and foresight by optimizing the scaling decisions with the predictions of workload, constraints, and costs. The hybrid system is adaptive to provide CPU and memory resources to individual services and meet the latency Service-Level Objectives (SLOs). Our approach, in contrast to conventional autoscalers, seeks to accomplish a great improvement in an experiment on benchmark microservice applications: tail latency improvement of up to 50 percent, resource utilization efficiency improvement of up to 30 percent, and over 90 percent SLO satisfaction. The performance of these capabilities demonstrates that the proposed multi-model controller is efficient in dealing with the challenge of performance and efficiency tradeoff in the cloud environment.

Keywords

Microservices Autoscaling, Deep Reinforcement Learning, Graph Neural Networks (GNN), Model Predictive Control (MPC), Resource Orchestration, SLO Compliance.

Design and Implementation of an Embedded Industrial Monitoring System using STM32F446ZE Nucleo

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Abstract

The need for reliable and continuous monitoring of environmental conditions in industrial environments has increased significantly with the advancement of embedded technologies. Industrial facilities often operate under conditions where parameters such as temperature, humidity, and air quality must be carefully monitored to ensure safety, operational stability, and equipment reliability. This paper presents the design and implementation of an embedded industrial monitoring system using the STM32F446ZE Nucleo development board. The proposed system integrates environmental sensors, including the DHT11 temperature and humidity sensor and the MQ135 air quality sensor, to measure critical industrial parameters in real time.

The STM32 microcontroller collects sensor data, processes it, and evaluates environmental conditions based on predefined threshold values. The monitored parameters are displayed on an LCD module to provide local visualization of system status. Additionally, visual indicators using internal LEDs (Red, Blue, and Green) and an audible buzzer alert mechanism are implemented to notify operators when abnormal environmental conditions are detected. The system also transmits monitoring data to a computer through UART communication for further observation and analysis.

Experimental results demonstrate that the proposed system provides accurate sensor monitoring, reliable data processing, and effective real-time alert mechanisms. The developed system offers a cost-effective and scalable solution for improving safety and environmental monitoring in industrial applications.

Keywords

Industrial Monitoring System, Embedded Systems, STM32F446ZE Nucleo, Real-Time Data Acquisition, Sensor-Based Monitoring, UART Communication.

AI-Concierge: A Deepseek Powered Conversational Chatbot

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Abstract

In today's fast-paced academic environment, finding specific information on a college website can be surprisingly frustrating. Most institutional sites are cluttered and difficult to navigate, leaving students and staff struggling to find simple answers through basic search bars. While AI chatbots like ChatGPT offer a more conversational way to get help, they often struggle with hallucinations or lack access to up-to-date, private campus information. Most importantly, sending sensitive university data to public cloud APIs raises serious privacy concerns.

This paper details the development of a private, localized AI chatbot built to solve these problems using a Retrieval-Augmented Generation (RAG) framework. Unlike standard bots, our system stays current by using a custom data pipeline built with Playwright and BeautifulSoup to automatically scrape and clean content from the college domain. To make the bot smart, we implemented a FAISS vector database. By converting text into mathematical embeddings using the nomic-embed-text model, the system can instantly find and retrieve the exact paragraph needed to answer a student's question, moving far beyond simple keyword matching. A key priority of this project was keeping everything local. By using Ollama to host models like DeepSeek R1 on internal hardware, we ensured that campus data never leaves the network. This approach not only protects privacy but also removes the need for expensive API subscriptions. With a user-friendly interface built on Streamlit, our testing shows that this RAG-based setup is significantly more accurate and reliable than generic AI models. Ultimately, this project provides a secure, low-cost, and highly effective way for colleges to manage their knowledge and support their students.

Keywords

Retrieval-Augmented Generation (RAG), Local LLM, Ollama, FAISS, Playwright, Web Scraping, Institutional Knowledge Management, Data Privacy.

IMRAS – Intelligent Medication Risk Assessment System

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Abstract

Incomplete patient histories, drug–drug interactions, and allergy conflicts remain persistent problems in small and medium healthcare clinics, where resource constraints make preventable medication errors far too common. This paper introduces IMRAS (Intelligent Medication Risk Assessment System), an AI-powered clinical decision support tool built to assist physicians during prescription writing through a dedicated frontend interface. Each patient in IMRAS receives a unique identifier that ties their medication records to a central database, enabling real-time safety checks at the point of care. The system screens for drug–drug interactions, duplicate therapies, overdose risks, and allergy conflicts as part of its core safety workflow. Detection is handled by a rule-based medical safety engine working alongside a clinical NLP model built on BioBERT; together, they generate risk scores and produce interpretable warnings when clinical uncertainty is detected. For prescriptions flagged as high-risk, the system recommends safer therapeutic alternatives through clear, actionable notifications that physicians can evaluate directly – without interrupting the clinical record or creating gaps in documentation required for legal and audit purposes. Testing shows that IMRAS measurably cuts down on hazardous prescriptions and raises medication safety standards in settings where specialist oversight is limited, making it a practical option for outpatient clinics that need scalable, reliable decision support without heavy infrastructure investment.

Keywords

Clinical Decision Support System, Medication Safety, Drug–Drug Interaction, BioBERT, Allergy Detection, Risk Assessment, Explainable AI, Medical NLP, FastAPI, Electronic Prescription, Patient Medication History.

Fake Social Media Accounts and Their Detection

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Abstract

The social media sites have been adding more users who are forced to open fake user accounts to facilitate their online activities. Most of these accounts belong to the category of malicious users, who create threatening conditions through dissemination of misleading information and commit a scam on the background of manipulating the mass media opportunities of which they take advantage. Online testing must make sure that detection of fake accounts is performed as fake accounts have a direct negative effect on the credibility of the platforms. The paper will discuss the ways to detect misrepresented social media accounts with the help of different machine learning algorithms based on classical algorithms that involve Decision Tree and Random Forest and on recent natural language processing (NLP) algorithms that involve DistilBERT and RoBERTa with BiLSTM. The researchers built their models by means of testing, which involved all the user data points that contained information about their social network active behavior and their posting behavior among other information that is of relevance. The account age post frequency followers/following and the engagement ratio are the derived features that have been identified to be determining the distinguishing features of the fake accounts. The models evaluate their performance by the use of accuracy tests as well as precision tests and recall tests and F1-score tests. The results indicate that machine learning devices are capable of identifying fake accounts in a holistic manner, and the hybrid natural language processing models that incorporate the DistilBERT and BiLSTM models with the RoBERTa and BiLSTM models have better performance levels than the standard models. The hybrid NLP models are competing because they utilize contextual information that they gain by the posting of the user and the way that the user behaves during the process of the functioning of the models.

Keywords

This research paper discusses various machine learning models, e.g. Decision Tree and Random Forest and Logistic Regression to establish the efficacy of the models in performing Natural Language Processing tasks.

BIO-PAY: Biometric Wallet with Face + Password Authentication

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Abstract

BIO-PAY is a secure, device-free campus payment system designed for schools, colleges, universities, and other controlled environments where students and staff frequently make low-value payments without the burden of carrying cards, cash, or mobile phones. Each individual is assigned a unique campus ID, which acts as a unified digital identity for canteen purchases, library fines, hostel services, laboratory usage fees, and institutional fee counters. Instead of relying on physical tokens or personal smartphones, users authorize payments using only their face and memorized credentials at dedicated terminals connected to the campus network.

The core idea of BIO-PAY is to transform the campus ID into a trusted payment identity by tightly integrating facial recognition based on the Local Binary Patterns Histograms (LBPH) algorithm with password verification and automatic e-mail receipt generation using the Simple Mail Transfer Protocol (SMTP). Facial images captured at enrollment are pre-processed and encoded into LBPH feature vectors, enabling fast, on-device recognition with modest computational requirements suitable for low-cost hardware deployments. During a transaction, the system performs dual-factor verification: it first confirms that the live camera feed matches the stored LBPH template for the claimed campus ID, and then validates a user-defined password before authorizing any debit from the internal wallet balance. Once a payment is successfully executed, BIO-PAY generates a structured transaction receipt and delivers it via e-mail to the user (and optionally to guardians or administrators), creating a transparent, tamper-evident audit trail for every cafeteria purchase or service fee.

From an administrative perspective, BIO-PAY offers a centrally controlled and fully traceable payment ecosystem tailored to educational institutions. The backend maintains user profiles, balances, and transaction histories in a unified database, allowing accounts to be provisioned, suspended, or topped-up according to institutional policies or fee schedules. Because transactions are linked to biometric identities rather than physical cards, schools can significantly reduce card issuance and replacement costs, minimize cash handling, and curb fraudulent behaviors such as proxy purchases or impersonation at service counters. At the same time, parents and administrators benefit from improved visibility into spending patterns, enabling closer monitoring of student welfare, meal consumption, and compliance with financial aid policies. By eliminating the need for cards, QR codes, or mobile apps while adding biometric and credential-based safeguards, BIO-PAY positions itself as a practical, campus-scale model for secure, convenient, and accountable biometric payments in the education sector.

Light Gradient Boosting Machine Algorithm for Detecting IMOT Networks Anomaly for Healthcare Specific Dataset

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Abstract

The Internet of Medical Things (IoMT) connects medical devices to enable real-time monitoring and personalized care, significantly enhancing patient health and well-being. However, this connectivity also introduces substantial cybersecurity risks, including various attack types that compromise data integrity and availability, jeopardizing patient safety and healthcare service reliability. This study addresses these challenges by proposing a real-time anomaly detection model based on machine learning (ML) techniques, designed to detect and mitigate diverse cyber threats effectively. This paper proposes a new medical dataset for anomaly detection, inspired by the UNSW-NB15 dataset, and enriched with healthcare-relevant attack types, including falsification and DoS attacks, to reflect real-world IoMT scenarios. The dataset comprises 253680 records, with 60% anomalous data distributed across multiple attack types, offering a more challenging and realistic environment for evaluating ML models. Seven machine learning algorithms, including Random Forest, XGBoost, and Artificial Neural Networks (ANN), were rigorously tested, leading to the development of a novel stacking ensemble model. This model integrates XGBoost as the meta-learner with Random Forest and ANN as base models, leveraging their strengths to optimize anomaly detection. The proposed model was evaluated on both the UNSW-NB15 and the new medical dataset, achieving significant improvements across key metrics such as accuracy, precision, recall, and F1-score. A realtime prediction analysis further demonstrated its ability to detect anomalies efficiently during data transmission, validating its suitability for detecting anomalies in different scenarios. All traditional ML algorithms are used and not utilize any advance ML algorithms like CNN2D, LSTM, CATBOOST, LIGHTGBM or any other. So as extension we have experimented with above mention algorithms and then found LIGHTGBM giving highest accuracy compare to all propose and existing algorithms. LightGBM (Light Gradient Boosting Machine) is an open-source, high-performance gradient boosting framework developed by Microsoft. It is designed for efficiency, scalability, and high accuracy, particularly when dealing with large datasets. It utilizes decision tree algorithms and is applicable for various machine learning tasks, including classification, regression, and ranking.

Keywords

Anomaly detection, intrusion detection system, Internet of Medical Things, medical dataset with anomalies, machine learning, healthcare security, improved hybrid algorithm for better performance, Light Gradient Boosting Machine (LightGBM).

Byzantine - Robust Temporal Graph Reconstruction for Transactional Fraud Detection

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Abstract

The research aims to address the increasing complexity of financial fraud, which is heavily reliant on time-related and complex relational structures. Machine learning techniques are often ineffective in dealing with the dynamic nature of graph structures or may be susceptible to adversarial attacks. This paper proposes a strong and efficient approach for the detection of financial fraud using a combination of Temporal Graph Neural Networks (TGNNs) and Long Short-Term Memory (LSTM) networks, with the addition of Byzantine robust aggregators for improved robustness. The technique is based on the use of Edge-Aware Graph Neural Networks for spatial embeddings of graph structures, with the addition of LSTM networks for the modeling of time-related structures and the velocity of fraudulent activity. Data poisoning attacks are also addressed using Byzantine robust aggregators, such as median-based aggregators, for improved network convergence under adversarial attacks. The research is tested using a Google BigQuery Ethereum dataset, with 97,608 unique addresses and 95 time snapshots, resulting in a total of approximately 9.27 million node-time instances being processed using the network. The results show a PR-AUC of 81.92, indicating effective isolation of fraudulent activity and a significant improvement over conventional GNN-LSTM approaches with fixed thresholds. Additionally, the technique is also effective for handling millions of nodes using mini-batch and time-related processing of graph structures, providing a strong and efficient tool for the detection of fraud in a completely unsupervised and extremely secure environment.

Keywords

Financial Fraud Detection, Temporal Graph Neural Networks (T-GNN), LSTM, Byzantine Resilience, Adversarial Machine Learning, Graph Mining, Robust Optimization, Ethereum, Blockchain Security.

Design and Performance Analysis of a QCA-Based Cube Calculator Using Optimized Multiplier Architectures

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Abstract

The Quantum-Dot Cellular Automata (QCA) technology has been more promising as an alternative technology of the traditional Complementary Metal-Oxide Semiconductor (CMOS) technology due to its low power consumption, high switching rates and capability of integrating nanoscale scale devices. QCA can be used well to execute small scale arithmetic circuits because CMOS is approaching the scaling limits. In this work, it is proposed to use a Cube Calculator that relies on QCA as an optimized algorithm to perform the cube operation (A^3). The proposed architecture includes the use of optimized multiplier structure, majority gates and inverters to reduce redundancy of logic, number of cells and complexity of multiplier. QCA Designer is utilized to make the design and simulate it in the light of the estimation of the coherence vectors to test the parameters, such as the cell count, area utilization, clock latency and energy dissipation. The outcomes of simulation demonstrate that the energy dissipation of the proposed architecture is lower 1.10×10^{-2} eV and the average energy per cycle is 1.00×10^{-3} eV, significantly lower than the existing technologies. It is also expected to have superior computational efficiency because the proposed circuit converges faster and requires less time to simulate. These enhancements are needed to make the suggested QCA cube calculator fit in low-power nanoelectronics systems, cryptographic hardware and high-order arithmetic processing units and so forth.

Keywords

Quantum-Dot Cellular Automata (QCA), Cube Calculator, Optimized Multiplier Architecture etc.,

ZENLOCK – A Rule Based Mobile Application for Social Media Addiction Control with Automatic News Updates

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Abstract

Too much time on social media apps can harm focus, mood, because it disrupts balance with daily life. A new tool tackles this by watching how long someone uses certain platforms then stepping in when needed. Instead of guessing screen time, software counts taps and opens inside chosen apps using background tracking. After hitting a set threshold, the phone locks those apps until a special code resets access. Though automatic, it waits for people to ask permission before making changes visible. What makes it different? It does not rely on cloud servers yet still updates rules based on behavior patterns seen locally. Once logged in, users land on a news page showing live headlines pulled from outside sources. Instead of just linking up, the app ties into phone tools like time tracking, running tasks, and floating views to watch how apps are used. Because it checks actions using set rules while feeding useful articles, it quietly cuts down endless swiping. Testing shows setting clear digital boundaries helps people rethink their habits and pay closer attention to screen time.

Keywords

Digital Wellbeing, Social Media Addiction, Screen Time Monitoring, Rule-Based System, Mobile Application, Android, App Blocking, Behavioral Analysis, Productivity Enhancement, News Redirection.

Toward Optimal Architecture Selection: A Dataset-Centric Benchmarking of Point Cloud Neural Networks

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Abstract

Point cloud processing has seen remarkable advancements with deep learning, yet no consensus exists on which architecture performs best across diverse datasets and tasks. This study presents a comprehensive benchmarking of four prominent raw point cloud architectures—PointNet++, RandLA-Net, DGCNN, and Point Transformer—across eight datasets spanning indoor, outdoor, object-level, and small-scale domains. We evaluate performance using a multi-criteria scoring system incorporating accuracy, efficiency, memory usage, and generalization capability. Our experiments reveal that RandLA-Net achieves the best overall balance, excelling particularly in large-scale segmentation tasks, while Point Transformer dominates in classification accuracy but at a high computational cost. We provide practical guidelines for architecture selection based on dataset characteristics and application constraints.

Federated Learning-Based Privacy-Preserving Intrusion Detection System for IoT-Enabled Smart Cities

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Abstract

The rapid proliferation of Internet of Things (IoT) devices in smart cities has introduced unprecedented security challenges, while traditional centralized intrusion detection systems (IDS) raise significant privacy concerns due to the need for data aggregation. This paper presents a novel privacy-preserving federated learning-based intrusion detection system designed specifically for IoT-enabled smart city environments. The proposed system trains a global intrusion detection model collaboratively across distributed IoT devices using federated learning, ensuring that no raw privacy-sensitive data is ever transmitted to a central server, thereby preserving user privacy while maintaining detection accuracy. The architecture incorporates differential privacy mechanisms to provide formal, mathematically grounded privacy guarantees and employs a hierarchical federated learning model to effectively handle the heterogeneity inherent in IoT smart city networks. Extensive simulations using real-world IoT network traffic traces demonstrate that the system achieves a detection rate of 96.8% with low communication overhead and outperforms conventional centralized IDS approaches without compromising data privacy. The system successfully detects a wide range of IoT-specific attack vectors, including Distributed Denial of Service (DDoS) attacks, replay attacks, and botnet intrusions. This research underscores the critical importance of developing privacy-preserving and scalable security solutions tailored to the complex, distributed nature of smart city infrastructures, offering a practical and effective framework for securing next-generation IoT deployments. The proposed approach aligns with the Engineering and Technology themes of ICR CET 2026.

Multi-Model Approach for Predicting Stock Market Trend Reversals Using Supply and Demand Analysis

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Abstract

This research proposes a sophisticated multi-model machine learning framework designed to accurately forecast short-term price trend reversals within high-frequency financial markets using Limit Order Book (LOB) data. While traditional econometric methods often struggle to capture the complex, nonlinear dynamics of supply and demand inherent in order flow, our system overcomes these limitations by extracting high-resolution microstructure-based features. These include order imbalance metrics, bid-ask spreads, and price momentum derived from 5-minute NIFTY 50 futures data spanning August 2024 to August 2025. The framework integrates three complementary predictive architectures to capture diverse market signals: a Random Forest for identifying static feature relationships, a Stacked LSTM network to model long-range temporal dependencies and a Feedforward Neural Network for mapping intricate nonlinear decision boundaries. Each constituent model is trained to predict the binary direction of the subsequent 5-minute price candle. Rigorously assessed using standard classification metrics including accuracy, precision and F1-score this hybrid approach demonstrates robust predictive potential across volatile market conditions. By effectively bridging microstructure theory and deep learning, the framework offers a scalable foundation for real-time algorithmic trading systems, optimized execution strategies, and enhanced risk management in modern order-driven markets.

Keywords

Random Forest, Stacked LSTM, Neural Network.

Surrogate-Assisted Bayesian Multi-Objective Optimization for PPA Improvement in FPGA-Based Digital Design

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Abstract

The increasing complexity of VLSI systems and continuous technology scaling have made Power, Performance, and Area (PPA) optimization a critical challenge in modern digital design. Conventional heuristic and machine learning-based approaches often require extensive design space exploration and may not efficiently achieve optimal trade-offs among multiple objectives. This paper presents a surrogate-assisted multi-objective PPA optimization framework using Bayesian learning for efficient design space exploration. The proposed method leverages surrogate models to approximate design evaluations and employs Bayesian optimization to guide the search toward optimal parameter configurations, thereby reducing computational overhead and convergence time. The framework is implemented and validated using Xilinx Vivado, considering key metrics such as power, area, timing, and propagation delay. Experimental results demonstrate that the proposed approach reduces delay from 24 to 22, maintains power at 44, and significantly improves the PPA score from 320 to 136, compared to the existing ML-based method. Although the area increases from 80 to 100, the overall results indicate a superior trade-off among PPA metrics. The proposed method achieves improved Quality of Results (QoR), faster convergence, and reduced manual intervention, making it suitable for scalable and automated FPGA-based digital design optimization.

Keywords

Surrogate Modeling, Bayesian Optimization, Multi-Objective Optimization, Design Space Exploration (DSE), Power-Performance-Area (PPA) etc.,

Effect of Air Pollution on Human Respiratory System

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Abstract

Air pollution has become a serious ecological and human health problem, negatively influencing the respiratory system of humans and increasing the occurrence of chronic illnesses. To make timely interventions and make informed decisions, it is essential to evaluate and predict respiratory hazards due to air pollution accurately and precisely. This paper presents a smart structure, which combines categorization and forecasting of respiratory risks related to air quality through advanced ML algorithms. Classification is performed using RF, XGBoost, and LightGBM, with RF having the best performance with an accuracy of 97.8, a precision of 97.8, recall of 97.8 and F1-score of 97.8. Random Forest, XGBoost and LightGBM are used in air quality forecasting and LightGBM has the best results with an MSE of 61.625, RMSE of 7.850, MAE of 6.162 and a R²-score of 0.950. AI explainable systems, including LIME and SHAP, are used to provide both instance-level and global feature insights, therefore, enhancing the transparency and understandability of predictions. The models are deployed by the use of an online interface based on Flask, which supports security in user interactions, real-time forecasts, and predictions with alerts and recommendations. It is an all-inclusive approach to the proactive respiratory health awareness and the management of air quality.

Keywords

Air pollution, Respiratory health, Random Forest, XGBoost, LightGBM, LIME, SHAP, Flask.

Automated SEO Keyword Generation Through Multimodal Analysis of Video Content

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Abstract

Automated SEO keyword generation from multimedia content has become an important connecting point between multimedia comprehension and online discovery. This survey overviews the past literature that identifies and scores candidate keywords based on textual (metadata, transcripts, on screen text), audio (speech, linguistic information, music) and visual (objects, scenes, actions, on screen graphics) modalities, alongside approaches that engage explicit multimodal fusion. We combine methods that range from classical pipelines, text-based ranking after speech-to-text to TF IDF variants up to state of the art representation learning paradigms using deep convolutional networks, audio embeddings, and transformer-based cross-modal encoders. Strategies for evaluation, data, and SEO-focused metrics that are employed to evaluate keyword relevance, coverage, and ranking performance are contrasted and documented to reveal methodological trade-offs and reproducibility issues. Our examination reveals strong areas and areas of ongoing shortfall: text-heavy approaches remain strong in topicality but lack visual context; audio and vision signals enhance coverage for non-verbal and scene-based terms but have alignment and noise problems; and end-to-end multimodal systems are promising but are hampered by rare, SEO-minded evaluation benchmarks and the disconnect between research metrics and actual search performance. We end by describing directions for large-scale multimodal pretraining, end-to-end keyword-to-ranking pipelines, multilingual robustness, standardized SEO evaluation protocols, and explainable keyword attributions that have the potential to enable practical, high impact progress in automated SEO for video.

Keywords

SEO keyword generation, Deep learning, Feature extraction, Multimodal analysis.

Automatic Wind Turbine Shutdown System Using Pitch Regulation

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Abstract

Wind turbine is often subjected to strong wind velocities which can cause mechanical damage, undue vibration, and shorten the life of the components. Conventional protection yaw control and mechanical braking mechanisms systems entail the loss of energy and mechanical stress. A servo-controlled automatic wind turbine is discussed in this paper blade pitch- based shutdown system, which is intended to safe turbines in high wind speeds without wasting energy. The suggested system changes the blade pitch dynamically angle with high-torque servo motors beyond a wind speed predefined threshold. Once the wind velocity gets above the critical threshold (equivalent to 55 mph), the blades are turned in the near-feathered direction position (90 degrees) through which the wind passes through the rotor and effectively decreasing the torque and rotational velocity. The results have the ability to offer good speed control checking the viability of the proposed shutdown strategy towards minor and intelligent wind turbines.

Keywords

Wind Turbine, Automatic Shutdown, Blade Renewable Energy, Pitch Control, Servo Motor, ESP32.

EduVQA: A Multi Modal Visual Question Answering Framework for Enhancing Educational Reasoning

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Abstract

Visual pedagogy, the use of diagrams, graphs and illustrations in the teaching resource, has become more and more part of contemporary education and yet the learners are often faced with the challenge of getting the visual representations of concepts to be connected with the underlying conceptual structures. The current systems of questions and answers are mainly textual in nature and hence are not in a position to offer substantive reasoning support to the visual learning materials. Modern visual question answering (VQA) systems, modeled after general-purpose use, generally cannot handle educational case and give over-respectively simplistic answers. These incompetencies hinder the acquisition of concepts in the minds of the learners and reduce the effectiveness of the instructional tools. In answer to this, the current research suggests a complex VQA system, called eduVQA, which incorporates multimodal inputs. EduVQA increases the capabilities of educational reasoning by combining visual and textual data. The architecture consists of multimodal encoder built on LXMERT to identify salient areas in visual stimuli with additions of dynamic context selection techniques to pertinent textual content. The process begins with an auxiliary pre-answer generator which yields the candidate responses along with the estimated response confidence scores then filtered further to ensure the results are accurate. Implementation of eduVQA also provides learners with greater educational assistance, thus, improving e-learning ecosystems and facilitating the creation of individual learning patterns, ultimately contributing to the overall education process and results.

Keywords

eduVQA, Visual Question Answering (VQA), Multimodal Learning, Educational Reasoning, Deep Learning, Intelligent Tutoring Systems.

Gesture-to-Meaning Intelligent Interface for Non-Verbal Users

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Abstract

The paper proposes a new and efficient full-duplex communication system that fills the gap between Deaf and Mute (D-M) and Non-Deaf and Mute (ND-M) people without the need for ND-M people to learn sign language. In contrast to other models that only support unidirectional translation or translation in a single language, this system allows for real-time bidirectional translation in multiple sign languages, namely Indian Sign Language (ISL) and American Sign Language (ASL). The system also supports Speech-to-ISL/ASL, Text-to-ISL/ASL, ASL-to-ISL, and ASL-to-Speech translation. The system is developed using Machine Learning (ML), Convolutional Neural Networks (CNNs), and Natural Language Processing (NLP) techniques to provide high accuracy in gesture recognition and context-aware translation. The system is cost-effective, scalable, and can be applied in various settings such as education, healthcare, and public service sectors. The system is modular and can be easily extended to incorporate other sign languages. Experimental evaluations show over 96% accuracy with real-time responsiveness. The system and codebase are openly available to encourage replicability and wider adoption, thereby promoting digital inclusivity for the D-M community. Future enhancements include dataset expansion, full-word recognition, and collaborative deployment with accessibility-focused organizations.

