

e-SOUVENIR

INTERNATIONAL CONFERENCE ON ADVANCES IN COMPUTING & INTELLIGENT SYSTEMS (ICACIS-2026)

THEME : RECENT TRENDS IN INTELLIGENT AND SECURE COMPUTING

Hybrid Mode

18th – 19th September, 2026

Jointly organized by



SRMS

SRMS College of Engineering &
Technology, Bareilly (U.P.), India



Bundelkhand Institute of Engineering
& Technology, Jhansi (U.P.), India

VENUE

Shri Ram Murti Smarak College of Engineering & Technology

Ram Murti Puram 13 Km, Bareilly-Nainital Road, Bhojipura-243202, UP, India

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Conference Email: icac2026@srmscet.edu **Conference Website:** www.srms.ac.in/icacis-2026



Our Inspiring Soul ...



Lt. SHRI RAM MURTI JI
(08.02.1910 - 02.10.1988)

Shri Ram Murti ji was a veteran freedom fighter. He was so much impressed with the speeches, the logic and the sentiments of Gandhi ji that he courted arrest while studying at Banaras Hindu University. He took part in satyagrah and Quit India Movement launched by A.I.C.C. under the matured and dynamic leadership of Gandhi ji. Ram Murti ji was a true Gandhian.

Ram Murti ji declined to accept the pension offered by the State and the Central Govts. to the freedom fighters on the consideration that whatever he had done for the country was with the feelings of patriotism and not for any material gain. He donated his 30 acres of agricultural land to Acharya Vinoba Bhave in Bhoodan movement.

He was member of U.P. Assembly from 1964 till 1977. In 1977 he represented Bareilly in the Lok Sabha. Ram Murti ji served as Minister in the Cabinets of Pt. Govind Ballabh Pant, Dr. Sampurnanand, Sri C.B. Gupta & Mrs. Sucheta Kriplani for seventeen years and always worked for the development of the country and education of all. He breathed his last on October 2, 1988 at Bareilly.

श्रीपदं नित व्यक्तित्व आपका, राजनीति सेवा कल्प। मन तन धन नित परहित रस था, मूल्य परक संकल्प।।

PREFACE

It gives us immense pleasure to present the Souvenir of the International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026), being jointly organized by Shri Ram Murti Smarak College of Engineering & Technology (SRMS CET), Bareilly and Bundelkhand Institute of Engineering & Technology (BIET), Jhansi, on 18–19 September 2026.

The rapid evolution of computing and intelligent systems is transforming every aspect of modern society—from healthcare, education, and manufacturing to cybersecurity, communication, and sustainable development. ICACIS-2026 has been conceived as a global platform where researchers, academicians, industry professionals, and students come together to exchange ideas, present innovative research, and foster meaningful collaborations in these emerging domains.

This conference reflects our shared commitment to promoting excellence in research and higher education. Through keynote addresses, invited talks, technical paper presentations, and interdisciplinary discussions, ICACIS-2026 aims to encourage scientific inquiry, inspire innovation, and strengthen the bridge between academic research and industrial applications.

We sincerely thank all the distinguished keynote speakers, session chairs, reviewers, authors, delegates, sponsors, and organizing committee members whose dedication and valuable contributions have made this conference possible. We also extend our heartfelt gratitude to the management and leadership of SRMS Trust and BIET Jhansi for their continuous encouragement and support in making this international event a reality.

This souvenir commemorates the collective efforts of everyone associated with ICACIS-2026. We hope it serves not only as a record of the conference but also as a source of inspiration for future research, innovation, and academic collaboration.

We wish all participants a productive, enriching, and memorable conference experience.

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The background features a light gray grid with four decorative corner elements. Each corner contains a complex, symmetrical mandala-like pattern in a light gray color. The patterns are composed of various geometric shapes, including stars, circles, and lines, arranged in a balanced, repeating fashion.

Messages

सुरेश कुमार खन्ना

मंत्री
वित्त एवं संसदीय कार्य विभाग



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दिनांक: 26/05/2026



संदेश

मुझे यह जानकर हार्दिक प्रसन्नता हुई कि श्री राम मूर्ति स्मारक कॉलेज ऑफ इंजीनियरिंग एण्ड टेक्नोलॉजी, बरेली द्वारा "INTERNATIONAL CONFERENCE ON ADVANCES IN COMPUTING & INTELLIGENT SYSTEMS (ICACIS-2026)" का आयोजन दिनांक 18-19 सितम्बर, 2026 को किया जा रहा है, जिसमें भारत और विदेश से बड़ी संख्या में शिक्षाविदों/शोधकर्ताओं एवं वैज्ञानिकों के भाग लेने की सम्भावना है। इस अवसर पर कॉलेज द्वारा एक स्मारिका का प्रकाशन भी किया जा रहा है।

आशा करता हूँ कि स्मारिका में प्रकाशित लेख कॉलेज के बारे में विस्तृत जानकारी उपलब्ध कराने, राष्ट्र निर्माण, नैतिक व मानवीय मूल्यों के विकास के साथ-साथ शिक्षाविदों/शोधकर्ताओं एवं वैज्ञानिकों के लिये मार्गदर्शक और उपयोगी सिद्ध होंगे।

उक्त स्मारिका के सफल प्रकाशन हेतु मेरी हार्दिक शुभकामनाएं।

(सुरेश कुमार खन्ना)

प्रो. जयप्रकाश पाण्डेय
कुलपति
Prof. Jai Prakash Pandey
Vice Chancellor



डॉ० ए०पी०जे० अब्दुल कलाम प्राविधिक विश्वविद्यालय
उत्तर प्रदेश, लखनऊ
Dr. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
Uttar Pradesh, Lucknow

Dated: 26.05.2026



MESSAGE

It is a matter of great honour and pleasure for me to write a message to be published in the souvenir being brought out by the Shri Ram Murti Smarak College of Engineering & Technology, Bareilly (UP) on the occasion of International Conference on the topic of "**Advances in Computing & Intelligent Systems (ICACIS-2026) from 18th – 19th September 2026.**

This conference aims to bring together researchers, academicians, industry professionals, and students from around the world to share and discuss the latest advancements, trends, and challenges in the field of computing. (ICACIS-2026) will provide a platform for fruitful exchanges of ideas, collaboration opportunities, and dissemination of cutting-edge research outcomes.

While felicitating the management, faculty employees and students, I would wish them all a big success in their endeavours.

(Prof. Jai Prakash Pandey)
Vice Chancellor



हरकोर्ट बटलर प्राविधिक विश्वविद्यालय

नवाबगंज, कानपुर - 208002, उ.प्र., भारत

HARCOURT BUTLER TECHNICAL UNIVERSITY

NAWABGANJ, KANPUR - 208002, U.P., INDIA

प्रो. समशेर

कुलपति

Prof. Samsher

Vice Chancellor

Date: 29.05.2026



MESSAGE

It gives me immense pleasure to know that Shri Ram Murti Smarak College of Engineering & Technology, Bareilly is organizing the **International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026)** on 18–19 September 2026.

The rapid advancements in Computing and Intelligent Systems are transforming every sphere of human life, creating new opportunities for innovation, research, and sustainable development. Conferences such as ICACIS-2026 provide an excellent platform for academicians, researchers, scientists, industry experts, and students from across the globe to exchange ideas, share knowledge, and discuss emerging trends and challenges in these dynamic fields.

I appreciate the efforts of the organizers in bringing together distinguished experts and scholars to foster collaboration and promote high-quality research. Such initiatives play a significant role in strengthening the academic and research ecosystem and contribute meaningfully to technological progress.

I extend my best wishes for the grand success of ICACIS-2026 and hope that the deliberations and outcomes of the conference will inspire innovative solutions and pave the way for future advancements in Computing and Intelligent Systems.

With my sincere greetings and best wishes.

(Prof. Samsher)



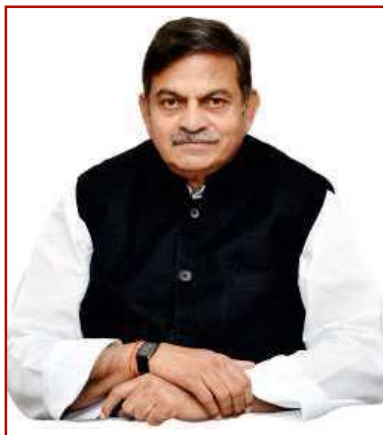
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Chairman's Message



It gives me immense pleasure to extend my warm greetings and best wishes to all the distinguished academicians, researchers, industry professionals, scholars, and participants attending the **International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026)**, being organized by **Shri Ram Murti Smarak College of Engineering & Technology (SRMSCET)**, Bareilly, in collaboration with **Bundelkhand Institute of Engineering & Technology (BIET)**, Jhansi, on **18–19 September 2026**.

The rapid advancement of computing, Artificial Intelligence, Machine Learning, Data Science, and emerging intelligent technologies is transforming every sphere of human activity. In this rapidly evolving technological landscape, academic institutions have a significant responsibility to promote research, innovation, interdisciplinary collaboration, and the responsible application of technology for the betterment of society.

I am pleased to note that ICACIS-2026 has been conceived as a platform for researchers, academicians, industry experts, and students to share their ideas, present contemporary research, deliberate upon emerging challenges, and explore new possibilities in computing and intelligent systems. Such academic interactions are essential for bridging the gap between theoretical knowledge and practical applications and for nurturing a culture of innovation and excellence.

At SRMS Trust, we have always believed that **quality education, meaningful research, technological innovation, and ethical values** are the foundations of a progressive society. Conferences such as ICACIS-2026 provide an excellent opportunity to strengthen these foundations by encouraging intellectual exchange and fostering meaningful academic and professional collaborations.

I am confident that the deliberations, research presentations, and interactions during the conference will contribute significantly to the advancement of knowledge and inspire new directions in computing and intelligent systems.

I congratulate the organizing committee, faculty members, researchers, and students for their dedicated efforts in bringing this international academic event to fruition. I also extend my sincere welcome to all the delegates and participants and wish the conference every success.

With my best wishes for a fruitful, stimulating and intellectually enriching conference.

Dev Murti
Chairman, SRMS Trust



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Approved by AICTE, Ministry of HRD, New Delhi

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Message



It is a matter of great honour and pleasure for me to extend my warm greetings and heartfelt best wishes to the eminent academicians, researchers, industry professionals, scholars, and participants from across the country and beyond who are associated with **the International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026)**, jointly organized by **Shri Ram Murti Smarak College of Engineering & Technology (SRMSCET)**, Bareilly and **Bundelkhand Institute of Engineering & Technology (BIET)**, Jhansi.

The world today is witnessing remarkable advancements in computing and intelligent technologies. Artificial Intelligence, Machine Learning, Data Science, Automation, Cyber Security, and related emerging technologies are creating new opportunities while simultaneously presenting complex challenges. In such a dynamic environment, conferences that bring together diverse academic and professional perspectives play an important role in advancing knowledge and encouraging innovation.

ICACIS-2026 is a welcome initiative that provides a valuable platform for researchers, academicians, professionals, and young scholars to present their research, exchange ideas, deliberate on emerging developments, and establish meaningful collaborations. I am confident that the discussions and research presented during the conference will contribute to the development of innovative approaches and practical solutions to contemporary technological challenges.

At **SRMS Trust**, we remain committed to promoting quality education, research excellence, innovation, and professional development. We particularly value initiatives that provide young researchers and students with opportunities to interact with experts, broaden their perspectives, and become active contributors to the rapidly changing technological landscape.

I would like to place on record my appreciation for the dedicated efforts of the organizing committee, faculty members, researchers, and students in conceptualizing and organizing this international academic event. Their commitment and collective endeavour are instrumental in creating a meaningful platform for intellectual exchange.

I extend a warm welcome to all the delegates and participants and hope that their association with ICACIS-2026 will be academically enriching, professionally rewarding, and intellectually inspiring. May the conference generate new ideas, strengthen research networks, and pave the way for lasting collaborations in the field of computing and intelligent systems.

I wish ICACIS-2026 grand success and extend my very best wishes to all the participants for a fruitful and memorable conference.

Aditya Murti
Secretary, SRMS Trust



बुन्देलखण्ड अभियांत्रिकी एवं प्रौद्योगिकी संस्थान Bundelkhand Institute of Engineering & Technology

JHANSI (झाँसी) - 284 128 U.P. (INDIA) Tel : 0510-2980211 & 2980212 (Office), 2980215 (Camp Office)



Message

It gives me immense pleasure to note that Sri Ram Murti Smarak (SRMS) College of Engineering and Technology, Bareilly, is organizing an International Conference focused on the highly relevant theme, *"Recent Trends in Intelligent and Secure Computing."*

In today's rapidly evolving digital landscape, the convergence of artificial intelligence, machine learning, and cybersecurity is not just transforming the technology sector, but fundamentally reshaping how society operates. As we integrate intelligent systems into our critical infrastructure, healthcare, and daily lives, the mandate for robust, secure computing paradigms becomes paramount.

Academic symposiums like this conference play a vital role in addressing these modern challenges. They serve as a dynamic catalyst for innovation, providing a crucial platform for researchers, academicians, industry professionals, and students to exchange pioneering ideas, share research findings, and forge collaborative partnerships that will drive the next generation of technological advancements.

I extend my heartfelt appreciation to the management, organizing committee, and faculty of SRMS CET Bareilly and BIET Jhansi for their dedication and meticulous efforts in hosting this significant event in collaboration. Bringing together global minds to deliberate on such a forward-looking theme is a commendable endeavour.

I also wish to congratulate all the contributing authors and delegates. I am confident that the deliberations during the conference will yield valuable insights and that this souvenir will serve as a rich repository of the knowledge shared.

I wish the International Conference a grand success and extend my best wishes for all future endeavours

(Prof. Jitendra Kumar Sharma)

Director

Bundelkhand Institute of Engineering & Technology
(BIET), Jhansi



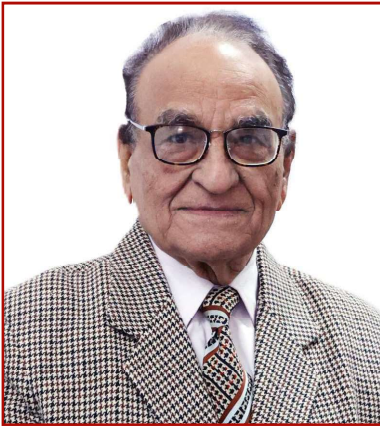
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Message



It is a matter of great pleasure and privilege to extend my warm greetings to all the distinguished academicians, researchers, industry professionals, scholars, and participants of the **International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026)**, being organized by **Shri Ram Murti Smarak College of Engineering & Technology (SRMSCET)**, Bareilly, in association with **Bundelkhand Institute of Engineering & Technology (BIET)**, Jhansi.

We are living in an era of unprecedented technological transformation, where Artificial Intelligence, Machine Learning, Data Science, Cyber Security, Intelligent Computing, and other emerging technologies are redefining the way we learn,

work, communicate, and address complex societal challenges. Such rapid developments make it imperative for academic institutions to create platforms where knowledge, research, innovation, and experience can converge.

ICACIS-2026 is a significant initiative in this direction. The conference provides an important forum for researchers and professionals to exchange ideas, present innovative research, discuss emerging technological challenges, and explore new avenues of collaboration. I firmly believe that meaningful academic dialogue and interdisciplinary interaction are essential for generating ideas that can translate into practical and sustainable solutions.

Our vision has always been to promote excellence in education while encouraging research, innovation, professional competence, and social responsibility. We believe that an institution of higher learning must not merely impart knowledge but should also inspire young minds to question, explore, innovate, and contribute meaningfully to society.

I am confident that ICACIS-2026 will bring together a vibrant community of scholars and professionals and will encourage fruitful discussions on the opportunities and challenges associated with emerging intelligent technologies. I also hope that the conference will lead to enduring academic collaborations and open new pathways for research and innovation.

I extend my sincere appreciation to the organizing committee, faculty members, researchers, and students whose collective efforts have made this academic initiative possible. I warmly welcome all the delegates and participants and wish them an intellectually stimulating and rewarding experience.

May ICACIS-2026 serve as a catalyst for new ideas, meaningful collaborations, and transformative research in the field of computing and intelligent systems!

With my best wishes for the grand success of the conference.

Subhash Mehra
Advisor, SRMS Trust



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Message



It brings me immense joy, pride, and satisfaction to extend my warmest greetings on the occasion of the International Conference on Advances in Computing & Intelligent Systems (ICACIS 2026), jointly organized by SRMS CET, Bareilly, and BIET, Jhansi.

In 2026, computing technology is experiencing a profound paradigm shift. The amalgamation of Artificial Intelligence, Machine Learning and Next Generation Data Networks is no longer restricted to research only but now it has become the substratum of modern innovation, and industry transformation. ICACIS 2026 reflects our commitment to nurture technological rejuvenation by bringing together global academicians, researchers, and technical leaders to share pioneering revelations.

I offer my heartfelt congratulations to the entire assembly of the conference including delegates, paper presenters, discussants etc whose high impact research papers and keen observations enrich the conference proceedings. My sincere appreciation goes to the Technical Program Committee, Advisory Board, Organizing Committee, and Student Coordinators. Your relentless execution, meticulous planning, and collaborative effort behind the scenes have made this international conference a great success.

May the proceedings collated in this souvenir serve as a valuable reference, create further scientific inquiry, and foster future research across the globe.

With my earnest benedictions, I wish all participants great success, more achievements, and a bright future ahead. May ICACIS 2026 be a milepost for all of us and make us able to bring new ideas and innovations through mutual research collaborations.

Dr. Prabhakar Gupta
Conference Director and
Principal, SRMSCET, Bareilly



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BAREILLY-243202 (U.P.)

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Message



It gives me immense pleasure to extend my best wishes on the occasion of the International Conference on “Advances in Computing & Intelligent Systems.”

In an era driven by Artificial Intelligence, Machine Learning, Data Science and emerging computing technologies, such conferences provide a valuable platform for knowledge exchange, research collaboration and

industry–academia interaction.

I am confident that the deliberations will inspire innovative ideas, encourage interdisciplinary research and contribute to developing technology-driven solutions for real-world challenges.

I congratulate the organisers, researchers, delegates and participants for their valuable contribution and wish the conference great success and meaningful outcomes.

Prof. (Dr.) Anuj Kumar
Director – Training, Development & Placement Cell
SRMS Institutions, Bareilly



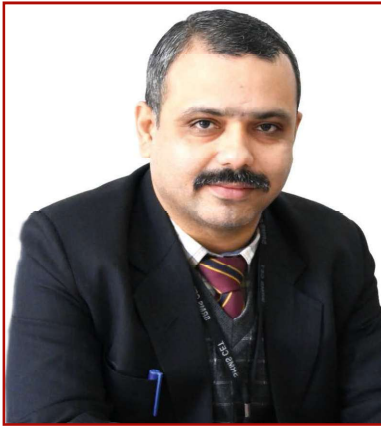
SHRI RAM MURTI SMARAK COLLEGE OF ENGG., TECH. & RESEARCH

BAREILLY-243202 (U.P.)