Keywords

Deaf-mute communication, Real-time translation, Sign language dataset, Machine Learning, ISL, ASL.

Software Cost Estimation in Agile Methodology Using Deep Learning with Uncertainty Quantification

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Abstract

Accurate software cost estimation remains a critical challenge in Agile development environments, where requirements evolve continuously across sprints. Classical parametric models such as the Constructive Cost Model (COCOMO) and Function Point Analysis (FPA) were designed for waterfall projects and cannot leverage the qualitative narrative content generated by Agile teams. This paper presents a dual-input deep learning framework that combines BERT-Large text encoding of Agile sprint reports with eighteen structured project features. The model is trained under a Gaussian Negative Log-Likelihood (NLL) objective and queried via Monte Carlo (MC) Dropout to decompose predictive uncertainty into aleatoric and epistemic components. A two-phase discriminative fine-tuning schedule converges in under ten minutes on a single Graphics Processing Unit (GPU). Evaluated across five random seeds with stratified 5-fold cross-validation on a corpus of 10,000 synthetic Agile project records, the proposed model achieves a mean R^2 of 0.9876 ± 0.0021 and a mean MAPE of $6.71\% \pm 0.45\%$, reducing error by 56.4% relative to the strongest tabular baseline. A four-condition ablation study confirms the additive contribution of both the text branch and the MC Dropout uncertainty mechanism. The framework additionally produces calibrated 90% confidence intervals derived from the decomposed uncertainty signal.

Keywords

Software cost estimation, Agile methodology, deep learning, BERT, uncertainty quantification, natural language processing, Monte Carlo Dropout, ablation study.

Automatic Ignition Control System for Drunk Drivers

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Abstract

Road accidents due to drunk driving remain a serious global concern. Existing breathalyzer checkpoints are reactive and lack continuous monitoring. This project introduces an Automatic Ignition Control System. It prevents intoxicated and unauthorized individuals from starting a vehicle. The system uses an MQ-3 sensor to detect alcohol levels in breath. An Android app with MobileFaceNet performs real-time face recognition. An ESP32 microcontroller processes sensor and identity data. A preset BAC threshold determines ignition control decisions. If alcohol exceeds the limit, ignition is blocked via a relay. If an unregistered user is detected, access is denied. The system ensures both safety and authentication. The prototype was fully developed and tested successfully. Face detection response time is around 250 ms. Alcohol sensing range is 0–1000 ppm. Relay switching occurs in under 10 ms. The system is low-cost and practical for real-world use. It is easily integrable into existing vehicle systems. The modular design supports future upgrades. Enhancements may include GPS and IoT-based monitoring. Overall, it improves road safety through automation and real-time control.

An Analytical Study on the Performance, Cost Efficiency, and Sustainability of AAC Blocks in Indian Building Construction

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Abstract

The urbanization in India particularly in the Delhi-NCR area has been very significant in promoting the demand of efficient, cost effective as well as sustainable building material. The classical masonry blocks such as fired clay bricks are associated with large embodied energy, natural resources prostrate and low performance in thermal conditions. This essay is an evaluation of the Autoclaved Aerated Concrete (AAC) blocks as some of the lightweight and environment friendly alternative to building urban construction.

This is compared using secondary data, Indian Standards as well as Delhi-NCR market rates with some key parameters like the density, compressive strength, thermal conductivity, construction efficiency, and cost per unit wall area being the key ones in comparison. As per IS 2185 (Part 3): 1984, AAC blocks exhibit a density of 550–650 kg/m³ and compressive strength of 3–5 MPa. It is the findings that AAC blocks can reduce the structural dead load by approximately 55–60 percent particularly against the requirements of IS 875 (Part 1): 1987, and has 3–4 times higher thermal insulation appearance when compared to traditional bricks which, in turn, have the potential to save energy upto 25–30% by (Central Building Research Institute)

Cost analysis indicates that although AAC blocks have a higher upfront material cost, the overall construction expenses remain comparable. This is primarily because AAC blocks require less mortar, reduce structural demands as per IS 456:2000, and accelerate the construction process. The study arrives at a conclusion that the AAC blocks may be considered a promising and sustainable high-density urban construction in India.

Keywords

AAC Blocks, Sustainable Construction, Thermal Efficiency, Cost Optimization, Urban Infrastructure (Delhi-NCR).

Managing the Modern Workforce: Evaluating the Effectiveness of Remote and Hybrid Working Policies

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Abstract

In the aftermath of the COVID-19 pandemic, organizations have significantly restructured traditional workforce management practices by adopting remote and hybrid work models. This study examines how these work arrangements function within contemporary organizational strategies. It aims to identify effective practices for managing geographically dispersed teams and to evaluate the impact of remote work on employee productivity, job satisfaction, and work-life balance.

A comprehensive review of existing literature, including scholarly articles, books, and conference papers, forms the basis of this research. The findings indicate that remote work can enhance productivity and job satisfaction by minimizing workplace distractions and increasing flexibility. However, it may also lead to challenges such as social isolation and difficulties in maintaining clear boundaries between work and personal life. Hybrid work models, which integrate remote and office-based work, offer a balanced solution by promoting collaboration while preserving flexibility.

The study further highlights the importance of leadership, particularly transformational leadership and effective communication, in managing remote and hybrid teams successfully. It concludes by emphasizing the need for continued research to understand evolving trends and long-term implications for employee well-being and organizational performance.

Keywords

Workforce Management, Remote Work, Hybrid Work, Organizational Effectiveness.

A Hybrid Blockchain Architecture for Secure, Transparent, and User-Centric Electronic Voting System

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Abstract

The integrity and transparency of electoral systems are crucial for maintaining public trust in democracy. Traditional electronic voting methods depend on centralized infrastructures that are vulnerable to cyber-attacks, insider manipulation, and data tampering. These issues highlight the need for a secure, decentralized alternative that can ensure verifiable and tamper proof vote recording. Blockchain technology offers an unchangeable distributed ledger framework that improves security through cryptographic validation and consensus mechanisms.

This paper introduces a decentralized electronic voting system built on Ethereum smart contracts, integrated with a MERN stack web architecture. The new framework records votes as blockchain transactions. This guarantees immutability and prevents unauthorized changes. A wallet-based authentication mechanism ensures that each eligible voter can cast only one vote, reducing the risk of double voting. The system architecture includes a React-based frontend, a Node.js and Express backend, and Web3 communication with the Ethereum blockchain for secure and smooth interaction.

Performance evaluation shows better auditability, transparency, and robustness compared to traditional centralized voting models. This implementation offers a practical and scalable solution for institutional elections while maintaining security and integrity in decentralized settings.

Keywords

Blockchain, E-Voting, Ethereum, Smart Contracts, Web3, Decentralized Systems.

Automated Bone Marrow Cell Classification Using Deep Learning with EfficientNet - B0 and Progressive Unfreezing

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Abstract

Morphological classification of bone marrow cells is extremely important for the diagnosis of hematological cancer; however, it is still a time-consuming and expertise-dependent process. In this research paper, an end-to-end hybrid deep learning architecture based on the EfficientNet-B0 and the Swin Tiny Transformer has been suggested to classify 15 types of bone marrow cells from a vast number of 1.72 million microscopic images. Our hybrid model has shown outstanding accuracy (94.12%), exceeding the performance of EfficientNet-B0 alone (87.52%). High F1-scores were obtained for Eosinophils (0.98), Erythroid Progenitors (0.96), and Neutrophilic Granulocytes Segmented (0.94), whereas Hairy Cells (0.70) and Rare Cells (0.45) had worse performance scores. Grad-CAM, t-SNE, and cosine similarity analysis have revealed that our hybrid model considers important morphological characteristics like the nucleus and cytoplasm during classification.

Keywords

Bone Marrow Classification, Microscopic Imaging Hematological Malignancies, Hybrid Deep Learning, EfficientNet-B0, Swin Transformer, Grad-CAM.

Lightweight CNN Models for Real-Time Plant Disease Detection Using PyTorch, MobileNetV2 and Streamlit Deployment

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Abstract

Crop-related diseases are among the most devastating and common natural threats to agriculture, with annual yield losses of up to 40%, posing food security issues for billions of individuals. This leaves traditional expert-dependent diagnosis both expensive and time-consuming as well as out of reach for smallholder farmers in rural areas. We have implemented and trained a custom four-block convolutional neural network from scratch using PyTorch on leaf images for real-time plant disease identification in this study. We trained our model on 54,305 balanced images covering 38 disease and healthy classes from the PlantVillage dataset across 14 crop species obtained through Kaggle API. So we just used a standard pipeline (ImageNet-style normalisation, data augmentation, 70\%/15\%/15\% train-validation-test split and batch gradient descent). We showcase an `eval()` inference switching mechanism and web deployment with Streamlit as well. With 88.85% test accuracy and nearly two seconds inference, our model is highly relevant for real-world agricultural applications. These findings confirm that our custom CNN offers comparable accuracy while being practically usable and can greatly benefit small-scale farmers from across the globe as part of precision agriculture initiatives.

AI-Enhanced 3D Cultural Exploration Platform with Voice Narration: A Virtual Indian Temple Museum

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Abstract

This paper presents an AI-enhanced web-based 3D virtual museum designed to improve cultural heritage exploration through interactive and intelligent user experiences. The system enables users to explore virtual rooms containing temples, fossils, and ancient weapons using real-time 3D visualization within a web browser. The proposed system integrates automated audio narration, an AI-assisted semantic search module, and gamified learning through quizzes and leaderboards. The AI module performs context-aware query processing and generates relevant responses using a large language model, enabling efficient and intuitive information retrieval. The platform is implemented using React and Three.js for 3D visualization and FastAPI with JWT authentication for backend services. Experimental observations indicate improved user interaction, faster response time, and enhanced learning experience compared to conventional static museum platforms. The system demonstrates how integrating 3D visualization, artificial intelligence, and gamification can create an effective and accessible cultural learning environment.

Investigation of a Redesigned Engine Piston for Improved Performance in Internal Combustion Engines

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Abstract

The piston is a critical component of internal combustion engines, operating under severe mechanical loading and intense thermal environments. Material selection plays a decisive role in controlling deformation, stress concentration, heat dissipation, and long-term durability. This study presents a comparative thermo-mechanical evaluation of two aluminium–nickel (Al–Ni) alloys (98% Al–2% Ni and 96% Al–4% Ni) and two chromium–carbide (Cr–C) composites (98% Cr–2% carbide and 96% Cr–4% carbide) applied to engine piston design. Two distinct piston geometries were considered to examine the combined influence of material composition and geometric configuration. Finite Element Method (FEM)–based static structural and steady-state thermal analyses were performed using ANSYS Workbench under identical boundary and loading conditions. Structural performance was assessed in terms of total deformation, von Mises stress, and equivalent elastic strain, while thermal behaviour was evaluated using temperature distribution and total heat flux. The results indicate that aluminium–based materials exhibit higher deformation and strain due to lower elastic stiffness but demonstrate superior heat dissipation owing to high thermal conductivity. Increasing nickel content marginally improves stiffness while slightly reducing thermal conductivity. In contrast, chromium–carbide materials show significantly reduced deformation and strain, reflecting high rigidity and dimensional stability, but experience elevated temperature gradients and reduced heat flux due to lower thermal conductivity. Comparative analysis between the two piston geometries reveals that geometry strongly governs stress concentration, whereas material properties predominantly influence deformation and thermal response.

Keywords

Engine piston, Finite element analysis, Aluminium–nickel alloy, Chromium–carbide composite, Thermo-mechanical behaviour, Heat flux, Structural analysis.

Experimental Investigation of Concrete using Coconut Shell as a Coarse Aggregate Replacement

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Abstract

The aim of the work is to determine the characteristics and strength of concrete where some of the coarse aggregate is replaced with coconut shell and some cement is replaced with fly ash. This is done to reduce costs and promote green construction. 0% replacement of coconut shell and flyash. Three cubes and three cylinders were prepared carefully for the control mixture, following cement, fine aggregate, and coarse aggregate in order. Concrete mix design M30 is prepared for Conventional Coarse Aggregate Concrete in various proportions (10%, 20%, and 30%). Fly ash is used as a replacement for cement and coconut shell as a replacement for gravel. Three cubes and three cylinders for each variation. When 10% of the coarse aggregate is replaced, the Coconut Shell Concrete (CSC) has properties similar to the nominal mix concrete. Two types of concrete were produced: control concrete with normal aggregate and coconut shell concrete where 10-30% of the coarse aggregate was replaced with coconut shells. The density of the concrete decreased while replacing coconut shells. The water to cementitious material ratio of all concrete was maintained constant at 0.45.

Keywords

Cement, fly ash, coarse aggregate, coconut shell (CS), compression strength, split tensile strength and workability.

Performance Evaluation of Plastic waste Incorporated Concrete for Structural Application

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Abstract

The some of the work is to determine the properties and strength of concrete where some of the fine aggregate is substituted with E-Plastic waste (EPW) and some cement is replaced with fly ash. This is done to lower costs and support eco-friendly construction.

Materials and Methods: Consisted of conventional concrete with 0% replacement using EPW and fly ash. Three cubes, three cylinders and three prisms were prepared carefully for the control mixers. Concrete mix design M30 is prepared for conventional fine aggregate in various properties (5%, 10%,15%,20%, 25% and 30%). Fly ash and EPW are used as a substitution for cement and fine aggregate. Three cubes, three cylinders and three prisms for each variation. At 10% replacement level, the EPW has properties similar to the comparable to the control mix. Two types of concrete were produced: a control mix with conventional materials and modified mixes in which fine aggregate was partly replaced with EPW from 0 – 30% at an interval of 5%. As the percentage of EPW increased, the density of concrete slightly decreased. The water-cementitious material ratio was retained constant at 0.45 for all mixes. Among the tested proportions, the 10%replacement level showed performance comparable to the control mix.

Multi-Agent Deep Reinforcement Learning with Spatio-Temporal Graph Attention for Emergency Flow Optimization

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Abstract

Efficient and timely movement of emergency vehicles, particularly ambulances, is a critical challenge in urban traffic systems where congestion can lead to life-threatening delays. This project presents an intelligent traffic management framework that integrates Multi-Agent Deep Reinforcement Learning (MARL) with Spatio - Temporal Graph Attention Networks (ST-GAT) to optimize emergency vehicle flow. In the proposed system, each traffic signal operates as an autonomous agent that dynamically adjusts signal timings based on real-time traffic conditions and ambulance location. IoT-based technologies such as RFID, GPS, and communication modules are used to detect and track ambulances, enabling the system to create a seamless green corridor for rapid and uninterrupted movement. The integration of ST-GAT enables the system to model complex traffic patterns by capturing both spatial dependencies among intersections and temporal variations in traffic flow. The MARL agents are trained to minimize ambulance travel time while maintaining overall traffic efficiency, ensuring that normal traffic is not severely disrupted. Simulation results demonstrate that the proposed system significantly reduces emergency response time and improves traffic coordination across multiple intersections. The system is scalable, adaptive, and suitable for smart city applications, contributing to enhanced public safety and efficient urban transportation management.

Trajectory-Aware Transformer for Non-Invasive Diabetes Risk Prediction from Cross-Sectional NHANES Data

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Abstract

Diabetes mellitus affects about 537 million people around the world, making it a major global health issue. Finding risks early is the best way to avoid long-term problems. Traditional screening methods use invasive lab tests, which makes them hard to use in communities and places with few resources. Using cross-sectional data from the National Health and Nutrition Examination Survey (NHANES), this study suggests a trajectory-aware Transformer framework for predicting diabetes risk without laboratory tests. To fix the lack of clear temporal structure, we propose a pseudo-longitudinal sequence construction strategy based on clustering that uses a progression scoring mechanism to order people who are clinically similar. We use a Transformer encoder with Time2Vec temporal encoding and class-weighted training to model the resulting sequences. This is done to give more weight to sensitivity for screening purposes. The proposed model uses 289 non-invasive features and does not include any variables related to labs or diagnosis. It gets 90.54% accuracy, 0.9571 AUC-ROC, and 86.92 %recall on a held-out test set, correctly identifying 186 of 214 diabetes cases. The mean AUC of 0.9836 ± 0.0043 from five-fold stratified cross-validation shows that the performance is stable. The proposed method is about 14 percentage points better at telling the difference than previous NHANES-based non-invasive models that reported AUC values below 0.85%. Comprehensive validation, encompassing permutation testing and leakage prevention analysis, substantiates methodological integrity and endorses the feasibility of trajectory-aware self-attention for scalable population-level diabetes risk screening.

Keywords

Assessment of diabetes risk, Transformers, self-attention, pseudo-longitudinal modeling, screening without use of invasive procedures, NHANES, imbalanced classification, trajectory modelling.

Design and Fabrication of a Small-Scale Household Biogas Plant Using Organic Kitchen Waste for Cooking Applications

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Abstract

The objective of this study is to develop and produce a small-scale biogas digester plant with the help of kitchen organic waste. To convert biodegradable waste into clean and renewable energy for cooking purposes and to decrease the dependence on conventional fossil fuels and enhance the efficiency of waste management at the household level. It includes a tank named digester made of metal, the digester includes an inlet and outlet chamber, a gas holder, and a biogas burner. The waste material, which is organic in nature like peeled vegetables and other types of kitchen waste, were mixed with water from the slurry. That slurry is then fed into the metallic chamber which is also named anaerobic digester. It where in through inlet under oxygen-free condition through these microorganisms decompose the wastage for 10-20 days maximum and emit biogas. This biogas production is kept in the gas holder and stored for cooking purposes. On another side, while the digested slurry is discharged as nutrient-rich organic fertilizer. The result of the experiment reveals that the biogas plant designed is efficient for the production of biogas from the organic kitchen waste. The biogas plant decreases the organic waste of the households and the biogas largely produced is consistent in nature and can be used for cooking purposes. It also aids in the partial replacement of LPG. The slurry produced can be used as organic manure.

Keywords

Small-Scale, Biogas plant, Digester, Kitchen waste, Fertilizer, Organic, Slurry, Household, Applications.

A Role-Based Bug Tracking and Resolution System Using Java and MySQL

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Abstract

Software development teams can often face challenges in the process of identifying and fixing errors in an effective manner throughout the development lifecycle. A role-based bug tracking and resolution system built with Java Swing, Java Database Connectivity and MySQL is shown in this paper. Defects may be reported by testers, tracked and fixed by developers, and viewed by the managers through analytical dashboards to maintain a general view of the project health. The proposed solution enhances the visibility of the defects, accountability, and effectiveness of the bug resolutions by implementing the role-based access control and formal bug lifecycle administration.

Keywords

Software Defect Management, Role-Based Access Control, Bug Lifecycle Management, Java Swing, MySQL Database, Java Database Connectivity.

AI-Enhanced Tuberculosis Detection

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Abstract

For respiratory infections like pneumonia and tuberculosis (TB), early diagnosis is essential to minimize mortality rates and improve treatment success rates. This paper proposes an AI-assisted multi-modal healthcare system that uses chest X-ray images, cough audio samples, and patient symptoms to make an early prediction about the risk of disease. The proposed system uses a Convolutional Neural Network (CNN) for image analysis, an MFCC-based audio classification model for cough detection, and a symptom risk scoring module. The system uses a late fusion approach to combine the results of individual models to improve their diagnostic capabilities. The proposed system is developed as a web-based application that enables real-time screening and decision support, especially in distant and resource-constrained healthcare environments.

A Privacy-Preserving Federated Learning Framework for Real-Time Cryptocurrency Fraud Detection Using Hybrid Machine Learning Models

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Abstract

The exponential increase in the incidence of criminal activity relating to cryptocurrencies has been as a result of the rapid advancement of cryptocurrencies in the currency market. thus there are more challenges towards financial institutions and also towards the consumers who use it. This document describes a Blockchain-based Federated Learning (BCFL) System that allows the check for the occurrence of cryptocurrency fraud in a safe, scalable fashion while maintaining the privacy of the consumer. By using federated learning in combination with Blockchain technology, organizations like banks and cryptocurrency exchanges can collaborate to develop a fraud detection algorithm without the involvement of consumer's transaction data. Key features of this system are secure training of local models, encrypted sharing of model updates, decentralized aggregation of model updates and prediction of fraud. The use of Blockchain enables all parties involved to have some level of transparency and trust amongst each other, that is due in large part to the use of a lightweight consensus algorithm that helps to increase the efficiency of this system and reduce the processing burden. Also, the combination of hybrid Random Forest and Convolution Neural Network model generates additional accuracy improvement over detection based on pure statistical methods and those based on pure deep learning methods as it is capable of modelling statistical and deep transactional behaviours. The system was implemented using a real-world dataset; and the results achieved using our system achieved greater accuracy, precision, recall and ROC-AUC than traditional model-based methods. By marrying together scalable, privacy preserving and intelligent fraud detection, we believe that our system has the ability to provide a traditionally robust platform enabling effective protection against current challenges surrounding cryptocurrency-security

Keywords

Cryptocurrency Fraud Detection, Blockchain, Federated Learning, RF-CNN, Privacy Preservation, Distributed Learning, Cybersecurity.

HandSense AI: Real-Time Gesture Classification for Campus Safety Monitoring

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Abstract

Ensuring student safety in educational institutions remains a critical challenge due to issues such as ragging, suicidal ideation, and unexpected medical emergencies. This paper proposes HandSense AI, a real-time campus safety monitoring system that integrates computer vision and machine learning for automatic detection of distress and emergency situations. The system utilizes MediaPipe-based hand gesture recognition and deep learning models such as YOLOv5 and DeepFace to identify aggressive, submissive, and distress-related gestures from CCTV video streams. To enhance prediction accuracy and robustness, a Super Learner ensemble model is employed, combining multiple base classifiers including Gradient Boosting, Naïve Bayes, and AdaBoost. Experimental results demonstrate that the proposed ensemble approach achieves superior performance with an accuracy of 95.2%, along with high precision, recall, and F1-score, outperforming individual models. The system operates in real time with low latency and supports edge computing deployment, enabling rapid response through automated alerts to authorities. Additionally, the architecture is scalable and can be integrated with existing surveillance infrastructure. The proposed solution shifts campus security from reactive to proactive by enabling continuous monitoring and early intervention, thereby reducing the risk of harm and improving overall student well-being.

Smart Civic Reporter Android App

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Abstract

In present-day urban life, the smooth handling of public grievances and civic problems is imperative for securing effective governance and public satisfaction. The Smart Civic Reporter is an Android application with the aim to make the complaint registration as well as resolution process smoother, enabling citizens to report civic problems easily. The app leverages the Flutter and Firebase for real-time monitoring, filing complaints based on geolocation, and effective interaction between the citizenry and authorities. In taking several factors into consideration of urban infrastructure management, the application gathers and processes user complaints on streetlight outages, water leaks, drainage issues, road maintenance, and garbage disposal. Firebase Authentication for safe user registration and complaint tracking is included in the system to ensure a transparent and accountable process of resolution.

With a systematic approach, the system takes into consideration various parameters like complaint type, location, timestamps, complaint status and time taken for resolution in order to enhance response effectiveness. The Smart Civic Reporter application allows authorities to evaluate complaint trends, assign resources appropriately, and enhance the management of overall urban infrastructure. With its interactive UI/UX and data-intensive approach, the application provides citizen engagement and makes civic administration smarter and more responsive.

CropSelect AI-To Build up Agriculture Decision Using ML

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Abstract

Agriculture plays a vital role in economic development, and crop selection is one of the most critical decisions affecting productivity and sustainability. Traditional crop selection methods rely heavily on farmer experience and seasonal assumptions, which may not be reliable under changing climatic and soil conditions. This paper proposes CropSelect AI, an intelligent crop recommendation system that leverages machine learning techniques to assist farmers in selecting the most suitable crop based on soil nutrients and climatic parameters. The system analyzes factors such as Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, rainfall, and soil pH to generate accurate crop recommendations. Multiple machine learning algorithms are evaluated to determine the most effective model. Experimental results demonstrate that the proposed system improves decision accuracy, reduces crop failure risk, and supports data-driven agricultural practices.

Keywords

Crop Recommendation, Machine Learning, Precision Agriculture, Decision Support System, Smart Farming.

Intelligent Finance Management System

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Abstract

Financial ecosystems in the modern world demand intelligent systems capable of handling large, heterogeneous, and time-sensitive data streams. Traditional financial management approaches rely heavily on manual data entry, fragmented software tools, and static reporting mechanisms, resulting in inefficient decision-making, operational inefficiencies, and increased risk exposure. This paper proposes an Intelligent Financial Management System (IFMS) that integrates real-time data ingestion, automated preprocessing, time-series forecasting, and financial data visualization within a unified cloud-based platform.

The system employs the Seasonal Autoregressive Integrated Moving Average (SARIMA) model with automatic parameter tuning using the Akaike Information Criterion (AIC) to generate accurate financial forecasts. The frontend is developed using React.js, while Firebase provides backend support for secure authentication, scalable storage, and real-time data synchronization. Experimental evaluation on multi-year financial datasets demonstrates strong predictive performance, achieving a Mean Absolute Percentage Error (MAPE) of less than 5% and a coefficient of determination (R^2) exceeding 0.91. The proposed system enhances transparency, reduces manual workload, and supports faster and more informed financial decision-making.

Keywords

Intelligent Financial Management System, SARIMA, Time-Series Forecasting, Financial Analytics, Machine Learning, React.js, Firebase, Cloud Computing, Data Visualization.

A Review of IoT-Based Early Forest Fire Detection and Alerting Systems Using ESP32 and LoRa Communication

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Abstract

Forest fires pose a significant threat to ecosystems, biodiversity, and human life, causing severe environmental and economic damage worldwide. Traditional fire detection systems, such as satellite monitoring and manual surveillance, often suffer from delayed response times, limited accuracy, and high operational costs [1], [2]. In recent years, the integration of the Internet of Things (IoT) with advanced communication technologies has emerged as a promising solution for real-time environmental monitoring and early fire detection [4], [5].