Approved by AICTE, Ministry of HRD, New Delhi

Affiliated to A.P.J. Abdul Kalam Tech. University, Lucknow

Message



On behalf of the entire fraternity at SRMS CETR, I send my warmest regards to our sister institution, SRMS CET, Bareilly, on hosting the International Conference on Advances in Computing & Intelligent Systems in collaboration with BIET, Jhansi. Organizing an academic event of such prestige is an attestation to SRMS CET's pursuit of research elevation and visionary leadership.

The rapid evolution of Artificial Intelligence has brought humanity to a crucial juncture. We are witnessing groundbreaking progress in generative foundational models, multi-modal systems, automated reasoning, and edge deployed intelligence. As deep learning models grow increasingly resource intensive, the global scientific community must prioritize green computing architectures, carbon-aware algorithmic design, and sustainable hardware solutions to ensure that intelligent technologies serve humanity without compromising environmental harmony.

I believe ICACIS 2026 will work as a much required platform to address both the frontiers of computational intelligence and the ethical, sustainable frameworks required to govern them.

I take this opportunity to heartily commend all research scholars and academicians, presenting their work during this two day international conference. Furthermore, I applaud all the Committee, paper presenters, attendees etc for their exceptional initiative, careful execution, and collaborative spirit in assembling a conference of international standing.

With my sincere blessings and best wishes, may this souvenir remain as a timeless archive of intellectual knowledge exchange and creative future solutions.

All the best !

Dr. Shailesh Saxena
Dean Academics
SRMS CET&R, Bareilly



बुन्देलखण्ड अभियांत्रिकी एवं प्रौद्योगिकी संस्थान Bundelkhand Institute of Engineering & Technology

JHANSI (झाँसी) - 284 128 U.P. (INDIA) Tel : 0510-2980211 & 2980212 (Office), 2980215 (Camp Office)

Message



It is with a deep sense of joy and pride that I welcome you to the International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026), jointly hosted by Shri Ram Murti Smarak College of Engineering and Technology, Bareilly, and my own institution, Bundelkhand Institute of Engineering & Technology, Jhansi. Bringing two institutions together for an event of this scale has been a labour of love, and seeing it take shape has been one of the most fulfilling experiences of my academic journey.

Our theme, Recent Trends in Intelligent and Secure Computing, is close to my heart. Over more than two decades in this field, I have watched computing evolve from a specialised discipline into the very fabric of how we live, work, and think. Conferences like ICACIS-2026 remind me why I chose this profession in the first place — the chance to sit across the table from bright minds, young and experienced alike, and simply talk about ideas.

I am truly moved by the warmth with which researchers from across India and abroad have responded to our call, and by the generosity of our advisory committee members who have lent their time and wisdom to this endeavour. None of this would have been possible without the quiet, tireless work of my co-organizers, colleagues, and students, to whom I owe more than words can express.

To every author, speaker, and delegate joining us — thank you for trusting us with your work and your time. I hope these two days offer you not just academic exchange, but also the kind of conversations and friendships that outlast the conference itself.

With warm regards and best wishes for a memorable ICACIS-2026.

With gratitude,

Prof. (Dr.) Narendra Singh Beniwal

Convener, ICACIS-2026
Bundelkhand Institute of Engineering &
Technology, Jhansi, U.P.



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Message



It gives me immense pleasure to welcome all the distinguished guests, invited speakers, researchers, academicians, industry experts, and participants to the International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026) jointly organized by Shri Ram Murti Smarak College of Engineering & Technology, Bareilly U.P. India with Bundelkhand Institute of Engineering & Technology, Jhansi U.P. India.

The theme of ICACIS-2026, “Recent Trends in Intelligent and Secure Computing,” reflects the growing significance of Artificial Intelligence, intelligent systems, cyber security, data science, and emerging computing technologies in shaping a smarter and more sustainable future. This conference provides a valuable platform for exchanging innovative ideas, presenting quality research, fostering collaborations, and exploring technological advancements that address real-world challenges.

I would like to express my deepest gratitude to our respected Chairman, Shri Dev Murti Sir, whose visionary leadership, encouragement, and unwavering commitment to academic excellence continue to inspire us.

I extend my sincere and heartfelt gratitude to our respected Principal, Dr. Prabhakar Gupta, for his continuous guidance, encouragement, and valuable support in organizing ICACIS-2026.

I also extend my sincere appreciation to the organizing committee, technical program committee, reviewers, faculty members, student volunteers, sponsors, and all contributors whose dedicated efforts have ensured the successful organization of ICACIS-2026.

I am especially thankful to our invited speakers and authors for enriching the conference through their valuable knowledge, research contributions, and scholarly participation.

I warmly welcome everyone and wish ICACIS-2026 a grand success.

Prof.(Dr.) Jyoti Agarwal
Convener, ICACIS-2026



Message



"It gives me immense pleasure to extend my warmest greetings to the organizers, delegates, and participants of the International Conference on Advances in Computing & Intelligent Systems (ICACIS-2026), hosted by Shri Ram Murti Smarak College of Engineering & Technology, Bareilly.

As we stand at the crossroads of unprecedented digital transformation, the conference theme—Recent Trends in Intelligent and Secure Computing—could not be more timely. The rapid convergence of artificial intelligence, cybersecurity, quantum technologies, and intelligent systems presents extraordinary opportunities alongside complex challenges. Addressing these demands requires collaborative research, robust frameworks, and ethical foresight.

ICACIS-2026 serves as an exceptional platform for researchers, academicians, and industry pioneers to exchange groundbreaking ideas, foster meaningful partnerships, and drive sustainable technological progress. Having shared a long and meaningful association with SRMS CET, it is particularly gratifying to witness the institution's steadfast commitment to fostering academic and research excellence.

I congratulate the organizing committee for their dedicated efforts and wish the conference grand success, vibrant discussions, and memorable outcomes."

Dr. Saurabh Agarwal

Yeungnam University, Gyeongsan,
Republic of Korea



Speakers



Prof. (Dr.) Jasni Mohamad Zain

Professor Dr. Jasni Mohamad Zain is the Director of the Institute for Big Data Analytics and Artificial Intelligence (IBDAAI) at Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia. Over a distinguished academic career spanning more than three decades, her research has focused on the intersection of cybersecurity, digital watermarking, big data analytics, and artificial intelligence. She earned her PhD from Brunel University London in 2005, where her early pioneering work focused on reversible watermarking algorithms for medical image authentication. Her recent research initiatives advance the frontiers of machine learning and data privacy, particularly focusing on lightweight cryptographic frameworks, intrusion response mechanisms, and federated learning models.

Title: Recent trends in Intelligence and Secure Computing

Abstract: The historical trajectory of Artificial Intelligence is examined, tracing its evolution from early symbolic logic to modern data-intensive foundation models. Through this progression, a fundamental paradigm shift is observed: compute and data scales have transformed security from a perimeter-enforcement mechanism into a core architectural requirement for intelligent systems. The convergence of Big Data, AI, and secure computing is analyzed, highlighting how contemporary machine learning pipelines face sophisticated threats, including data poisoning, privacy leakage, and adversarial exploits. To mitigate these vulnerabilities, emerging paradigms in secure intelligent computing are evaluated. Particular emphasis is placed on Privacy-Preserving Machine Learning (PPML), Federated Learning, Homomorphic Encryption, and Differential Privacy within large-scale distributed systems. Furthermore, hardware-anchored security mechanisms, such as Trusted Execution Environments (TEEs), are investigated alongside post-quantum cryptographic primitives to safeguard data throughout the execution lifecycle. Finally, key open research challenges are identified, providing a strategic roadmap for academics to advance resilient, privacy-centric, and provably secure AI architectures.

Keywords: Privacy-Preserving Machine Learning (PPML), Federated Learning, Confidential Computing, Data Provenance



Dr. Pradeep K. Atrey

Pradeep K. Atrey is an Associate Professor of Computer Science at the **University at Albany, SUNY**, where he serves as Director of the Undergraduate Program and Founding Co-Director of the Albany Lab for Privacy and Security (ALPS). He earned his Ph.D. from the National University of Singapore and completed postdoctoral research at the University of Ottawa. Guided by “**Science in Service to Society**,” his research focuses on AI and cybersecurity, with emphasis on privacy, trust, and fairness in multimodal data. His work spans multimodal AI, security and forensics, applied cryptography, and social media analysis. He has co-authored **160+ publications**, served on leading journal editorial boards, and co-chaired major conferences, including **ACM Multimedia 2023** and **IEEE MIPR 2023**.

Title: AI in the Dark: Multimedia Intelligence Without Decryption

Abstract: Today, it is increasingly common to outsource both small- and large-scale data storage and computationally intensive AI tasks to third-party high-performance computing platforms, particularly cloud data centers. These platforms provide highly scalable and virtualized resources that support the efficient execution of a wide range of data-intensive services. However, outsourcing sensitive data and computation to third-party providers—who may not always be fully trustworthy—raises significant security and privacy concerns. In this talk, I will present our research on secure cloud-based computation, focusing on the SecureCSuite framework. SecureCSuite enables a variety of computational operations to be performed directly on encrypted data, allowing cloud-based services to process sensitive information without exposing the underlying plaintext. This approach helps preserve data confidentiality and privacy throughout the computation while leveraging the scalability and efficiency of cloud platforms. I will demonstrate SecureCSuite through several applications, including image and video scaling (SecureCScale), multimedia enhancement (SecureCEnhance), document editing (SecureCEdit), secure emailing (SecureCMail), PDF merging (SecureCMerge), and privacy-preserving search (SecureCSearch). These applications illustrate the potential of performing practical multimedia and AI tasks securely within encrypted environments.

Keywords: *Security, Privacy, AI*



Dr. Prabhat Kumar

Prabhat Kumar (Member, IEEE) received the Ph.D. degree in Information Technology from the National Institute of Technology Raipur, Raipur, India, under the prestigious fellowship of the Ministry of Human Resource Development, Government of India. He is currently working as an Assistant Professor (Tenure Track-Level-2) with the Department of Software Engineering at LUT University, Lappeenranta, Finland. He also serves as the Head of the Responsible Information Systems Development Master's Programme and holds the title of Docent in Artificial Intelligence for Cybersecurity. His research focuses on AI-driven intrusion detection, federated learning, explainable AI, blockchain security, software security and privacy-preserving computation. Dr. Kumar has been actively involved as co-principal investigator and work package lead in several CHIST-ERA / Academy of Finland and HORIZON-funded projects. He has published over 65 peer-reviewed, including 15+ IEEE Transactions papers and contributes to the scientific community as a reviewer, editor, and technical program committee member for leading journals and conferences. At LUT, he also established “ChainLab” (<https://chainlab-fi.eu/>), a research lab focused on AI and blockchain-integrated cybersecurity solutions. He was also honoured with the Best Postdoctoral Researcher Award (2023) by the Research Foundation of LUT University, Finland, through the Lauri ja Lahja Hotinen Fund.

Title: Responsible AI in Practice: Trustworthy Software Vulnerability Detection

Abstract: As AI systems increasingly influence critical decisions, responsibility must be engineered—not assumed. This keynote discusses Responsible AI as an engineering framework grounded in reliability, fairness, transparency, interpretability, security, and accountability. It examines how opacity emerges in modern deep learning systems and why this becomes problematic in high-impact domains. To illustrate these principles in practice, the talk presents a case study in AI-based Software Vulnerability Detection (SVD). While deep learning models can detect vulnerabilities at scale, security decisions require more than accurate predictions—they demand explanations, validation, and trust. By integrating explanation techniques and faithfulness checks into the detection pipeline, the case study demonstrates how Responsible AI principles can be operationalized in real-world systems. The keynote argues that Responsible AI should be treated as a core software quality attribute in the design and deployment of intelligent systems.



Dr. Ihtiram Raza Khan

Dr Ihtiram Raza Khan is senior academician and researcher at Jamia Hamdard Delhi. He has done Post Doc from NTUB Taiwan and PhD from Jamia Delhi. He has 42 patents, 26 books, 205 research papers including 95 SCI Scopus papers and 350 invited talks including MMTTC and ATAL talks and multiple appearances on Doordarshan and Akashvani.

Title: Quantum AI framework for sustainable development

Abstract: Quantum Artificial Intelligence (Quantum AI) represents a promising approach to addressing complex sustainability challenges by combining the computational capabilities of quantum technologies with the learning and optimization capabilities of artificial intelligence. This talk presents a **Quantum AI Framework for Sustainable Development** that integrates quantum computing, AI, real-world data, and secure cloud platforms to support progress toward the United Nations Sustainable Development Goals (SDGs). The framework explores the use of state-vector and density-matrix quantum simulators, hybrid quantum-classical AI models, and quantum-safe infrastructure for developing scalable and responsible solutions. Key application areas include climate modeling and carbon capture, smart-grid and energy-storage optimization, accelerated drug discovery and disease modeling, and intelligent management of water, agriculture, and supply chains. The talk also addresses secure collaboration, ethical deployment, capacity building, and partnerships among government, academia, and industry. By connecting emerging quantum capabilities with practical sustainability needs, the framework aims to translate quantum advantage into measurable outcomes such as reduced emissions, improved resource efficiency, and enhanced quality of life. The overarching vision is to harness Quantum AI as a responsible technological enabler for sustainable development and human well-being.

Keywords: Quantum AI, Sustainable Development, Quantum Computing, Sustainable Technologies.



Prof. Dheeraj K. Khatod

Prof. Dheeraj K. Khatod is a Professor in the Department of Electrical Engineering at the Indian Institute of Technology Roorkee (IIT Roorkee). He specializes in Power System Engineering, with research interests in distributed generation, renewable energy, power-system analysis, and optimization. His recent research focuses on active distribution networks, data-driven control and optimization, distribution-network state estimation, topology and parameter estimation, smart-inverter-based voltage control, and integration of distributed energy resources. He has supervised 11 Ph.D. theses, 64 M.Tech. dissertations, and 20 B.Tech. projects. He has also been involved in several sponsored research projects supported by agencies including DST, SERB, and Grid-India

Title: AI-Enabled Intelligent and Resilient Power Systems: From Data-Driven Analytics to Autonomous Grid Operation

Abstract: The rapid integration of renewable energy sources, distributed energy resources, electric vehicles, energy storage systems, and flexible loads is transforming conventional power grids into complex, dynamic, and data-intensive cyber-physical systems. At the same time, extreme weather events, equipment failures, cyber threats, and increasing operational uncertainties pose significant challenges to the reliability, resilience, security, and quality of power supply. This talk explores the transformative role of Artificial Intelligence (AI), Machine Learning (ML), and data-driven analytics in addressing these challenges and enabling intelligent power-system operation. The talk will discuss AI applications in load and renewable-energy forecasting, state estimation, fault detection and diagnosis, topology identification, predictive maintenance, voltage control, energy management, and optimal operation of distributed energy resources. Particular emphasis will be placed on AI-enabled resilience and cybersecurity, including detection of abnormal conditions and cyber-physical threats. Emerging technologies such as digital twins, physics-informed AI, explainable AI, reinforcement learning, and generative/agent AI will also be discussed. The talk concludes by highlighting the transition from smart grids toward adaptive, self-healing, resilient, and increasingly autonomous power systems, along with key research challenges and future opportunities.

Keywords: Artificial Intelligence, Machine Learning, Smart Grid, Intelligent Power Systems, Resilient Grids, Cyber-Physical Systems, Distribution Networks, Cybersecurity, Autonomous Grid Operation



Dr. Somesh Kumar

Dr. Somesh Kumar is an accomplished researcher, educator, Senior Member of IEEE, and Assistant Professor in the Department of Electrical and Electronics Engineering at ABV–IIITM Gwalior, India. He earned his Ph.D. in Electrical Engineering from IIT Ropar, specializing in VLSI interconnects, nanoelectronic devices, 3D integration, graphene-based hybrid interconnects, 5G/6G antennas, and machine-learning-based IC modeling. He has authored numerous SCI/SCIE journal papers, over 100 international conference papers, and multiple Indian patents. His research has received support from DST-SERB, ISRO RESPOND, TIIC–TIDE 2.0, and industry projects. He has delivered invited talks globally and held leadership roles in IEEE conferences and ABV–IIITM. He has guided 9 Ph.D. scholars and over 60 student theses. He is Joint Secretary, IEEE MP Section, Chair, IEEE EPS MP Section Chapter, and Fellow of IETE.

Title: Machine learning for the VLSI Systems

Abstract:

The rapid advancement of Very Large-Scale Integration (VLSI) technology has resulted in increasingly complex integrated circuits, making conventional design, optimization, and verification techniques computationally intensive. Machine Learning (ML) has emerged as a powerful approach for improving the efficiency and intelligence of VLSI design methodologies. This work explores the application of ML techniques across different stages of the VLSI design flow, including circuit design and optimization, performance and power prediction, physical design, placement and routing, timing analysis, design-rule checking, fault detection, process-variation modeling, and yield optimization. Supervised learning, neural networks, ensemble methods, reinforcement learning, and other data-driven techniques can learn complex relationships among design parameters and rapidly predict circuit performance, thereby reducing the need for repeated computationally expensive simulations. ML-assisted VLSI design can also enable efficient exploration of large design spaces and facilitate multi-objective optimization of power, performance, and area (PPA). The integration of machine learning with Electronic Design Automation (EDA) tools therefore offers significant potential to reduce design time, improve prediction accuracy, and accelerate the development of reliable and energy-efficient semiconductor systems. This emerging ML–VLSI convergence is expected to play an important role in the design of next-generation integrated circuits and intelligent semiconductor technologies.



Dr. Ashwani Kumar

Dr. Ashwani Kumar is a Professor in the School of Computer Science, Engineering and Technology, Bennett University, Greater Noida, India. He received his Ph.D. in Computer Science and Engineering from Jaypee University of Information Technology in 2017, M.Tech. in CSE in 2011, and B.Tech. from UPTU Lucknow in 2009. With over 15 years of teaching and research experience, he has published 80+ research papers in SCI/SCIE and Scopus-indexed journals and reputed conferences. He serves as a reviewer and editorial board member for several international journals and has been a guest editor and session chair at international conferences. His research interests include image security, watermarking, multimedia security, cryptography, network security, and privacy. He is a lifetime member of IEEE, ISTE, IACSIT, IAENG, and SDIWC.

Title: Machine Learning Algorithms for AI Systems

Abstract: Machine Learning (ML) has emerged as a fundamental technology for building intelligent and adaptive Artificial Intelligence (AI) systems capable of learning from data, identifying complex patterns, and supporting automated decision-making. This invited talk, “Machine Learning Algorithms for AI Systems,” provides an overview of the principles, methodologies, and practical applications of key machine learning algorithms used in modern AI systems. The talk will cover major learning paradigms, including supervised, unsupervised, semi-supervised, and reinforcement learning, along with widely used algorithms such as Linear and Logistic Regression, Decision Trees, Random Forests, Support Vector Machines, k-Nearest Neighbors, clustering techniques, and Artificial Neural Networks. Particular emphasis will be placed on how these algorithms contribute to intelligent perception, prediction, classification, recommendation, and decision-making. The discussion will also introduce deep learning, transfer learning, ensemble learning, and emerging AI approaches, highlighting their advantages and limitations. Real-world examples from healthcare, agriculture, cybersecurity, computer vision, natural language processing, and smart systems will be used to demonstrate practical applications. The talk will conclude by discussing challenges related to data quality, model interpretability, scalability, bias, robustness, and the responsible development of next-generation AI systems.

Keywords: Machine Learning, Artificial Intelligence, Deep Learning, Machine Learning Algorithms, Intelligent AI Systems

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An Intelligent Hybrid FCM–LSTM–RL Model for Adaptive Energy Consumption Prediction and Optimization in Smart Environments

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Abstract

The active growth of electricity demand and the active user behavior requires smart solutions of energy management to the modern smart environment. Conventional methods, which are mostly hardware-related, or rule-based, are not able to adapt to changing consumption trends and inherent uncertainties. The three main objectives of the study include: (i) to determine the complex and uncertain patterns of energy consumption, (ii) to precisely predict future energy consumption and (iii) to dynamically optimize consumption towards cost efficiency and sustainability. To meet the mentioned goals, this paper will suggest a hybrid AI-based system combining Fuzzy C-Means (FCM) clustering, Long Short-Term Memory (LSTM) networks, and Reinforcement Learning (RL). The FCM algorithm forgoes time-series data to identify latent consumption patterns through the application of the fuzzy membership modeling, which is useful in dealing with overlapping behavioral patterns in time-series data. The LSTM module forecasts the future energy demand with a temporal dependency learners and the RL agent allows the optimization of policies regarding energy use to be adaptive to real-time conditions and user preferences. The system has included the time-based usage analysis, cost estimation in real time and an intelligent alert system in case of threshold violation. An end-to-end pipeline comprising of preprocessing, feature engineering, hybrid modeling, and recommendation engine produces customized energy-saving tips. Interpretability is also increased by an interactive visualization dashboard. The experimental results indicate that the presented framework is more adaptable, predictive, and energy-efficient than conventional and standalone frameworks. Its scalable and hardware-independent design allows it to be deployed in smart homes and buildings, to optimize energy smartly, with data, and sustainably.

Keywords: *Energy Management, Hybrid AI, Fuzzy GMeans, LSTM, Reinforcement Learning, Smart Homes, Energy Optimization, IoT, Predictive Analytics, Sustainable Computing*

Large Language Models and Generative AI for Healthcare: A Systematic Review of Clinical Integration and Emerging Trends

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Abstract

The arrival of large language models (LLMs) and generative artificial intelligence (GenAI) has heralded a revolutionary era for healthcare, enabling un-precedented progress across clinical, research, and educational domains. This paper systematically reviews the existing evidence on the implementation, performance, and impact of LLMs and GenAI in healthcare, including systematic reviews, comparative studies, and benchmark analyses. Significant progress in natural language processing, medical image analysis, predictive analytics, and synthetic data generation has been achieved through recent advances in deep learning architectures, especially transformer-based and diffusion models. Proprietary and open-source models, such as GPT-5.5, Claude Opus, Gemini, DeepSeek, and Nano Banana Pro, have shown capabilities that allow for data extraction, documentation automation, diagnostics assistance, and decision-making augmentation. The clinical integration of these AI technologies has demonstrated potential to improve work-flow efficiency, data accuracy and patient communication within specialties like surgery, radiology, dentistry and medical education. GenAI also allows for the creation of synthetic medical images, visualization of molecular mechanisms, and generation of educational resources, thereby speeding up research and dissemination of knowledge. However, challenges persist around the reliability, transparency and ethical deployment of LLMs and GenAI. The authors highlight issues of variability in model performance, risks of algorithmic bias, privacy concerns, and the need for expert oversight as important considerations. Open-source LLMs offer the potential for broader adoption due to scalability and affordability, but this necessitates robust governance and empirical validation. In this review, the authors highlight the opportunities and challenges that LLMs and GenAI bring to healthcare. It calls for interdisciplinary collaboration, integration of AI literacy in medical education, and establishment of strong ethical frameworks. Further research and consensus guidelines are necessary to ensure these transformative technologies are implemented in a responsible, effective, and equitable fashion.

Keywords: *Large Language Models, Generative AI, healthcare automation, open-source LLMs, AI-driven diagnostics, ethical AI deployment, AI governance, AI literacy, responsible implementation.*

Explainable AI for Nutrient Stress Characterization and Paddy Yield Prediction Across Agro-Climatic Zones: A Systematic Review

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Abstract

Paddy is a most important staple crop in the world and productivity is highly influenced by the nutrient deficiency, agro-climatic condition and climate variability. With the recent developments in Artificial Intelligence (AI) and Deep Learning (DL), automated nutrient stress detection and yield prediction became possible, but these models are still black-box models and hence it is not easy to make them transparent and useful for precision agriculture. Although there are several review studies, they mainly focused on individual AI techniques or specific application in agriculture, and a comprehensive study which integrates Explainable Artificial Intelligence (XAI) with multimodal learning concepts and climate-aware paddy yield prediction is limited. This paper reviews the XAI techniques for nutrient stress characterization and prediction of paddy yield in various agro-climatic zones systematically. In addition to the explainability techniques, SHAP, LIME, Grad-CAM and attention mechanism, recent advancements in hyperspectral imaging, remote sensing, IoT based sensing, multimodal deep learning, transformer architectures, ensemble learning and federated learning are critically analyzed. In addition, a detailed taxonomy, comparative analysis, research gap analysis and an integrated explainable AI framework for intelligent paddy farming are provided. The review indicates that multimodal transformer-based models with XAI can provide better prediction performance and interpretability while lightweight and federated learning can have the potential to be scaled in real-world applications. Lastly, future research avenues toward transparent, climate resilient, and sustainable precision agriculture with AI are provided.

Keywords: *Explainable AI, Paddy Yield Prediction, Nutrient Stress Detection, SHAP, LIME, Precision Agriculture, Agro-Climatic Zones, Federated Learning, Deep Learning.*

Predicting Market Performance Using Machine and Deep Learning Techniques

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Abstract

Predicting the Performance of Cryptocurrency Market is Key to Making Financial Decisions; however, Cryptocurrency Market Are Volatile and Non-Linear, Therefore Forecasting the Performance of Cryptocurrency Is Very Difficult. The purpose of this project is to develop an "Automatic Framework for the Prediction of Performance in Cryptocurrency Market," in which "Advantages of Machine Learning and Deep Learning Techniques" are utilized to "Predict Future Trends" regarding the "Performance of Cryptocurrency Market." The Automated System will use (Machine Learning Techniques (Linear Regression, Random Forest and ARIMA) and Long and Short Term Memory Network (LSTM) to predict Future Cryptocurrency Prices Using Historical Data. Of these models the best prediction will come from RNN-LSTM due to its Strength in capturing temporal Dependencies and complex relationships in Time Series Data. Data Preparation includes Data Preprocessing, Data Normalization, Feature Engineering, and Generation of a Sliding Window Sequence for the Required Data Formats for Model Development. Evaluation of the Performance of Each of These Models Will Be conducted Using MAE, RMSE, and MAPE and Will Show Lower than Traditional Models' Error Rates. Therefore, This Framework Will Produce More Accurate, More Stable, and More Robust Results than Traditional Models Regardless of Variance in the Market. The system will also be developed in the way of a web application. Additionally, the software will produce real-time predictions regarding how Cryptocurrency perform. Therefore, investors can use this information to make informed decisions about Cryptocurrency. In summary, the new combined ML (Machine Learning) and DL (Deep Learning) will allow for scalable, effective, and low-cost methods for predicting finance. The new system will also have many different areas of application within the predicting cryptocurrencies, and so forth.

Keywords: *Market Performance Prediction, Machine Learning, Deep Learning, LSTM, ARIMA, Time-Series Forecasting*

Explainable Hybrid Machine Learning Framework for Early Cardiovascular Risk Prediction Using Lifestyle and Clinical Data

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Abstract

Cardiovascular disease (CVD) remains a leading cause of morbidity and mortality globally, and is a substantial burden to health systems. Early identification of at-risk individuals prior to the development of severe complications allows for early intervention, improved patient management and supports preventive healthcare strategies. Machine learning techniques have recently shown considerable promise for predicting cardiovascular risk. However, many high performing predictive models are black-box systems, making their decisions difficult to interpret for clinicians and hindering their practical adoption in health-care settings.

To tackle this challenge, this research proposes an Explainable Hybrid Machine Learning (EHML) framework that harmonizes predictive performance and clear decision-making. The framework combines demographic, clinical, and lifestyle information such as age, gender, blood pressure, cholesterol level, glucose level, body mass index (BMI), smoking status, alcohol intake, physical activity, sleep behaviour, and stress-related features. A stacking ensemble architecture based on Logistic Regression, Random Forest, and XGBoost is used to capture the complementary learning patterns and improve the prediction reliability.

The proposed framework is evaluated on a publicly available cardiovascular disease dataset. The dataset is pre-processed before the model development with data cleaning, feature scaling, categorical encoding, feature selection and class balancing to enhance data quality and model robustness. To improve transparency, we use SHapley Additive explanations (SHAP) to determine the overall contribution of individual features and Local Interpretable Model-agnostic Explanations (LIME) to explain predictions for individual patients. These complementary explanation techniques provide global and case-specific insights into the decision making process of the model.

We propose the EHML framework that combines accurate prediction with meaningful explanations to provide trustworthy cardiovascular risk assessment. The framework can improve the interpretability of machine learning results which can help healthcare professionals in early diagnosis, personalized preventive planning and evidence-based clinical decision-making.

Keywords: *Cardiovascular Disease, Explainable Artificial Intelligence, Hybrid Machine Learning, Clinical Decision Support, Healthcare Analytics, Risk Prediction, SHAP, LIME, XGBoost.*

Pseudo-MOS Supervised No-Reference Image Quality Estimation of denoised Images via Deep Transfer Learning and convnext Feature Representation

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Abstract

The Blind Image Quality Assessment (NR-IQA) is important to understand how good an image is when no good reference images exist particularly when referencing denoised images. We propose a pseudo-MOS-based NR-IQA framework for the evaluation of denoised images created from the LemGendizedNAFNetDenoising Dataset. The images have been preprocessed by resizing, normalizing and augmenting through random cropping, random horizontal flipping, random rotation and random color transformations to enhance generalization of the model. Due to the lack of subjective quality annotations, pseudo-MOS values were created automatically by combining the following five perceptual quality measures sharpness, noise level, contrast, entropy and exposure consistency. Utilizing transfer learning, a variety of deep learning architectures were trained including MobileNetV2, ResNet18, EfficientNet-B3, DINOv2+MLP, CLIP+MLP and ConvNeXt-Tiny. Multilayered perceptron regression networks were used to map convolutional and transformer based backbone feature representations to quality scores. To increase prediction stability and ranking consistency, the following strategies were employed: Huber loss, pairwise ranking loss, feature normalization, and Exponentially Moving Average optimization. The performance of the models was benchmarked based upon the following statistical evaluation measures PLCC, SRCC, RMSE and MAE. The results of the experiment demonstrated that the ConvNeXt-Tiny architecture outperformed all other comparative model architectures with a PLCC of 0.9920, SRCC of 0.9901, RMSE of 0.0577 and MAE of 0.0386. Based upon these results, it can be concluded that advanced pretrained architecture models combined with pseudo-MOS type supervision are a viable and scalable solution for conducting a blind image quality assessment on denoised images.

Keywords: *Blind Image Quality Assessment, NoReference IQA, Pseudo Mean Opinion Score, Perceptual Quality Assessment, Quality Score Prediction, Image Quality Regression, Computer Vision, Feature Learning*

Reliability Aware Deep Learning Framework On Brain Tumour Detection with Explainable Ai

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Abstract

Accurate and timely identification of intracranial neoplasms from Magnetic Resonance Imaging (MRI) scans remains a formidable challenge in computational neuro-oncology, where diagnostic errors carry severe clinical consequences. Existing single-backbone classifiers frequently attain satisfactory aggregate accuracy while concealing inter-class performance disparities and providing no mechanism for validating the spatial basis of their decisions. This paper addresses both limitations by proposing a Hybrid Attention-VGG architecture that fuses the hierarchical texture representation of VGG16 with a spatial attention-gated decoder inspired by the U-Net paradigm, enabling the model to weigh spatially informative feature map regions before committing to a classification verdict. Five established architectures ResNet50, DenseNet121, Attention U-Net, EfficientNetB4, and VGG16—are evaluated on a publicly available four-class brain MRI dataset comprising glioma, meningioma, pituitary tumour, and healthy tissue categories. The proposed hybrid model achieves a classification accuracy of 99.06 % together with a macro-averaged precision of 0.9917, recall of 0.9895, and F1-score of 0.9904, outperforming all individual baselines. Gradient-weighted Class Activation Mapping (Grad-CAM) is applied to the attention branch of the trained model, generating class-discriminative heatmaps that consistently localize pathological tissue at anatomically expected sites. Reliability is further substantiated through per-class precision–recall decomposition and confusion matrix analysis, confirming that the model maintains diagnostic consistency across all tumour categories, including the morphologically challenging meningioma class. The dual contribution of superior quantitative performance and spatially faithful interpretability positions the proposed framework as a clinically credible decision-support instrument for neuro-radiological workflows.

Keywords: *Convolutional neural network, brain tumour classification, attention mechanism, VGG16, Grad-CAM, explainable artificial intelligence, MRI image analysis, deep learning, reliability analysis.*

A Review of Machine Learning Approaches for Air Quality Prediction During Crop Residue Burning in Northern India

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Abstract

Crop residue burning in the Indo-Gangetic Plain is one of the most persistent and environmentally damaging agricultural practices in Northern India, contributing significantly to seasonal air quality deterioration across Punjab, Haryana, Uttar Pradesh, and the National Capital Region of Delhi. The post-harvest burning of paddy straw, concentrated primarily in October and November, generates dense smoke plumes laden with fine particulate matter (PM_{2.5}, PM₁₀), nitrogen dioxide, sulfur dioxide, and carbon monoxide. This review surveys the current state of machine learning (ML) methodologies applied to monitoring, modelling, and predicting air quality degradation arising from these burning events. We examine the use of satellite-derived fire detection data (MODIS, VIIRS), ground-level sensor networks operated by the Central Pollution Control Board (CPCB), and meteorological inputs from the Indian Meteorological Department (IMD) as data sources. Supervised learning approaches including Random Forest (RF), Extreme Gradient Boosting (XGBoost), Support Vector Regression (SVR), and deep learning architectures such as Long Short-Term Memory (LSTM) networks are systematically reviewed and compared. Important findings include the superior performance of ensemble and deep learning models compared to traditional linear models, whereby LSTM models have been seen to predict PM_{2.5} using $R^2 \geq 0.94$. In addition, the paper covers how the explainability technique involving SHAP values can make the model predictions understandable for use in policies. Finally, the persistent issues of low data availability in rural areas, lack of satellite observations due to cloud coverage, and the resolution of emissions datasets continue to be highlighted.

Keywords: *air quality prediction, crop residue burning, machine learning, Northern India, PM_{2.5}, MODIS, LSTM, XGBoost, CPCB, Indo-Gangetic Plain*

Comparative Analysis of Convolutional and Transformer Architectures for Robust Multi-Class Human Facial Expression Recognition

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Abstract

Recognition of facial expressions is an essential aspect of human-computer interaction for emotion analysis and intelligent surveillance systems. Although deep learning techniques have continuously progressed, it has been difficult to achieve reliable expression recognition in varying conditions because of differences in pose, brightness of lighting, and intensity of expression. This study will examine convolutional and transformer-based architectures used to conduct Facial expression recognition (FER) on the "Human Face Emotions" (HFE) dataset developed by SamithChimminiyan. The dataset contains a total of 63,099 images classified into five categories as angry, fear, happy, sad, and surprised. A comprehensive preprocessing approach was developed to enhance the model's generalization ability by resizing, normalizing, and augmenting the data. The approach used three pre-trained models for transfer learning for ResNet-152, DenseNet-201, and Visual Transformers (ViT) in conjunction with fine-tuning of the classification layers to conduct emotional recognition on each respective model's output. Each of the experiments consisted of different train-test splits, which served to verify the robustness of the three aforementioned models used to conduct Facial expression recognition. The evaluation of the models' accuracy showed the highest average accuracy of 97.04% with DenseNet- 201 model, followed by a ResNet-152 model with an average accuracy rate of 96.55%, and the ViT with an average accuracy rate of 95.92%, which further supports the effectiveness of CNN for feature extraction to complete FER. Therefore, these models demonstrated their application for real-time systems. Future research will include investigation of hybrid architectures, lightweight models for implementation on edge devices, and the incorporation of temporal analysis to support video-based recognition of emotions.

Keywords: *Transfer Learning, Image Classification, Convolutional Neural Network, Facial Expression Recognition, Emotion Classification, Deep Learning*

Thermal Imaging-Based Fault Detection in Photovoltaic Modules: A Comprehensive Review

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Abstract

The paper will discuss the fault detection using thermal imaging in photovoltaic modules with the focus on fault taxonomy, the diagnosis process, data format and performance reported in the recent literature. The review discusses the development of infrared thermography that was initially used manually through the process of hotspots detection to the sophisticated automated fault detection mechanisms in the form of conventional image analysis, machine learning, deep-learning, and hybrid inferences. The discussion indicates that thermal imaging works as lots of photovoltaic malfunctions can be identified by spatially resolvable temperature variations when electrical degradation is not too severe and thus extremes are not seen at the alterations. Meanwhile, the literature shows that performance reported is highly dependent on the size of the data set, granularity of classes, radiometric quality, platform of acquisition, annotation procedure, and validation scheme. Depending on the environment, deep learning models tend to be most competitive in more complicated multi-class cases whilst feature-based and hybrid models are also competitive in more limited diagnostic settings. Other significant unanswered questions that are highlighted by the review are benchmark fragmentation, inconsistent fault labeling, less cross-climate validation and the poor correspondence between experimental accuracy and conditions of application to plants on the plant level. On the basis of such findings, the paper claims that a progressive advancement is less about individual architectural novelty, but on standardized data, reproducible evaluative protocols, multimodal incorporation of evidence and computation of maintenance-based diagnosis. The review offers a refined technical overview to scholars who have conducted experiments on valid and feasible photovoltaic fault detection systems.