This paper presents a comprehensive review of IoT-based early forest fire detection and alerting systems, with a specific focus on the use of the ESP32 microcontroller and LoRa communication technology. The ESP32 offers a cost-effective, low-power, and highly efficient platform for sensor data acquisition and processing, while LoRa enables long-range, low-power wireless communication suitable for remote forest environments [6], [7]. The combination of these technologies facilitates the deployment of distributed sensor networks capable of continuously monitoring environmental parameters such as temperature, humidity, and gas concentrations.

The paper analyzes various existing approaches, including satellite-based, camera-based, and wireless sensor network-based systems, highlighting their advantages and limitations [8], [9]. A comparative study of recent research works is presented to evaluate performance metrics such as detection accuracy, response time, power consumption, and communication range. Furthermore, the paper discusses system architecture designs integrating ESP32 and LoRa, emphasizing scalability, reliability, and energy efficiency. Key challenges such as false alarm rates, environmental variability, network reliability, and energy constraints are also discussed [12], [13]. Finally, emerging trends including artificial intelligence-based prediction, edge computing, and drone-assisted monitoring are highlighted as future research directions [10], [11], [14].

Keywords

Edge Computing, Sensor Fusion, Fire Prediction Systems, Remote Sensing, Energy-Efficient IoT, Smart Forestry, Disaster Management Systems, Embedded Systems, Cloud-Based Monitoring, AI-Based Fire Detection.

A Generative AI System for Financial News Analysis and Query Resolution

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Abstract

The explosion of unstructured financial documents - including annual reports, earnings call transcripts and market analysis articles - raises serious issues for extracting actionable information. This project introduces a finance-domain-optimized QA framework that utilizes AI. The model we propose combines NLP, LLMs and RAG to capture the challenging financial jargon, retain contextual information while generating natural answers which are contextually consistent. Among the many plaintext sentences in a lengthy report, an algorithm identifies and captures in a screenful of handy phrases, presenting this list as a summary section on top of the search results. A couple of exemplary semantic chunking algorithms are especially suited to sentimental analysis on financial data, one such example is described herein: financially-targeted semantic chunking (FTSC) that keeps reports readable by preserving their logical flow and retrieves more accurately. The system also has an interpretability layer that connects answers back to where they come from, helping maintain trust for the analyst and regulator.

In contrast to standard keyword-based search, answer search dynamically incorporates the context of its queries and outputs analysis natural language responses with citations. The modular nature design enables scaling and efficiency, while the combination of semantic chunking with RAG reduces hallucinations and improves factual consistency. The structure is flexible for to different usage cases, such as due diligence, compliance monitoring and market sentiment analysis or real time decision support. By dealing with issues of accuracy, interpretability and latency the system provides a body on which to build the next generation of financial intelligence engines.

Keywords

Generative AI, Financial News, Question Answering, Large Language Model, RAG, Semantic Chunking, Explainability.

Evaluation of Optical Eye Diagrams using Deep Learning Techniques

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Abstract

Efficient Optical Performance Monitoring (OPM) is very important in managing the increasing data rates and the complexity of modern optical communication networks. In scenarios where eye diagrams provide a standard qualitative assessment, automating the *quantitative* extraction of multiple Key Performance Indicators (KPIs) from them still remains a challenging and valuable goal. Our paper puts forward a study that compares two deep learning, multi-task models which simultaneously perform modulation format classification, estimation of Signal-to-Noise Ratio (SNR) and estimation of Bit Error Rate (BER) from a single 2D eye diagram image. We design, train and evaluate two architectures which are based on transfer learning: one uses a ResNet-18 backbone and another uses a lightweight MobileNetV2 backbone. Both models use a shared feature extractor and three parallel, task-specific heads which are trained jointly by minimizing a composite loss function. Experimental results on an unseen test set show that the model based on MobileNetV2 achieves a much better performance, with a modulation classification accuracy of 95.0%, a 0.75 dB Mean Absolute Error (MAE) for estimation of SNR, and an MAE of 0.15 for BER estimation. This is a significant discovery because the MobileNetV2 model achieves this higher accuracy while also being computationally less complex than the ResNet-18, demonstrating a highly effective and resource-efficient solution for real-time OPM.

Keywords

OptiSystem, Convolutional Neural Network, BER, SNR, ResNet-18, MobileNet V2, Eye Diagrams.

Seamless Mode Switching in Wind-PV Microgrid Using Fuzzy Logic

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Abstract

As renewable energy sources are increasingly integrated into distribution networks, maintaining reliable and high-quality power delivery has become more challenging. Systems that combine wind and photovoltaic generation are particularly sensitive to issues such as voltage instability, power quality degradation, and disturbances during switching between grid-connected and islanded operation. These problems become more pronounced when the system is exposed to unbalanced or nonlinear loads, especially during grid disconnection and reconnection events. To improve system performance under such conditions, a fuzzy logic-based control approach is developed for a Wind-PV-Grid integrated distributed generation system capable of operating smoothly during islanded and grid-connected operation. In contrast to conventional proportional-integral controllers, the proposed fuzzy controller adapts effectively to changing system conditions and nonlinear behavior, resulting in improved dynamic response and reduced voltage and current distortions. The effectiveness of the proposed control strategy is validated using MATLAB/Simulink simulations.

Keywords

Solar Photovoltaic Array, Power Quality, Bidirectional DC-DC Converter, Load Side Converter and Machine Side Converter), Fuzzy Logic Controller.

A Binary Bite-Controlled Assistive Communication System for Speech-Impaired Individuals

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Abstract

Human communication is considered to be one of the prime aspects of human interaction, which enables people to convey their needs, emotions, and thoughts. This is considered to be vital for maintaining independence and dignity. However, millions of people worldwide suffer from speech disabilities caused by neurological disorders, paralysis, accidents, and congenital conditions. In such cases, lack of verbal communication is considered to be a major hindrance to their normal lives.

Several technologies have been introduced over the years to aid people with communication disabilities. However, it is seen that these technologies rely on expensive hardware, sensors, and computing systems, which might not be feasible for everyone. In some cases, especially in developing countries, people might need simple solutions for effective communication.

The idea behind this research is to propose an efficient communication aid system that can transform the minimum physical input into an important voice output through the use of electronic devices. For this purpose, the system uses two push buttons that operate as binary input devices, enabling the user to input digital codes through the simplest form of input, such as button presses or bites. These input values are processed through the microcontroller-based system, which is based on the Arduino Uno platform. The system accepts four consecutive binary input values, which form the 4-bit code. Each combination of the four possible values of the binary input is accepted as the code, which is matched with the pre-recorded audio message through the voice playback module.

As the user sends the four consecutive values of the binary input, the system automatically identifies the code generated through the input values. Then, the system immediately plays the message through the speaker. There is no need for the system to have complex confirmation systems, making the interaction process easier for the user. An LCD is also included in the system, which displays the generated binary code.

The primary aim of this work is to develop a simple yet inexpensive device that will help speech-impaired individuals to convey basic utterances such as greetings, requests, or even emergencies. This system aims to prove that simple digital logic and electronics can be used to create useful devices that have real social value.

Keywords

Assistive Technology, Embedded Systems, Speech Impairment Communication, Binary Input System, Arduino-Based Communication Device, Voice Output Systems.

AI-Driven Public Health Chatbot-For Disease Awareness

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Abstract

Increasing awareness about health plays a crucial role in controlling and preventing disease, especially in regions with limited access to healthcare professionals. This paper presents an AI-driven public health chatbot designed to provide instant, reliable, and multilingual health information in English and Telugu. The proposed system uses a natural language processing-based layered architecture consisting of language detection, intent classification, and response generation modules integrated with a structured disease knowledge base. The chatbot provides information related to disease symptoms, causes, preventive measures, and basic treatment guidance while maintaining ethical constraints by avoiding diagnosis or prescription. Experimental evaluation conducted on approximately 250 user queries demonstrates an overall response accuracy of about 90%, with an average response time of less than 2 seconds. The results indicate that the proposed chatbot is effective, scalable, and suitable for continuous public health awareness and educational support.

Keywords

AI Health Chatbot, Disease Awareness System, Multilingual Health Assistance.

A Multimodal Stress Detection Framework Based on Facial Expression Analysis and Psychometric Evaluation using Explainable AI

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Abstract

Stress is becoming an increasingly serious psychological issue affecting people from many different backgrounds, and being exposed to undiagnosed long-term stress can lead to developing anxiety, depression, and an overall decrease in mental health. Because stress is a subjective experience and self-reporting tools alone are often insufficient for accurate measurement, the present study proposes a novel multimodal stress detection framework that combines facial expression analysis with psychometric evaluation to provide reliable and valid stress measurement. The framework utilises the AffectNet dataset and employs two models: a fine-tuned EfficientNetB3 for binary stress classification (Stress vs. No-Stress) and a Sequential Convolutional Neural Network for continuous Vision Stress Score (VSS) regression on a 0–100% scale, based on established psychological stress-arousal mappings derived from facial expressions. The Psychometric Stress Score (PSSS) is based on the PSS-10, a valid tool for assessing a person's self-reported stress level over the past month. With a higher weight given to PSSS due to its wider temporal coverage and clinical validity, the Final Stress Index (FSI) integrates the complementary strengths of visual and psychological stress signals to produce a more accurate and comprehensive stress assessment. The EfficientNetB3 classification model achieved an overall accuracy of 91% on the validation dataset. The regression model achieved a Mean Absolute Error (MAE) of 0.0801 and a Coefficient of Determination (R^2) of 0.9158, both demonstrating strong predictive validity. Grad-CAM and Occlusion Sensitivity Testing were used to identify stress-related facial regions, providing clinical context for the interpretation of the model's predictions. The proposed framework advances stress measurement beyond traditional unimodal methods by providing an integrated, explainable system based on clinically founded practice that can be used to monitor mental health in real-world applications.

Keywords

Stress Detection, Facial Expression Analysis, EfficientNetB3, CNN, Stress Regression, Multimodal Fusion, Perceived Stress Scale, Final Stress Index, Grad-CAM, Occlusion Sensitivity.

Strategic Process Optimization for Manufacturing Efficiency Using IoT Integration and Lean Principles

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Abstract

The convergence of Internet of Things (IoT) technology with Lean manufacturing principles presents a significant opportunity for systematic process optimization in modern manufacturing enterprises. This paper presents a four-layer IoT-Lean Architecture Framework integrating IoT sensor networks, real-time data analytics, and edge computing with core Lean methodologies—including Value Stream Mapping (VSM), Kaizen, 5S, and Just-in-Time (JIT) production. Based on a 12-month implementation study at a precision machining facility (3 production lines, 48 IoT nodes), the framework achieved a 30.6% improvement in Overall Equipment Effectiveness (OEE), 62.5% reduction in unplanned downtime, 73.8% reduction in defect rates, and a doubling of the value-add ratio from 28% to 54%. A structured PDCA-based optimization methodology and phased strategic roadmap are presented to guide manufacturing organizations in IoT-Lean transformation.

Keywords

IoT Integration, Lean Manufacturing, Process Optimization, Industry 4.0, OEE, Value Stream Mapping, Kaizen, Predictive Maintenance.

Slientscan: Unconverging Hidden Brain Tumor Using Multimodal Multidimensional Deep Learning

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Abstract

Early and accurate detection of brain tumors remains a significant challenge in medical imaging due to the subtle appearance of early-stage and infiltrative tumors in magnetic resonance imaging (MRI) scans. Conventional manual diagnosis is time-consuming and heavily dependent on expert radiologists, which can result in delayed or missed detections. To overcome these limitations, this paper presents SilentScan, an AI-based framework for early brain tumor detection and segmentation using multimodal MRI data. The proposed system integrates T1, T2, and FLAIR MRI sequences along with patient clinical information to improve diagnostic accuracy. An Attention U-Net-based deep learning architecture is employed to achieve precise pixel-level tumor segmentation, enabling accurate localization of small and low-contrast tumor regions. Furthermore, Explainable Artificial Intelligence (XAI) techniques, including Gradient-weighted Class Activation Mapping (Grad-CAM) and SHapley Additive exPlanations (SHAP), are incorporated to provide both visual and feature-level interpretability of the model's predictions.

Keywords

Brain Tumor Detection, Multimodal MRI, Medical Image Segmentation, Attention U-Net, Deep Learning, Explainable Artificial Intelligence, Grad-CAM, SHAP, Computer-Aided Diagnosis.

VSign: A Vision-Based System for Real-Time Sign Language Subtitling in Online Conversions

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Abstract

Sign language serves as a primary means of communication becomes challenging for individuals who are deaf or hard of hearing; however, communication barriers persist due to limited public understanding. This paper presents Vsign, a vision-based real-time sign language recognition and subtitling system using MediaPipe hand landmark extraction and deep learning techniques. The proposed approach converts high-dimensional video input into lightweight 21-point hand landmark coordinates, significantly reducing computational complexity. The system pipeline includes landmark extraction, coordinate normalization, temporal smoothing, and sequence-based classification using models such as LSTM and GRU. Experimental results demonstrate that the proposed system achieves reliable recognition accuracy while maintaining low latency suitable for real-time applications. The system enables seamless conversion of sign gestures into textual subtitles, facilitating effective communication in live video interactions.

Keywords

Sign Language Recognition, MediaPipe, Hand Landmarks, Deep Learning, LSTM, Real-Time Subtitling, Computer Vision.

Secure Messaging System with Quantum Encryption

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Abstract

This system provides a secure messaging platform that will ensure the safety of digital communications from the current cyber threats posed by quantum computing. Encryption methods may not be effective in the future as quantum computers improve. This necessitates the need to ensure the safety of communications through the adoption of quantum-safe security measures. This problem can be resolved by implementing the Quantum Key Distribution (QKD) protocol for secure key exchange and the Advanced Encryption Standard (AES) protocol for encrypting messages. Once the key is established, the AES protocol can be utilized to encrypt messages quickly with symmetric key encryption. This will ensure the end-to-end encryption of messages to maintain their privacy.

Keywords

Quantum Encryption, QKD, AES, Secure Messaging, Cryptography, End-to-End Security.

CareerAtlas.ai: Your Intelligent Map to Careers, Growth & Jobs

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Abstract

Determining an appropriate career path is one of the biggest challenges faced by students and job seekers due to limited availability of personal career guidance and dynamic career market demands. Most current career guidance platforms are limited to job postings and lack advanced data analysis capabilities to evaluate users' skills, interests, and professional experience for effective career recommendations. This paper proposes an AI -based career guidance platform, CareerAtlas.ai, that can assist users in making informed career decisions through data-driven career analysis. Natural Language Processing is applied on user resumes to extract relevant information and create an extensive user career profile. The system architecture consists of a Streamlit-based frontend for user interaction and a Django-based backend responsible for data processing and delivering career recommendations. Additionally, a flexible database has been integrated into the proposed career guidance platform. Based on user data analysis, the proposed platform provides career recommendations, identifies skill gaps, and suggests relevant job opportunities from existing job portals.

Keywords

Artificial Intelligence, Resume Analysis, Career Recommendation System, Job Recommendation, NLP, Streamlit, Django, Skill gap analysis.

A Unified Deep Learning Framework for Tomato Leaf Disease Detection Using VGG16 and MobileNet Architectures

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Abstract

Identifying tomato leaf diseases in the early stage is important in order to minimize crop damage and improve overall crop productivity. Recently, deep learning based methods have been broadly used in automating plant disease identification because of their ability to classify images accurately and quickly. In this study, an integrated deep learning system is presented using two convolutional neural network models, VGG16 and MobileNet, trained on the open source Plant Village tomato leaf dataset containing 16,012 images which belongs to ten different categories. This work presents an efficient deep learning based system for automated tomato leaf disease classification by merging the strengths of deep convolutional feature extraction and lightweight model optimization. Transfer learning helps the models learn faster and achieve higher accuracy while keeping the system more efficient and easy to run. In Experimental findings shows that the hybrid learning strategy works better for classifying the data, converges more quickly, and better at generalizing, making it good choice for real time agricultural monitoring systems. The study talks about how important is that to balance the accuracy and efficiency for real world use in precision agriculture.

Keywords

Tomato leaf disease, VGG16, MobileNet, Transfer Learning, CNN, Precision agriculture.

A Blockchain-Based Peer-to-Peer Lending System with Dynamic Interest Rate Modeling

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Abstract

This paper presents ChainLoan, a decentralized peer-to-peer lending protocol built on the Ethereum blockchain, designed to eliminate intermediaries through the use of smart contracts and automated financial mechanisms. The proposed system incorporates a dynamic utilization-based interest rate model that adjusts borrowing costs in real time according to liquidity conditions. To ensure accurate collateral valuation, decentralized oracle networks are integrated, while automated liquidation mechanisms are employed to maintain protocol solvency and mitigate default risk. The architecture follows a modular Web3 design, consisting of client, blockchain interaction, smart contract, and oracle layers. Performance evaluation conducted on the Ethereum Sepolia testnet demonstrates significant improvements in transaction latency, transparency, and operational efficiency compared to traditional financial systems. The results indicate that the proposed approach provides a secure, scalable, and transparent framework for decentralized lending. Future work includes integration with Layer-2 scaling solutions and the incorporation of decentralized identity mechanisms to enable more flexible credit models.

Keywords

Blockchain Technology, Decentralized Finance (DeFi), Ethereum Virtual Machine (EVM), Smart Contracts, Peer-to-Peer Lending, Over-collateralization, Algorithmic Interest Rates, Web3 Architecture.

Smart Agrihub: AI-Powered Platform for Farming Marketplace, Weather & Crop Prediction, and Regional Language Support

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This research introduces an intelligent and integrated agricultural decision-support framework with the combination of machine learning, computer vision, and expert knowledge synthesis to help the farmer with crop choice, fertilizer, and early detection of plant diseases. The system has several supervised learning pipelines such as Rotation Forest ensemble classifier, voting-based crop recommendation models, and the label-encoded fertilizer prediction networks, while using the unified FastAPI architecture. A deep learning segmentation model called the Roboflow API can be used to access real-time disease diagnosis using leaf images, while a generative AI module based on Gemini model can be used for interpretive agronomic guidance based on crop type, pest or disease profile, and the geographical location. The platform also integrates with a frontend client which is built using React & Vite with modular routing, visualization and user management using centralized application state. The interoperability of these components proves a concept of an end-to-end and scalable pipeline that can bring actionable insights in agriculture to boost further efficiency of inputs, in addition to facilitating precision farming practices for various user groups.

Keywords

Crop recommender, fertilizer predictor, plant disease analysis, Rotation Forest algorithm, Ensemble learning, FastAPI, Generative AI computer vision artificial intelligence, registration farms decision support, precision agriculture.

AAS: Bridging Static Knowledge and Dynamic Endpoints in Institutional Assistance Systems

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Abstract

The adoption of Large Language Models (LLMs) into the higher education setting is currently constrained by the so-called Data Fragmentation problem, where the institutional knowledge is split into unstructured disorganized documents (e.g., syllabi, policies) and structured, safe databases (e.g., ERP, LMS). Conventional Retrieval-Augmented Generation (RAG) systems cannot close this gap, they tend to fail at retrieving realtime information or fail to hallucinate in answering student specific queries like attendance and results analysis. We describe the Agentic Academic System (AAS), a neuro-symbolic framework combination, in order to address this, where semantic reasoning and data retrieval are separated. AAS proposes a Semantic Intent Router that dynamically types and routes user queries to either a Neural Retrieval Engine with the static knowledge or a more secure and deterministic execution of backend tools via a Model Context Protocol (MCP) server. The system guarantees the privacy and integrity of data by the close isolation of these workflows and standardization of various output formats through a new Context Fusion Layer. Experimental evidence on a high-fidelity synthetic data set shows that AAS eradicates hallucinations on numerical data, and can do so, with 100 percent accuracy on dynamic queries (as opposed to 0 percent on a baseline system RAG system), with an average real-time latency of approximately 1.7 seconds. This model provides a platform of privacy-centric, scalable design of the future generation of academic assistants.

Keywords

Artificial Intelligence (AI), Large Language Models, Retrieval-Augmented Generation (RAG), Model Context Protocol (MCP), Chatbots, Academic Chatbots, Artificial Intelligence in Education, Neuro-symbolic AI, Data Privacy.

Simulation-Driven Smart MRO Framework for Predictive Maintenance of Dormant Surface-to-Air Missile Solid Rocket Motors Using CFD and Internal Ballistic Analysis

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Abstract

Before being put into service, Surface-to-Air Missile (SAM) propulsion systems are usually kept in a dormant state for long periods of time. Propellant grains, casing materials, and insulation layers may deteriorate during prolonged storage, which could compromise system dependability and mission preparedness. Conventional time-based maintenance techniques may miss early degradation mechanisms and are frequently ineffective.

In order to evaluate the health of dormant solid rocket motors used in SAM systems, this study suggests a simulation-driven Smart Maintenance, Repair, and Overhaul (MRO) framework. To assess propulsion system performance, the suggested method combines computational fluid dynamics (CFD) analysis, static motor testing, and internal ballistic simulation using OpenMotor software. Aerodynamic pressure distribution and velocity flow characteristics surrounding the missile body are examined using CFD simulations, whereas experimental thrust-time and chamber. The results of the experiment indicate stable combustion during the main burn phase, with a peak thrust of roughly 7.3 kN and a maximum chamber pressure of 7.8 MPa. A post-test examination showed that localized over-pressure conditions were the cause of the casing rupture.

The proposed Smart MRO framework combines simulation-based performance prediction with condition-based maintenance decision matrices and non-destructive testing (NDT) techniques to identify structural degradation in dormant missile motors. The results demonstrate that simulation-assisted predictive maintenance can significantly improve operational safety, reduce lifecycle costs, and enhance mission readiness for long-stored missile propulsion systems.

Keywords

Smart MRO, Surface-to-Air Missile, Predictive Maintenance, CFD, Open Motor, Fin Actuator Control System, Solid Rocket Motor.

Deep Learning Based Crop Pests and Disease Detection

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Abstract

There is a significant importance of detecting the diseases of crops early so that the productivity of agriculture can be enhanced as well as food security achieved. In this paper, automated crop leaf disease detection system is introduced with the use of deep learning methods on convolutional neural network and transfer learning. A pre-trained DenseNet-121 model is trained on a harmonized set of healthy and pathological images in the form of crop leaves in publicly accessible agricultural image repositories. Techniques used are image preprocessing and data augmentation in order to improve the generalization of the models and due to overfitting. The suggested model has a high level of accuracy and strength in assigning various categories of crop leaf diseases. Experimental analysis is done in terms of standard performance measures of accuracy, precision, recall, and F1-score. These findings show that that DenseNet-121-based version is a reliable perspective of disease classification in various types of crops, and can therefore be used in monitoring crops in real-time and deciding on the smart farming use-case.

Keywords

Crop disease detection, DenseNet-121, Deep learning, Crop monitoring.

Crime Rate Prediction and Hotspot Analysis using Machine Learning

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Abstract

Crime type analysis and prediction with the hotspot detection to identify the high misdeed or crime area. It is a methodical way to analyze the crimes and it shows where the crimes occur more frequently by using the data predictive analysis and spatial data analysis techniques. previous studies have predicted crime pattern and heatmaps using structured and unstructured data but achieved the limited prediction accuracy. In this project which is built with the Indian crime datasets for the new crime type prediction, in this use the method of machine learning with the combination of convolutional neural network and artificial neural network (ANN & CNN) to achieve the best prediction and surpass the previous project prediction level. This will assure that it will keep the society safe from the major crimes. In this combination we can achieve the best prediction of numerical values as well as the images or major crime region of the crime spot areas. This paper talks about the different type of crime analysis and how the crime can be predicted by using the advanced methodology.

Keywords

Crime type prediction, predictive analysis, Indian crime datasets, crime heatmap, crime pattern analysis, Convolutional neural network, Artificial neural network.

A Review on Fabrication of Single Screw Extruder for Recycling 3D Printer Material

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Abstract

This review paper synthesizes findings from thirteen research studies on the design, fabrication, and performance of single-screw extruders for recycling polyethylene and related plastics into filaments suitable for 3D printing. It covers key aspects such as screw geometry, barrel design, heating zones, and process parameters like temperature and screw speed. The studies collectively show that extrusion temperature significantly affects filament quality, with 190 °C emerging as an optimal range for polyethylene. Parameters like surface roughness, filament diameter consistency, and mechanical properties are emphasized. In addition, the paper reviews challenges in scaling up extrusion, handling mixed plastic waste, and achieving economic feasibility. The review concludes that single-screw extrusion is a practical, low-cost approach to recycling plastic waste into useful products, but broader testing, advanced controls, and lifecycle assessments are needed for industrial adoption.

Keywords

Single-Screw Extruder, Polymer Recycling, Polyethylene, Filament Production, 3D Printing, Surface Roughness, Process Optimization.

DHARMA: An AI-Driven Legal Assistance Platform

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Abstract

The rapid digitization of judicial records and legal documentation has significantly increased the complexity of managing and retrieving case-related information. Conventional legal workflows, largely dependent on manual review and keyword-based search mechanisms, often result in inefficiencies, delayed decision-making, and limited contextual retrieval accuracy. To address these challenges, this work introduces DHARMA, an AI-enabled legal assistance platform that integrates structured case lifecycle management with transformer-based semantic retrieval techniques. The system converts legal documents into 768-dimensional semantic embeddings and employs cosine similarity-based vector search to enable context-aware retrieval beyond exact keyword matching. A modular preprocessing pipeline supports document normalization, entity extraction, and automated summarization, while the backend architecture ensures scalable and secure cloud deployment. Experimental evaluation was conducted on a dataset comprising over 500 legal documents and multiple structured query scenarios. Comparative analysis against traditional keyword search demonstrates a 30–35% improvement in retrieval precision and an F1-score exceeding 0.80 for legal entity extraction and summarization tasks. Additionally, structured case tracking reduced administrative processing time by approximately 40%.