Keywords: *Photovoltaic modules, solar fault detection, infrared thermography, thermal imaging, photovoltaic diagnostics, hotspot detection, deep learning, machine learning, UAV inspection, predictive maintenance*

A Review of Privacy- Preserving Deep Learning for Automated Diabetic Retinopathy Detection Using Hybrid CNN–Transformer Models

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Abstract

To be more specific, Diabetic retinopathy (DR), is the cause of several number of preventable blindness all over the globe. The automated screening systems using deep learning have proven to be highly beneficial in increasing the accuracy and accessibility of such diagnostic testing when detected early. Recently, hybrid CNN-Transformer architectures were built combining the local feature extraction capabilities of convolutional neural networks along with the global context awareness of vision transformers showing a better performance in comparison to standalone models. Yet, creating robust deep learning models requires a large and heterogeneous data set or in other words, data from many health care systems thereby endangering privacy and security. This survey study presents privacy-preserving techniques and hybrid deep learning architectures for DR detection, specifically review of federated learning, homomorphic encryption, differential privacy and secure multiparty computation. Performances of different hybrid architectures on benchmark datasets are evaluated, we review privacy-preserving approaches such as federated learning frameworks achieving 96 to 98% accuracy while keeping data encrypted, and outline major challenges including computational complexity, data heterogeneity, model interpretability and clinical integration. We also address multi-modal and multi-task educational approaches, performance metrics comparison, and prospects for future studies on lightweight structures, sensitive cryptographic methodologies, temporal development of diseases assaying mechanisms based on relevant features corresponding to standardized validation standards. The review can be used as a thorough reference point for researchers and clinicians involved in the field of privacy-preserving artificial intelligence applied to automated diabetic retinopathy screening.

Keywords: *Diabetic Retinopathy, Hybrid Federated Learning, Vision Transformers, Homomorphic Encryption, Medical Image Analysis, Automated Screening, Data Privacy, Multi-Modal Learning*

Performance and Evaluation of Machine Learning Algorithms in Prediction of Liver Cirrhosis: A Literature Survey

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Abstract

Liver cirrhosis represents a major health problem on a global scale and leads to many fatalities annually. Early diagnosis and proper prediction of outcome are critical factors in this case. Machine learning is becoming more widespread in predicting disease outcomes as the volume of clinical data grows. This review considers recent developments in the application of machine learning techniques, such as Decision Trees, Random Forests, Support Vector Machines, Logistic Regression, Gradient Boosting, and Neural Networks, for predicting cirrhosis outcomes. Various measures, such as accuracy, recall, F1 score, area under the curve, and confusion matrices, are used to assess model performance. The F1 score is an adequate measure that combines the parameters of precision and recall; the confusion matrix demonstrates the correctness of predictions made by a machine learning algorithm. According to various studies, ensemble and deep learning algorithms outperform other methods, although there are certain issues in this field.

Key Terms: Machine Learning, Decompensation of Cirrhosis, Hepatorenal Syndrome, Receiver Operating Characteristic Curve Area, Harrell's Concordance Index (C-index), Indian Liver Patient Data Set (ILPD), University of California Irvine Repository, Primary Biliary Cirrhosis (PBC) Survival Data Set, Kaggle, performance measures for highly imbalanced clinical data sets, interpretability of models, comparison with conventional clinical scoring systems, k-fold cross-validation, stratified sampling, external validation, confusion matrix.

Keywords: *Random Forest, Artificial Neural Network (ANN), Logistic Regression, performance measures (accuracy, precision, recall, F1score, ROG-AUC), high recall (sensitivity).*

Machine Learning Techniques for Phishing Website Detection: A Comprehensive Review

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Abstract

Phishing attacks have become one of the most prevalent cybersecurity threats, aiming to deceive users into disclosing sensitive information through fraudulent websites. With the rapid growth of internet services, traditional detection methods have proven inadequate in handling the increasing complexity and volume of phishing attacks. As a result, machine learning-based approaches have gained significant attention for their ability to automatically detect and classify phishing websites. This paper presents a comprehensive review of various machine learning techniques used in phishing detection. Several approaches focus on analyzing URL-based features to identify malicious patterns, enabling efficient detection of phishing websites [1][5][6]. In addition, content-based methods, such as the CANTINA approach, utilize webpage content and textual analysis techniques to improve detection accuracy [2]. Data mining and associative classification techniques have also been explored to enhance classification performance and reduce false positives [3]. Furthermore, frameworks for understanding and measuring phishing attacks provide valuable insights into attacker behavior and detection strategies [4]. Recent advancements in machine learning, including the use of neural networks, deep learning models, and hybrid techniques, have significantly improved detection performance and adaptability [8][9][10]. These approaches enable systems to learn complex patterns and respond effectively to evolving phishing strategies. Additionally, related research in malware detection highlights the importance of supervised learning techniques in identifying unknown and zero-day threats [7]. Despite these advancements, challenges such as feature selection, data imbalance, and real-time detection remain critical issues in phishing detection systems. Therefore, there is a need for more robust, scalable, and adaptive models to effectively combat emerging phishing attacks.

Keywords: *Phishing Detection, Machine Learning, Cybersecurity, URL Analysis, Deep Learning, Data Mining, Classification Algorithms, Feature Extraction, Neural Network*

Pain Ensemble Net: A Hybrid Ensemble Framework for Multi-Class Chronic Pain Classification Using Machine Learning

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Abstract

Chronic pain is a complex clinical problem due to its multi-factorial nature and different anatomical presentations. Localization of pain is valuable since it helps in diagnosis, planning of treatment and monitoring treatment outcomes. In this paper, a powerful hybrid machine learning paradigm is proposed, which integrates systematic and clinical data, and textual patient description to locate the source of pains with accuracy. It consists of the variables related to demographics of the participants: ‘age, gender’, clinical measurements: ‘Pain Score, DN4’, preprocessed and normalized symptom durations, and expert clinical assessments of the six clinical characteristics: ‘Agitation, Aphasia or dysarthria, weakness left leg, weakness left arm, cognitive changes, motor changes’. Numerical and categorical variables were transformed into a rich set of features and Textual features were turned to dense embeddings using the Sentence Transformer model “all-MiniLM-L6-v2”. The multi-class classifier achieved great predictive performance using the Cat-Boost classifier ‘with 80:20 stratified train-test split’. The model succeeded in achieving an accuracy of 99.6% and a macro F1 score of 0.996 across seven pain site categories Facial, Head, Neck, Knee, Low Back, Upper Extremity and Joint/Multiple Joints. The confusion matrix analysis showed the minimal misclassifications. The focusing of training around the loss and F1 is demonstrated with data being iterative. This pipeline proves the effectiveness of a text plus numerical clinical data combination to localize chronic pain in an automated and high-fidelity manner, offers potential opportunities to be applied in clinical decision support systems.

Keywords: *Chronic Pain, Site of Pain, Machine Learning, Artificial Intelligence, Predictive Modeling, Feature Selection, Classification.*

MedGraphGuard: Agentic Hybrid RAG for Clinical AI

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Abstract

Large language models (LLMs) are capable of answering numerous healthcare and clinical domain-related queries. Yet, these models still face the danger of providing erroneous, non-up-to-date, or even completely false information, also referred to as hallucination. One of the common approaches to alleviating this hazard is retrieval-augmented generation (RAG), which employs the information retrieval step to base model responses on reliable and relevant sources. Still, since medical information can come from various domains, the search results may lack required context or fail to consider several pieces of information. The paper introduces MedGraphGuard – a novel evidence-based framework designed to safely and reliably answer medical queries. The system uses RAG with medical information graphs and employs multiple agent-based approaches, each of which solves a particular subtask. These subtasks include query understanding, retrieving relevant information, consulting clinical guidelines, applying graph-based reasoning, detecting hallucinations, and evaluating the response's confidence level. MedGraphGuard is trained on reliable medical information sources, including PubMed, UMLS, SNOMED CT, DrugBank, clinical guidelines, and electronic health records when available. The experiments conducted with MedQA, PubMedQA, MedMCQA, and MIMIC-IV datasets demonstrate the framework's ability to avoid hallucinations and respond with clinically plausible answers. The evaluation results also highlight the system's efficiency and effectiveness, as it outperforms other methods in most of the considered metrics, including accuracy, hallucination detection rate, precision, recall, F1 measure, and response time. Moreover, the framework is deemed safe and effective based on the clinicians' feedback. By focusing on the properties of reliability, validity, and comprehensiveness, MedGraphGuard aims to eliminate hazardous information and provide clinicians with high-quality answers. The system advances the clinical decision-support field while promoting the trustworthiness of artificial intelligence in medical settings.

Keywords: *MedGraphGuard, Large Language Models (LLMs), Medical AI, Clinical Decision Support, Retrieval-Augmented Generation (RAG), Knowledge Graphs, Hallucination Detection, Multi-Agent System, Healthcare.*

CIFR: A Color Invariant Deep Learning Framework for Robust Face Recognition

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Abstract

The use of AI-powered biometric technology is increasingly vital in the realms of safe digital services, wise enterprises, and Industry 4.0 applications. But variations in illumination and color have restricted the reliability of face recognition systems in real world applications. This paper introduces Color Invariant Face Recognition framework (CIFR), a deep learning-based approach that provides a solution to perform color invariant feature analysis towards illumination robust face recognition. Specifically, a comparative study is conducted among HSV, HSI, and HSL cylindrical color models in order to find their suitability for enhancing the performance of face recognition systems. The proposed CIFR framework further includes channel contribution analysis to measure the discrimination ability of individual channels such as Hue, Saturation, Intensity, and Lightness. Moreover, an illumination robustness experiment is also performed in which a range of illumination changes are simulated for each color space. To further evaluate the efficacy of the suggested framework, an ablation analysis is performed to determine the importance of feature normalization, color-space conversion, and classifier enhancement. As illustrated in the experiment performed on the AR face dataset, CIFR-Net reaches an accuracy rate of up to 99.02%, and the HSV color space shows better performance than RGB, HSI, and HSL models. It can be seen that the Value component holds more discriminatory data about the human face, and HSV is more robust against varying illumination. In addition to boosting biometric recognition performance, the proposed framework helps enable intelligent vision systems powered by AI to facilitate secure digital authentication, efficiency, and sustainable use of secure biometric recognition technologies in enterprise and smart-service environments.

Keywords: *Artificial Intelligence, Face Recognition, Color Invariant Learning, Illumination Robustness, Deep Learning, Sustainable Digital Technologies.*

An Ensemble Federated Blockchain Integrated Graph Neural Network with Explainable AI for Multi Class Network Intrusion Detection

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Abstract

The intense increase in cyber threats in distributed and heterogeneous systems requires intrusion detection systems to be precise, privacy-assuring and reliable. Conventional centralized machine learning methods have some limitations of data silos, extreme class imbalances, and in transparency of the decision-making process. In order to overcome these shortcomings, this paper suggests a multi-class intrusion detection framework that combines federated learning, blockchain and a residual graph neural network architecture. The proposed model employs a deep residual Graph SAGE network with attention-based gating to capture the relational information among network flows while retaining their node representations in deeper layers of the graph. In order to improve the minority attack classes, a hybrid imbalance handling approach that fuses Borderline SMOTE and focal loss is used. Federated learning makes it possible to train models in a decentralized manner, with majority-conscious weighted aggregation, and where privacy is preserved without the need to share data. The technology is integrated with blockchain that ensures that model updates are recorded safely enhancing trust, and integrity in collaborative setting. Furthermore, attempt to improve the model calibration and interpretability is achieved via temperature scaling and explainable AI techniques. Compared to conventional and shallow graph-based methods, experimental results indicate better performance with 99.5% accuracy and a 99.51% weighted F1-score and large improvements in minority class detection.

Keywords: *Blockchain, Convolutional Neural Network, Explainable Artificial Intelligence, Federated Learning, Graph Neural Network.*

A Deep Learning Model Approaches Detection of Lung Disease(TB) Using CXR Images

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Abstract

Tuberculosis (TB) is a very dangerous infectious disease; many people get affected by this disease worldwide and it requires early detection to prevent complications and transmission. Chest X-ray imaging is done as an investigation because it is one of the most common diagnostic tools due to its availability and low cost for TB detection. A CNN model is trained and applied to the dataset. Here we have taken the dataset of around 2494 chest X-ray images of TB patients and 514 normal test X-ray images. This data has been taken from the site of Mendeley. We evaluated that the model shows an overall Accuracy of 94% to distinguish between normal patients and TB patients. The images were pre-processed, resized, and normalised so that the performance of the model is increased. Here, we use the InceptionV3 model, which is an advanced CNN (convolutional neural network) architecture. InceptionV3 uses a more complex architecture, which allows for better accuracy in image classification tasks. This model is made of multiple inception modules, where multiple convolution layers with varying kernel or filters to produce multiple image features. Therefore, improving its capacity to detect the disease. The model obtained precision values of 0.94 and 0.93 for Normal and Tuberculosis classes respectively, which shows that the predicted values of the model are quite reliable. The recall values were 0.99 for Normal and 0.68 for Tuberculosis, highlighting strong performance in identifying healthy cases. The F1-score of 0.93 further confirms the stability of the model. The confusion matrix shows the 693 Normal and 95 TB cases, with minimal false positive predictions. Thus, the model shows good performance and is suitable for medical professionals to detect the disease early. For further studies, more data could be taken to achieve much better results.

Keywords: *Tuberculosis (TB) Detection, Chest Xray (CXR), Deep Learning, Convolutional Neural Network (CNN), InceptionV3, Medical Image Classification, ComputerAided Diagnosis (CAD).*

A Comprehensive Review of Adaptive Traffic Signal Control Using Machine Learning and Real-Time Data Analysis

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Abstract

Urban traffic congestion continues to erode travel time reliability, fuel economy, and air quality across fast-growing metropolitan regions, and this pressure has kept adaptive traffic signal control (ATSC) an active research area for more than two decades. This paper surveys how machine learning has reshaped ATSC, tracing the path from the classical coordinated systems SCOOT and SCATS through tabular and deep reinforcement learning, multi-agent coordination, fuzzy and neuro-fuzzy control, and vision-based perception. Alongside the control algorithms, we examine the sensing and computing stack that feeds them — inductive loops, radar and camera perception, edge and fog processing, and the communication protocols that tie an intersection network together — and we assemble a comparative summary of reported outcomes across a representative set of studies. Particular attention is given to how well these techniques transfer to the heterogeneous, non-lane-disciplined traffic typical of Indian cities, where sensor budgets are tighter and vehicle mixes are less predictable than in the corridors where SCOOT and SCATS were originally designed. The review closes by cataloguing the open problems that keep most reinforcement-learning results confined to simulation — sensor robustness, the simulation-to-reality gap, multi-agent scalability, communication latency, cybersecurity, and the absence of shared benchmarks — and by outlining research directions including vehicle-to-infrastructure communication, 5G-assisted edge inference, federated learning across cities, and explainable, safety-verified controllers.

Keywords: *Adaptive Traffic Signal Control, Machine Learning, Reinforcement Learning, Deep Learning, Real-Time Data Analysis, Intelligent Transportation Systems, Internet of Things, Computer Vision, Edge Computing, Smart Cities.*

TL-ISL NET: A Transfer Learning-Based Framework for Multi-Class Indian Sign Language Gesture Recognition

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Abstract

Indian Sign Language is the primary language of communication for millions of Hearing, Speech and impaired individuals in India. While this is important, there is a significant communication challenge, as not everyone is aware and understands the ISL, and therefore cannot have access to the required services such as education, health care and public administration. In this thesis, one of the frameworks of multi-class gesture recognition of Indian Sign Language is presented which would provide a seamless interaction between the deaf community and society by converting the gestures into text and speech by using the framework of transfer learning. The proposed system employs the latest deep learning models, which include Convolutional Neural Networks, Long Short-Term Memory network and transfer learning model, in order to efficiently recognize both still and moving hand gestures. High-level discriminative features of input images using different pre-trained models including ResNet50, MobileNetV3, VGG16 and VGG19 are learned. CNN-based models mainly focus on spatial information, while CNN+LSTM hybrid model captures the temporal information of gesture sequences which makes it particularly applicable for dynamic sign language recognition. In terms of data classification, VGG16 is the best when compared to the accuracy of 99.67% and the perfect precision, recall and F1 values, respectively. With the assistance of model MobileNetV3 and CNN+LSTM, the accuracy of over 99% can also be achieved to support real-time and sequential recognition of gestures. The model ResNet50 is marginally less accurate, but it is known to have stable training, and good generalization. Using resource-constrained systems, like mobile devices, that are deployed can be important for MobilenetV3.

Keywords: *Indian Sign Language, Gesture Recognition, Machine Learning, Deep Learning, CNN, LSTM, Transformers, Computer Vision, Image Processing.*

Balancing Security and Sustainability in Edge IOT: A Threshold-Based Sleep-Awake Federated Learning Protocol

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Abstract

The integration of Federated Learning (FL) in the Internet of Things (IoT) allows privacy-preserving decentralized model training. However, implementing FL in real-world environments introduces critical challenges, including severe energy constraints, limited power supply, risks associated with battery-powered edge devices, and sensitivity to data poisoning attacks. Existing FL frameworks often fail to optimize communication protocols based on energy constraints, or struggle to aggregate weights effectively in the presence of unreliable or malicious nodes. To address these limitations, we propose T-SAFE (Threshold-based Sleep-Awake Federated Energy), a novel and lightweight FL protocol designed for resource-constrained IoT networks. At the edge layer, T-SAFE introduces a local delta-thresholding mechanism that allows devices (such as the ESP8266) to skip local model updates and enter a deep sleep mode when changes are statistically insignificant, substantially reducing communication overhead and extending battery life. At the server layer, we propose a dual-layer secure aggregation mechanism that utilizes distance-based anomaly detection and dynamic trust scoring to distinguish energy-saving sleeping nodes from malicious adversaries. The aggregator effectively segregates poisoned updates and performs trust-weighted federated aggregation. We developed a physical hardware prototype of T-SAFE using ESP8266 microcontrollers and a Python-based aggregator. Preliminary results demonstrate that T-SAFE significantly minimizes power-intensive Wi-Fi transmission cycles while preserving high global model accuracy and robustly mitigating extreme data poisoning attacks, establishing a scalable, secure, and sustainable pathway for next-generation IoT-FL deployments.