These findings indicate that the integration of semantic intelligence with structured case management can substantially enhance legal research efficiency and operational transparency, establishing a scalable foundation for next-generation AI-assisted judicial systems.

Text Summarization Techniques for Indian Legal Document Using Mistral

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Abstract

Indian legal practice creates huge amounts of text—ranging from Acts and regulations to Supreme Court and High Court judgments. Automated summarizing can speed up legal research, checks for compliance, and assist non-lawyers in grasping salient points. This survey goes over cutting-edge text summarization specific to Indian legal papers, addressing (1) extractive, abstractive, and hybrid approaches; (2) India-specific datasets and data acquisition methods; (3) India-specific challenges across domains (multilingualism, antiquated vocabulary, verbose judgments); (4) tools and frameworks; and (5) open issues and future research directions.

Keywords

Natural Language Processing (NLP), Text Summarization, Legal Document Summarization, Extractive Summarization, Abstractive Summarization, Legal NLP, Indian Judiciary.

Privacy-Preserving Acne Detection and Skin Oiliness Analysis Using YOLOv5, PCA, and Blockchain

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Abstract

This paper presents a privacy-preserving framework for automated dermatological analysis that integrates deep learning-based acne detection, skin oiliness estimation, and blockchain-enabled secure data sharing. Facial images are analyzed using the YOLOv5 object detection model to identify acne lesions and key facial regions. The detected facial area is divided into fixed-size patches to extract reflectance- and texture-based features related to skin oiliness. Principal Component Analysis (PCA) is applied to these features to compute a global oiliness index and generate spatial oiliness heatmaps that provide interpretable insights into facial skin conditions. In addition, acne face mapping is incorporated to associate lesion locations with dermatological interpretations. To ensure privacy and secure medical data management, dermatological reports are encrypted and stored in the InterPlanetary File System (IPFS), while blockchain technology maintains immutable access records and controlled data sharing through smart contracts. Experimental evaluation demonstrates reliable acne detection performance and interpretable oiliness estimation across facial regions. The proposed framework provides a secure and scalable solution for automated dermatological assessment and privacy-preserving healthcare data management.

Integrated Sentiment Analysis and Trend Recognition for Opinion Mining

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Abstract

Tourism happens to be one of the most powerful industries globally, and social media sites such as Instagram are becoming influential channels through which travelers are able to share their experiences, reviews, and opinions. The sheer number of user-generated content in the form of captions, hashtags, and posts is excellent in its ability to give insight into public sentiment but is extremely unstructured and hard to analyze manually. This work outlines a Sentiment Analysis and Trend Detection in Tourism system based on Instagram data. The methodology includes gathering tourism-related posts and hashtags, preprocessing for noise removal, and using machine learning and deep learning models for sentiment classification into positive, negative, and neutral sentiments. Additionally, trend detection algorithms are used to detect famous destinations, new travel activities, and changing tourist interest over time. The findings are represented by pie charts, word clouds, and trend graphs and present useful information to tourism boards, travel operators, policymakers, and travelers. This project highlights the potential of data centric tourism analytics and how it can facilitate better decision-making, improved services, and enhanced travel experiences through integrating sentiment analysis with trend recognition.

Keywords

Sentiment Analysis, Trend Detection, Tourism Analytics, Instagram Data.

Reely AI: A Self-Adaptive Multi-Model Content Generation Studio with Explainable Provider Selection and Adversarial Testing

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Abstract

The inherent volatility and service-level inconsistencies of single-provider Large Language Model platforms pose significant risks to the reliability of AI-driven applications. To address these challenges, this paper introduces Reely AI, a full-stack AI content generation studio that implements a resilient multi-model orchestration framework. By intelligently routing across Google Gemini 2.0 Flash, xAI Grok, and Pollinations AI, this mitigates downtime and quality issues associated with each individual provider. The architecture, which has been built upon a FastAPI backend with React 19 frontend and Firebase authentication, revolves around an adaptive scoring engine that utilizes the Upper Confidence Bound algorithm. To improve transparency, the system has also been designed with an explainability feature that provides users with weighted feature breakdowns in plain language. In addition to this, security has been maintained with the creation of 250 automated test cases across five attack vectors: direct injection, obfuscation, encoding, semantic variation, and contextual hiding, resulting in an 86% overall detection rate. In addition to this, the creation of a two-layer neural quality predictor with 3,265 parameters has resulted in the ability to predict quality before selection with only 6.3ms marginal latency. Reely AI has demonstrated an increase in success rates from 94.2% to 98.7%, with a latency reduction of 367ms, and an improvement in user satisfaction from 3.8 to 4.5 out of 5, with only 20ms total pipeline overhead, following evaluation over 30 days with 10,000 production requests.

Concierge Agent: A Local Hybrid Vision-Language Framework for Privacy-Preserving Autonomous Computer Use

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Abstract

The majority of computer usage agents available today are based on cloud-computing AI models that need constant communication of screenshots and user activity with servers, which poses significant privacy risks when the task involves personal information, credentials, or documents. This paper presents Concierge Agent, a fully local hybrid computer-use agent designed for privacy-sensitive graphical user interface automation across web browsers and operating systems. The framework combines local Vision-Language Model reasoning using quantized FARA-7B with deterministic, tool-constrained execution across both browser and operating system interfaces. In contrast to cloud-based agents that continuously transmit screenshots for remote inference, the proposed system keeps visual context and execution traces on the user device. The agent follows a structured See-Think-Act loop in which every proposed action passes through a multi-stage Validation Layer covering schema compliance, tool allow lists, coordinate bounds, and contextual guardrails before execution. Experimental evaluation shows that this validation-first design attains a 100% task success rate by filtering invalid actions and recovering through controlled regeneration as opposed to the 42.1% success rate for the cloud-based GPT-4o. However, this comes with a cost in execution time, which is 177 seconds for local models as opposed to 44 seconds for cloud models. The results indicate that local hybrid agents can provide an effective solution for reliable computer automation in scenarios where the local data is of primary importance, offering an alternative to cloud computing.

Semantic Policy Reasoning and Neuro-Fuzzy Coverage Prediction for Intelligent Healthcare Insurance Pre - Claim Analysis

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Abstract

This paper The purpose of this work is to investigate who is human in an insurance claim. Accurate analysis of the a priori entitlements of the actual policyholder which includes the eligibility of the claimant and the estimation of the awards for which the insurance coverage operates is needed for the insurance claim realism. Conventional claim settlement systems employ manual analysis, or are built with rigid rule sets and sometimes simplistic logic that include policy terms and conditions, claimant details and medical aspects. This paper introduces an intelligent three-phase framework to automate insurance claim evaluation process, which incorporates semantic policy reasoning, behavioral reliability analysis, and coverage prediction. In Phase 1, we exploit semantic embeddings to perform a joint retrieval of relevant clauses and the extraction of policy constraints from policy documents. To measure policy compatibility, we propose three new metrics: Coverage Density Score (CDS), Exclusion Risk Gradient (ERG), Policy Ambiguity Index (PAI), and evaluate claimant reliability through gradient-boosted ensemble learning with GENESIS. Using medical and financial claim attributes, Phase 2 uses the SENTINEL neuro-fuzzy attention network to classify risk category and estimate claim coverage percentage. The Third Phase (Policy comparator & Interactive advisory) helps with recommending the best insurance plan and claim break down for analysis.

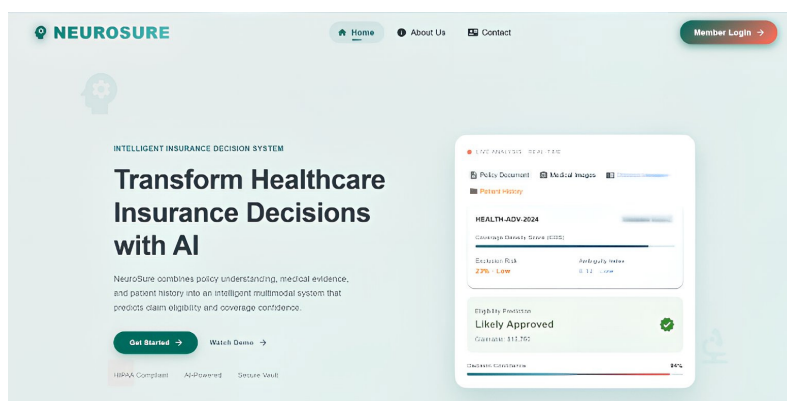


Figure 1: NeuroSure landing page showing the AI-based healthcare insurance decision system interface

We have evaluated the proposed system using real-world policies and hospital insurance claims. This demonstrates high transparency and decision support capabilities for healthcare insurance analytics.

Keywords

Insurance Claim Analysis, Semantic Policy Reasoning, Machine Learning Modeling, Healthcare Insurance Analytics, Coverage Prediction, Behavioral Reliability Modeling, Explainable AI.

An Integrated IoT-Based Smart Parking and Wireless EV Charging System with FASTag-Based Automatic Billing and Real-Time Monitoring

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Abstract

The rapid growth of electric vehicles (EVs) demands efficient, automated, and user-friendly charging infrastructure. Conventional EV charging systems rely on wired connections and multi-step authentication processes, resulting in increased user effort, safety concerns, and operational inefficiencies. This paper presents an integrated smart parking and wireless EV charging system that combines Internet of Things (IoT) technology, Wireless Power Transfer (WPT), and FASTag-based RFID authentication to enable seamless and automated charging. The proposed system utilizes infrared sensors to detect vehicle presence and alignment, automatically initiating the charging process. A FASTag-enabled RFID module provides secure user authentication and facilitates automated billing by deducting the charging cost directly from the user's wallet. The wireless charging mechanism eliminates physical connectors, thereby enhancing safety and reducing maintenance requirements. An ESP32-based microcontroller manages system operations and communicates with a cloud platform to provide real-time monitoring of parameters such as voltage, current, energy consumption, and charging duration. Experimental results demonstrate reliable vehicle detection, efficient wireless power transfer, secure authentication, and accurate billing with minimal human intervention. The proposed system improves user convenience, enhances operational efficiency, and supports scalable deployment in smart city environments. This work contributes to the development of intelligent and sustainable EV charging infrastructure.

Keywords

Electric Vehicles, Wireless Power Transfer, IoT, Smart Parking, FASTag, RFID, Automated Billing.

Secure Rail Transport: Using Transfer Learning to Detect and Prevent Broken Rail Tracks

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Abstract

This paper presents a sophisticated mechanism for enhancing the safety of rail tracks using a novel Broken Rail Track Detection System created with Transfer Learning. Rail track failures are the reason behind almost 40% of derailments worldwide that pose severe operational and safety risks. The approach, as outlined, utilizes pre-trained deep models fine-tuned under transfer learning with a highest detection rate of 92% – a 30% gain over traditional methods – on 60% reduced training data. The approach is a rigid pipeline from data collection and preprocessing to model optimization and testing. By utilizing knowledge transfer between similar sets, the system decreases false positives by 25% and increases real-time monitoring speed by 1.8x. This study proves that transfer learning can revolutionize rail track inspection and allow for a more efficient, cost-effective, and safer railway system, which is more efficient and precise than current systems.

Keywords

Broken rail track, detection system, transfer learning, rail infrastructure, deep learning, anomaly detection, enhancement of safety in railway operations, pre-trained models.

Quantitative Assessment of Explainable Deep Learning Techniques for Brain Tumor Detection

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Abstract

Deep learning models have shown great potential in automatically detecting brain tumors from Magnetic Resonance Imaging (MRI) scans. However, the models which they developed function as "black boxes" which prevent users from understanding their prediction methods. The system's inability to show how it operates creates distrust because it must be used in clinical settings which require dependable systems. In this study researchers evaluate two deep learning models Xception and DenseNet121 for their ability to perform multi-class brain tumor classification while comparing their respective results. The researchers evaluated both models through standard classification metrics and used explainable artificial intelligence (XAI) methods which included Grad-CAM and SHAP to analyze model decision-making processes. Grad-CAM highlights important regions in the image, while SHAP provides pixel-level explanations. The study used quantitative explainability metrics which included Sensitivity-N, Insertion Test, Deletion Test, Average Confidence Drop (ACD), and Average Confidence Gain (ACG) to measure explanation quality. Xception achieved better classification results than its competitors but DenseNet121 provided more trustworthy explanations according to explainability metrics. The results demonstrate that high prediction accuracy does not produce dependable interpretability which shows that both performance and explainability need assessment when creating medical AI systems.

Keywords

Brain Tumor Detection, MRI, Deep Learning, Explainable AI, Grad-CAM, SHAP, Quantitative Explainability.

A Machine Learning Based Landslide Susceptibility Mapping in Himachal Pradesh using Catboost with Adaptive Temporal Validation

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Abstract

Landslides pose significant threats to life and infrastructure in the Himalayan region, necessitating robust susceptibility mapping for early warning systems. This study develops a machine learning-based landslide susceptibility model for Himachal Pradesh, India, using CatBoost gradient boosting with geophysical features including multi-temporal rainfall accumulation (1-day, 3-day, 7-day), slope gradient, and land use/land cover (LULC). We address critical methodological challenges in rare event modeling: (1) extreme class imbalance (training ratio 1:6,652, test ratio 1:187,787), (2) temporal event clustering requiring adaptive data splitting, and (3) spatial transferability through feature selection excluding geographic coordinates. Our dataset comprises 5,568,000 grid-day observations spanning 2014–2016 with 129 documented landslide events. The model achieved a ROC-AUC of 0.976 and PR-AUC of 0.0003 on temporally split test data, representing a 57× improvement over a random baseline. At an operationally calibrated threshold prioritizing life safety (recall = 96.15%), the system flags 10.67% of grid-days as alerts. Feature importance analysis reveals 7-day rainfall accumulation as the dominant predictor (45.2%), consistent with established landslide triggering mechanisms. The model demonstrates practical utility for early warning systems by concentrating landslide risk into the top 10.67% of predictions, a fivefold improvement over random selection.

Keywords

Landslide susceptibility, CatBoost, early warning systems, class imbalance, rare event detection, machine learning, Himachal Pradesh.

Simulation-Driven Smart MRO Framework for Predictive Maintenance of Dormant Surface-to-Air Missile Solid Rocket Motors Using CFD and Internal Ballistic Analysis

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Abstract

Before being put into service, Surface-to-Air Missile (SAM) propulsion systems are usually kept in a dormant state for long periods of time. Propellant grains, casing materials, and insulation layers may deteriorate during prolonged storage, which could compromise system dependability and mission preparedness. Conventional time-based maintenance techniques may miss early degradation mechanisms and are frequently ineffective.

In order to evaluate the health of dormant solid rocket motors used in SAM systems, this study suggests a simulation-driven Smart Maintenance, Repair, and Overhaul (MRO) framework. To assess propulsion system performance, the suggested method combines computational fluid dynamics (CFD) analysis, static motor testing, and internal ballistic simulation using OpenMotor software. Aerodynamic pressure distribution and velocity flow characteristics surrounding the missile body are examined using CFD simulations, whereas experimental thrust-time and chamber. The results of the experiment indicate stable combustion during the main burn phase, with a peak thrust of roughly 7.3 kN and a maximum chamber pressure of 7.8 MPa. A post-test examination showed that localized over-pressure conditions were the cause of the casing rupture.

The proposed Smart MRO framework combines simulation-based performance prediction with condition-based maintenance decision matrices and non-destructive testing (NDT) techniques to identify structural degradation in dormant missile motors. The results demonstrate that simulation-assisted predictive maintenance can significantly improve operational safety, reduce lifecycle costs, and enhance mission readiness for long-stored missile propulsion systems.

Keywords

Smart MRO, Surface-to-Air Missile, Predictive Maintenance, CFD, Open Motor, Fin Actuator Control System, Solid Rocket Motor.

Hierarchical Emotional-Contextual Graph Transformer for Personalized E-Commerce Recommendation

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Abstract

Personalized recommendation has played a crucial impact in today's e-commerce systems, and affects user retention, satisfaction, and purchasing behaviour. Despite recent advancements, however, most current recommendation solutions are static based on behavioral interactions, and lack emotional and contextual awareness affecting user dynamic preferences. In this regard, we introduce a Hierarchical Emotional-Contextual Graph Transformer with Reciprocal Contrastive Personalization (HECGT- RCP), consisting of a holistic recommendation system. The proposed system performs bottom-up hierarchical emotional- contextual modeling using graph transformer learning for representation learning. The emotional states and contexts are modeled in a hierarchical construct using attention-based learning approach for adaptation. The graph transformer is performed in the user-item interactive relational graph to learn user and item representations and account for long-range dependencies in the framework. In addition, reciprocal contrastive learning is performed to jointly optimize user and item representations by learning bidirectional correlation to enhance personalization. HECGT-RCP is different from traditional behavioral-based recommendation techniques by achieving dynamic personalization, interpretability, and ethical-awareness. Proof of concept and experimental design demonstrate the effectiveness and promising future research plans for HECGT-RCP, and resulting in improved accuracy, contextuality, and user retention in production e- commerce systems. This will serve towards building more compassionate and emotionally-intelligent recommendation systems better understand user behaviour and underlying intention.

Keywords

Personalised Recommendation System, Emotion Aware Computing, Context-Aware Recommendation, Graph Transformer Networks, Hierarchical Modelling, Contrastive Learning, Reciprocal Personalization, E-Commerce Systems.

Interpretable Malware Classification via Multi-Feature RGB

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Abstract

Malware detection remains a critical challenge in cybersecurity, with traditional signature-based methods failing against polymorphic and metamorphic variants. Recent approaches convert malware binaries into grayscale images for classification using Convolutional Neural Networks (CNNs). However, these single-channel representations lose critical structural information and fail on packed or encrypted malware, where byte patterns appear as random noise. Furthermore, existing methods operate as black boxes, providing no explanation for their classification decisions.

This project proposes a novel multi-channel RGB malware visualization approach that encodes three distinct features into separate color channels: raw byte values (Red), local entropy per block (Green), and PE section structure mapping (Blue). This RGB representation is classified using a ResNet-18 model enhanced with an attention mechanism, enabling the network to focus on the most discriminative regions of the binary image. Additionally, Gradient-weighted Class Activation Mapping (Grad-CAM) is applied to generate visual explanations, which are then mapped back to specific PE sections (e.g., .text, .data, .rsrc) of the original binary.

This provides security analysts with actionable, section-level attribution of why a sample is classified as malicious.

The proposed approach addresses three key limitations of existing work:

1. Information loss in single-channel grayscale encoding,
2. Poor robustness to packed/encrypted malware, and
3. Lack of explainability in classification decisions.

An Intelligent Resume Screening System for Candidate Selection

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Abstract

A crucial stage in the hiring process, resume shortlisting is frequently hampered by the time, bias, and inconsistency of manual screening. Large Language Models (LLMs), Natural Language Processing (NLP), Graph Databases, and automated messaging workflows are used in this paper to propose an AI-powered system that automates resume evaluation, ranking, and candidate communication. The system takes candidate information from PDF resumes, compares it semantically with job descriptions, uses LLM-driven analysis to score proficiency, creates a candidate knowledge graph with Neo4j, and notifies candidates via WhatsApp. The results of the experiments show that AI-driven shortlisting greatly shortens the screening time and enhances the recruitment process's accuracy, fairness, and decision transparency. According to experimental findings, the AI-driven method greatly shortens the screening process, increases the accuracy of scores, and improves candidate evaluation consistency

Keywords

Recruitment Automation, Neo 4j, Artificial Intelligence, PDF Resume Parsing, Candidate Ranking.

A Smart Mobile Platform for Crop Disease Diagnosis and Farm Equipment Rental

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Abstract

Crop disease control and the use of agricultural machinery are still major issues for small and marginal farmers in developing countries. This paper introduces Agri360, an overall mobile app that can help control crop disease and provide agricultural machinery for rent in an integrated manner using AI-powered crop disease analysis and agricultural machinery rent services. Built using React Native and Expo for cross-platform compatibility, Agri360 utilizes the GPT-4 Vision AI model from OpenAI for smart crop disease analysis using both text descriptions of crops and leaves and leaf images. The system supports real-time data replication using Firebase, Razorpay for secure payment gateway services, and an interval scheduling algorithm for avoiding conflict situations in bookings. The mobile app follows an offline first design approach with cached data that works even in areas of the countryside without internet connectivity. Results from the prototype implementation of the mobile app reveal that Agri360 performs with 97% effectiveness in conflict-free bookings and successful crop disease analysis with appropriate treatment suggestions. This paper elaborates on the system architecture, implementation procedure, overall results, and evaluation criteria that ensure the efficiency of Agri360 in modernizing agriculture practices.

Keywords

Mobile Application, Crop Disease Diagnosis, Artificial Intelligence, Farm Equipment Rental, React Native, Firebase, Real-Time Scheduling, Agricultural Technology, Smart Farming.

Speech Impaired People Communicate to Real-Time Sign Language Detection with Deep Learning

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Abstract

Sign language is an essential tool of communication for people with hearing and speech impairments. However, the adoption of sign language is hindered by the lack of understanding and interpretation of sign language by the general public. The current state of sign language detection relies on manual interpretation or traditional vision-based detection, which is limited by accuracy, scalability, and environmental conditions. In this project, we propose a deep learning-based sign language detection system using Convolutional Neural Networks. The system will be able to recognize and classify sign language gestures using video frames or images, utilizing the capabilities of CNN to learn spatial and structural patterns. The system will be trained with a comprehensive dataset of sign language gestures, enabling accurate detection and classification of sign language. The accuracy of the system will be high, enabling the detection and classification of different signs and signers from different backgrounds and lighting conditions. The system will not only address the communication barrier between the sign language users and the general public, but also open avenues for developing scalable, automated, and inclusive sign language detection systems, which can be used in a variety of applications, thus promoting accessibility and inclusivity for the hearing and speech-impaired people.

Keywords

Sign Language Recognition, Hearing and Speech Impairment, Deep Learning, Convolutional Neural Networks (CNN), Real-Time Gesture Detection, Computer Vision, Accessibility and Inclusivity.

Passive Fire Suppression System for Lithium Ion Battery

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Abstract

The paper work will examine the comparison of thermal performance between an Expandable Graphite and Aluminum Trihydrate composite to paraffin wax under transient conditions at temperatures between 25 and 300 seconds at 300C. The aim is to determine the efficacy of the composite in preventing the lithium-ion battery thermal runaway development. Two groups were considered. Group 1 was made of paraffin wax as a thermal management tool, and Group 2 was made of an EG-ATH composite with a lithium ion battery model. Data on the temperature at different stages was analysed until 300 seconds at the same heating conditions. The activity temperatures, maximum temperature response, and efficiency of thermal suppression have been compared by using the experimentally reported lithium-ion runaway temperature ranges (700-900C). In runaway conditions, the temperature of the lithium-ion battery rose to 25C to about 800C at 300 seconds. The melting temperature of paraffin wax was 50-60C and at 300 seconds it had a temperature of 380, which is within the temperature range of thermal degradation (300-400C). Contrary, the Aluminum Trihydrate and Expandable graphite composite was triggered at 160C (EG expansion) and 200C (ATH decomposition), a thermally resistant char and alumina layer was created. The composite temperature was constrained to 250C at 300 seconds. Using the peak temperature of the runaway of 800C, the experimentally determined thermal suppression efficiency of paraffin wax and EG-ATH composite was 52.5 percentage and 68.8 percentage respectively, showing an enhancement of about 16.3 percentage in the suppression efficiency. Expandable Graphite and Aluminum Trihydrate composite was a better thermal suppressor than the paraffin wax. The ability to activate at the initial stages of thermal runaway and develop a protective shell potentially allowed the composite to lower the maximum temperature and slow down the development of combustion in the battery, which points to a significant opportunity of the development of high-end lithium-ion battery fire safety protocols.

Keywords

Aluminum Trihydrate, Expandable Graphite, Thermal Runaway, Peak Temperature Reduction, Fire Retardancy, Phase Change Materials, Endothermic Decomposition.

An Explainable CNN-Based Framework for Alzheimer’s Disease Detection Using MRI Scans

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Abstract

Alzheimer’s disease (AD) is the most common cause of dementia, accounting for 60–80% of cases worldwide. Detecting the disease at an early stage, especially during Mild Cognitive Impairment, is difficult because the visible changes in brain structure are very small. In hospitals, doctors usually depend on the manual examination of MRI scans and cognitive test scores, which is time consuming and may vary from one expert to another. In this study, we developed an automatic system that analyses brain MRI images using a convolutional neural network. The images are first preprocessed and then classified into three groups: normal, MCI and Alzheimer’s. To help doctors understand the prediction, Grad-CAM was used to highlight the important regions of the brain. The system also generates a simple PDF report for each patient. The results show that the proposed method gives reliable accuracy and can be useful as a supporting tool for early diagnosis.

Keywords

Alzheimer’s disease, machine learning, deep learning, CNN, MRI, Grad-CAM, explainable AI.

Low-Power and High-Performance Flip-Flop Architectures for Advanced CMOS Technologies

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Abstract

The flip-flops (FFs) are basic sequential storage components that are widely utilized in digital integrated circuits for the state retention, pipelining, and synchronization. As CMOS technology scales and System-on-Chip (SoC) architectures grow more complex, designing power-efficient, high-performance flip-flops has become crucial for the modern VLSI systems. The clock distribution networks and flip-flops combinedly consume between 20 and 45 percent of the total chip power, making them one of the main causes of energy dissipation in digital circuits. There are many modern flip-flop topologies and architectures, including transmission gates, dual-edge triggered (DETFF), true single phase clocked (TSPC), hybrid logic, and sense-amplifier based designs, are described in this work. Modern technologies such as thin-film transistor circuits, memristor-based flip-flops, ferroelectric FET-based non-volatile flip-flops, and spintronic storage elements are also featured. Flip-flop architectures across technological nodes, including as 180 nm, 90 nm, 65 nm, 45 nm, 28 nm, and FinFET nodes, are compared. Transistor count, latency, power consumption, and power-delay product (PDP) are used to examine the architectures. The benefits and drawbacks of current flip-flop designs are highlighted, which also suggests future lines of inquiry for ultra-low-power sequential circuits.