Keywords: *Federated Learning, Dynamic Trust Management, Edge Computing, IoT, Energy-Efficient Computing.*

DENTIQ: An AI-Driven Real Time Multi Class Dental Anatomy Detection and Classification Pipeline Using Enhanced YOLOV8M Model

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Abstract

The accurate and automated detection and localization of dental anatomical structures in dental images could save considerable time for clinicians and automate the process of electronic patient charting. Results from recent object detection approaches using deep learning have achieved high accuracy on a variety of dental image classification and detection tasks. This study aims to develop a high-precision dental object detection model and investigate its possible applications. A YOLOv8m model pre-trained on ImageNet was fine-tuned to detect seven categories of dental anatomical structures (incisors, canines, premolars and molars). It was trained for 100 epochs with an input resolution of 640 pixels and incorporated automated letterboxing. The model achieved a mean Average Precision (mAP@0.5) of 0.9729 and mAP@0.5:0.95 of 0.7658 on a completely independent holdout test set of 2,360 instances of anatomical structures. It achieved an average precision of 0.9552 and average recall of 0.9602. In addition, an open-source OpenCV-based real-time inference pipeline was designed and implemented, which can rapidly process images in real time, and annotate and score detected dental anatomical structures in real time. Results indicate that this approach has great potential for the automated dental screening of patients and can significantly reduce the diagnostic time of clinicians. The model also provides a solid basis for development of future instance segmentation research and automatically generated digital odontograms.

Keywords: *YOLOv8, Dental Anatomy Detection, RealTime Object Detection, Transfer Learning, Deep Learning, Automated Dental Diagnostics, Digital Odontology*

Claude Fable 5 And Mythos 5: A Critical Examination of Frontier AI, National Security, and the Unforeseen Economic Inertia

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Abstract

The study examines the complete sequence of events which led to the global suspension of Anthropic Claude Fable 5 and Mythos 5 models during June 2026 because of exceptional government actions. The study examines how national security threats which include the risk of 'jailbreaking' for cyber and biological purposes lead to conflicts between software developers who want quick market entry and the changing export regulations and the complete loss of trust between technology companies and government entities. The economic situation which includes these advanced AI technologies will be analyzed in our research. The empirical data and comparative trends which we analyzed demonstrate a major gap between two things which should be connected: AI capabilities have grown substantially yet they have not produced any noticeable effect on total market productivity or worldwide GDP development.

This research frames the incident not merely as a product withdrawal but as a definitive shift toward a more securitized and fragmented AI landscape. We conclude by discussing the necessity of architectural resilience, such as multi-provider AI gateways, and the persistent 'AI productivity paradox' that continues to challenge optimistic economic forecasts.

Keywords: *Frontier AI, Claude Fable 5, Mythos 5, National Security, Export Controls, AI Governance, Dual Use Technology, AI Productivity Paradox, Economic Impact of AI, Geopolitical Resilience.*

Modern Network Security: Key Issues, Threats, and Emerging Challenges

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Abstract

In the present digital era, secure networking has become an essential requirement for every organization in India, whether in the government, education, industry, or defense sectors. The expansion of high-speed wired and wireless networks, together with the growth of the Internet, has increased security threats, making networks less safe and reliable. Today's security systems must protect data while they handle the increasing security needs of India's growing industrial and technological sectors. The requirement for secure and authenticated access becomes fundamental in defense, banking, healthcare and e-governance sectors which handle crucial information security matters. This document examines the vital security protections and requirements that Indian organizations and industrial sectors need to develop their secure network systems. Wi-Fi networks, which serve as the primary method for wireless internet access face multiple security risks that include unauthorized network entry and data theft and hacking attacks. Therefore, special attention is given to handling wireless security challenges. This study explores various security techniques applicable to different network scenarios in order to create a fully protected organizational network environment. A case study is also presented to highlight the minimum essential measures required for implementing effective network security in any organization.

Keywords: *Cryptography; Security Attacks; Security Measures; Security Tools; WAN; Security Factors; Firewalls; Gateways; Intrusion Detection.*

A Scalable Machine Learning Architecture for Healthcare and Pharmaceutical Research and Development Towards Viksit Bharat-2047

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Abstract

Healthcare systems worldwide are undergoing a digital transformation driven by rapid advances in artificial intelligence, machine learning, cloud computing, and biomedical informatics. In India, healthcare remains one of the most critical sectors for achieving the national vision of Viksit Bharat-2047, which emphasizes technological self-reliance, improved healthcare accessibility, indigenous innovation, and sustainable development. The healthcare ecosystem generates massive amounts of heterogeneous data from hospitals, diagnostic centers, wearable devices, genomic sequencing platforms, pharmaceutical laboratories, and public health surveillance systems. Traditional data analysis methods are often incapable of extracting actionable insights from such complex datasets due to limitations in scalability, adaptability, and predictive capabilities. Simultaneously, pharmaceutical industries face significant challenges, including prolonged drug discovery cycles, high clinical trial costs, low success rates in candidate selection, and increasing regulatory requirements. Machine learning techniques offer opportunities to overcome these challenges by enabling intelligent pattern recognition, predictive modelling, molecular property estimation, and automated decision support.

Keywords: *Machine learning, artificial intelligence, healthcare analytics, pharmaceutical research, federated learning, explainable AI, blockchain, precision medicine, Viksit Bharat 2047.*

Predicting Hospital Stay Length Using Explainable Machine Learning

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Abstract

The accurate prediction of a patient's Length of Stay (LOS) serves as the primary goal for achieving hospital operational efficiency while reducing traffic congestion and enhancing patient movement throughout the medical facility. Current Machine Learning (ML) models provide accurate forecasting results yet their "black-box" structure prevents doctors from trusting these systems because they cannot use them in critical medical situations. This study presents a new performance-based framework for Explainable Artificial Intelligence (XAI) which predicts Length of Stay (LOS) by converting the task into two distinct categories: Short Stay and Long Stay. The framework uses ensemble learning techniques to evaluate three optimized models: XGBoost, LightGBM, and CatBoost, which create a Voting Ensemble system through their combination that uses Electronic Health Record (EHR) data for model training. The system uses post-hoc XAI methods which include SHAP (SHapley Additive exPlanations) to achieve both clinical validity and system transparency. The integration creates two types of interpretability which show how important features affect model performance while providing reasons for every prediction based on individual patient data. The results show that using an ensemble structure leads to better predictive results than using separate classifiers. The system produces explanations which deliver human-understandable information that enables the system to operate as a reliable element in Clinical Decision Support System (CDSS) because it enhances resource distribution and supports the development of smart healthcare systems.

A CNN-Based Deep Learning Approach for Automated Oral Cancer Detection

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Abstract

Oral cancer has been a collective health problem in many parts of the world, since late detection and lack of effective screening technology. Traditional diagnostic methods like visual inspection and biopsy are invasive, time-consuming, and require clinical practice, which limits their scalability. Despite promising results achieved with deep learning models, many are based on transfer learning and do not optimize and generalize to the domain. In this work, a tailor-made convolutional neural network will be established to perform the one-on-one oral cancer detection of clinical oral images. The dataset consists of cancer and non-cancer categories and is balanced (3580 images). It has been down sampled to a 192x192 resolution. Preprocessing involves normalizing, rotation, zoom, and horizontal flipping to make it more robust. This model is tested with several train-validation splits (95:05, 90:10, 85:15, 80:20, 75:25, 70:30, 65:35 and 60:40) and trained with Adam optimizer with learning rate 0.00008, early stopping strategies, and decreasing learning rate. This model has a high stability and generalization as the model has an accuracy of 96%-99% in validation, and the mean value is 96.00. Nonetheless, it has some weaknesses such as dependence on balancing by duplication, absence of external validation, and binary classification. The next generation of work will feature multi-center datasets and explainable AI, along with real-time deployment in clinical practice.

Keywords: *Oral Cancer Detection, Deep Learning, Convolutional Neural Network, Clinical Oral Images, Computer-Aided Diagnosis*

Flood Monitoring System: An AI-Powered Flood Damage Detection and Assessment Framework Using YOLO Object Detection

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Abstract

Floods are one of the most common and devastating natural disasters that result in damage to properties, infrastructure and human livelihood. Field surveys remain the traditional approach for assessing post flood damage but they are slow and labour intensive while being unsafe in flooded areas and prone to inconsistent reporting. A Flood Monitoring System using AI: A Well-Designed Program to Automate the Detection and Assessment of Damaging Floods with YOLO (You Only Look Once)-based object detection in a Flask web app for this paper. This system enables the user to input aerial/satellite imagery of an area impacted by flooding and then use the yolo model to identify and count the houses within that region (as well as flooded sections) and estimate the damage from the flood. Additionally, it will generate a “heat map” displaying the severity of the flood impact. Finally, it will compile the previous information into a PDF document assessing the overall damage. There is also an interactive dashboard that shows all pertinent operational statistics, including but not limited to the total number of images processed, the number of structures identified, and how many were damaged. In addition to providing a reduction in the amount of time required to complete assessments compared to traditional survey-based methods, preliminary testing on some sample images has shown that this method has provided reliable results for detecting damage. It is expected that this technology could be used to assist government agencies, NGOs, and emergency response units with making quick, data-driven decisions regarding where to direct rescue efforts and what can be done to aid in recovering affected communities after disasters have occurred.

Keywords: *Flood Damage Assessment, YOLO Object Detection, Deep Learning Disaster Management, Heat Map Visualization, Automated Report Generation.*

Stereo-Aware Multimodal Ambulance Detection and Real-Time Traffic Signal Preemption Using Edge AI

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Abstract

Emergency medical services experience delays because urban traffic congestion prevents timely responses which results in unnecessary deaths. GPS and RFID-based ambulance prioritization systems currently face three main issues which include signal degradation problems and false positive detections and the system lacks capability to identify active duty ambulances. The present research introduces a new framework which uses multiple stereo-aware methods to combine YOLOv8 visual detection with CNN-based siren classification and Interaural Time Difference and Interaural Level Difference directional audio analysis. The system uses perspective-corrected bounding box dynamics to estimate speed and time-to-arrival (ETA) without requiring GPS information. The safety-aware signal preemption method uses fixed buffers to block sudden changes which decreases simulated surrogate safety risk (based on Time-to-Collision, TTC) by 85.4% (95% CI: 72-93%). The system shows 93% precision and 91% recall in testing 12 real-world traffic videos which contain 3.5 hours of footage and 47 manually annotated ambulance passages while SUMO simulation testing with 500 preemption events achieved 96% precision and 94% recall results and reduced average ambulance wait time by 43% (paired bootstrap, $p < 0.001$). The fully edge-deployable system functions without any need for internet access and it achieves 322 ms processing time. The entire signal preemption testing process uses high-fidelity SUMO simulation while the team plans to conduct live intersection testing in future projects.

Early Detection of Asperger's Syndrome

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Abstract

Asperger's is still diagnosed later than would be hoped, and it is a notable example of the diagnostic challenges that we face for some conditions within the autism spectrum. In this study, we detail the current landscape of early diagnosis strategies for Asperger's/ASD, highlighting issues of diagnostic latency and implications for outcome with treatment. The age at which children are diagnosed with Asperger's is now known to have a mean value 11 years – this contrasts with a mean value of about 5.5 years commonly quoted for classic Autism. Unfortunately, despite the fact that parents notice something wrong in terms of development long before 30 months, there was an overall delay of an average 45.28 months before they were provided with a formal diagnosis. Several screening tests including Modified Checklist for Autism in Toddlers (M-CHAT), Childhood Autism Spectrum Test (CAST) as well as specified ADI-R inquiries exhibit adequate discriminatory capacity regarding timely recognition. Neuroimaging studies revealed that patients presenting Asperger's syndrome inevitably manifested atypical brain structures and functions on their scans; specifically, they had modifications in caudate nucleus volumes linked to occurrence of repetitive behaviors. Among these behavioral intervention measures, Early Start Denver Model (ESDM) instituted during the period surfacing between 18-30 months appears very beneficial and advantageous based on collected data regarding favorable IQ outcomes averagely increasing by eighteen points among beneficiaries and constant success on long-term follow-ups which came following subsequent research works.

A Comparative Evaluation Framework of Machine and Deep Learning Architectures for Real-Time Flood Level Forecasting

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Abstract

Floods remain among the most destructive natural calamity on earth, causing great loss to population globally. Accurate flood-level forecasting has become essential for hydrological risk management systems. While machine learning (ML) and deep learning (DL) methods have enhanced the traditional physics-based models, the comparative forecasting literature remains limited across geographic scope and flood-specific evaluation criteria. This paper presents a efficient multi-dimensional evaluation framework comparing two machine learning and three deep learning architectures (RF, XGBoost, GRU, LSTM and ME-LSTM) for one-day ahead daily streamflow prediction. The framework is evaluated on Caravan dataset spanning 4,840 global basins over a 34-year record, models are evaluates across seven specific metrics consisting of hydrological prediction skill (NSE, KGE, MPTE, PBIAS-HF) and computational efficiency (inference latency, memory footprint, training convergence time). Results shows that XGBoost achieves overall dominance for accuracy and efficiency with a median NSE of 0.798 and a peak timing error of 1.76 days, while DL architectures offer advantages in memory footprint and inference latency for deployments. This work implements the existing academic model assessment over practical operationality by introducing a standard evaluation pipeline which provide deployment guidance flood early warning system practitioners operating under resource constrained, memory-constrained edge and fog-computing environments.

Keywords: *flood forecasting, streamflow prediction, machine learning, deep learning, LSTM, XGBoost, hydrological benchmarking, Caravan dataset, computational efficiency, early warning systems*

A Review on Machine Learning Techniques for Carbon Emission Prediction in Smart Cities

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Abstract

The urgent task of managing the carbon footprint of cities has grown particularly relevant against the backdrop of GHG emissions generated by urban populations around the world, which comprise a considerable portion of total anthropogenic emissions. This review paper will explore the scientific efforts related to the use of machine learning algorithms and approaches to predict GHG emissions within the framework of smart city projects. In particular, we will analyze the current algorithmic solutions used to tackle the problem, from simple baseline models of regression analysis to sophisticated hybrid models based on time-series and deep learning. We will also examine the ways in which IoT can facilitate the creation of necessary data flows required to train these models. The main topics covered include an assessment of model efficiency, common approaches to feature selection and evaluation of results, along with the discussion of how XAI can enhance the relevance of ML-based predictions. Furthermore, we will outline some of the major problems faced by researchers working in this field, including limited availability of data, lack of model generalizability, and the black-box problem, as well as promising trends toward addressing these problems through transfer learning, real-time emission management, and other strategies.

Keywords: *Carbon emission prediction; smart cities; machine learning; greenhouse gas; IoT; deep learning; hybrid models; urban sustainability; explainable AI.*

AI-Powered Farmer Support System: An Intelligent Integrated Platform for Crop Disease Diagnosis, Agricultural Information Retrieval, and Direct Farmer-to-Buyer Marketplace

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Abstract

Agriculture plays a vital role in the economic development of India, yet farmers continue to face challenges such as crop diseases, fluctuating market prices, limited awareness of government schemes, high agricultural input costs, and dependence on intermediaries for selling their produce. The lack of an integrated digital platform often forces farmers to rely on multiple sources of information, resulting in delayed decisions and reduced productivity.

The AI Powered Farmer Support System is a web-based application developed to provide a comprehensive solution to these challenges. The system integrates Artificial Intelligence, real-time government data, and an online agricultural marketplace into a single platform. It enables farmers to detect crop diseases by uploading images, where the Google Gemini API analyses the symptoms and provides disease identification, treatment suggestions, and preventive measures. Additionally, the application offers live mandi prices, information on government agricultural schemes, fertilizer and pesticide details, and a secure marketplace where farmers can directly connect with buyers, reducing dependence on middlemen.

The system is developed using React.js, Vite, and Tailwind CSS for the frontend, while Node.js and Express.js are used for backend development. Pocket Base is employed for database management and user authentication, and data.gov.in APIs provide real-time agricultural information. The platform also includes role-based authentication, farmer and buyer dashboards, and an administrative module for managing marketplace listings. The proposed system aims to improve agricultural decision-making, increase farmers' awareness of available resources, reduce crop losses through early disease detection, and enhance farmers' income by facilitating direct market access. Furthermore, the system is designed to be scalable and can be extended with future features such as weather forecasting, multilingual support, AI-powered chatbot assistance, voice interaction, and yield prediction. Overall, the project demonstrates how modern web technologies and Artificial Intelligence can be utilized to support sustainable agriculture and contribute to the digital transformation of the farming sector.

Keywords: *Smart Agriculture, Artificial Intelligence, Detection, Crop Disease Google Gemini, Precision Agriculture, Farmer Marketplace, Decision Support System, Agricultural Information System.*

Weedspotter: “AI-Driven Weed Detection System for Precision Herbicide Application”

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Abstract

Crop yield losses due to weed competition for resources such as water, light, and nutrients are large-scale problems. Herbicide applications and manual weeding are the most common forms of weed control, but both options for weed control can lead to large increases in environmental degradation. Developments in deep learning, ML and robotics streamline the identification of weed populations through machine learning and provide the capability for weed identification in real-time. A comprehensive plan to integrate an innovative mode of crop production through image processing, machine learning algorithms, and precision agriculture has emerged based on many previous studies. This research provides many contributions, such as an evaluation of the challenges of occlusion, light variations, and the need for real-time processing; as well as the methods for preparing and preparing the input data and the method for classifying inputs. Finally, this research provides an accurate method of detecting weed populations within the field, while promoting environmentally sustainable practices by decreasing the negative impacts caused by conventional methods.

Keywords: *Agricultural Weed Identification, Farming Precision Technologies, Digital Video Analysis Technology, Image Processing Technology (3D), Ground Control Points, Digital/Social Media Platforms, CloudBased Processing of Data, Robotic Automation of Gardening/Farming Practices, Rapid Increase of Agricultural Yield, Reduced Use of Herbicides, Increased Efficiency of Crops, and Decreased Use of Herbicides by Using aAI Robot.*

AI Driven Synthetic Audit Data and Verification System

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Abstract

Testing and teaching audit software requires realistic data, but real ledgers contain confidential information such as account numbers, salary amounts, and vendor names, so organizations rarely share them, and anonymized extracts lose much of the ledger's structure. This paper presents an AI-Driven Synthetic Audit Data and Verification System that generates realistic financial records without depending on confidential source data. The generation module combines a Conditional Tabular Generative Adversarial Network (CTGAN) and a Tabular Variational Autoencoder (TVAE) to handle the columns typical of audit tables: transaction dates, ledger codes, debit or credit amounts, vendor categories, and approval status. CTGAN allows conditioning on attributes, such as a target fiscal quarter or an irregular posting rate, while TVAE smooths relationships between columns; the system runs both models together. Output quality is verified across four dimensions: column distribution fidelity, preservation of inter-column relationships such as approval hierarchies, resistance to record memorization, and downstream usefulness, measured by training a classifier on synthetic data and testing it on real data. A second layer checks for duplication, inconsistencies, and statistical anomalies using isolation forests and autoencoder reconstruction error, gating data before release and supporting fraud-detection experiments. The system is a web application with role-based access for administrators, auditors, and reviewers, built with a React front end and Spring Boot services, with a relational database that decouples generation and verification models from the service layer. Each dataset records its model version, parameters, and verification scores for reproducibility, enabling testing and research without exposing real financial records.

Keywords: *Synthetic Data, Financial Auditing, Generative AI, CTGAN, TVAE, Anomaly Detection, Fraud Detection, Data Privacy, Audit Verification.*

Brain Tumor Detection and Classification

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Abstract

Detecting and classifying brain tumors is one of the most essential processes in medical imaging, where early diagnosis leads to better treatment outcomes results and higher survival rates. MRI has emerged as a preferred modality for diagnosing brain tumors because of its high spatial resolution and soft tissue contrast. However, the analysis of the MRI images is time-consuming; it is very subjective and highly dependent on the expertise of radiologists. To overcome limitations, automatic intelligent systems will be required to assist clinicians in detecting and classifying tumors accurately. The main idea of the paper is to offer an integrated framework for the detection and classification of brain tumors using machine learning and deep learning algorithms such as SVM, InceptionV3, and ResNet50. The proposed method handles the preprocessing of MRI images by removing noise and normalizing intensity, after which the segmentation of the tumor area is performed. Transfer learning was employed for the InceptionV3 and ResNet50 architectures; these models are pre-trained on the Image Net dataset and then fine-tuned for brain tumor classification. Deep convolutional neural networks effectively represent the complex spatial and structural patterns of MRI images. Each model is assessed for performance using standard metrics such as accuracy, precision, recall, F1 score, and analysis of the confusion matrix.

Keywords:*Brain Tumor Classification, MRI, Deep Learning, ResNet50, InceptionV3, SVM*

Caresense Web: Intelligent Symptom – Based Disease Prediction System

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Abstract

Early disease prediction systems play an important role in preventive healthcare by providing timely insights based on patient-reported symptoms. However, many existing disease prediction platforms focus only on prediction accuracy and fail to provide clear explanations for their decision, reducing user trust and interpretability. To address this limitation, this research proposes Caresense Web, an Explainable and confidence-aware Disease prediction system developed as a web-based healthcare application. The proposed system uses the XGBoost multi class classification algorithm to predict diseases based on the user input. To improve transparency and explainability, the system integrates SHAP, which identifies and visualises the most influential symptoms contributing to the primary disease prediction. This enables users to better understand the reasoning behind the model's output. The entire application is implemented using Flask with a user-friendly multi-page interface for symptom input. Prediction visualization and explanation display. Experimental results demonstrate that the proposed system provides transparency disease prediction system. The developed model serves as an effective tool for early disease assessment and preventive healthcare support.

Keywords: *Web-Based Health Application, XGBoost, Machine Learning, SHAP, Confidence-Based Risk Classification, Flask Web Framework, Web Application.*

Significance of Deep Learning Techniques for Early Identification of Dental Caries: A Review

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Abstract

Dental caries is one of the most common oral diseases in the world. Early detection of lesions can still be difficult as early changes are often difficult to detect in the routine radiographs and intraoral images. If these lesions are not detected early, they could progress into a disease that will need more advanced and intensive treatment. AI techniques can be used to review dental radiographs, intraoral photographs and clinical information to help the clinician determine if there are suspicious lesions or if there is an area of interest and to enhance treatment planning. We review the latest studies using, U-Net based segmentation models and YOLO object detection frameworks to classify the progression stages of dental caries. The selected studies were classified by imaging modality (bitewing and intraoral images) and by the main task of the study (classification, lesion localization or segmentation). The reviewed studies have shown that CNN-based models are frequently used for images classification, YOLO-based models are useful in localization of the lesions, and U-Net are widely used for pixel-level segmentation.

Keywords: *Artificial Intelligence, Dental Caries, Deep Learning, U-Net, CNN, Radiographs, Oral Healthcare.*

Scope of Using Explainable Artificial Intelligence to Improve the Classification of Indian Miniature Paintings

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Abstract

Explainable AI focuses on “Why” a decision was made in comparison to deep learning algorithms which focuses on “what” while learning patterns from large databases to gain accuracy in classification like tasks. Till now, explainable AI has been implemented in the field of healthcare, agriculture, sentiment analysis etc. but very limited work has been done in niche fields like visual arts. In the vast diversification of Indian culture, Indian paintings have played a vital role and when it is about rich Indian miniature paintings, one must talk about the different schools like Mewar, Marwar, Bundi, Kishangarh, Jaipur etc of Rajasthan miniature paintings. As all Rajasthan art schools follow fine grain techniques and are akin to each other, it is sometimes very difficult to classify these paintings manually. Various researchers have applied explainable AI along with machine learning algorithms like convolution neural network, and transfer learning etc to classify different art styles and Artist’s works and have shown significant results. This paper examines the scope of using explainable AI along with Machine learning techniques to classify paintings of these miniature art schools. This paper will also be a great foundation for the researchers to get knowledge about the use of explainable AI for the betterment of the classification process of cultural heritage objects.

Keywords: *Machine Learning, Explainable AI, Cultural Heritage, Miniature Paintings, Deep Learning*

Satellite Image Super-Resolution Using Generative Adversarial Network

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Abstract

High-resolution satellite imagery is a key ingredient in today's geospatial applications, including precision agriculture, land-use planning, environmental monitoring, disaster management and infrastructure mapping. Many commonly available satellite sensors (e.g. Sentinel-2) deliver images at relatively coarse spatial resolutions, which limits the ability to observe fine-scale geographic features. To overcome this limitation, this project builds an artificial intelligence-based Super-Resolution (SR) framework that translates low-resolution satellite imagery into high-detail, analysis-ready data. The proposed method is based on Generative Adversarial Network (GAN) for multispectral satellite image enhancement. The workflow starts with data preprocessing including radiometric normalisation, patch extraction, data augmentation and multispectral band stacking to generate paired low resolution (LR) and high resolution (HR) training samples. This project demonstrates that deep learning-based super-resolution can make coarse satellite imagery more informative, improving the efficiency of environmental monitoring, urban planning, agricultural assessment, and disaster management. By providing analysis-ready high-resolution outputs, the Super Sat framework bridges the gap between low-resolution satellite data and high-resolution geospatial analysis needs.

Keywords: *Super-Resolution, GAN, Satellite Imagery, and Deep Learning, Remote Sensing.*

Hypergraph Based Retrieval-Augmented Generation for Semantic Ambiguity Resolution in Multilingual Business Communication

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Abstract

Semantic ambiguity poses a major challenge in multilingual business communication systems, especially for low-resource languages where resources for context and domain are limited. Existing Retrieval Augmented Generation (RAG) models are mostly dependent on static k-chunk retrieval strategies with less flexibility to the varying semantic and contextual complexities of the multilingual business queries. We propose a framework of Hypergraph-Enhanced Retrieval-Augmented Generation with diffusion-based dynamic retrieval for semantic ambiguity resolution in multilingual business communication. The proposed framework leverages hypergraph semantic modeling to capture higher-order contextual relationships between multilingual entities, business intents and domain-specific concepts. Besides, a diffusion-guided adaptive retrieval mechanism dynamically decides the number of semantic chunks according to the query uncertainty and contextual complexity. Experimental analysis shows improvements in semantic consistency, retrieval precision and contextual relevance over conventional transformer and standard RAG-based approaches. The proposed system contributes to the development of sustainable AI-driven multilingual communication systems for enterprise environments as well as low-resource linguistic communities.

Keywords: *Retrieval-Augmented Generation; Hypergraph Learning; Semantic Ambiguity, Augmentation; Diffusion*

Deepfake Image Detection Using Deep Learning: A Comprehensive Review

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Abstract

Deepfake technology is one of the fastest growing fields in the domain of artificial intelligence and deep learning. By creating highly realistic fabricated images, videos, and audio files, it has quickly found its application in fields such as entertainment, education and digital media. However, there is a dark side also. The rising misuse of deepfakes has created serious concerns worldwide regarding spread of misinformation, privacy violations, cybersecurity threats, and identity fraud. As deepfake generation techniques continue to improve, detecting fake content has become an important challenge.

This study reviews the recent developments in deepfake detection using deep learning. Various detection approaches like Convolutional Neural Networks (CNN), GAN-related techniques, autoencoder based approaches, and image forensics methods are studied and compared. Datasets play an important role in training of detection models. Therefore, some commonly used datasets like Celeb-DF, DFDC, Face Forensics++, are also examined.

Currently, existing detection models face several challenges. These include high computational costs and rapid improvements in the Deepfake generation technique itself.

To counter this, the paper outlines the areas where the future research can be made to improve the framework of detecting models in future. With the main aim of increasing the reliability, generalization and effectiveness of future detection models.

Keywords: *Deepfake Detection, Deep Learning, CNN, GAN, Autoencoder, Image Forensics.*

Smart Coatings for Smart Cities: Machine Learning-Guided Pollution Mitigation Materials

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Abstract

Machine learning (ML) is increasingly used to accelerate the design of functional materials for urban pollution mitigation. This review examines ML-based inverse-design methods for developing photocatalytic and adsorptive architectural coatings, with emphasis on their suitability for Indian smart cities. It summarizes the operating principles of TiO₂-based and hybrid oxide coatings and evaluates the use of surrogate models, conditional variational autoencoders, Bayesian optimization, and explainable ML for identifying high-performance formulations. Particular attention is given to Indian environmental conditions, including monsoon humidity, variable ultraviolet exposure, dust deposition, and mixed industrial and vehicular pollutants. The review also considers experimental validation, field performance, lifecycle cost, scalability, and integration with urban sensor networks. Current evidence indicates that ML-guided design can reduce experimental screening and improve coating efficiency and durability; however, standardized datasets, long-term field trials, and environmental-safety assessments remain necessary for reliable large-scale deployment.

Keywords: *smart coatings, machine learning, inverse design, photocatalysis, pollution mitigation, TiO₂, sustainable infrastructure, smart cities, India, materials informatics*

AI-Driven Smart Resource Allocation in Higher Education Institutions: A Predictive Optimization Framework

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Abstract

In this paper, one predictive optimisation using Artificial Intelligence (AI) smart resource allocation for the colleges is proposed. The Controlled Experiment utilized a representative synthetic set of data simulated to represent how classes could be used, which faculty are available, how much they are needed, waiting time, risk of conflict, attendance and maintenance restrictions, consisting of 5,760 observations across 40 operational fields. These techniques are combined in proposed pipeline where the pre-processing has been done using Structured technique, the demand has been predicted using RandomForestRegressor and the status of the allocation and priority scores of the demand has been assigned. The averaged waiting time (AWT) is reduced from 55.24min to 22.84min when compared to manual-first-come scenario, the conflict rate (CR) is significantly reduced from 16.91% to 1.42% and the prediction results of demand is 1.773MAE and 0.974R2. The result from that shows the resources of the College can be managed as an auditable decision making process, which is data-based and which could be physically restricted via approved college ERP and the Time-table.

Keywords: *Artificial Intelligence; Smart Resource Allocation; Higher Education; Predictive Optimization; College Management; Decision Support System.*

Liver Cirrhosis Prediction Using Random Forest and XGBoost

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Abstract

Liver cirrhosis is a chronic and life-threatening disease characterized by progressive liver damage. Early diagnosis remains challenging due to complex clinical parameters and inconsistent patient data. Traditional diagnostic methods rely on manual interpretation of biochemical tests, which may lead to delayed or inaccurate risk assessment. To address these limitations, this study proposes a machine learning-based liver cirrhosis prediction system using ensemble learning techniques. The proposed system utilizes the Indian Liver Patient Dataset (ILPD) and applies Random Forest and Extreme Gradient Boosting (XGBoost) algorithms for classification. Data preprocessing includes handling missing values, encoding categorical variables, and preparing clinical features such as bilirubin, SGPT, SGOT, albumin, and alkaline phosphatase levels. Experimental results show that XGBoost outperforms Random Forest, achieving an accuracy of approximately 65–70%, compared to 60–65% for Random Forest. Performance is evaluated using accuracy, precision, recall, and F1-score. Furthermore, a Streamlit-based web dashboard is developed for real-time prediction, visualization, and report generation, enhancing clinical decision support.

Keywords: *Liver Cirrhosis, XGBoost, Random Forest, Machine Learning, ILPD, Clinical Decision Support, Streamlit*

Advancing Deepfake Forensics: RESNET50-Powered Face-Swap Detection

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Abstract

The prolific generation of face swap deep fakes represents a major threat to digital authenticity. These highly advanced manipulations of digital media allow face swap manipulations of human identity within video media, which compromises personal privacy and public trust of multimedia evidence. In this context, a highly effective detection method using deep residual learning and the ResNet50 algorithm is presented. The proposed method is highly accurate and effective with the Deep Fake Detection DFD Entire Original Dataset, including compressed media, to ensure robustness under real-world conditions.

Experimental results demonstrate the effectiveness of the proposed approach, achieving an overall classification accuracy of 89%, with precision values of 0.85 and 0.93 for fake samples, resulting in F1 scores of 0.89 and 0.88, respectively. These results indicate that proposed ResNet50- based framework provides reliable and efficient deepfake detection, making it a promising solution for enhancing the security and authenticity of digital multimedia content.

Keywords: *Deepfake detection, face-swap, ResNet50, convolutional neural networks, deep residual learning, multimedia forensics, artificial intelligence, video manipulation, face extraction, deep learning.*

Multi-Agent Artificial Intelligence Framework for Intelligent Supply Chain and Logistics Network Optimization

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Abstract

Modern supply chain and logistics networks are increasingly complex due to globalization, dynamic demand patterns, and operational uncertainties. Traditional centralized optimization approaches often lack scalability and real-time adaptability. This paper proposes a Multi-Agent Artificial Intelligence (MAAI) framework for intelligent optimization of supply chain and logistics networks. The proposed system models key entities—suppliers, warehouses, transportation units, and distribution centers—as autonomous agents that collaborate through a decentralized communication mechanism. A Linear Regression-based demand prediction model is integrated to enable proactive decision-making. The framework dynamically optimizes routing, inventory allocation, and delivery scheduling. Simulation-based evaluation demonstrates significant improvements in delivery efficiency, transportation cost reduction, and overall system performance compared to traditional and existing AI-based approaches. The results highlight the effectiveness of multi-agent intelligent systems in building scalable, adaptive, and resilient supply chain infrastructures.

Keywords: *Artificial Intelligence, Multi-Agent System, Supply Chain Management, Logistics Networks, Intelligent Optimization*

Exploring Ensemble Neural Architectures for Accurate Sea Surface Temperature Forecasting

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Abstract

SST (Sea Surface Temperature) prediction lies in the domain of both physical oceanography and contemporary machine learning techniques and has significant implications for climate prediction, fishery forecasting, and detection of marine heatwaves. This review analyzes a new ensemble-based deep learning technique which utilizes anomaly pre-processing in conjunction with an LSTM model architecture, along with multi-step output forecasting and averaging multiple predictions made by different models in the ensemble. The RMSE reported in the paper decreased by 50%, achieving 0.24°C at a one-day lead time and 0.52°C at seven days compared to a dynamic baseline. We place these findings in the context of the existing literature on ML methods for SST prediction, tracking the progress from simple feed-forward neural networks all the way through the breakthroughs in deep learning. At the same time, we analyze alternative ML methods such as convolutional LSTMs, attention mechanisms, and physics-ML hybrids. Moreover, we review the key methodological decisions taken in this study (anomaly pre-processing, multi-input multiple-output prediction, and ensemble-based reduction of variance) and assess their merits and limitations.

Keywords: *Sea surface temperature; machine learning; LSTM; deep learning; ensemble methods; ocean forecasting; marine heatwave; anomaly preprocessing.*

Explainable AI (XAI) Techniques, Applications, And Open Challenges in Healthcare

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Abstract

Artificial Intelligence (AI) and Machine Learning (ML), especially deep learning, have vastly improved the accuracy of many areas of clinical medicine. Still, their black-box nature makes them difficult to trust and potentially violates regulatory policies. The nature of black-box deep learning is especially concerning for clinicians and patients where accountability for autonomous decisions is critical. Explainable Artificial Intelligence (XAI) is a field of research that attempts to design frameworks that help AI systems make decisions in a way that is transparent and interpretable. This paper reviews a large portion of the research conducted in the field of XAI, specifically in healthcare. The particular interest in this paper are techniques for interpreting the decisions made by deep learning, such as LIME and SHAP, which are discussed in the context of clinical decision support systems and medical diagnostics. There are many challenges still open for research, like trade-offs, and XAI design that helps fulfill regulatory policies, and we discuss the many aspects of research in the field of XAI that are most probable meant to improve the state of trade-off and design challenges.

Keywords: *Explainable AI, XAI, Healthcare, Interpretability, Machine Learning, Deep Learning, Clinical Decision Support, SHAP, LIME, Trust*

Hybrid Ensemble Learning for Sustainable Healthcare Decision Support: A VAM -STACKNET-4 Framework

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Abstract

Obesity is a major threat to human health, thus effective solutions far off conventional methods are required. This research presents an efficient framework for accurate obesity classification. VAM-StackNet-4, a hybrid ensemble approach has been proposed which combines Support Vector Machine (SVM), Extreme Gradient Boosting (XGB), Linear Discriminant Analysis (LDA) and Logistic Regression (LR) into a stacking model to optimize classification outcomes. Z-Score & Interquartile Range (IQR) techniques have been used for handling outliers followed by normalization and category encoding. To obtain effective parameter tuning Halving Grid Search has been used for hyperparameter optimization. The proposed model VAM-StackNet-4 ensemble outperformed individual base classifiers [SVM-92.90%, XGB-96.80%, LDA-89% and LR-89.71%] accuracy with an accuracy of 98.22%. The obtained results demonstrate that obesity classification can be enhanced by hybrid stacking in combination with efficient outlier treatment providing a viable strategy for healthcare decision support systems.

Keywords: *Obesity Classification Stacking Ensemble Learning, XGBoost, Support Vector Machine, Halving Grid Search Optimization, Logistic Regression*

Quantum Reinforcement Learning for Vehicle-To-Grid (V2G) Energy Management

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Abstract

Vehicle-to-Grid (V2G) technology enables Electric Vehicles (EVs) to exchange energy with the smart grid, allowing EV batteries to act as distributed energy storage systems. This paper proposes a Quantum Reinforcement Learning (QRL)-based V2G energy management framework for smart grid applications. The proposed system utilizes reinforcement learning for intelligent decisionmaking and incorporates quantum computing concepts to improve optimization efficiency and computational performance. Simulation results demonstrate that the proposed framework effectively reduces operational cost, improves energy efficiency, minimizes peak load demand, and enhances grid stability compared to conventional energy management methods.