Keywords

Flip-Flops, Low-Power VLSI Design, High-Performance Circuits, CMOS Technology Scaling, FinFET Technology, Sequential Circuit Design.

Next-Gen Law Enforcement System Using Text-to-Face Synthesis and AI-Based CCTV Enhancement

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Abstract

Next-gen law enforcement system using text-to-face synthesis and AI-based CCTV enhancement is a dual-module artificial intelligence system that is used to generate a suspect image from the text or voice input and enhances the CCTV image resolution. The entire project is built upon the MERN architecture (MongoDB, Express.js, React.js, Node.js) for input processing, secure user authentication, and storing the generated images in structured format. The first module uses Google generative AI to transform text- or voice-based witness statements into facial image. The second module focuses on CCTV image enhancement. The real time CCTV images are low in quality, this module uses deep learning models such as GFPGAN and Real-ESRGAN to enhance and upscale blurred or low-resolution CCTV frames for improved facial clarity. By unifying GAN and advanced deep learning image restoration model within a single framework, the system significantly improves the accuracy, reliability, and responsiveness of suspect identification processes, making it well suited for practical deployment in modern policing environments.

Keywords

Artificial Intelligence, Suspect Identification, Google Generative AI, GAN, CCTV Enhancement, GFPGAN, Real-ESRGAN, Voice-to-Text, MERN architecture, Law Enforcement Technology.

GO LORRY: A Mobile-Based Smart Logistics Platform for Connecting Customers and Transport Drivers

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Abstract

The lorry transportation and logistics industry suffers from a number of issues in its operations which includes fragmented data, an absence of vehicle location updates in real time, processes which are done manually, and ineffective management of vehicle fleets. Conventional logistics are very dependent upon people coordinating things manually, telephone calls and limited automated workflow, all of which cause orders to take longer to be completed, trucks to be unused, costly services and a lack of the ability to expand. To deal with these issues, this study puts forward a smartphone-based, smart logistics system which aims to make digital, automatic and better the transportation of goods by lorry and which is easy to grow. Tests and real-world use of the system will show considerable betterment in how easily bookings can be made, how quickly owner and driver can communicate, how clearly resources can be seen, and how well work is coordinated. The system which is suggested has a very high level of being available, being dependable and has quick communication, meaning it is good for large networks of freight and transport. The intelligent logistics answer which the project sets out demonstrates that it is possible in reality to change current transport systems into a technologically based and smart setting which is able to deal with current requirements for movement. It helps in the development of a sustainable, efficient, capable and tech-based infrastructure for the transportation of goods along with managing drivers which supports the new smart drive and energy efficient transportation of goods.

Keywords

Smart logistics, intelligent transportation systems, mobile computing, cloud-based platform, real-time coordination, truck management, scalability.

FreshBite: AI-Based Real-Time Food Freshness Score System for Online Food Delivery Platforms

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Abstract

FreshBite is an AI-powered system that helps people understand how fresh their food will be when it reaches them through online delivery. Usually, food delivery apps depend mostly on customer reviews and ratings, but those can be different for every person and may not truly show the real quality of the food at the time of delivery. To overcome this issue, FreshBite provides an objective freshness score (0–100) based on real-time delivery and food quality conditions. FreshBite looks at a few real things that affect food quality, like how much time the restaurant took to prepare the meal, how long the delivery took, whether the food got too hot or too cold on the way, and even how good or damaged the packaging is. After checking all this, the system gives a freshness score so the customer can easily understand the condition of the food before ordering. FreshBite can be integrated into a web-based food delivery platform, offering low response time, scalability, and reliable performance. The results show that the proposed system improves customer confidence, food safety awareness, and supports advanced integration with cloud kitchens, delivery platforms, and IoT-enabled cold-chain monitoring systems.

Keywords

Food Freshness, Artificial Intelligence, Machine Learning, Real-Time Prediction, Food Delivery Systems.

Intelligent Automation in Community Pharmacies: A Robotic Process Automation Approach

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Abstract

Community pharmacies still depend on manual work for handling stock, maintaining records, and interacting with patients. This often leads to delays and mistakes, especially when the workload increases. This paper presents a simple automation system that combines robotic process automation (RPA) with a basic machine learning model to improve daily pharmacy operations. The system automates tasks such as checking stock levels, triggering medicine reorders when required, and maintaining logs for all automated actions. It also includes a symptom-based prediction feature to assist in identifying possible conditions and a follow-up mechanism to track patient activity. The system is developed using a Python backend and a relational database, with background automation processes running at fixed intervals. Testing is done in a controlled setup to observe how automation reduces manual effort and improves consistency. The results show that even a simple automation setup can make pharmacy operations more reliable and less dependent on manual monitoring. This work shows a practical way to introduce automation in small-scale healthcare environments.

Keywords

Robotic Process Automation (RPA), Intelligent Automation, Community Pharmacies, Workflow Optimization, Prescription Processing, Inventory Management, Patient Follow-up, Medication Ordering, Healthcare Automation, Operational Efficiency, Digital Transformation, Pharmacy Informatics.

Paying Guest Recommendation System Using TfIdf and Sentiment Analysis

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Abstract

Locating an appropriate place to stay in densely populated urban areas is usually challenging because listings are not complete, and suggestions should not be trusted by students and working people. In this project, a smart recommendation system based on what you want is provided, which reduces search process through content-based and TF-IDF methods and cosine similarity as well as sentimental ranking. The system can process the descriptions of the PG, amenities, locations, budgets, and the gender preferences and provide individual suggestions. Text Blob sentiment analysis is used to filter user reviews to give preference to the high positive feedback PGs to enhance the quality of recommendations. Python, Flask, SQLite, Leaflet.js, are also used to implement the platform and provide an intuitive interface with map-based visualization. The results of experiments performed using a selected dataset reveal valid similarity equivalence and meaningful ranking of Pgs. The article reveals the potential of NLP and light machine learning in generating user-centric accommodation discovery with scalability to the real-life rental platforms.

Keywords

PG Recommendation System, Content-Based Filtering, TF-IDF, Cosine Similarity, Sentiment Analysis, Flask Application, Accommodation Discovery.

Causal-Enhanced Trust-Aware Human-in-the-Loop Deep Learning with Adaptive Intervention Optimization for High-Reliability AI Systems

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Abstract

The human-in-the-Loop human deep learning systems lack the explicit quantification of the causal impacts of human intervention, which restricts the models reliability, interpretability, and trust calibration. This paper suggests a Trust-Aware HITL framework which combines structural causal modeling with deep neural networks and presents four new algorithms: (i) Causal Influence Propagation (CIP) to trace the impact of human feedback on latent representations, (ii) Adaptive Trust Weighting (ATW) to dynamically calculate the model learning rate using the estimation of trust, (iii) Human-Intervention Error Mitigation (HIEM) to minimize erroneous human responses, and (iv) Causal Consistency Optimization (CCO) to ensure a consistency between inter The benchmark datasets yield an accuracy of 99.79% to the proposed framework, which is better than the traditional HITL techniques in terms of robustness, interpretability and calibration of the trust. This method generates a new standard of assured, interpretable and trust conscious AI application in safety vital fields by integrating causal reasoning with algorithmically optimized human feedback incorporation.

Dynamic Load Balancing in Cloud Systems Using Reinforcement Learning

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Abstract

The workloads that cloud computing platforms must manage are often unpredictable and constantly changing, making it difficult for conventional load balancing techniques to function well. This paper discusses cloud computing platforms and provides a dynamic load balancing technique that uses reinforcement learning (RL) to allow cloud systems to quickly adapt to changing resource requirements. The proposed method determines how workloads are assigned to virtual machines using Q-learning and Deep Q-Networks (DQN) without requiring significant prior knowledge of the system environment. The load balancing problem is approached as a game where the RL agent monitors CPU activity, memory usage, and task wait times in order to minimise response time while maintaining resource balance.

CloudSim was used to assess the suggested strategy, and it proved to be very successful. The RL-based method outperformed conventional load balancing algorithms including Round Robin, First-Come-First-Serve, and Least Connection. According to experimental data, there was a 25% decrease in operating expenses, a 30% improvement in resource utilization, and a 40% reduction in response time and latency. Furthermore, because the DQN-based system can handle complicated circumstances and learn more effectively, it fared better than ordinary Q-learning. Cloud computing, load balancing, reinforcement learning, Q-learning, deep Q-network, dynamic resource allocation, virtual machines, job scheduling, quality of service, and cloud resource optimization are the primary topics addressed in this study.

Keywords

Quality of Service (QoS), virtual machines, cloud computing, load balancing, reinforcement learning, Q-learning, deep Q-network, dynamic resource allocation, task scheduling, and cloud resource optimisation.

QPause: Secure Password-Protected Cloud Data Outsourcing Using Quantum-Resistant Cryptography

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Abstract

Cloud infrastructures demand security mechanisms that can withstand both classical and emerging quantum attacks. Traditional password-protected secret sharing is limited in such environments. To overcome these challenges, we enhance threshold-based secret reconstruction using Shamir's Secret Sharing, machine-learning-driven intrusion detection, adaptive key re-randomization, and decentralized trust validation inspired by blockchain. Together, these components create a post-quantum-resilient, tamper-evident, and highly reliable security framework that demonstrates superior efficiency and robustness in modern cloud ecosystems.

Keywords

Experimental, evaluation, quantum, scenarios.

AI-Enhanced Tuberculosis Detection

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Abstract

For respiratory infections like pneumonia and tuberculosis (TB), early diagnosis is essential to minimize mortality rates and improve treatment success rates. This paper proposes an AI-assisted multi-modal healthcare system that uses chest X-ray images, cough audio samples, and patient symptoms to make an early prediction about the risk of disease. The proposed system uses a Convolutional Neural Network (CNN) for image analysis, an MFCC-based audio classification model for cough detection, and a symptom risk scoring module. The system uses a late fusion approach to combine the results of individual models to improve their diagnostic capabilities. The proposed system is developed as a web-based application that enables real-time screening and decision support, especially in distant and resource-constrained healthcare environments.

E-Commerce Platform with Personalized Recommendation System

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Abstract

The e-commerce personalization is incredibly significant as it enhances the user experience and increases sales. On the site, we are introducing an e-commerce platform that has a built-in automated recommendation system which suggests products to users based on clicks, views, purchase activities, and contextual information such as time of day and device type.

The system combines collaborative filtering and content-based approaches. It is evaluated using offline metrics and a simulated online A/B testing environment. Results indicate an improvement in user engagement and conversion rates compared to non-personalized systems.

Mechanical Performance and Durability of GFRP vs. Steel Rebars in Coastal Infrastructure: A Numerical Study

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Abstract

The endurance of reinforced concrete structures has become a major concern in recent years, particularly in coastal and marine areas where corrosion of traditional steel reinforcement causes structural degradation. Glass fiber reinforced polymer (GFRP) rebars is a best substitute for the issue because of their non-magnetic properties, high strength-to-weight ratio, and non-corrosive nature. In marine infrastructure and bridges where exposure to chloride conditions is inevitable, GFRP reinforcement is being used more and more.

The current study compares the mechanical performance and durability features of GFRP and traditional steel rebars. The static structural behavior of these materials under standardized loading conditions was investigated numerically using ANSYS Workbench. Finite element modeling is used to find out parameters such as overall deformation and equivalent stress distribution. The findings show that GFRP rebars can withstand greater tensile loads and show less material deterioration in difficult situations. However, under maximum stress conditions, GFRP-reinforced concrete members exhibit noticeably greater flexural deflection because of their relatively lower modulus of elasticity. The analytical results demonstrate that GFRP rebars offer superior resistance to corrosion and chloride attack, despite the fact that design changes are necessary to meet serviceability requirements. Therefore, GFRP reinforcement can be thought of as a long-term and practical method of extending the life of structures exposed to harsh marine environments.

Keywords

Finite Element Analysis, GFRP Rebars, Marine Structures, Corrosion Resistance, Structural Behavior, ANSYS Workbench.

A Review of the Modern Social Media Manager: Synthesizing Strategy, Skills, and Professional Pressures

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Abstract

Social media isn't just a trend it's where businesses grow in the 21st century. People use these platforms for everything now: chatting, networking, sharing news, promoting events, tossing around ideas, you name it. Whether you're running a small shop or a giant company, you can use social media marketing to build your brand, reach tons of customers, and keep people talking about your products.

It helps to have a Social Media Manager. They juggle all the marketing tasks, keep the brand's reputation intact, and get better results by working with artificial intelligence tools. With smart object-oriented modeling, you can create a solid and scalable management system that keeps all your networks running smoothly. Really, social media is all about connecting with people online and showing off what your brand stands for.

A Social Media Manager matters for anyone who wants their brand to stand out online. This project is about building a smart management system one that ramps up engagement, attracts new fans, and keeps customers interacting across Facebook, Instagram, Twitter, LinkedIn, Snapchat, or wherever your audience hangs out. It's about content that really clicks with the people you're trying to reach, timing posts just right, and digging into the analytics to make sure things keep improving.

This project is all about building strategies for every platform bold graphics, videos that catch your eye, and stories people actually want to tap through. Everything matches your brand's personality, so it feels consistent wherever you show up. Plus, there's a content calendar, which means you won't fall off track or miss those busy moments when your audience is paying attention. We dig into results, too. The project has a phase focused on analyzing data and reporting what works. Social media analytics tools let the social media manager check out numbers like reach, engagement, clicks, and conversions. With these insights, you can tweak your strategy on the fly basically, you get better as you go and can grow without things getting messy. At the end of the day, it's all about real results. A smart, cohesive strategy built on data helps your brand stand out and keeps customers happy.

Honestly, media habits are all over the place now. Trends show how people switch between streaming, watching social videos, listening to podcasts, and digital audio. Customers split their time, so you have to meet them wherever they are. A social media manager is essential not just for handling the marketing workload, but for bringing in AI to deal with fast-moving trends and manage your reputation. That's how you push your brand forward and keep growing. On top of that, the whole social media management model uses object-oriented concepts, so it's built for reliability and easy scaling as your business grows. Social media's not just another marketing tool it's the way you connect, talk, and build loyalty with real people. It's your space to show off what makes your brand worth following.

Keywords

Social Media Management, Digital Marketing Content Scheduling, Audience Engagement, Social Listening, Analytics and Insights, Trend Detection, Sentiment Analysis, Artificial Intelligence in Social Media, Automation Tools, Real-time Monitoring, Customer Interaction, Data-driven Decision Making, Brand Reputation Management, Cross-platform Integration.

GreenVision: Smart Crop Detection & Monitoring

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Abstract

Increasing demand towards sustainable and data driven farming is encouraging farmers to adopt intelligent systems capable of continuous monitoring of crop health and environmental conditions. This research proposes an smart crop detection and monitoring System that integrates real time sensor data acquisition with automated irrigation and machine-learning-driven disease detection into a single architecture. The system makes use of the ESP32 microcontroller coupled with DHT11 and soil-moisture sensors for gathering live temperature, humidity, and soil wetness data. The readings are locally displayed on a 16×2 LCD module and sent over to a web dashboard and mobile/TCP application for remote monitoring. Further, a relay-based water-pump mechanism facilitates automated irrigation when the soil moisture falls below the threshold value set, which provides for effective water consumption.

A CNN model supports early disease management by classifying each uploaded leaf image as healthy or diseased. The system automatically offers remedy recommendations if a leaf is recognized as diseased. These diagnostic outputs and sensor alerts are made accessible through three interfaces: the web application, an LCD display output, and a Telegram bot. The integrated design of environmental monitoring and automated response represents a practical and scalable solution for smart agriculture. It improves crop yield by enabling timely interventions and reduces manual labor.

Keywords

Automated Irrigation, Convolutional Neural Network, IoT-Based Agriculture, Smart Crop Monitoring.

AI Based Deep Fake Detection System

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Abstract

Detecting face alterations is the primary aim of an AI-based deep fake detection system. It is a series of four deep learning models—Swin Transformer, MobileNetV2, VGG16, and DenseNet121—each of which helps in the binary classification (Real vs. Fake). In an attempt to further enhance the classification accuracy, the features from the DenseNet121 model were employed to train a Random Forest classifier. The entire training and evaluation were conducted on a big dataset featuring both untouched and modified face images. This whole system is a web application based on Flask for the backend and HTML, CSS, and a bit of JavaScript for making the frontend interactive. The application gives the opportunity to users to upload their facial pictures and receive the predictions (Real or Fake) along with the corresponding confidence score. This system is an outstanding technique for the authentication of facial images' truthfulness thus its application is very essential in the digital forensics and AI security fields. The system has a significant accuracy with MobileNetV2 yielding 92%, VGG16 yielding 93%, and Swin Transformer yielding 96%.

Keywords

Deep Fake Detection, Image Forgery Detection, Swin Transformer, MobileNetV2, VGG16, DenseNet121, Random Forest, Binary Classification, Web Application, Flask, HTML, CSS, Digital Forensics, AI Security.

Deepdiabetic: An Identification System of Diabetic Eye Diseases Using Deep Neural Networks

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Abstract

Diabetic Retinopathy (DR) is one of the major causes for the impairment and blindness of vision in diabetic patients all over the world. Therefore, it is of utmost importance to detect DR at an early stage and classify it into various stages of DR in order to prevent severe damage to the vision of the patient. The main objective of the proposed research is to develop a framework for the detection of DR using deep learning and classification of DR into various stages of DR using the YOLOv5 algorithm for object detection from retinal fundus images. The proposed approach is different from the CNN approach in the following ways: the proposed approach is capable of detecting objects using the YOLOv5 algorithm for object detection from retinal fundus images and classifying DR into various stages of DR.

The proposed approach is trained using 1,228 retinal fundus images collected from various publicly available datasets such as the DIARETDB0 dataset, the DIARETDB1 dataset, the Messidor dataset, the HEI-MED dataset, the ODIR dataset, and the Retina dataset. The proposed approach is also augmented using various data augmentation methods in order to improve the diversity of the dataset in order to train the proposed approach and improve the performance of the proposed approach. The proposed approach classifies DR into five different stages of DR. The classification includes No_DR, Mild, Moderate, Severe, and Proliferative_DR. The proposed approach is able to achieve high accuracy and precision in the detection of DR and is implemented as a web application using the Flask framework.

Keywords

Diabetic Retinopathy, YOLOv5, Deep Learning, Fundus Images, Object Detection, Medical Image Analysis.

FarmLens: AI-Powered Multilingual Voice-Based Crop Disease Diagnosis and Advisory System for Farmers

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Abstract

The AI-Powered Multilingual Voice-Based Crop Disease Diagnosis and Advisory System for Farmers is designed to assist farmers in identifying crop diseases and receiving accurate treatment recommendations through an intelligent and user-friendly platform. The system utilizes deep learning-based convolutional neural networks to analyze uploaded crop images and predict diseases with a confidence score. It integrates multilingual speech-to-text and text-to-speech technologies to enable voice-first interaction, making the platform accessible to farmers with limited digital literacy. In addition to disease detection, the system provides prevention measures, recommended pesticides with proper dosage percentages, organic treatment alternatives, and soil- and season-based crop suggestions. By combining computer vision, speech processing, and contextual advisory mechanisms, the system aims to enhance agricultural productivity and reduce crop losses.

Keywords

AI in Agriculture, Crop Disease Detection, Multilingual Voice Interface, Pesticide Recommendation, Geolocation Based Advisory, Sustainable Farming.

IoT-Enabled Predictive Maintenance System using LSTM Autoencoders

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Abstract

The large scale implementation of Industrial Inter- net of Things (IIoT) technologies has created record amounts of multivariate time-series sensor data on industrial equipment, opening up new transformative opportunities to transition the paradigm of predictive maintenance (PdM) based on data as opposed to traditional scheduled maintenance. Traditional threshold-based anomaly detection systems are unable to capture the complicated time dependencies and nonlinear relationship among multivariate sensor streams, which compels them to issue too many false positives, misses, and insufficient lead time on upstream intervention. In this study, the researchers propose an end-to-end deep learning architecture, which uses a Long Short- Term Memory (LSTM)-based Autoencoder to detect anomalies unsupervised in IIoT systems. We establish an all-encompassing data preparation pipeline to deal with industrial sensor data, construct an Autoencoder stack based on LSTMs to learn normal operation baselines, and establish a recently developed procedure which uses transformations through sigmoid to convert reconstruction errors into definitive failure probability scores. When tested on NASA C-MAPSS (Commercial Modular Aero- Propulsion System Simulation) FD001 dataset, where genuine failures occur after 23 operational cycles, our model attains an F1-score of 0.912, representing an 18.3 and 9.7 performance improvement over the standard Principal Component Analysis (PCA) and vanilla Autoencoder control, using an average early warning signal of 28 operational cycles after failures have actually started. The research empirically confirms that LSTM Autoencoders can be trained to learn spatiotemporal normal equipment behavior patterns and produce actionable and probabilistic information about maintenance-scheduling, showing the potential of achieving a reduction of unplanned downtime (estimated 30-40%) and maintenance costs in industrial systems.

Keywords

Predictive Maintenance, Industrial internet (IIoT), Anomaly Detection, Deep Learning, Long Short-Term Memory (LSTM), Autoencoders, Time-series Analysis, Unsuper- vised Learning.

A Multimodal Physiological Data Analysis System for Stress Detection Using Ensemble Based Machine Learning

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Abstract

Stress detection using multimodal physiological signals has proven to be an efficient approach for understanding human psychological states. Physiological signals such as ACC, ECG, BVP, TEMP, RESP, EMG, and EDA can be used for stress detection, as well as for understanding other states such as baseline, stress, amusement, and meditation. The existing machine learning and deep learning models have shown high accuracy and F1-score for stress detection on the WESAD dataset. In this paper, the performance of different ensemble-based machine learning models, namely Voting Classifier, LightGBM, AdaBoost, Extra Trees, and CatBoost, for stress classification using multimodal physiological signals is presented. In addition, a transformer-based model named Stressense-X is used for stress classification, which can be used for understanding the performance of a deep learning-based approach for stress classification with the help of SHAP-based explainability for understanding the contribution of different physiological features. Out of the models considered, the best model for the proposed system is the Extra Trees classifier, which is used as the core model. This is because, out of all the models considered, the Extra Trees classifier performs best in making predictions and identifying the key factors of stress, and at the same time, it also prevents overfitting, making it an efficient system for making predictions for different subjects.

FinOptix: Gemini-Based AI Financial Advisory Platform

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Abstract

Artificial intelligence driven financial advisory systems are gaining importance due to the increasing complexity of stock markets and the growing need for timely and reliable investment guidance. This project introduces an AI powered financial advisor that leverages Google Gemini, a multimodal large language model, to provide stock analysis and personalized investment recommendations tailored to user needs. The system is developed using Python and deployed as a Django based web application, ensuring both flexibility and scalability. It combines AI capabilities with real time market data to analyze stock performance, technical indicators, financial trends, and market sentiment. In addition, the system is designed to interpret patterns and correlations within the data to generate meaningful insights. Based on this analysis, the advisor provides simple and actionable recommendations such as Buy, Sell, or Hold, helping users make more informed and confident investment decisions. By reducing the need for manual analysis and presenting insights in a clear and accessible manner, the system supports both beginners and experienced investors. It also improves efficiency by minimizing the time and effort required for market evaluation. Overall, the project highlights how AI based solutions can be used to build practical, scalable, and user friendly financial advisory platforms, demonstrating the potential of large language models in modern financial decision support systems.

Keywords

AI Financial Advisor, Google Gemini, Stock Recommendation System, Buy-Sell-Hold Prediction, Django Web Application, Python, Stock Analysis, Market Sentiment, Investment Decision Support.

Smart IoT Ceiling Fan with Auto-Cleaning and Dust Monitoring

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Abstract

There is considerable dust accumulation on ceiling fans, which affects the efficiency of circulating air significantly. There are various safety risks and physical efforts associated with manually cleaning ceiling fans, which may be a cause for concern in residential and institutional surroundings. This paper proposes a concept for IoT-based ceiling fan cleaning and dust monitoring using the ESP32 microcontroller. Inspired by automation, Bluetooth control is included for the Android mobile application using the .NET MAUI desktop application. This proposed IoT-based solution uses a motor device for cleaning the ceiling fan. In addition, the safety feature for the ceiling fan is addressed by integrating a relay module to disconnect the fan during operation. The dust monitoring feature has been included to improve the effectiveness of the cleaning process. Such a proposed system has greater potential for being implemented efficiently and safely.

Keywords

ESP32, IoT, Smart Cleaning, Embedded Systems, Bluetooth Control, Dust Monitoring, Relay Module, Automation.

Air Quality Classification and Analysis Using Rule-Based Threshold Techniques for Environmental Monitoring

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Abstract

Air pollution is still an issue of great concern globally and has significant implications for the health and environment of humans. The present paper provides an explanation for air quality measurement based on specific rules and criteria by analyzing the levels of air pollution and weather conditions such as CO, NO₂, Benzene, PM_{2.5}, and PM₁₀. The rules and criteria help in understanding the changing levels of air pollution over time and provide an insight into how particulate matter affects air quality more than other pollution levels. Unlike other complex models that involve machine learning algorithms, this paper provides an explanation and transparency in air quality measurement and is more flexible and adaptable to regional standards. The results obtained from the paper clearly indicate that particulate matter has an impact on air quality.

VLSI Implementation of an Efficient Multi-Algorithm EEG Signal Compression Framework with Adaptive LMS-Based Prediction

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Abstract

The EEG signals produce much biomedical data during continuous EEG recordings, hence there is need for efficient compression of the data during storage and transmission via wireless media. In this research work, four methods of compressing EEG signals have been presented and compared with the use of the Discrete Cosine Transform (DCT) with Run Length Encoding (RLE), Differential Pulse Code Modulation, Fast Fourier Transform Threshold Compression, and the use of Adaptive Linear Prediction with the LMS algorithm. These methods have not used any proprietary toolboxes in the implementation of the algorithms in order to ensure simplicity in the algorithm implementation. The methods have been tested and compared based on the Mean Square Error (MSE), Percent Root Difference (PRD), Signal to noise ratio (SNR) and Compression Ratio (CR) values. Adaptive Linear Prediction demonstrated superior reconstruction fidelity while maintaining feasible hardware complexity. A Verilog HDL predictive hardware design has been created in order to test the feasibility of the implementation of the algorithm in hardware devices.