Keywords: *Vehicle-to-Grid, Quantum Reinforcement Learning, Smart Grid, Electric Vehicles, Energy Management.*

Applying Machine Learning and Deep Learning Techniques for The Classification and Feature Extraction of Paintings

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Abstract

Deep Learning works on the concept of artificial Neural Network with multiple layers and so is known as the advanced extension of machine learning. Over the years, machine learning and deep learning techniques have been applied in various fields like medical imaging, supply chain, botanical studies, etc. for Classification and feature identification but very limited work has been done in the field of cultural heritage i. e. art and craft, through deep learning. This paper attempts to study and review the prospects of machine learning and deep learning techniques in the field of World Wide Visual Art Cultural Heritage and presents a comparative study of the algorithms being applied for the identification of art styles, classification of artworks and Feature identification of Indian folk artworks etc. This paper provides a perfect road map to the future researchers who want to use machine learning for the upliftment of cultural heritage. This paper also checks the strength of activation functions ReLU, GeLU and SeLU with five different deep learning architectures to classify the Indian miniature paintings of Mewar and Jaipur Schools over a custom made dataset.

Keywords: *Deep Learning, Machine Learning, Cultural heritage, Folk Art, Miniature Paintings*

Exploring AI-Based Chat Interfaces for Efficient Student Information Access

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Abstract

Now colleges have old bad systems. These systems are confusing. Students cannot get their study records fast. They also cannot get advice or help easily. This wastes time and staff work. So we need very simple screens and apps. These new things must be easy to use. But they must keep data safe. This study checks AI chat tools. We tested with many students. We read real chat records. We checked if talks are smooth. We checked if answers are correct. We checked if it works with old systems. AI chats are much better. Students can talk like normal. It is easy and fun to use. Less struggle to find things. But still some problems. Hard questions are not answered well. It does not work same for all students. Especially students without good internet. In short, AI chats are a good start. We need to make them even simpler. So every student can use them easily. And colleges can work better.

Keywords: *Administrative support, artificial intelligence, chat interfaces, large language models.*

LLM-Based Knowledge Distillation for Efficient Chatbots

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Abstract

Natural Language Processing (NLP) has been transformed by Large Language Models (LLMs) because to their remarkable performance on a wide range of tasks. However, they are not feasible for real-time applications due to their enormous processing requirements, particularly on devices with limited resources. In order to improve efficiency while addressing problems like data memory, this work investigates the integration of Knowledge Distillation (KD) with LLMs. We examined current developments and real-world applications, offering an organized study that included techniques, assessment, and applications. Despite advancements, problems with current methods include a lack of contextual richness and a lack of diversity in information. Our results demonstrate that distilled models are perfect for real-world conversational systems since they significantly reduce inference time and memory utilization without sacrificing accuracy.

Keywords: *Large Language Models (LLMs), Knowledge Distillation (KD), Efficient Chatbots, Model Compression, Natural Language Processing (NLP), Conversational AI, Lightweight Models, Edge Deployment*

Detect Dental Caries Detection

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Abstract

Tooth Dental caries is a common oral health problem, especially among children, and it often remains undetected until it becomes quite severe. This research presents a deep learning approach for automatically identifying dental caries using a custom-designed Convolutional Neural Network (CNN). By using intraoral images captured with smartphones from a carefully selected dataset, we developed a binary classifier that distinguishes between healthy and decayed teeth. To improve feature extraction, we applied techniques such as image pre-processing, enhancement, and histogram analysis. The model showed strong results in terms of accuracy, precision, and recall, highlighting the potential of AI to aid in the early detection of dental decay.

A Review on Machine Learning and Its Impact on Various Fields

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Abstract

Machine learning (ML) has come a long way from being a theoretical curiosity in computer science to a revolutionising technology in the real world. This review analyses the ten credible research articles to assess whether machine learning is a blessing or a curse for the humanity. The outcome of the synthesis demonstrates that ML is a double-edged sword which should be used ethically. On the one hand, it is a blessing for cybersecurity, education, and accelerating scientific discoveries via physics-informed machine learning. On the other hand, ML poses a threat to employment because of automation in various industries, data privacy, and discrimination through statistical biasing. The review concludes that although there are perilous risks, they could be mitigated through unified frameworks and XAI-compatible algorithms and reinforced by institutional governance

Keywords: *Machine Learning, Automation, Job Displacement, Data Privacy, Algorithmic Bias, Cybersecurity, Scientific Machine Learning.*

Machine Learning-Assisted Optimization of 3D Printing Parameters for a Universal Adjustable Orthopedic Cast

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Abstract

This paper describes the design, fused deposition modeling fabrication, testing, and optimization of a universal adjustable orthopedic cast made of polylactic acid. The three factors investigated through a face-centered central composite design, including 20 experiments, include nozzle temperature (200-230°C), printing orientation (0-90°), and layer thickness (0.15-0.35 mm). The four responses recorded in each experiment include the ultimate tensile strength, impact strength, manufacturing time, and material mass. A feed-forward artificial neural network with backpropagation training methodology is trained, validated, and tested using the experimental data to model the four responses, and the trained network is employed as the fitness function in a genetic algorithm formulated as multi-objective optimization based on desirability functions. The optimal values of the three factors obtained using GA were validated experimentally with percentage errors within the engineering acceptability range. This study confirms the engineering viability of the suggested cast.

Keywords: *Response surface methodology, artificial neural network, genetic algorithm, multi-objective optimization, mechanical properties.*

MBDiff-AttNet: A Multi-Branch Diffusion-Attention Network with Counterfactual Saliency Fusion for Interpretable Parkinson's Disease Detection from Neuroimaging

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Abstract

Parkinson's disease affects more than ten million people, yet a fifth to a quarter of early referrals are still assigned the wrong diagnosis because the imaging signature at that stage is faint and diffuse. Reported accuracies above 97 per cent are common on public cohorts, but many survive only while slices from one participant sit on both sides of the split, and the saliency maps offered as justification localise poorly. This paper introduces MBDiff-AttNet, a framework in which a patch-wise multi-scale convolutional encoder, a pixel-wise fully convolutional branch with atrous spatial pyramid pooling, and an adversarial counterfactual attention branch that needs no manually drawn region masks are combined by a denoising-diffusion refinement stage before a gradient-boosted decision head. Every split is subject-disjoint. On the PPMI PD-versus-control task (1,290 of 1,516 participants) the framework reaches 97.83 per cent accuracy, 98.04 per cent sensitivity, 97.39 per cent specificity and an area under the receiver operating characteristic curve of 0.9913; NTUA (78) and NEUROCON (43) give 96.15 and 93.02 per cent. Transferred without fine-tuning, the PPMI-trained model retains 89.74 per cent on NTUA and 86.05 per cent on NEUROCON. Diffusion refinement contributes 1.08 points over channel concatenation, and counterfactual attention localises dopaminergic structures at 87.34 per cent Pointing Game accuracy against 82.51 per cent for the strongest gradient-based alternative.

Keywords: *Parkinson's disease, diffusion models, counterfactual attention, interpretable deep learning, neuroimaging, crosscohort validation, medical image classification*

Emergent Paradigms in Generative Language Modeling: A Systematic Survey

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Abstract

In the modern era, technologies such as Generative Artificial Intelligence (Generative AI) and Large Language Models (LLMs) have significantly enhanced human-computer interactions making tasks simplified and yielding higher efficiency. The term Generative AI refers to a type of artificial intelligence system that is capable of generating original content in the form of text, images, audios, videos and code while LLMs are artificial intelligence systems trained on large-scale text datasets that can understand and generate human-like responses. Recent advancements in Transformer-based architecture, attention mechanisms, large-scale pretraining, instruction tuning, knowledge augmentation and multimodality have led to improvement in contextual understanding, in-depth reasoning and improved content generation capabilities. These technological advancements have expanded the applications of Generative AI and LLMs across several domains, including medical assistance, education, software development and scientific research. However, they still continue to face challenges such as hallucination, bias, privacy and safety issues, high computational cost and lack of reliable information. This review particularly focuses on RAG(Retrieval Augmented Generation), Parameter-Efficient Fine-Tuning(PEFT), Multimodal Large Language Models(MLLMs), Small Language Models(SLMs) and autonomous agents. Additionally, the research examines their applications, limitations and future directions.

Keywords: *Generative AI, LLMs, Foundation Models, Transformers, Instruction Tuning, PEFT, RAG, Multimodal LLMs, SLMs, Hallucination*

Performance Evaluation of Hybrid ECC–Crystals-Kyber Key Exchange for Quantum-Secure IOT Environments

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Abstract

In the era of large-scale quantum computers, such new quantum technologies as the quantum bit (qubit) opens up a new danger for public-key cryptosystems (PKC) including Rivest-Shamir-Adleman (RSA) and Elliptic Curve Cryptography (ECC). These resource-constrained Internet of Things (IoT) devices are highly vulnerable to intercept-now-decrypt-later attacks, which are designed to capture the data as it moves through the network. Lattice-based Post-Quantum Cryptography (PQC) is quantum resistant and the NIST standardized CRYSTALS-Kyber is being adopted; however, PQC requires heavy computational and communication burdens for lightweight hardware. This paper proposes and discusses a simplified hybrid cryptographic framework allowing to run an Elliptic Curve Diffie-Hellman Ephemeral (ECDHE) protocol concurrently with a CRYSTALS-Kyber-512 Key Encapsulation Mechanism (KEM), to cover this security transition. Our hybrid construction which is implemented through Open Quantum Safe (liboqs) library and tested on an ARM Cortex-M4 microcontroller and an edge-gateway illustrates total connection time of less than 10ms. The empirical findings strongly suggest that this dual-layer design ensures strong security barriers against classical and quantum attackers while maintaining an acceptable operational complexity, offering a promising path forward for transitioning legacy IoT architectures to post-quantum security.

Keywords: *Post-Quantum Cryptography, CRYSTALS-Kyber, Hybrid Cryptography, Internet of Things, Quantum Security, Performance Assessment.*

An AI-Driven Zero-Trust Security Framework for Smart Environments

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Abstract

This work addresses the security challenges of smart environments, such as IoT enabled homes, campuses, healthcare systems, and industrial infrastructure, which rely on a large number of heterogeneous, interconnected devices. While these systems enhance automation and performance, they increase the attack surface as a result of dynamic network response, resource-constrained devices, and poorly defined limits of trust. The conventional perimeter-based security models fail once a competitor gets initial access. ZTA advocates for ongoing verification and least-privilege access, but its classic implementation relies on static policies that cannot adapt to the evolution of risks. The proposed AI-driven Zero-Trust security framework allows a smart eco-system to continuously assess trust and flexibly control access. This framework combines behavioural analysis techniques such as Extreme Gradient Boosting (XGBoost) and Random Forest with Zero-Trust principles to generate trust scores, which are dynamic and change over time based on the user and tool. The trials are conducted with the datasets CIC-IDS2017 and UNSWNB15 and the results demonstrate that it is possible to achieve a greater level of detection (97.8% precision rate and a lower false-positive rate of 2.1%) than static Zero-Trust and perimeter-based approaches.

Keywords: *Zero-Trust Architecture, Artificial Intelligence, Smart Surroundings, Network Security, Machine Learning, IoT Security*

An Enhanced Intrusion Detection System Based on Dilated CNN, Bidirectional GRU and Multi-Head Attention for Network Security

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Abstract

NIDS struggle with class imbalance, high-dimensional feature spaces, and the inability of single-component models to jointly capture spatial and temporal attack patterns. This study proposes a hybrid deep learning architecture to overcome these limitations. The model integrates Dilated Convolutional Neural Networks (DCNN) arranged in a DenseNet-like block formation, enhanced with Squeeze-and-Excitation attention, Bidirectional Gated Recurrent Units (BiGRU), and stacked Multi-Head Attention (MHA) for multi-class intrusion detection. Experiments are conducted on the UNSW-NB15 benchmark dataset across six network traffic categories. Preprocessing includes rare class removal, a two-stage balancing strategy combining Normal class downsampling, majority class undersampling, and Gaussian noise augmentation for minority classes, and feature engineering that expands the input space to 84 features, with data partitioned using an 80:10:10 stratified split. The model records a test accuracy of 98.00%, validation accuracy of 98.12%, weighted F1-score of 0.982, and AUC-ROC of 0.9996. Normal traffic is classified with 100% precision. Results confirm that the proposed architecture outperforms existing binary and multi-class baselines, demonstrating strong generalization and practical applicability in real-world network security environments.

Keywords: *Network Intrusion Detection System, Dilated Convolutional Neural Network, Bidirectional Gated Recurrent Unit, Multi-Head Attention, Class Imbalance, Feature Engineering, Hybrid Deep Learning.*

The Transparent Ledger — Revolutionizing Charitable Donations Through Blockchain

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Abstract

Traditional charitable donation systems suffer from opaque financial reporting, delayed audits, and donor mistrust, with 1 out of 5 individuals reporting fraud concerns. This paper proposes a blockchain-based donation framework for non-profit organizations (NGOs) that integrates six tightly coupled components: (1) Ethereum multi-signature joint accounts with 2-of-3 cryptographic approval ensuring shared, tamper-proof fund control [1, 4]; (2) a Convolutional Neural Network (CNN) signature authentication engine achieving 98.36% accuracy, augmented by Tesseract OCR-based bill validation [12, 13, 14]; (3) a novel NGO credibility scoring system driven by XGBoost and blockchain-verified expenditure data, enabling donors to assess NGO trustworthiness through verifiable virtual-point accumulation [17, 18]; (4) a universal QR code cryptocurrency payment gateway on the Aptos blockchain supporting BTC, ETH, and USDC with real-time fiat conversion [8]; (5) IPFS decentralized storage with SHA-256/SHA-3 cryptographic hashing for tamper-proof record keeping [9, 16]; and (6) Grok API-powered analytics for anomaly detection and predictive fund-allocation insights [7]. An 18-month pilot reduced audit times by 94.7%, eliminated fraud, increased donation volumes by 42%, and achieved transaction processing at 2.1 s versus 8.2 s in conventional systems [17, 19]. The proposed framework solves long-standing problems with NGO accountability and is a scalable, future-ready solution for the nonprofit sector.

Keywords: *Blockchain, Smart Contracts, Multi-Signature Accounts, IPFS, CNN Signature Verification.*

A Comparative AI Framework for Malware Detection Using Wireshark-Derived Packet Analysis

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Abstract

Wireshark is a software tool that helps to capture and analyze network traffic. With modern vulnerabilities of networks for malware, including polymorphic malware, and the emergence of new forms of malware attacks, traditional signature-based detection approaches cannot detect new malware. Thus, there is an evident need for malware detection mechanisms based on the detection of traffic patterns in the network. In this study, we offer a framework for comparative analysis of different machine learning techniques to detect network-based malware through the analysis of traffic captured by Wireshark. Network traffic patterns are examined in terms of the packet size, flow duration, and time intervals between packets. Later, the obtained information is utilized for training machine learning algorithms such as Random Forest, XGBoost, Support Vector Machine, and Naïve Bayes to test their ability to detect network traffic patterns while being efficient and using little computational power. Thus, the proposed framework offers a solution that is efficient for people who work in cybersecurity, network administrators, and researchers who want to improve network security by automatically detecting malware and analyzing threats with data. An experimental evaluation shows the effectiveness of the proposed framework in detecting malicious and benign traffic within the network.

Keywords: *Malware Detection, Machine Learning, Comparative Analysis, Wireshark, Network Flow Features, Network Traffic Analysis, XGBoost, Random Forest, Cybersecurity, Intrusion Detection System.*

A Practical Analysis of AI-Augmented Cyber Risk in Context of Competitive Intelligence

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Abstract:

The rapid expansion of generative artificial intelligence, autonomous agent frameworks, and large-scale language models has brought about a fundamental shift in the global threat landscape. Recent data from early 2026 indicates that cyberattacks amplified by AI have risen by roughly 89% year-over-year, while synthetic media files in active circulation have reached approximately 8 million. In one documented incident, a single agent compromise within a sales automation platform expanded laterally across more than seven hundred enterprise organisations. This paper advances six contributions: (1) the Adversarial AI Lifecycle (AAL), an original eight-phase taxonomy enumerating thirty-seven distinct AI-augmented attack techniques, distinguished from prior kill-chain models by its treatment of AI supply-chain compromise and agentic autonomy exploitation as independent attack phases; (2) a graph-theoretic multi-agent propagation model; (3) a granular examination of twelve AI attack categories; (4) empirical analysis of eight documented AI security incidents from 2024 through 2026; (5) a systematic mapping of all ten OWASP 2026 Agentic AI risks (ASI01-ASI10) onto the proposed taxonomy; and (6) a gap analysis of recent literature identifying three structural limitations and research directions.

Keywords: *Artificial Intelligence, Cybersecurity, LLM Security, Prompt Injection, Jailbreaking, Data Poisoning, Agentic AI, Adversarial Attacks, Malware Generation, Deepfakes, OWASP Agentic AI Top 10*

Recent Advances in Terahertz Microstrip Antennas: A Critical Review of Design Evolution, Performance Enhancement Techniques and Future Perspectives

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Abstract

With the advancement in wireless networks such as sixth generation (6G), terahertz (THz) communication has emerged as a main enabling technology because of its capability to provide ultra-high data rates, huge connectivity and improved sensing functionalities. Among different antenna configurations, microstrip antennas have attracted considerable attention due to their compact size, low profile, simple integration and compatibility with monolithic fabrication processes. Although considerable progress has been made, the practical implementation of efficient THz microstrip antennas is still difficult, as conductor losses, surface-wave effects, limited bandwidth and even minor fabrication inaccuracies can significantly affect their performance.

In this paper, recent advances in THz microstrip antennas are reviewed with special attention to the evolution of antenna structures, methods used for performance enhancement and possible directions for future research. Earlier reviews mainly addressed THz antennas as a whole. However, in this paper we have focused on microstrip based THz antennas because of their importance in future communication systems. Different designs reported over the years, including double T-slot antennas, dual-band patches, slotted rectangular structures, stacked antennas and array configurations, are reviewed and compared in terms of their performance and design characteristics. This paper also includes recent studies published on topics such as photonic band gap (PBG) structures, graphene assisted antennas and high gain THz array designs to highlight the recent trends in this research area.

From the reviewed literature, it can be observed that single-element THz antennas usually achieve gains between 4 and 8 dBi, while using antenna arrays much higher gains can be achieved, sometimes exceeding 18 dBi. Recent work has also shown growing interest in graphene based reconfigurable antennas and the use of artificial intelligence for antenna optimization. The information presented in this review may assist researchers in developing compact and high-performance THz antennas for emerging 6G communication networks.