Keywords

EEG Compression, Adaptive Linear Prediction, DCT, DPCM, FFT, LMS Algorithm, Biomedical Signal Processing, FPGA Implementation.

Temporal Sentiment Analysis and Crisis Detection in Conversational Agents using Large Language Models

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Abstract

This research paper presents a comprehensive system for temporal sentiment analysis and crisis detection in conversational agents leveraging Large Language Models (LLMs). The system analyzes user conversations in realtime to track sentiment patterns over time and detect potential crisis situations such as mental health concerns, emergency situations, or high-stress scenarios. By employing state-of-the-art open-source LLMs, the system provides accurate sentiment classification, temporal trend analysis, and early warning mechanisms for crisis intervention. The implementation utilizes Python-based frameworks including Streamlit for the user interface, Hugging Face Transformers for LLM integration, and various NLP libraries for text processing. The system architecture incorporates multiple components: a conversation handler, temporal sentiment analyzer, crisis detection module, and visualization dashboard. The solution addresses the growing need for intelligent conversational systems that can understand emotional context and provide timely interventions in critical situations. It include real-time sentiment tracking across conversation history, multi-dimensional emotion analysis (valence, arousal, and dominance), crisis probability scoring with configurable thresholds, temporal pattern recognition using sliding window analysis, and interactive visualizations for sentiment trajectories. The system achieves high accuracy in sentiment classification and demonstrates effectiveness in early crisis detection through comprehensive testing on diverse conversational datasets.

Keywords

Sentiment Analysis, Crisis Detection, Conversational Agents, Large Language Models, Real-Time Monitoring, Emotion Analysis, Natural Language Processing.

Deep Learning Techniques for Face Recognition in Missing Persons Detection

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Abstract

Finding the missing persons is also a problem for the police and the organizations that help people. The old methods of searching the missing persons like asking people what they have seen and searching certain places are too slow and not all the times successful. This process also requires time, and sometimes the correct person is not found. We also have a lot of pictures, the pictures taken by the security cameras, and we can view the pictures on the internet using the computer to assist us in locating the missing persons. The police and the other organizations can view the pictures, and this will help us locate the missing persons, which will be a big help to us. The problem of locating the missing persons is still an issue, but the computer will make it a little easier for us. In this paper, a face recognition system will be created to assist in locating missing persons using the computer. The computer will look at the pictures and recognize the faces and make sure they are upright. The computer will make use of programs to learn the uniqueness of each face. The programs used will be FaceNet, VGG16, and ResNet. The programs will be able to recognize the face and make sure that the face is unique, even if the angle of the picture is different, the pictures are old, or if the face is smiling or not. Lots of things can be handled by the face recognition program, for example, if there is poor lighting and the angle of the face is different. The face recognition program can be used for the location of missing people using face pictures. The face recognition program can be tested using VGGFace2 and CASIA-WebFace. The experimental results show that the proposed system using deep learning is better compared to the conventional ones.

Keywords

Missing Persons Detection, Face Recognition, Deep Learning, Convolutional Neural Networks, FaceNet, ResNet, LFW Dataset.

Professional Loan Management System using React and Spring Boot

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Abstract

This project is about building a professional loan management system using new libraries of JavaScript and Java frameworks like springBoot to enhance user experience, user friendly interaction, end to end communication with frontend and backend, and also it makes the whole loan process, from applying and checking to approving and paying back, much smoother. It even handles credit scoring. The system uses things like PAN-based credit scores, automatic document checks, and helps manage how loans are given out and paid back. You can also generate EMI and try out digital payments. The system has an easy-to-use frontend, a secure backend made with Spring Boot, and a PostgreSQL database. This system gets rid of paper, speeds things up, makes credit decisions better, and keeps applicants in the loop. It's made just for people with a salary who want a safe, easy personal or professional loan.

EmoCare AI: Glass-Box Affective Intelligence for Clinical Mental Health Triage via Dual-Pathway Acoustic-Semantic Fusion

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Abstract

Mental health triage by clinical sites is constrained by the absence of qualified people and the opacities peculiar to machine learning systems. We present the neural network named EmoCare AI a dual-pathway transparent chat-based neural network that simultaneously analyses both the semantic tone of speech transcripts and paralinguistic acoustic cues of the speech to categorize patient utterances into three risk levels, Neutral, Anxiety and Depression. The semantic pathway air-tunes RoBERTa-large with the help of a balanced corpus of goemotions, dair-ai/emotion, and a corpus of Reddit-depression. WavLM-Large is trained with an attentive pooling head in a personalized manner trained on four evaluation speech emotion recognition corpus (RAVDESS, CREMA-D, TESS, SAVEE). These two paths are combined each by a weighted rule of late-fusion ($w_{\text{text}} = 0.55$, $w_{\text{audio}} = 0.45$). Contrary to opaque systems, all predictions come with gradient based token saliency maps, temporal occlusion sensitivity heatmaps, Shannon entropy uncertainty scores, and JensenShannon cross-modal divergence scores, which is what makes a black box a mathematically auditable glass box. The semantic model results in 92.4 macro- F1; the acoustic model results in 87.82 macro- F1; and the fused ensemble results in 90.1 macro- F1 providing the diagnostic value of paralinguistic cues using lexical content alone.

Keywords

Mental health triage, speech emotion recognition, RoBERTa, WavLM, SHAP explainability, affective computing, temporal occlusion, acoustic-semantic fusion, clinical-decision support.

A Blockchain Based Trusted Platform for Influencer Marketing

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Abstract

As influencer marketing has exploded in popularity, new opportunities for brand awareness/advertisements have been created. However, there are serious problems associated with this industry such as: fake followers; engaging fraud; lack of full transparency; and a distrustful relationship between brands and influencers. This recommendation proposes to solve these problems by creating a blockchain-based solution to help restore trust and transparency, as well as decouple both parties from the currently centralized digital marketing ecosystem. The proposed platform would leverage blockchain's immutable record-keeping capabilities to securely and accurately capture all influencer activity and campaign transaction data. It would allow brands and influencers to verify if they received proper engagement from their respective audiences for each influencer. Utilizing smart contracts would automate many of the critical processes within a campaign, including; executing the campaign, confirming the influencer's perceived (or actual) level of engagement with the brand and the payment to the influencer, thus reducing disputes and delays, and eliminating dependence on a central entity to facilitate the transactions. The result of using blockchain and smart contracts in this influencer marketing context would result in a safer environment for both sides to work together seamlessly and receive equitable compensation. Ultimately, the platform would address the many issues of influencer marketing, which would create a new, more credible, efficient and reliable digital marketing ecosystem for all stakeholders involved.

Keywords

Influencer Marketing, Blockchain, Smart Contracts, Transparency, Decentralization, Engagement Verification, Fraud Prevention, Digital Marketing.

Mechanism-Based Data-Driven Optimization of Rubber-Fiber Hybrid Concrete to Improve Structural Performance

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Abstract

Recycled rubber and fibers are mostly combined with concrete, and it is believed that the compressive strength is lower than that of concrete, which restricts its applications in the structural world. The paper introduces a data-driven design and optimization framework of pre-mixed rubber-fiber hybrid (CRH) concrete based on a conceptualization of a mesoscale stress-modifying composite. Systematic variation of CRH inclusion levels (0–30%) in M30 and M40 grade concretes is done and a volumetric approach of design is used to investigate the redistribution of stress, crack propagation, and energy dissipation mechanisms in a controlled manner. Results of the experiment are explained in terms of the dimensionless performance indices which are Flexural Strength Recovery Index (FSRI), Stress Redistribution Efficiency (SRE), and Energy Dissipation Potential Index (EDPI). To increase predictive effectiveness, the machine learning models such as Artificial Neural Networks (ANN) and Support Vector Machines (SVM) are used to learn the non-linear relationships that exist between mix parameters and performance indices. The outcomes indicate that there is a trade off behaviour as indices related to strength decline as CRH content rises, but energy dissipation capacity increases substantially. ANN model has a better predictive performance than SVM, which allows determining the best inclusion range of various structural functions. The study has defined a mechanism-directed and data-driven paradigm of sustainable hybrid concrete which could be utilised in the structure of structures with absorbing energy and with fatigue to reduce its application in energy-absorbing and fatigue-resistant structural systems.

Legal Document Summarization Using Large Language Models: LoRA-Based Fine-Tuning of Gemma-3 on Indian Legal Texts

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Abstract

The growing volume and complexity of legal documents in the Indian judicial system have created a need for automated tools that support efficient legal document analysis and summarization. In this work, we present a domain-adapted language model fine-tuned specifically for Indian legal text using the Gemma-3 instruction-tuned architecture combined with the Unsloth framework. To enable resource-efficient and scalable training, we employ Low-Rank Adaptation (LoRA), allowing parameter-efficient fine-tuning without compromising performance.

The model is trained on a curated “Indian Legal” dataset sourced from HuggingFace, consisting of legal case documents paired with human-written summaries. This enables the model to learn domain-specific legal terminology as well as the structural and argumentative patterns typical of judicial decisions. To better align with real-world legal interactions, the data is preprocessed using multi-turn chat templates that simulate user–assistant conversations, improving the model’s ability to handle conversational legal queries.

Training is performed using HuggingFace’s TRL SFTTrainer with a selective loss function focused on assistant responses, ensuring concise and contextually accurate summary generation. Additionally, comprehensive data filtering techniques are applied to remove noisy and incomplete samples, thereby improving training quality and output reliability.

Model performance is evaluated using BERTScore to assess semantic similarity with reference summaries. The proposed approach achieves an average BERTScore F1 of 0.8947, indicating strong semantic alignment and effective capture of key legal facts, arguments, and conclusions. Overall, this work demonstrates an efficient and modular pipeline for domain-specific adaptation of large language models in legal NLP, with potential applications in court record summarization, legal research assistance, and e-governance systems to enhance legal accessibility and transparency.

Analogue Gauge Detection and Digitization using OpenCV: A Robust, Computationally Efficient Framework for Industrial Retrofitting

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Abstract

Despite the rapid proliferation of Industry 4.0 and the Industrial Internet of Things (IIoT), analogue gauges remain deeply entrenched in critical industrial infrastructure due to their inherent robustness, passive operation, and zero electrical dependency. Their continued use, however, creates significant data silos, impeding real-time monitoring, predictive maintenance, and operational efficiency. This paper presents a comprehensive computer vision framework for the automated digitization of circular analogue gauges using the OpenCV library. The proposed pipeline employs the Hough Circle Transform (HCT) for gauge localization and the Probabilistic Hough Line Transform (PHLT) for pointer segmentation, augmented by adaptive image preprocessing and angular interpolation for value computation. Unlike data-hungry deep learning architectures requiring specialized GPU hardware, the proposed classical approach employs a semi-automated human-in-the-loop calibration strategy that ensures generalizability across diverse gauge types and configurations. Experimental evaluation demonstrates real-time performance at approximately 28 frames per second on a Raspberry Pi 4 Model B (4 GB RAM) with a mean reading error between 0.1% and 0.5%. The system achieves competitive accuracy relative to state-of-the-art deep learning methods while operating at a fraction of the computational and financial cost, making it a viable solution for retrofitting legacy industrial facilities.

Keywords

Computer Vision, Industrial Automation, OpenCV, Hough Transform, IIoT, Edge Computing, Analogue Gauge Reading, Image Processing, Raspberry Pi, Predictive Maintenance.

Securing Social Media Platforms Using Face Recognition and Liveness Detection

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Abstract

The rapid growth of social media platforms has led to a significant rise in fake and duplicate accounts, which are often exploited for malicious activities such as spamming, phishing, and cyberbullying. Traditional authentication mechanisms, including passwords, email verification, and one-time passwords (OTPs), are increasingly vulnerable to security breaches. This paper proposes a lightweight and efficient face-based authentication system that integrates multi-frame verification and duplicate face prevention to enhance security. The system utilizes the Haar Cascade algorithm for real-time face detection and the Local Binary Pattern Histogram (LBPH) method for facial recognition. To ensure robustness against spoofing attacks, a multi-frame liveness detection mechanism is incorporated, where multiple frames are analyzed to confirm user authenticity. Additionally, duplicate account creation is prevented by validating both username and facial identity during registration. The system is evaluated using a real-time dataset collected from users under varying conditions, with an 80:20 training and testing split. Experimental results demonstrate that the proposed approach achieves an authentication accuracy of **90.3%**, with reduced False Acceptance Rate (FAR) of **4.8%** and False Rejection Rate (FRR) of **3.1%**, while maintaining low computational complexity suitable for real-time applications. The proposed system effectively enhances authentication security and provides a practical solution for preventing unauthorized access and fake account creation in social media platforms.

Keywords

Face Recognition, Liveness Detection, Social Media Security, Spoof Detection, MultiFrame Verification, Duplicate Detection.

Semantic Communication: An AI Driven Transport Layer Approach for Ultra Low Latency 6G Applications

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Abstract

With 6G networks, ultra-reliable and ultra-low latency communication (URLLC) is to be made possible in mission-critical applications including remote surgery, autonomous transportation, smart grids, and emergency response systems. Conventional transport layer protocols like TCP are reliability-based and retransmission-based that enhance the latency in situations of packet losses. Nevertheless, the 6G services of the future require intelligent adaptive communication systems which focus on meaning rather than delivery of raw data. The following paper presents and analyzes the simplified model of an AI-based semantic transport layer that will prioritize the packets on the fly depending on their semantic importance instead of considering all packets to be equal. A Python simulation is done to compare between a traditional retransmission based transport and a semantic aware transport mechanism. In the proposed model, the high importance (emergency) packets are given priority and are sent with minimum latency and low-importance packets might be dropped when there is congestion. The simulation findings of 1000 packets with 10 per cent packet loss show that the average latency decreases by 45.27 per cent with the semantic transport approach over the traditional transport mechanisms. The cumulative graph in latency also depicts significant progress in the ranking of the transmission efficiency. According to the findings, semantic-aware transport mechanisms can provide significant benefits to latency performance of 6G applications without prejudice to the delivery of critical data. This study will be used to advance the design of smart transport layers to future AI-native wireless networks.

Keywords

Network Simulation, Intelligent Protocols, AIDriven Networking, 6G Networks, Semantic Communication, Transport Layer, Ultra-Low Latency.

Low-Power and High-Performance Flip-Flop Architectures for Advanced CMOS Technologies

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Abstract

The flip-flops (FFs) are basic sequential storage components that are widely utilized in digital integrated circuits for the state retention, pipelining, and synchronization. As CMOS technology scales and System-on-Chip (SoC) architectures grow more complex, designing power-efficient, high-performance flip-flops has become crucial for the modern VLSI systems. The clock distribution networks and flip-flops combinedly consume between 20 and 45 percent of the total chip power, making them one of the main causes of energy dissipation in digital circuits. There are many modern flip-flop topologies and architectures, including transmission gates, dual-edge triggered (DETFF), true single phase clocked (TSPC), hybrid logic, and sense-amplifier based designs, are described in this work. Modern technologies such as thin-film transistor circuits, memristor-based flip-flops, ferroelectric FET-based non-volatile flip-flops, and spintronic storage elements are also featured. Flip-flop architectures across technological nodes, including as 180 nm, 90 nm, 65 nm, 45 nm, 28 nm, and FinFET nodes, are compared. Transistor count, latency, power consumption, and power-delay product (PDP) are used to examine the architectures. The benefits and drawbacks of current flip-flop designs are highlighted, which also suggests future lines of inquiry for ultra-low-power sequential circuits.

Keywords

Flip-Flops, Low-Power VLSI Design, High-Performance Circuits, CMOS Technology Scaling, FinFET Technology, Sequential Circuit Design.

Spectral Discrimination and Separable Analysis of Crops and Weeds Using Deep Learning Techniques

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Abstract

Weeds are a big problem for farming because they compete with crops for water, nutrients, and sunlight, which lowers yields. Using herbicides and manually pulling weeds are two common ways to control weeds, but they are expensive, time-consuming, and bad for the environment. This research introduces an automated system for crop and weed detection, developed using the YOLOv3 deep learning framework.

The model was trained on a set of 1,300 labeled agricultural images that showed sesame crops and different types of weeds. The system uses YOLOv3 and OpenCV to find crops and weeds in real time, making bounding boxes and confidence scores for each class. Using confidence thresholds and non-maximum suppression in post-processing makes sure that predictions are strong.

The system is available on a number of platforms to make it easier to use. These include a command-line tool, a Flask-based web app with interactive features, a demo app for people who aren't tech-savvy, and an OpenCV Jupyter notebook for research and teaching. This ecosystem works on many platforms and helps farmers, researchers, and teachers. It encourages sustainable precision agriculture.

Exploring YOLO-Based Object Detection to Enhance Flood Disaster Response

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Abstract

Floods are one of the most devastating natural events that endanger human life, the infrastructure, and the general environment. Fast flood recognition is therefore necessary for the rescue teams to carry out their operations effectively and it also helps in the allocation of resources. In this work, we look into a YOLO-based object detection system that can identify people, vehicles, and objects in the flood scene from the pictures using Generative AI techniques. The suggested system is a fusion of real-time computer vision, visibility estimation, and the user's spatial relationship with the help of an interactive web interface. The users can upload their pictures, see the detections, and understand the contextual information in a convenient way. This system, unlike existing methods, which have low accuracy, poor scalability, and limited real-time integration, intends to provide reliable detection under different environmental and lighting conditions [1], [3]. The project, by localizing the objects in images using deep learning and making the system available on the web, thus, can be a great tool in enhancing the situational awareness and speeding up the decision-making process in the case of a flood disaster response.

Keywords

Generative AI, You Only Look Once (YOLO), Object Detection, Flood disaster response, Synthetic data, Flood image generation.

Energy-Adaptive SNNs with Real-Time Power Feedback for Edge AI

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Abstract

Edge AI applications can be differentiated by tight energy and resource constraints, and thus energy efficiency is a fundamental design goal rather than a secondary optimization. Although Spiking Neural Networks (SNNs) and neuromorphic architectures provide natural energy benefits through event-driven processing, most existing solutions are based on statically optimized parameters or hardware-focused energy management strategies such as Dynamic Voltage and Frequency Scaling (DVFS). These solutions do not have the ability to dynamically adjust neural processing to match actual real-time power conditions.

The goal of this research is to make progress on a closed-loop, power adaptive SNN architecture that combines real-time power control with neural adaptation. The proposed system adjusts the neuron thresholds, spiking activity, and inference time steps at runtime to maintain operation within a specified power budget while maintaining inference accuracy and latency. In contrast to DVFS-based methods, the proposed system tightly couples power control with neural dynamics for fine-grained power control.

The method is compared with static SNNs, DVFS-only approaches, and TinyML CNN baselines in terms of energy per inference, classification accuracy, inference time, and power stability. The experimental results show that the adaptive SNN provides a dramatic energy savings and average power consumption while maintaining competitive accuracy and real-time performance. Moreover, the system has a graceful degradation with limited power budgets, making it suitable for battery-powered and energy-harvesting edge computing applications.

These results highlight the success of closed-loop, power-aware adaptation in SNNs and confirm its potential as a reliable software-level approach for energy-efficient edge AI inference.

Keywords

Edge AI, Spiking Neural Networks, Neuromorphic Computing, Power Aware Inference, Closed-Loop Control, Energy-Efficient AI.

Image Based Waste Classification and Soil Recommendation Using Machine Learning

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Abstract

This project focuses on using Machine Learning techniques to identify different types of waste through images and suggests suitable use for soil or otherwise through disposal recommendations. The system basically extracts important visual features such as colour, texture, and shape from the input image of waste using image processing methods. The extracted features are then provided as input to the Support Vector Machine (SVM) classifier, which classifies the waste into two major categories: biodegradable and non-biodegradable. The biodegradable group includes organic material like food scraps, leaves, and paper, while non-biodegradable wastes are made up of plastic, metal, and glass.

Based on the classification result, the system develops appropriate recommendations to help in environmentally responsible waste management. In the event that the garbage is classified as biodegradable, it suggests utilizing garden soil or compost soil for natural decay and recycling of organic refuse. On the other hand, if the garbage is non-biodegradable, the system recommends its recycling or proper methods of disposal to avoid pollution of the environment. This intelligent approach ensures that users make an accurate decision on the best way of waste disposal without requiring any technical knowledge in that field. Overall, this project enhances eco-friendly activities by reducing pollution, promoting better waste segregation practices, and providing a simple, automated, and intelligent decision-making system.

LearnSphere: An AI Powered Classroom Platform for Smarter Learning

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Abstract

Access to and control of learning resources over a period of years is a shared dilemma for college students, which mostly involves tedious searching from broken sources. LearnSphere is suggested as one integrated e-learning system that aims to meet the challenge of addressing this dilemma by concentrating study materials and offering intelligent learning support. The platform supports AI-enhanced summarization to summarize long notes, study buddy matching to enable peer learning, and semantic search to effectively retrieve relevant resources. Developed on a scalable architecture with the MERN stack and modular AI services, LearnSphere provides seamless and engaging user experience. LearnSphere plans to offer an integrated, smart learning environment that maximizes academic productivity, collaboration, and access during the college experience.

Keywords

E-learning, MERN, semantic search, AI summarization, recommendation engine, study buddy matching.

SecureVote: A Blockchain-Integrated Facial Recognition Framework for Tamper-Proof Electronic Voting

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Abstract

SecureVote is a next-generation electronic voting framework designed to address the major weaknesses of both traditional paper-based elections and centralized e-voting systems. Its architecture rests on two core components: a deep learning-based facial recognition system enhanced with real-time liveness detection, and a permissioned blockchain network that manages vote storage and counting through automated smart contracts.

The biometric module verifies each voter by capturing a live facial image, generating a compact feature embedding using a Convolutional Neural Network (CNN), and matching it with a pre-registered cryptographic hash. A liveness detection mechanism distinguishes genuine users from spoofing attempts such as photographs, replayed videos, or 3D masks, achieving a False Acceptance Rate (FAR) below 0.5.

Within the blockchain layer, each vote is recorded as an immutable transaction on a distributed ledger, making tampering computationally impractical. Smart contracts automatically handle voter eligibility checks, vote tallying, and overall election management, minimizing human intervention and associated risks. Biometric images are not stored; only salted SHA-256 hashes are retained, maintaining separation between identity information and voting data. Experimental evaluation shows that the complete authentication-to-vote recording process completes in under three seconds on standard hardware, demonstrating its suitability for practical deployment.

Keywords

Blockchain, Facial Recognition, Liveness Detection, Smart Contracts, Electronic Voting, Voter Authentication, Biometrics, Cryptographic Hashing.

Smart Agriculture Applications for Predicting Soil Moisture in Farming

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Abstract

Agriculture is rapidly adopting modern technologies to enhance productivity and sustainability. Contemporary farming integrates advanced tools such as sensors, automated machinery, and information technology systems. These innovations in precision agriculture and robotics enable farms to operate more efficiently, safely, profitably, and sustainably. A critical factor influencing agricultural productivity is maintaining optimal soil moisture levels. Soil moisture refers to the amount of water present in the soil, which plays a vital role in providing nutrients to plants, supporting transpiration, and promoting strong root development. Accurate prediction of soil moisture levels assists farmers in selecting suitable crops and improving overall yield.

To achieve precise soil moisture estimation, this study employs multiple machine learning algorithms, including Long ShortTerm Memory (LSTM) networks and Extreme Gradient Boosting (XGBoost), and proposes a novel hybrid approach. The proposed model enhances prediction accuracy and computational efficiency by effectively analyzing complex patterns within the dataset. Overall, the smart agriculture framework contributes to sustainable farming by optimizing resource utilization, increasing crop productivity, and promoting environmentally responsible agricultural practices.

Keywords

Agriculture, Machine Learning, Soil Moisture, LSTM, XGBoost, Smart Farming.

Smart Foreign Student Monitoring

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Abstract

The proposed system is a secure web-based application designed to modernize and safeguard crime and investigation records within police departments. Currently, many crime-related processes rely on manual paperwork or partially automated systems, which are vulnerable to unauthorized access and data breaches. The new system aims to digitize and secure critical records such as crime complaints, investigation reports, criminal profiles, and terrorist activity logs. In addition, the application will address the growing need to monitor foreign students, some of whom may be involved in criminal or suspicious activities. It integrates key stakeholders—Passport Departments, Colleges, and Police Stations—into a single platform that enables real-time access to foreign student information, including passport details and identity verification. This collaboration ensures continuous monitoring, quick verification, and secure data sharing while preserving privacy and preventing unauthorized third-party access. By enhancing transparency, accountability, and data protection, the system strengthens national security and modernizes law enforcement infrastructure.

Keywords

Foreign student Monitoring, Crime Records, Web Security, Passport Verification, Law Enforcement.

HVT-CNN-SVM RetinalNet: A Hybrid Vision Transformer-CNN-SVM Framework for Automated Multi-Class Retinal Disease Classification

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Abstract

The identification of diseases in a timely and accurate manner is essential in averting irreversible loss of vision in patients with ocular diseases. However, traditional methods of identification are based on a labor-intensive examination of fundus images of the retina of patients, and despite recent breakthroughs in deep learning algorithms with convolutional neural networks, they may lack effectiveness in perceiving and analyzing global features in patients with similar ocular diseases with distinct features that are visually similar. Therefore, this report proposes HVT-CNN-SVM RetinalNet Vision Transformers and CNNs combined with a Support Vector Machine classification system that effortlessly classifies patients with multi-class ocular diseases with improved class separability and distinct boundaries between related diseases with remarkable accuracy based on a hybrid system that incorporates Vision Transformers and CNNs that perceive global and local features of patients with ocular diseases influenced by optic disc deformation, micro-aneurysms, and diseases with cataracts that cause light-induced opacities of patients with ocular diseases identified by adaptive contrast enhancement of patients with ocular diseases that may result in hidden inconsistencies within patients with limited lighting conditions of patients with ocular diseases. To counter the issues arising from class imbalance during multi-class training, the process of balanced loss is included during training. Additionally, the use of Grad-CAM-based visual explanation techniques helps to focus attention on the relevant retinal area, hence enhancing the interpretability and trustworthiness of the model. Based on the experimental studies conducted on the retinal images, the proposed integrated model HVT-CNN-SVM RetinalNet establishes its significance by ensuring better classification, interpretability, and trustworthiness than the existing standard approaches based on CNN. This concludes the reliability and efficiency of HVT-CNN-SVM RetinalNet for real-time eye screening.

Keywords

Retinal Disease Classification, Vision Transformer, Convolutional Neural Network, Support Vector Machine, Hybrid Deep Learning Model, Fundus Image Analysis, Automated Ophthalmic Diagnosis, Explainable Artificial Intelligence.

Smart Menstrual Health Assistant

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Abstract

Development of accurate predictions of menstrual cycle is an issue since it contains disparities depending on lifestyle, physiological elements not considered and consequently unfamiliar to the conventional calendar-based method. This proposal is a research project of Vylora, a full stack web application which integrates a three step machine learning pipeline in enhancing personal prediction. The algorithm includes a Random Forest Regressor that estimates the cycle length, an XGBoost Classifier that identifies the probability of the lifestyle disruption, and a Logistic Regression model that achieves the adjustment of the confidence rates. It relies on dynamically adjusted predictions on real-time behavioral data such as stress, sleep, travel and disturbance of routines. The experimental study reveals that a higher accuracy is developed as compared to the baseline procedures involving coined down prediction error and stable classification. The architecture includes React as a frontend and Node.js as a backend and database, MongoDB and Flask inference engine. Vylora is a flexible, privacy-aware architecture that can be adapted to support future applications in embarking on menstrual health tracking and make additional applications in fertility tracking and reproductive health analytics.

Keywords

Machine Learning, XGBoost, Predicting Menstrual Cycle, Random Forest, Digital Health, Lifestyle Analytics, Personalised Healthcare.

Multi-Platform Social Media Post Scheduler

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Abstract

The proliferation of social media platforms has imposed significant operational overhead on digital content creators and marketing teams, who must manage platform-specific publishing workflows simultaneously. Existing third-party scheduling tools are cost-prohibitive, architecturally fragile with respect to API compliance, and lack deeply integrated analytics. This paper presents the design, implementation, and evaluation of a Multi-Platform Social Media Post Scheduler—a unified, full-stack web application that automates cross-platform content publication across YouTube, Instagram, and X (formerly Twitter). The system employs a three-tier architecture comprising a ReactJS presentation layer, a Spring Boot application layer, and a relational database backend. Secure delegated authorization is achieved through the OAuth 2.0 protocol with AES-256 token encryption at rest. The scheduling engine adopts a database-backed polling mechanism that executes pending tasks within a target window of 60 seconds from the designated publish time. Platform-specific challenges—including YouTube's asynchronous video processing pipeline, Instagram's media format constraints, and X's character restrictions—are encapsulated within dedicated PlatformService abstractions. Evaluation results demonstrate a dashboard load latency of approximately 350ms, a scheduling accuracy within 30 seconds, and 95% unit test coverage for the scheduler and token management subsystems. An integrated analytics module provides visualization of engagement metrics including Views, Likes, Subscriber growth, and demographic distributions across connected accounts. This work establishes a modular, scalable baseline for future enhancements including AI-driven posting optimization and real-time event-driven analytics pipelines.

Keywords

Social Media Automation, Multi-Platform Scheduling, OAuth 2.0, Spring Boot, ReactJS, Content Management, API Integration.

Soil Moisture for Precision Agriculture using Machine Learning: A Survey

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Abstract

Soil moisture is a fundamental variable in controlling crop water and nutrient availability, as well as biophysical processes in farming. Timely and accurate soil moisture information at field and sub-field scales can support precision irrigation, yield prediction and climate-smart agriculture. There has been a recent surge in ML approaches to estimate and predict soil moisture by integrating in-situ sensors, Internet-of-Things (IoT) systems, remote sensing (radar/radiometer and optical), weather forecasts, and topographic/soil maps. This survey synthesizes the state of the art in ML-based soil moisture estimation and prediction for precision agriculture. We identify exciting opportunities: physics-informed networks, sensor data fusion with edge ML, federated learning for privacy-preserving farm data, uncertainty estimation, and active learning for optimal sampling. Finally, we provide guidelines for integrating ML soil moisture models into precision agriculture systems (data pipelines, feature engineering, model retraining, and validation). High-quality ML-based soil moisture products can help significantly save water in irrigation and boost resilience – but adaptation, interpretability, and validation are key before operational deployment.

Keywords

Precision Agriculture, Machine Learning (ML), Soil Moisture.

Bidirectional GRU Based Network Intrusion Detection System with Hybrid Deep Learning Techniques

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Abstract

Network Intrusion Detection Systems (NIDS) are essential for identifying and mitigating malicious activities in network environments. As cyber threats evolve in complexity, traditional NIDSs often struggle to detect sophisticated attacks effectively, especially those involving intricate temporal and spatial dependencies within network traffic. The ability to capture these dependencies is crucial for reducing false positive rates and improving detection accuracy. However, existing models face significant challenges, including handling varying sequence lengths and capturing long-range dependencies, which are essential for accurate anomaly detection. This system proposes a hybrid model that combines Sequence to Sequence (Seq2Seq) architecture with Convolutional Long Short-Term Memory (ConvLSTM) units to address these challenges. This hybrid model handles spatial and temporal dependencies by incorporating convolutional layers within LSTM cells. This enables the model to leverage the spatial feature extraction capabilities of Convolutional Neural Networks (CNN) alongside the sequential learning strengths of LSTM networks. In addition, to enhance the interpretability of the model, the proposed architecture integrates Explainable Artificial Intelligence (XAI) through Local Interpretable Model-agnostic Explanations (LIME). This approach provides insights into the model's decision-making process, highlighting the temporal and spatial features that influence predictions, and improving transparency in detecting anomalies. Experimental evaluations on benchmark datasets, including CIC-IDS 2017, CIC- ToN-IoT, and UNSW-NB15, demonstrate that the proposed hybrid ConvLSTM-Seq2Seq model outperforms existing methods in reducing false positives and achieving higher accuracy. This model offers a promising solution for NIDSs by improving detection capabilities and better handling complex temporal and spatial relationships in network data.

Keywords

Network intrusion detection, deep learning, Seq2Seq autoencoders, ConvLSTM, Bidirectional LSTM, GRU, hybrid architecture, explainable AI.

Multimodal Prediction of Omega-3 in Age-Related Macular Degeneration Using Transformers

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Abstract

Age-related macular degeneration (AMD) is a leading cause of permanent vision impairment among older adults. Although Omega-3 supplementation has been explored to slow disease progression, patient responses vary widely due to differences in clinical profiles and retinal structural features, making outcome prediction challenging. This paper presents a multimodal transformer-based framework to predict individual response to Omega-3 therapy by integrating structured clinical data with retinal fundus images. An FT-Transformer is utilized to capture complex interactions within tabular clinical variables, while a Vision Transformer (ViT) is employed to learn discriminative representations from retinal images. Features from both modalities are fused to estimate the likelihood of a positive treatment response. Experimental results indicate that the proposed multimodal approach outperforms conventional machine learning and single-modality models by effectively modeling nonlinear clinical patterns and fine-grained visual cues. The findings demonstrate the potential of multimodal transformers to support personalized nutritional guidance and assist clinicians in identifying AMD patients who are most likely to benefit from Omega-3 supplementation.

An API Gateway Architecture for Secure Query-Driven Access to Survey Microdata

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Abstract

Ministry of Statistics Programme Implementation (MoSPI) issues a immense repository of micro data of more than 170 macro scale surveys on socio-economic statistics. But the current dissemination process is based on manual download of files and processing of the surveys, which causes a major delay to access the data and has limited the use of the data by the researcher and the policymakers. In this paper, the researchers would suggest an Automated Data Dissemination Gateway which would allow to execute SQL queries on heterogeneous survey data dynamically with the help of a secure API gateway. The suggested system uses a metadata-based design in order to insert various survey designs into a single PostgreSQL database with a storage type of JSONB. A RESTful API is a dynamically generated SQL query that generates the SQL query as per user request, imposes constraints that protect privacy and responds in consumer-friendly formats like JSON. The architecture provides scalability, adherence to official statistical dissemination policies and fair access due to role-based controls. The suggested solution modernizes the microdata delivery through the transformation into a Stats-as-a-Service environment that would be consistent with the Digital Public Infrastructure vision of India.

Keywords

Data Dissemination Gateway, metadata-based design, PostgreSQL, RESTful API, Microdata Delivery.

Efficient Vision-Based Sign Language Gesture Detection and Landmark Extraction for Real-Time Applications

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Abstract

Automatic sign language understanding can be explained as a concept that is of interest to the research in assistive technology because sign language will be one of the key modes of communication between the hearing impaired and the speech impaired persons. Sign language recognition system has very much relied on proper and uniform visual preprocessing prior to any meaningful interpretation being done. However, most of the designs that are currently proposed just seek to make the best use of classification performance and do not focus much on the efficiency, robustness and real-time performance of the vision pipeline thereof particularly with systems with resource limitations.

The paperwork presents a viable vision-based system of real time identification of gestures of a sign language, landmarks using a normal RGB camera. It is hypothesized that the system will be capable of operating with both live video feeds and recorded feeds to offer the possibility of using gestures in real-time without any special sensors or wearables. The structure uses the processing of the image at the frame level to identify image hand and upper-body position and eliminates the spatial landmarks that define the gesture structure. The landmarks further generate the skeleton representations and the bounding boxes which can be effectively applied to observe and examine gestures in regions.

It dwells upon the discussion of real-life problems concerning the implementation of a real-time vision system which include camera positioning, frame rate synchronization, latency tolerance, and performance consistency on mobile systems. Lightweight processing strategies and frame handling mechanisms are in place to make the pipeline real-time responsive. Experimental testing deals with non-classification properties such as frame rate, detection continuity, and overlay synchronization behavior in real-life situations of use. These results indicate that the proposed vision pipeline can support the real time performance of the pipeline and produce a stable landmark representation that can be utilized in downstream sign language recognition applications. Overall, this contribution offers a solid and powerful foundation of visual preprocessing that can be applied to the creation of expandable and real time systems of sign language interpretation and gesture recognition.

Keywords

Sign Language Recognition, Vision-Based Gesture Detection, Hand and Pose Landmark Extraction, Real-Time Computer Vision, Skeleton-Based Representation, Mobile Vision Systems, Human Gesture Analysis, Assistive Communication Technologies.

RouteOptiX: Intelligent Multimodal Supply Chain Optimization Using Machine Learning and Deep Learning

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Abstract

The growing complexity of modern supply chains, driven by multimodal transportation networks, dynamic demand patterns, and cost fluctuations, necessitates intelligent and adaptive decision making systems. Traditional supply chain optimization methods often rely on static assumptions and lack predictive capabilities, leading to inefficiencies in route planning, resource allocation, and delivery execution. This paper proposes RouteOptiX, an intelligent multimodal supply chain optimization system that leverages Machine Learning (ML) regression models for transportation cost and delay prediction, combined with Deep Learning Long Short-Term Memory (LSTM) networks for demand forecasting. The system integrates predictive analytics with multi-objective optimization techniques to select optimal transportation modes (road, rail, air, sea) and routes while minimizing costs and delivery times. Deployed through an interactive Streamlit-based web application with secure authentication and database-backed storage, RouteOptiX demonstrates significant improvements in operational efficiency. Experimental results on New York City taxi trip data show 85-90% accuracy in trip duration prediction, substantial cost reduction in route optimization scenarios, and effective handling of weather integrated delay estimation. The system addresses critical supply chain challenges including demand uncertainty, transportation delays, inefficient resource utilization, and poor risk management. By combining ML, DL, and optimization algorithms, RouteOptiX provides a scalable, data-driven solution for modern multimodal supply chain management across retail, manufacturing, and e-commerce industries.

Keywords

Supply chain optimization, multimodal transportation, machine learning, deep learning, LSTM networks, demand forecasting, route optimization, cost prediction.

Career Connect: An AI-Powered Job Matching and College Assistance Platform Using Machine Learning and Retrieval-Augmented Generation

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Abstract

The modern digital age has brought a lot of problems in the process of making informed career choices by the students because of insufficiently personalized guidance, lack of platforms as a single job, and inadequate access to structured academic information. The activities and functions of conventional systems are mostly about job postings, lack of smart suggestions, skills analysis, and educational support. To tackle these constraints, this paper proposes Career Connect' which is an AI-based application that combines the three services of job matching, career guidance, and college support into one system.

The suggested system is based on the analysis of user profiles and similarity-based methods of matching them with the appropriate job descriptions using the methods of Machine Learning and Natural Language Processing. It establishes skills deficiencies and offers one-upon-one learning plans on how to become employable. Additionally, the portal can use Retrieval-Augmented Generation (RAG) to provide users with an AI chatbot that responds to their queries about the academic procedures, courses, hostel facilities, and other information about the institution with the help of the structured body of knowledge.

The system is composed in a full-stack architecture, i.e. a React-based front-end and a Django-driven backend with installed AI modules. The backend uses similarity search and embedding in vectors to retrieve the relevant contextual information that is then handled by a large language model to produce accurate and context-sensitive responses. It has also got a role based access to students, recruiters and administrators where they are able to post jobs, track their applications and monitor the systems.

The experimental analysis has allowed showing that the suggested system is efficient in terms of job matching, improves user engagement with personalized recommendations, and provides accurate responses during the management of queries based on academic queries. The system is very effective to both students and institutions since it combines both career guidance and institutional help under one platform. The proposed solution will add to the intelligent career development systems that integrate machine learning, conversational interface based on AI technologies, and real-life data integration.

Keywords

Career Guidance, Job Matching, Machine Learning, Natural Language Processing, Retrieval-Augmented Generation (RAG), Resume Analysis, Recommendation Systems, FAISS, AI Chatbot, Skill Gap Analysis, Full-Stack Web Application

Development and Evaluation of a Clinical Decision Support System Based on Machine Learning for Antibiotic Resistance Analysis

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Abstract

The World Health Organization estimates that if antimicrobial resistance (AMR) is not addressed, it would cause 10 million deaths annually by 2050, making it a significant global health concern. Because standard culture and sensitivity testing takes 48–72 hours, there is a dangerous empirical prescribing window. This work develops, trains, and assesses a machine learning-based clinical decision support system (CDSS) for predicting antibiotic zone of inhibition and recommending effective antibiotics based on structured patient and microbiological input qualities. An XGBoost regression model was trained using a dataset of 1,284 clinical isolates, comprising nine species and six antibiotics collected from four ward groups. Five-fold stratified cross-validation was used to assess the model against baselines for Support Vector Machine, Random Forest, and Logistic Regression. With a mean accuracy of 91.4% (SD: 0.8%), precision of 90.2%, recall of 91.7%, F1-score of 90.9%, and AUC-ROC of 0.95, XGBoost demonstrated the best performance. Organism identity and specimen type were found to be the most important predictive factors using SHAP-based feature importance analysis. The system, which offers real-time zone prediction, CLSI-based susceptibility interpretation, antibiotic recommendation, and population-level resistance analytics, is implemented as a full-stack web application (FastAPI backend, React frontend). Institutional approval, data anonymization, and ethical compliance are verified. The findings show that XGBoost-driven CDSS systems trained on local microbiology data provide a deployable, clinically significant method for quick antibiotic susceptibility recommendations in resource-constrained

Keywords

Zone of inhibition, SHAP interpretability, XGBoost, machine learning, antimicrobial resistance, and clinical decision support.

BERT-Enhanced Automated Pattern Recognition in Software Repositories Using Natural Language Processing and Machine Learning

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Abstract

The sheer volume of textual data created by software repositories (e.g., bug reports, developer comments, commit messages) is becoming increasingly challenging to manually analyze due to the increasing size and complexity of software projects. As such, existing text-mining and traditional machine-learning approaches to analyzing these datasets rely primarily on the frequency of keywords and do not capture the contextual meaning behind technical descriptions. In response to this challenge, this research presents an automated pattern-recognition approach using a Bidirectional Encoder Representations from Transformers (BERT)-based model to leverage advances in Natural Language Processing (NLP), and Machine Learning (ML) to analyze and effectively interpret software-repository data. Using contextual embeddings from the BERT model this proposed method can be used to automatically classify bugs, find common error patterns in the code base, predict severity of errors based on their frequency of occurrence, and even find duplicate bug reports by analyzing similarities between them. Additionally, the system includes confidence-scores, root cause-hints, and bug-trend insight at the repository level through a Web-Based User Interface. Experimental results show that the proposed framework enhances the developers' ability to semantically understand their source-code, reduces the manually required work, increases the speed and accuracy of software-maintenance activities. Therefore, the results of this research illustrate the practicality of utilizing transformer-based models to automate the analysis of software-repositories, and enhance decision-making by software-development teams.

Keywords

BERT (Bidirectional Encoder Representations from Transformers), Software Repository Mining, Bug Severity Prediction, Duplicate Bug Detection, Text Clustering, NLP-Based Software Maintenance.

Development and Design of Intelligent Web-Driven Decision Support Framework for Smart Agriculture

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Abstract

To improve executive, communication of information, and market accessibility for farming communities, this paper proposed a web-based agricultural support system. To facilitate individualized service delivery, the platform has a secure user registration and profile management module that records location, crop preference, and language settings. A Starter Kit subsystem helps new and small-scale farmers in particular by making it easier to find and purchase appropriate crops, seeds, fertilizers, and agricultural equipment. With scientific details on crop physiology, soil compatibility, cultivation techniques, and agronomic recommendations, the Farm School module serves as an organized information base. The system incorporates a Crop and agricultural Intelligence engine that evaluates soil properties, seasonal trends, and spatial location to produce crop plans and cultivation schedules to smooth data-driven agricultural decisions. To simplify operational planning, including planting, irrigation, and harvesting, this engine is closely linked with a real-time weather module. Crop-specific risks are identified, severity levels are estimated and suitable treatments, doses, and preventive measures are suggested by an intelligent Pest and Disease Management module. To smooth transparent transactions and feedback-based trust mechanisms, the Agri Direct module creates a digital marketplace that links farmers and buyers directly. To increase accessibility and uptake, local language assistance is integrated into every program. This makes the proposed system to support sustainable and financially feasible farming methods.

Keywords

Smart Agriculture (SA), Web-based agricultural support system, Starter Kit, Farm School module, Crop and agricultural Intelligence, Pest and Disease Management module, Agri Direct module.

Detecting Botnet Attacks in IoT Environments: An Optimized Machine Learning Approach

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Abstract

The project on "Detecting Botnet Attacks in IoT Environments: An Optimized Machine Learning Approach" addresses the growing threat of botnet attacks in Internet of Things (IoT) ecosystems. The project introduces an advanced machine learning-based solution designed to identify and mitigate botnet activities in IoT devices. The optimized approach focuses on improving accuracy, reducing false positives, and enhancing the overall efficiency of botnet detection in diverse IoT environments.

Tamil Character Identification from Palm Leaf Manuscript Using Deep Learning Models

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Abstract

Preservation of the ancient palm-leaf manuscripts has been considered increasingly essential in view of their historical, cultural, and linguistic importance, particularly in the context of classical Tamil literature. Digitization of such manuscripts is a challenging task as physical degradation, uneven background, scratches, and faded engraved text will badly affect the conventional OCR systems. This paper proposes an AI-based framework for digitizing Tamil palm- leaf manuscripts by using advanced image processing and OCR techniques. This approach integrates various modules, such as contrast enhancement, noise reduction, adaptive thresholding and binarization methods, to improve the visual quality of manuscript images before extracting the text. The framework utilizes multiple OCR engines and deep learning- based models to recognize Tamil text with high accuracy from the preprocessed images. Experimental results show that the proposed system improves the text recognition accuracy considerably compared with traditional OCR methods applied directly on raw images. The digitized output is further refined through post-processing and language-specific filtering to obtain clean and human-readable Tamil text. This paper explores the potential of AI-driven digitization systems in preserving the endangered manuscripts and improving their accessibility to the researchers, historians, and language scholars.

Keywords

Palm Leaf Manuscripts, Tamil OCR, Image Processing, Artificial Intelligence, Cultural Heritage Digitization, Optical Character Recognition.

A Lightweight Geometry-Aware Feature Preservation Approach for Inspection of PCB and PCBA Assemblies Using Residual and Channel-Guided Learning

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Abstract

Printed Circuit Boards (PCBs) and Printed Circuit Board Assemblies (PCBAs) inspection Automated defect inspection is important in ensuring quality in the contemporary electronics manufacturing. Current lightweight detectors operate by losing fine trace-level geometric detail via heavy downsampling and do not have explicit defect-sensitive channel recalibration. The article introduces a new detection framework with three carefully designed modules, including: (1) Lightweight Geometry-Aware Convolutional Backbone, which is a structural feature extractor, but with low-level spatial resolution; (2) two purpose-designed modules: (1) Dual-Attentive Channel-Spatial Recalibration (DACSR) that concatenates independent Squeeze-Excitation channel attention and convolutional spatial attention with learnable fusion in a single module; and (3) a Context-Aware Residual Fusion Transformer (C A Gradient-Balanced Localization approach that uses the IoU-regression stabilises the prediction of small structural defects in a bounding box. The Peking University Open Lab PCB defect dataset (1,386 images, 6 defect classes) is experimented on. Evaluation metrics such as precision, recall, mAP and analysis of confusion matrix are reported. Ablation experiments affirm autonomous efforts of both modules.

Keywords

PCB defect detection, geometry-aware backbone, channel attention, spatial attention, DACSR, CARFT, transformer neck, IoU loss, object detection, lightweight architecture.

Empowering the Gig Economy: Designing AI-Driven Job Platforms for Informal Workers

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Abstract

In developing economies specially India, blue-collar workers constitute a substantial portion of the labor force, yet because of various reasons like low literacy, inadequate sources, lower technical skills and mainly the absence of architecture catered to their specific needs. A large proportion of currently available systems cater to technically skilled workforce failing to address the limitations like specificity of skillset, their credibility, region-specific employment. This paper provides a socially inclusive view which is much more human-centered, of a job-matching platform assisted with AI for the informal workforce. The work focuses on the key design principles, accessibility considerations, and social impact factors over any algorithmic approach. The paper discusses multilingual interfaces, voice-assisted interactions, location-based matching, a policy-aligned system design that can foster greater opportunities in the informal labor market. With the help of AI-driven systems in the context of social and policy contexts, this paper provides a conceptual architecture for an inclusive, equitable and scalable digital employment system.

Keywords

Blue-collar workforce, Digital inclusion, Human-centered AI, Informal employment, Job-matching platforms.

Deep Learning-Based Indian Sign Language (ISL) Translation System

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Abstract

The Indian Sign Language (ISL) is important as it facilitates the communication of people with hearing and speech disorders. Nevertheless, there are still communication gaps because of the lack of awareness of the general population. This project is the Deep Learning-Based Indian Sign Language Translation System, which is used to automatically identify ISL gestures and transform them into a readable text through computer vision and Convolutional Neural Networks (CNNs).

The system is able to support character level and word level recognition and is flexible in use. Images, videos, or live webcam input are captured as the hand gesture and processed pre-adaptively by hand detection, resizing and normalization before being subjected to trained CNN models. In the case of the video-based input, the predictions of several frames are pooled to come up with smoother and more accurate output. The system is implemented in form of a Flask-based web application using a simple and easy-to-use interface to interact real-time.

In general, this project will be beneficial in minimizing communication barriers and offering an open and smart solution that may be advanced with such features as speech synthesis and sentence-level translation, which can be added later on.

Keywords

Indian Sign Language (ISL), Convolutional Neural Networks (CNN), Gesture Recognition, Deep Learning, Computer Vision.

Building AI Inside Enterprises: A Product Manager's Framework for Scalable AI Adoption

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Abstract

Artificial Intelligence is rapidly transforming enterprise software systems; however, many organizations struggle to transition from experimental AI prototypes to scalable, production-ready AI products. This challenge is particularly evident in large enterprises where data fragmentation, governance constraints, and cross-functional dependencies slow down AI adoption. This research explores the role of the Product Manager in bridging the gap between AI innovation and enterprise-scale implementation.

The study proposes a structured framework for building AI-enabled products within enterprise environments by focusing on five critical dimensions: data readiness, AI product lifecycle management, cross-functional collaboration, responsible AI governance, and continuous learning systems. The framework draws on industry practices and simulated case scenarios across sectors including healthcare, manufacturing, and financial services to illustrate how organizations can operationalize AI while ensuring scalability, compliance, and user trust.

The findings highlight how product managers can act as orchestrators between engineering, data science, and business stakeholders to deliver value-driven AI products. This research contributes a practical playbook for enterprises seeking to embed AI capabilities into digital products while maintaining strategic alignment, ethical standards, and long-term sustainability.

A Spatiotemporal Statistical Analysis of Dengue Burden and Mortality in Southern India (2005-2026)

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Abstract

Dengue fever has been a prominent public health issue in India because it propagates quickly, it is seasonal, and it recurs, which shows its powerful characteristic as a vector-borne disease. This paper is a detailed statistical data analysis of dengue incidence and mortality in four southern Indian states Kerala, Tamil Nadu, Karnataka, and Telangana between the period of 2005 and 2024 and thereafter provides short-term predictions (2025–2026) was collected from the National Centre for Vector Borne Diseases Control (NCVBDC), Government of India using HoltWinters exponential smoothing model.

The results show that the CFR is always highest in Kerala compared to the other four states, which implies that the disease severity or healthcare response problems are relatively high. In Karnataka, the incidence of dengue is increasing over the past few years which is indicative of the escalating intensity of transmission. Conversely, Telangana continues to record the lowest death rate, which means that the management of the disease is relatively efficient. Projections of the forecasts indicate that the dengue cases will keep increasing in majority of the states except in Telangana where the death rates are likely to be relatively low. ANOVA indicates statistically significant differences in dengue related deaths between states whereas differences in case counts are not statistically significant, suggesting that there could be differences between states in the effectiveness of healthcare services, environmental vulnerability, or a reporting dynamics.

In general, the paper highlights the role of specific approaches to public health and predictive models to reduce dengue cases among susceptible groups. There is a need to strengthen preventive and response mechanisms to tackle the changing epidemiological situation with dengue in India.

Keywords

Dengue fever, statistical analysis, forecasting, case fatality rate (CFR), ANOVA, time series modeling, public health, India.

AI-Powered Zero-Day Attack Detection using Deep Autoencoders

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Abstract

The increasing sophistication of cyber threats has made zero-day attacks one of the most critical challenges in modern network security. Zero-day attacks exploit previously unknown vulnerabilities, making traditional signature-based intrusion detection systems ineffective. This research proposes an AI-powered anomaly detection framework using deep autoencoders to identify previously unseen cyber intrusions without relying on labeled attack data.

The proposed system utilizes unsupervised deep learning to model the intrinsic behavior of benign network traffic. Network flow data undergoes preprocessing, including feature extraction, normalization, and encoding, before being fed into a fully connected deep autoencoder trained exclusively on normal traffic patterns. The model learns a compressed latent representation and reconstructs the input data. Reconstruction error is used as an anomaly score, where significant deviations indicate potential zero-day threats.

A dynamic thresholding mechanism enhances detection adaptability across varying traffic conditions while minimizing false positives. The framework is integrated with a real-time monitoring dashboard for visualizing anomaly scores, reconstruction error trends, and flagged attacks, improving operational transparency and response efficiency. Experimental evaluation on benchmark intrusion detection datasets demonstrates effective separation between benign and malicious traffic. The results confirm that deep autoencoder-based anomaly detection provides a scalable, adaptive, and intelligent defense mechanism for protecting modern digital infrastructures against emerging cyber threats.

Keywords

Zero-day attack detection, deep autoencoder, anomaly detection, unsupervised learning, cybersecurity.

Motion-Aware Vision Mamba with CNN-BiLSTM Framework for Suspicious Human Behavior Detection in Surveillance Videos

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Abstract

Suspicious human behavior detection in surveillance videos presents significant challenges due to motion blur, temporal complexity, and computational constraints in real-world deployment scenarios. This paper proposes a novel hybrid architecture, Motion-Aware Vision Mamba with CNN-BiLSTM (MAV-CB), that integrates motion blur handling, Vision Mamba for efficient temporal modeling, and CNN-BiLSTM for robust spatiotemporal feature learning. The framework introduces a motion deblurring preprocessing module, with spatial attention mechanisms for lightweight spatial feature extraction, Vision Mamba's selective state space modeling for long-range temporal dependency capture with linear computational complexity $O(T)$, and bidirectional LSTM for enhanced temporal context understanding. Comprehensive experiments on Violence Dataset, UT-Interaction, and New Action datasets demonstrate 97.14% accuracy while maintaining faster inference compared to transformer-based approaches. The framework exhibits remarkable resistance to severe blur degradation, surpassing baseline methods by a considerable margin and establishing selective state space models combined with motion blur mitigation as an effective solution for resource-constrained surveillance systems.

The Evolution of Precision Oncology: A Review of Deep Learning Architectures for Diagnostic Classification and Survival Prediction in Breast Cancer

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Abstract

The global burden of breast cancer continues to increase, with projections indicating that there will be over three million newly diagnosed cases each year by 2040. While traditional clinical interventions rely on manual histopathologic evaluation and known biomarkers, the aggressiveness of certain subtypes, like triple-negative breast cancer (TNBC), requires more targeted and automated diagnostics and prognostic interventions. This paper discusses a detailed review and analysis of recent advances in deep learning (DL) architectures for the analysis of breast cancer, focusing on the shift toward data-driven precision medicine and automated analysis of breast cancer. We test the effectiveness of convolutional neural networks (CNNs) and U-Net variants in lesion segmentation and classification and demonstrate the ability to reduce inter-observer variability and the rate of human errors. Moreover, this review examines the development of DL models as low-cost surrogates to molecular testing models that are able to predict estrogen receptor (ER) status and PAM50 intrinsic subtypes directly from hematoxylin and eosin (H&E) stained slides. Special attention is given to prognostic survival analysis in TNBC, where multiple instance learning (MIL) or the quantification of digital biomarkers, such as stromal tumor-infiltrating lymphocytes (sTILs) have been found to be superior for risk stratification. Finally, we discuss the integration of multimodal data (ultrasound radiomics combined with clinicopathologic features) which has been shown to have C-indices up to 0.93 in overall survival. The review concludes that, although challenges remain in the scarcity of datasets and the generalization of models, the integration of DL in clinical workflows is a paradigm shift in oncologic diagnostics.

EEG in Alzheimer's Disease Prediction Using Cognitive-Based Machine Learning Techniques

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Abstract

Electroencephalography (EEG) has become a potential non-invasive technique to predict Alzheimer disease (AD) at an early stage to identify the existence of some neural anomalies, and the clinical symptoms of the illness have not developed. This paper will suggest a machine learning model, which is cognitive-based and is built on EEG data to enhance the predictive accuracy of AD. The methodology consists of EEG preprocessing, feature extraction that can be related to cognition, and application of various machine learning classifiers that can differentiate between healthy controls and the individuals who have a form of AD in the initial stages of the disease. The experimental findings demonstrate that the given approach has higher classification results as compared to traditional techniques, which could be considered as the sign of its efficiency in the role of a diagnostic tool.

Lung Cancer Segmentation

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Abstract

One of the most deadly illnesses in the world is lung cancer, and increasing survival rates requires early identification. For the purpose of diagnosis and treatment planning, these lung tumours must be accurately segmented from computed tomography (CT) images. But manual delineation takes a lot of time, is subjective, and can be inconsistent. For reliable lung cancer segmentation, this research suggests a hybrid deep learning framework that combines convolutional and transformer-based architectures, specifically U-Net, DeepLabv3+, and Mask2Former. To improve segmentation performance, the suggested method combines attention-based learning, multi-scale feature extraction, and sophisticated preprocessing. Mask2Former outperforms U-Net and DeepLabv3+ with a test accuracy of 95.50%, according to experimental evaluation. The Outcomes Confirm how well hybrid deep learning models enhance segmentation accuracy and Dependability, enabling clinical Decision-making.

Keywords

Lung Cancer Detection; Lung Cancer Segmentation; Computed Tomography (CT) Imaging; Deep Learning; Medical Image Segmentation.

Leveraging Artificial Intelligence for Climate Forecasting and Carbon-Neutral Future

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Abstract

Growing intricacies surrounding climate change call for emerging strategies to forecast environmental trajectories and develop sustainable responses. This research explores the application of Artificial Intelligence (AI) to climate forecasting, underlining its importance in scrutinizing vast environmental datasets, predicting extreme weather events, and supporting policy decisions in reaching carbon neutrality. With the integration of machine learning algorithms, satellites, and sensor-climate monitoring, AI allows realistic simulations of atmospheric and ecological phenomena. The study further explores how knowledge drawn from AI can support renewable energy options, emission reduction plans, and climate-resilient infrastructure planning. Despite advances in technology, data integrity, algorithmic biases, and governance remain challenges, necessitating responsible AI deployment. The study traces a pathway from predictive analytics to practical climate action plans, providing an outline for governments, business organizations, and environment institutions to accelerate transformation to a carbon-neutral future.

Keywords

Artificial Intelligence, Algorithmic biases, Carbon Neutrality, Ecological.

Design and Implementation of a Hybrid Hardware-Software System for Enhanced Women Safety with Reliable Emergency Tracking

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Abstract

This study proposes a hardware-software hybrid solution that can overcome some of the most important shortcomings of the current women safety solutions. Although there are many mobile applications that may be used in assisting in case of an emergency, they are basically on the operational condition of the smartphone, its battery, and its network connection, which in the real emergency situations, is usually subdued. The paper suggests and realizes a twolevel safety net, which consists of a highly functional mobile application and a specific hardware component installed in a protective phone cover. The mobile application has conventional safety features such as one-tap SOS, live location sharing, geofencing, and silent alerts. The new hardware module, which provides unique GPS receiver, GSM modem, backup battery, and separate panic button will guarantee the constant functioning of the device even when the main smartphone is turned off, destroyed, or discharged. The prototype system was put through hard duress testing. It has been shown that with the hardware fallback mechanism a 99.2% alert success rate is reached with an average latency of 8.7 seconds to transmit a location message when the phone is in the disabled state. The hybrid concept of the Williams project having a Bill of Materials (BOM) cost of less than 25 dollars is a reliable, more affordable and more practical approach that will greatly increase personal safety infrastructure of women in adverse circumstances.

Keywords

Women Safety, Internet of Things, Emergency Response System, GPS Tracking, Hybrid Architecture, Embedded Systems, Fallback Mechanism, Mobile Application.

What Drives ROI in Social Media Campaigns? A Multicollinearity - Aware Regression Study

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Abstract

This study investigates the impact of key social media advertising metrics on Return on Investment (ROI) using regression modeling applied to a dataset of over 300,000 digital campaign records. The dataset consists of diverse demographic audiences and campaign characteristics, including impressions, clicks, engagement scores, conversion rates, and acquisition costs. The purpose of the analysis is to identify which metrics most strongly influence ROI within paid social advertising environments. Results indicate that Impressions are the strongest positive predictor of ROI, demonstrating that broader audience reach contributes substantially to improved profitability. There is a statistically significant negative correlation between clicks and ROI, meaning that increases in clicks, all else equal, would not increase ROI. Since more clicks mean spending too much on low-intent traffic, this suggests that the increase in clicks meant spending too much on low-intent traffic. The Customer Acquisition Cost is the most significant negative condition of ROI, which proves the place for a budget for efficiency and even perhaps expenditure quantity distinctions. The effect engagement score was interesting but small and conversion rate was not statistically relevant inside this data set; taken together with experience, this indicates that profitable reach optimization and cost-ineffective interaction minimization are important to successful ROI rather than purely trying to increase clicks. Again, these results lend themselves to actionable suggestions for marketers for managing digital advertising effectiveness.

Keywords

Social Media Advertising, Return on Investment (ROI), Digital Marketing Analytics, Regression Analysis, Campaign Performance Metrics, Impressions, Acquisition Cost, Engagement Effectiveness, Marketing Optimization, Predictive Modeling.

Smart Agriculture: AI-Driven Crop Yield Prediction and Farm Optimization

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Abstract

Global warming, unemployment of resources, and a growing population all making farming more harder are those that demand more food. Traditional agricultural activities are based on experience-based decision-making and which cannot be sufficient to deal with climate change and the complexities of modern farming practices. This paper would suggest an artificial intelligence-related system crop prescription relying on the environment and prediction of yield. The focus is to promote agricultural yield and sustainability. The proposed system is a combination of real-time weather, soil properties, and geographical data in order to predict the crops and potential yield results. Besides, the system suggests appropriate agricultural products to prevent failure of crops by determining the risk factors associated with environmental factors. Complex machine learning models, a Large Language Model (Gemini 2.5 Flash), various APIs like Metou API, the API of OpenStreetMaps, and Serper API are used to provide the accurate, understandable and practical conclusions. The backend is developed written in FastAPI and the frontend is written in HTML, CSS, and JavaScript, and a JSON storage to process data easily. The results indicate that the suggested system provides intelligent and scalable precision agriculture system, which enhances the decision-making process, minimizes the risk of crop failures and promotes environmental friendly farming.

Keywords

Accuracy agriculture, crop suggestion, yield forecasting, Artificial Intelligence, Machine Learning, LLM, sustainable farming.

A Comparative Analysis of Deep Learning Techniques for Smart Contract Security

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Abstract

The increasing use of smart contracts in decentralized finance ecosystems is examined in this study, along with the security risks that result from vulnerabilities. Although deep learning models like convolutional, recurrent, and graph neural networks have been used in earlier research to investigate vulnerability detection, there are still issues with scalability, consistency, and practicality. Effective deployment across large-scale blockchain environments is particularly hampered by a heavy reliance on source code, high computational complexity, and a lack of standardized datasets.

In order to overcome these obstacles, this paper suggests FusionNet, a novel hybrid deep learning framework that works directly on opcode-level representations inside the Ethereum Virtual Machine. The framework combines convolutional neural networks, bidirectional long short-term memory networks, and graph attention networks into a single architecture.

By combining structural and sequential analysis, it highlights both graph-based encoding using embeddings of opcode sequences. Furthermore, transfer learning improves adaptability to new vulnerabilities, and a multi-head attention mechanism is introduced to dynamically prioritize critical execution patterns.

The suggested method enhances detection performance, especially for complex vulnerabilities like reentrancy and timestamp dependency, according to experimental analysis. FusionNet outperforms current hybrid and graph-based models in terms of scalability, robustness, and generalization across a variety of smart contract datasets. The results emphasize how crucial it is to integrate temporal, structural, and semantic features into a single optimization framework. This work advances scalable and secure vulnerability detection techniques that are useful for high-throughput decentralized applications and real-time blockchain security.

Keywords

cnn: convolutional neural network, gnn: graph neural network, evm: ethereum virtual machine.

Long-Term Stock Price Forecasting Using Transformer Architecture

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Abstract

Financial markets are complex, nonlinear, and volatile; hence, stock price forecasting is a complex and a hard task to perform in the financial data analysis. Proper long-term forecasting can aid decision making and proper control of financial risks by the investors, financial analysts and institutions. Conventional statistical techniques such as ARIMA and ARMA have been widely used in prediction of time-based series but most of them are linear and would not in some cases be able to represent intricate nonlinear connections existing in data sets of stock markets. Deep learning, such as Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU), have improved the prediction by using sequential connections, however, it has flaws with extremely long-range temporal associations and still lacks the ability to efficiently work with these tremendous size of data and data mass. The study hypothesizes a Transformer-based architecture to make predictions of the stock price when predicting any long-term forecast based on the historical financial time-series data. The ideas are presented with the use of the self-attention mechanism of the Transformer model to effectively reveal the general patterns and long-term links within the stock market information. The system involves a number of steps like data of historical stocks, pre-processing of data, extraction of features, model training and forecasting. The Transformer architecture has enabled us to learn more effectively the temporal relationships by learning whole sequences simultaneously, as opposed to conventional recurrent models. The suggested model is supposed to provide a scalable and robust system of not only the financial time-series data analysis but also the creation of trustworthy long-term predictions of the stock prices and, thus, value in investment planning, portfolio management, and financial risk analysis.

Keywords

Stock price forecasting, transformer, forecasting time series, deep learning, prediction financial data, self attention mechanism, investment decision support by the long-term, feature extraction, financial markets, financial market investment decision support.

TrialSense – Agentic RAG for Clinical-Trial Eligibility Checking

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Abstract

It is hard and time consuming to find eligible clinical trial participants. It might involve a manual comparison of patient information and the attainment of the qualifying requirements. This screening stage can be an obstacle to research and a strain to clinicians. We provide TrialSense, which is an explainable patient-trial matching framework that uses a structured analysis of eligibility and semantic retrieval and is efficient and understandable. The process of TrialSense initially involves the use of a similarity search using vectors to locate desirable alternatives in massive trial libraries. Subsequently, it performs atomic eligibility checks to scrutinize the inclusion and exclusion criterion in fine detail and come up with explicit decisions. Clinical trial pre-screening is simplified with clear and rule-based reasoning and scalable retrieval.

Keywords

Clinical Trial Matching, Explainable AI, Large Language Models, Semantic Retrieval, FAISS, Eligibility Checking, Agentic RAG, Patient-Trial Matching.

Recent Advances in Vision and Sensor-Based Body Posture Analysis for Drowsiness Detection: A Comprehensive Review

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Abstract

The inability to drive due to fatigue has played a large part in road accidents, especially with increasing numbers of planes using partial automatic driving. The research presented here is an overview of the progress made over the past few years in relation to driver monitoring systems, focusing specifically on vision-based and sensor-based analysis of body posture to detect if the driver is fatigued, using drowsiness detection techniques. With traditional methods for determining driver impairment being reactive and more typically taking corrective actions instead of identifying early impairment in the driver, we can now look directly at the drivers' facial characteristics, head positioning and posture through the use of modern vision-based techniques, resulting in improved situational awareness of the driver and the driver's level of alertness. When it comes to using a physiological signal as part of detecting whether a driver is fatigued, these methods are able to accurately detect early indicators of fatigue; however, the physiological signal-based methods are usually very invasive due to the use of many electrodes and can be hard to use practically. New research has also shown that using a multi-modal approach to combine visual and physiological data will provide greater robustness and reliability to the DMS. The research illustrates that there are a number of ongoing challenges associated with current DMS's, including the inability to generalise across all of the different forms of real-world environments, occlusion of critical features of the body through typical vehicle configurations, limitations on the computing power required to process real-time output of DMS's and the trade-off between accuracy and comfort for drivers.

AI-Based Video Chaptering and Learning Support System

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Abstract

The increasing proliferation of educational videos on the internet has sparked the need to review and consume such content efficiently [12]. Moreover, the fact that reviewing such reviewed content manually is quite an arduous task has sparked the need for the conception of video understanding technology [10]. This can be done by leveraging AI technology, particularly by using the multimodal technology [1]. Generally, the multimodal model involves the use of Automatic Speech Recognition (ASR), Multi Model, and Large Language Models (LLMs) technology to review the content of the video [1] [2]. Moreover, the paper presents two advanced features: voice Q&A and video chaptering [4] [7]. The Q&A feature helps user to ask questions related to video [4] [13]. More so, the proposed model will provide the user with the desired response based on the asked question, either through text or voice [14]. An additional advanced feature that is showcased is video chaptering [7] [8]. This feature will segment the long video into semantic units while the chapter title is created based on the content [9]. The conventional video technology reviewed the content based on dialogue [5]. Conversely, the incorporation of the multimodal model is efficient since the content is reviewed based on audio- visual and linguistic information [1] [3].

Keywords

Multimodal Learning, Educational Video Analysis, Automatic Speech Recognition, Video Summarization, Video Models, Interactive Learning, Video Retrieval, Digital Education, Artificial intelligence.

AI-Based Self-Healing Electronics for Intelligent Fault Detection

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Abstract

Modern electronic and industrial systems should be able to run without any interruptions and should have very high reliability. The conventional approach to maintain the system involves performing routine inspections, which may result in delaying the detection of any faults and thus increasing the chances of risk. In this study, we propose a self-healing electronic system that uses Artificial Intelligence (AI) to detect any faults and restore the operation of the system automatically. The self-healing electronic system has several sensors that capture the values of the parameters such as temperature, vibrations, voltages, currents, and motions. These data are processed by an embedded machine learning algorithm and detect the faults. Once the fault is detected, the system isolates the faulted component and recovers from the fault automatically by communicating within the embedded components of the system. We have designed this system using ESP32 hardware, and experiments show promising results.

Keywords

Self-healing electronics, Embedded AI, Fault detection, Autonomous recovery, ESP32, Predictive maintenance, Industry 4.0.

Cerebral Analysis Using Eye Scanning Utilizing Machine Learning

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Abstract

The global prevalence of neurological and cognitive disorders has increased significantly over recent years; however, current diagnostic techniques such as Magnetic Resonance Imaging (MRI) and Electroencephalography (EEG), have been identified as expensive, invasive, and inaccessible in remote or resource-poor regions. In response, this research provides a framework to perform a cerebral analysis using eye-tracking technology in combination with machine learning which can detect and monitor neurologically related conditions at an early stage. Eye-tracking measures include fixation duration, saccade velocity, pupil dilation and blinking. To prepare these raw measurements for processing by machine learning techniques, they were subjected to a multi-stage preprocessing process consisting of median filtering and/or Kalman filtering followed by blink interpolation. Once cleaned, the processed gaze streams are used to derive ocular biomarkers that represent specific clinically relevant aspects of eye movements including attention, perception and motor control. A classifier is composed of multiple algorithms: CNNs (Convolutional Neural Networks) analyze the spatial distribution of gaze heatmaps; LSTMs (Long Short Term Memory) model the temporal characteristics of eye movement; SVMs (Support Vector Machine) classify boundaries. Validation of the proposed system was performed on a composite set of 4312 labeled datasets representing the gaze data from both healthy controls and individuals diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) and Alzheimer's Disease (AD). The proposed system achieved a top classification accuracy of 96% (AUC = 0.71); further, the average time required to process each sequence was 38 ms, providing sufficient speed for near-real time use in the clinic.

Multi-Layer Secure File System with RBAC and Biometrics

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Abstract

Modern organizations depend extremely on the internet for storing and sharing information. Therefore, the need of securing the digital files is very important. This importance led us to prepare and therefore are presenting multi-layer protected file storage and sharing system which ensures the organizations have top tier security. For authentication, facial authentication achieves nearly a 96% success rate while block chain logging delays only 15ms per logging. Alongside, strong encryption techniques, multi-factor authentication (MFA) and role-based access control (RBAC) strengthen the system. The system records all sensitive activities such as file uploads, downloads and administrative approvals inside an append only block chain ledger which ensures the auditing is tamperproof. Authentication workflow integrates password validation following RFC 6238 which reduces spoofing attacks. To confirm the user is real, the system is integrated with a facial liveness challenge which requires actions like blinking, turning left or right and smiling. The files are encrypted using AES-256 encryption which operates either in CBC or GCM mode. The encryption keys are generated through PBKDF2 which ensures the stored data is confidential. In our experiment, we concluded that encrypting a 10 MB file requires approximately 0.5 seconds in AES-CBC mode and 0.6 seconds in AES-GCM mode. The system achieved a zero false acceptance rate against spoofing attacks. We have enforced Access Control through combining detailed role policies with administrative approval mechanisms. Python and Flask models were used to implement the system. We also evaluated the system through experimental testing.

The system introduces only light computational load alongside improving data protection and system accountability as per the experimental testing conclusion. As we integrated block chain based audit logging and AES encryption, RBAC and biometric multi-factor authentication, the proposed system offers a unified and practical approach for a secure file storage system.

Real-Time AI Pose Estimation for Markerless Physiotherapy Assessment Using a Mobile Camera

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Abstract

Post-operative lower limb rehabilitation requires continuous monitoring of patient movement quality to ensure safe and effective recovery. Conventional physiotherapy assessment relies heavily on therapist supervision and subjective observation, limiting scalability and accessibility. This work presents an AI-based, markerless pose estimation framework for real-time tracking and analysis of human movement during physiotherapy exercises using a single RGB camera. A deep learning-driven pose tracking model identifies and tracks major body joints without the need for wearable sensors or physical markers. The system generates a skeletal representation of the patient's posture and movement, enabling objective assessment of exercise execution. Experimental results demonstrate reliable joint detection and real-time performance during common lower limb rehabilitation exercises. The proposed approach highlights the potential of artificial intelligence to support intelligent, accessible, and remote physiotherapy monitoring.

Keywords

Rehabilitation, Physiotherapy, Pose estimation, Pose tracking model, Joint detection.

Gain Improvement of Patch Antenna Using Frequency Selective Surface

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Abstract

Microstrip patch antennas are widely used in today's wireless communication systems because these types of antennas are small, flat, easy to manufacture, and are compatible with printed circuit board technology. However, antennas created from lower-cost dielectrics, like FR-4, due to the properties of these materials, have performance limitations due to (1) low efficiency, (2) reduced gain because of losses from the dielectric itself, and (3) surface wave propagation. The limitation caused by these factors can restrict the ability of this style of antenna to work well in practical applications. Elements of this paper include the design and increased performance of a hexagonal microstrip patch antenna (MPA) that operates at a frequency of 3.30 GHz through the use of slot loading and a frequency selective surface (FSS) meta-surface reflector. A 'baseline' antenna configuration, from the simulation return loss, radiation pattern, and gain, was established for a conventional hexagonal MPA manufactured on an FR-4 substrate. To enhance impedance matching and change the surface current distribution of the MPA, a rectangular slot was placed on the surface of the patch. To aid in further improving the radiating performance of the MPA, a 4×4 metasurface array (based on integrated frequency selective surfaces unit cells) was used beneath the MPA. Using ANSYS HFSS, a full-wave electromagnetic solver that uses the finite element method, simulated antennas show that slot modifications greatly enhance return losses and radiation characteristics. A FSS metasurface also enhances forward radiation and redirects back to the primary radiation direction reflected backward electromagnetic energy. The gain improved from -20.84 dB from a conventional antenna to -3.21 dB after slot loading and finally to 0.49 dB after a metasurface integrated. The results confirm that the combination of slot-based tuning and metasurface engineering is an effective method for enhancing the performance of antennas while keeping them compact in size and at low-cost manufacturing. The proposed antenna design is applicable to wireless communication devices operating near 3.30 GHz, such as WLAN and IoT.

Keywords

Microstrip patch antenna, hexagonal patch antenna, frequency selective surface (FSS), metasurface, gain enhancement, HFSS simulation, wireless communication.

Glacier Retreat Analysis Using Satellite Imagery and Machine Learning to Estimate the Impact of Global Warming

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Abstract

Glaciers are shrinking at an alarming rate, serving as powerful indicators of climate change. The proposed work utilizes satellite imagery and machine learning to monitor glacier ice loss over time and estimate the impact of global warming on this reduction. Multi-year satellite images of glaciers are collected and processed using image analysis techniques to detect and measure glacier areas. By comparing images across different years, the system quantifies ice loss accurately. Global temperature data is then used to train a machine learning model that correlates temperature increases with glacier retreat percentages. The result is a system capable of visually and quantitatively demonstrating the connection between rising temperatures and glacier shrinkage. This approach enhances understanding of the tangible effects of climate change and can contribute to environmental monitoring and informed policy planning. The integration of advanced technology and climate science makes otherwise invisible changes clearly observable.

Keywords

Glacier Retreat, Satellite Imagery, Remote Sensing, Machine Learning, Climate Change, Global Warming, Environmental Monitoring.