Keywords: *Terahertz antennas, Microstrip patch antenna, 6G communications, Graphene, Photonic band gap (PBG), Defected groundstructure (DGS), THz arrays.*

Investigating Quantum Computing as A Paradigm Shift in Information Processing

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Abstract

Quantum computing is an ideal of change in information processing, countering the problematic characteristics of classical systems to deal with exponentially complicated problems, including optimisation, simulation, and cryptography. The inherent limitations of traditional von Neumann architecture using sequential and bit-based computations face challenges in satisfying the computational needs of big data and complex molecular simulations to support the development of applications in areas such as drug development and climate change prediction. This exploration utilizes a complex approach that is a combination of the theoretical examination of the quantum principles, such as superposition and entanglement, as well as case studies of the landmark algorithms, and assessments of the existing hardware prototypes. The study presents the departure of quantum architectures to probabilistic, massively parallel computation through the systematic literature review and conceptual modelling, as opposed to deterministic processing. The most notable discoveries encompass the ability of quantum systems in redefining the nature of the information encoding and manipulation, making it possible to achieve unprecedented efficiency in recognizing and communicating patterns and in developing improved and secure methods of communication, besides exposing flaws in the old encryption techniques. After all, quantum computing opens up a new paradigm, which requires a reassessment of the basis of computationalism and encourages innovation across the board to realize the radical potential of quantum computing in the context of sustainable and scalable information ecosystems.

Keywords: *Big data, cryptography, entanglement, sustainable, quantum computing.*

Design and Evaluation of an Adaptive Browser Automation Framework for Intelligent Web Task Automation

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Abstract

Repetitive browser-based tasks on social media platforms, enterprise applications, cloud services, and other web systems often require considerable manual work and maybe its leads to execution delays and human error. This paperproposes an adaptive browser automation framework (ABAF) developed to minimize such effort by automate repetitive web interactions in dynamic browser environment. ABAF follows a modular architecture that having browser control, session and auth management, task execution, adaptive UI handling, exception recovery, logging and monitoring, and performance analysis.

The ABAF was developed using Python and Selenium WebDriver and evaluatedwith a practical case study on the management of pending follow requests on Instagram.

The evaluation in terms of task completion time, success rate, user efforts, and execution consistency. Although the prototype was evaluated on Instagram, its modular structure provides a basis for adapting the approach to other browser-based applications with some minimal modification. The framework also presents a path where future development may incorporate AI-based task planning, interface understanding, and autonomous web interaction to further improve adaptability.

Keywords: *Browser automation, Adaptive web automation, Selenium WebDriver, Web automation framework, ABAF, Dynamic user interface, Task automation, Intelligent browser automation.*

From Farm to Fork: A Blockchain-Enabled Framework for Secure Grain Supply Chain

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Abstract

The grain distribution landscape in many developing economies is characterized by systemic inefficiencies, vulnerability to adulteration, and inadequate mechanisms for end-to-end traceability. To address these challenges, this study introduces a blockchain-enabled framework that strengthens transparency, enhances provenance verification, and ensures the integrity of the grain supply chain. The proposed architecture synergistically integrates smart contracts with Internet of Things (IoT) sensor networks to enable continuous, tamper-evident monitoring of grain movement from production to consumption. Core functionalities—such as automated inventory management, payment authentication, and origin certification—are executed within a decentralized ledger environment, thereby minimizing human intervention, mitigating fraud, and optimizing logistical efficiency. The modular system design incorporates identity management protocols, real-time condition and location tracking, and advanced analytics for operational insights. A review of recent technological deployments and case studies underscores the transformative role of blockchain in modernizing agricultural logistics and advancing global food security imperatives.

Keywords: *Blockchain, Grain Supply Chain, Smart Contracts, Traceability, IoT, Provenance, Agricultural Logistics, Hyperledger, Food Safety.*

Green Computing Under VM Migration: An Energy Efficiency Optimization of Data Centres

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Abstract

The term green computing is a requiring value in terms of computing environment to reduce carbon emission. Now days the data centre's are the main requirement because of broadly uses of computing resources and data availability. Although cloud computing services are are very readily accessible, one of the main problems is energy usage and this is increased day by day as requirement increased so that we have a concept to resolve this issue is create green environment where we are mainly focused on to reduce carbon emission by reducing power consumption. This paper's primary goal is to create a green computing environment by reducing the energy consumption of cloud resources through a particular method of determining the amount of computing resources needed to compute cloud services. In which servers are categorised in six states like overloaded, underloaded, loaded, moderate, very underloaded, and idle/free. In which if any server have very few resources called very underloaded is switch off and if any have no resource then is also switch off. Here the transfer of resources between very overloaded to underloaded servers but if both servers are fully loaded then we can transfer data for process at new server. By determining the real resources that are accessible, the suggested method aids in converting cloud computing to green computing.

Keywords: *Green Computing, Energy consumption, Energy efficiency, Sleepmode, very underloaded servers.*

Realistic Urban Mobility Modeling for VANET Simulation: A SUMO-OSM Integrated Framework for NS3

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Abstract:

Vehicular Ad-hoc Network is the base for Intelligence Transport System (ITS). VANET enables Vehicles to Vehicles (V2V), Vehicle to Infrastructure(V2I) communication and plays a vital role for urbanization. The performance of VANET Routing Protocol is highly dependent on mobility model used during simulation. This paper proposes a SUMO-OSM integrated framework for NS3 which shows a realistic VANET simulation by using Gurgaon city road topology. Gurgaon map data is then processed through SUMO that generate mobility traces, that then used in vanet-routing-compare file. The framework is then evaluated for all scenarios across AODV, DSDV, OLSR and DSR (routing protocols) using IEEE 802.11p (WAVE) standard. The performance is measured through metrics like BSM - PDR, Goodput & MAC/PHY Overhead. Results show performance variation for different routing protocols for all scenarios, that demonstrates how realistic vehicle movements affects VANET routing. The proposed research can be used for region specific VANET studies and supports future Indian Smart City transportation.

Keywords: *VANET, NS3, SUMO, OSM, Routing Protocol, IEEE 802.11p*

Multi-Metric Performance Analysis of SDN Controllers in Dynamic MININET-Based Network

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Abstract

Software defined networking (SDN) provides the flexible and programmable networking architecture which disaggregates the control plane from data plane and enabling the centralized management, improved the traffic control. The performance of SDN controllers plays a critical role to determine the reliability and efficiency of the network. This work presents the comparative analysis of different SDN controllers namely POX, Ryu and OpenDaylight using Mininet emulator. The experimental setup consists the multiple OpenFlow switches and hosts configured under dynamic network conditions for simulating realistic network environment. The key parameters such as latency, throughput and packet loss measured under the different network loads for finding the efficiency of controllers. This study finds that Ryu performs well and provides low latency and high throughput among evaluated controllers. This work provides the insights for selecting suitable controller on the basis of efficiency and traffic management.

Keywords: *Software defined networking, SDN Controllers, POX, RYU, Opendaylight Network Emulation, Performance Evaluation, Latency, Throughput, Mininet*

Simulation of Wideband Micro-Strip Patch Antenna for 5G Communication in 28 Ghz Band

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Abstract

This paper titled “The simulation of wideband micro-strip patch antenna for 5G communication in 28 GHz band” is proposed as a solution to the high-band 5G standard. It supports ultra-low latency and ultra-fast bandwidth in the autonomous system of 5G wireless communication networks. This low-profile antenna of dimensions $4.24 \times 2.45 \text{ mm}^2$ is placed on a Rogers RT/duroid 5880 (tm) substrate with dielectric constant = 2.2 and loss tangent of 0.009. This proposed front-end device having operating frequency from 27.5 GHz to 31 GHz with a percentage bandwidth of 11.96% and VSWR of around 1.6. This antenna is perfectly resonating at 29 GHz with 14 dB return loss and a cross-polarization of -32 dB. This antenna is suitable for dense urban infrastructure for high-speed communication. Due to its mm-wave band of operation, it has inherent limitations, including a limited coverage range and high sensitivity to environmental effects, which lead to dispersion and fading. Further, this antenna will be integrated into an array format for multiple-input, multiple-output based communication.

Keywords: 5G Antenna, wideband antenna, patch antenna, autonomous system.

A LORA-Based Offline Communication Device for Network-Independent Emergency and Remote Messaging

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Abstract

Communication becomes difficult during disasters and in remote areas where mobile networks and internet services are not available. This work presents an offline communication device that allows users to exchange text messages without depending on cellular networks, Wi-Fi, or the internet. The device uses LoRa technology for long-range wireless communication and is connected to Mobile through a OTG connection. A mobile application is used to send and receive messages, while the microcontroller and LoRa module handle the messages between the two devices. If one device has internet access, it can forward a message received through LoRa to a recipient through WhatsApp. The developed prototype provides a low-cost and portable approach for communication in situations where normal network services are unavailable or limited. This can be useful in disaster situations, rural areas, outdoor activities, and other locations with poor network connectivity.

Keywords: *Offline connection, LoRa technology, offline messaging.*

Study and Analysis of Cosmic Inflation by Using Variation Based Quantum Algorithm

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Abstract

According to the theory of cosmic inflation, the early universe expanded very fast. Simulating those quantum fields is extremely difficult due to the requirement of high computational power. Quantum computing is a growing technology that solves complex problems using the laws of quantum physics. In this paper, we have used qubits in quantum computing to simulate the physical states of a quantum system. A software toolkit known as "QuantumCosmosis" is being developed to transform cosmological scalar fields, such as cosmic inflation, into quantum circuits. Algorithms like Variation Quantum Eigen solver (VQE) and time evolution through Trotterization in IBM's Qiskit platform enabled us to simulate the generation of particles and changes in energy in an expanding universe. We demonstrate the model on current quantum devices, showing that quantum computing can effectively bridge the gap between theoretical cosmology and scalable numerical simulation.

Keywords: *Quantum Computing, Cosmic Inflation, Qubit, Theoretical Cosmology*

YOLOv8n-Based Foreign Object Debris Detection for UAV-Assisted Intelligent Surveillance

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Abstract

Foreign Object Debris (FOD) in operational areas is a significant safety concern as objects such as metal objects, wires, screws, tools, batteries, and other unwanted objects can damage equipment or disrupt normal operations. Labour intensive, time consuming, and inconsistent monitoring of the process of the continuous manual inspection. In this research, the authors pro-posed an automatic framework for detecting FODs, which was based on the deep-learning based detector YOLOv8. The model has been trained using 33,793 annotated images from 31 categories of foreign objects. YOLOv8n is a much smaller model variant of YOLOv8, and XML annotations are converted to YOLO format for training for 10 epochs. The F1 score, recall, precision, mAP@0.5, mAP@0.5:0.95, and confusion matrix measures are used for experimental assessment. On the test set, the model achieves a recall of 0.9898, F1-score of 0.9870, precision of 0.9842, mAP@0.5 of 0.9899, and mAP@0.5:0.95 of 0.8817. The findings demonstrate a compact architecture's capability to achieve reliable FOD detection and its applicability for edge deployment with real-time surveillance. The reported mAP@0.5 is comparable to and in some instances superior to other recent FOD studies, which exist on the lightweight side. The framework can be extended to other intelligent-surveillance applications, industrial inspection and UAV-based monitoring, infrastructure safety and others.

Keywords: *Foreign object debris, YOLOv8n, UAV surveillance, deep learning, edge deployment.*

AI-Driven Skill Exchange Platform with Predictive Learning Analytics and Intelligent Matching System

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Abstract

Peer-to-peer-learning platforms typically rely on keyword matching and manual scheduling of sessions, therefore, they do not provide personalized and predictive insights. This paper discusses an AI-based Skill Exchange Platform that uses natural language processing (NLP), similarity matching algorithms, ranking algorithms, and supervised machine learning (ML) models to create optimized mentor/learner pairings and predict learning outcomes. TF-IDF vectorization is used to transform the skill descriptions into numeric representations, and then, cosine similarity is used to identify semantically similar learners and mentors. In addition, there is a mentor weighting system that ranks the mentors according to the similarity score, mentor performance ratings, previous session schedule history, and the degree to which they are responsive to sign requests. Furthermore, Logistic Regression, Decision Trees, and Random Forest algorithms are used as supervised learning models to predict the success of sessions and the engagement level of learners. Using a set of data about platform activity, experimental results demonstrate an increase in the accuracy of mentor recommendations and predictive capabilities of 85%-92%. The proposed Skill Exchange System will enable the transformation of conventional peer-learning platforms into adaptive and data driven academic systems.

Keywords: *Artificial Intelligence, Peer-to-Peer-Learning, Skill Exchange Platform, Machine Learning, TF-IDF Vectorization, Cosine Similarity, Recommendation System, Predictive Learning Analytics, Random Forest, Educational Data Mining*

Human-Computer Interaction in AI-Based Animal Welfare Monitoring Systems: A Review

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Abstract

The advent of intelligent sensing frameworks, machine learning techniques, and human-computer interaction (HCI) methods has created novel opportunities for monitoring and enhancing the well-being of animals in agriculture, ecology, and household environments. In this paper, we provide an extensive survey of contemporary research on this topic, exploring the combination of intelligent sensing, machine learning, and HCI principles for the design of intelligent animal monitoring systems that effectively contribute to the well-being of both the users and the animals being monitored. We review the progress from first-generation sensor-based systems to the emergence of deep learning animal monitoring solutions, consider the factors affecting the usability of such systems by exploring relevant HCI principles, and discuss the extensions of the field related to affective computing – attempting to understand the emotional state of monitored animals. At the same time, we will highlight several problems and challenges involved in such research, including issues related to deploying animal monitoring solutions in the rural areas, privacy aspects, design ethics, and inclusive design – ensuring that monitoring systems can be used by less digitally literate persons.

Keywords: *animal welfare, human-computer interaction, artificial intelligence, Internet of Things, precision livestock farming, affective computing, deep learning user-centred design, sustainable monitoring*

AI-Based Crop Recommendation for Farmers

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Abstract

Precision agriculture increasingly depends on data-driven decision support to match crop selection with local soil and weather conditions. This study develops and compares an artificial-intelligence-based crop recommendation framework using seven agronomic variables: nitrogen, phosphorus, potassium, soil pH, temperature, humidity, and rainfall. Classical machine-learning approaches are evaluated alongside deep-learning models, with particular attention to Random Forest, Logistic Regression, Long Short-Term Memory (LSTM), and TabNet. TabNet is included because its sequential attention mechanism is designed for structured data and can expose the variables that contribute to a prediction. Experimental observations on the crop recommendation dataset indicate that ensemble learning is especially effective for this static tabular problem, while TabNet provides a useful compromise between predictive capability and interpretability. The framework is also suitable for extension to sensor-driven and mobile advisory environments, where soil and climatic measurements can be collected continuously and converted into practical crop recommendations.

Keywords: *precision agriculture, crop recommendation, artificial intelligence, machine learning, deep learning, TabNet, LSTM, Random Forest, decision support system, soil nutrients, climatic variables, IoT, tabular data, attention mechanism.*

Kinematics Analysis and Trajectory Planning of ABB IRB2600 Robot

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Abstract

This paper presents the kinematics analysis of the ABB IRB 2600 robot. In the advancement of industry 4.0, the robot is widely used for flexible manufacturing systems, smart production and automated industrial services. Kinematics analysis is employed to interpret the robot's position, orientation and conversion from joint parameters to end effector coordinates and vice versa. It is essential for trajectory planning, which maps the motion paths for smart manufacturing systems like welding, assembly, etc. and to defines the workspace limits, improve production efficiency and singularities. Singularity is a configuration in which the robot loses one or more degrees of freedom, leads to unpredictable motion. Without kinematic analysis, a robot may fail to achieve accurate positioning and may experiences vibrations or jerky joint motion, resulting in discontinuous trajectories. The main objective of this work to achieve jerk-free joint motion by maintaining constant joint acceleration, linear joint velocity for reliable industrial operations. The Denavit-Hartenberg technique is used to perform the kinematics analysis. The obtained results of kinematics analysis are further utilized to determine joint velocity, joint acceleration and jerk with the successive time derivatives, this helps to achieve minimize jerk, avoid singularity, enhance operational efficiency and determine the effective workspace limits. This study of trajectory planning supports the sustainable and industry 4.0 driven production with minimizing the environmental impact and improved sustainable manufacturing practices in various operation with virtual simulated workplace such as MATLAB, validates the results with RoboAnalyzer and visualizes them in the ABB RobotStudio environment.

Keywords: *ABB IRB 2600 Robot, Forward Kinematics, Inverse Kinematics, RoboAnalyzer, MATLAB, ABB RobotStudio.*

Innovation in Education: Bridging the Gap Between Classroom and Technology

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Abstract

The world needs people who can use their critical and creative thinking abilities to work as a team to solve problems today and in the future. Technology has totally changed and modified the ways in which knowledge is created, acquired, and shared. It is debatable whether education can produce critical and imaginative thinkers who can meet the demands of the social and economic environments of the present and the future. They undermine instructors' authority in the classroom because of which phrases like "guide," "facilitator," or "coach" have begun to have the same meaning as "teacher." Daily technological gadget advancements have surpassed research in education and pedagogical approaches integrating educational technologies in education quickly. Educational, scientific and technological, pedagogical, economic, social, legal, administrative, and other innovations are all considered forms of innovation in education. Higher education institutions that have opted for innovation-based development have emerged as market leaders in the field of education.

Keywords: *Education, innovation, technology, pedagogy, models, generative AI*

Building an E-Commerce Clothing Website

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Abstract

Because of our reliance on online buying, platforms that provide safe, efficient, and personalized shopping experiences are essential. However, many current systems struggle with responsive design, secure payment, and real-time data management—all necessary for reliable transactions and seamless user interaction. This study provides a dynamic e-commerce infrastructure that combines robust payment gateways, intuitive user interfaces, and comprehensive customer, product, and transaction management to address these problems. The system makes use of modern web technologies and development frameworks to offer a scalable, secure, and user-focused platform. It also integrates analytically driven features like real-time order tracking, cart tracking, and personalized product recommendations, providing a way to improve the effectiveness and usability of online retail services.

Keywords: *E-commerce Platform, Web Development, Secure Transactions, Responsive Design, Personalized User Experience, RealTime Analytics*

An AI Energy Grid Nexus: A Systematic Review of Data-Centre Power Consumption, Infrastructure Constraints, and Inference Efficiency

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Abstract

The rapid deployment of artificial intelligence (AI), particularly large language models (LLMs) and generative AI systems, is transforming data centres from relatively predictable computing facilities into highly concentrated and dynamic electricity loads. This paper presents a systematic literature review synthesizing 25 peer-reviewed and archival research works published between 2020 and 2026 on AI inference efficiency, model compression, GPU and workload scheduling, carbon-aware computing, electricity-demand estimation, data-centre/grid interaction, power-quality and stability risk, and hierarchical energy-storage solutions. The evidence indicates that AI-driven electricity demand is governed by three coupled dimensions: how much energy AI computation requires, when and where that electricity is consumed, and how rapidly the associated load changes. Algorithmic techniques such as quantization, pruning, distillation, speculative decoding, and memory-efficient serving reduce computation and energy per request, while carbon- and grid-aware scheduling shift flexible workloads toward lower-carbon or less-constrained periods. At the infrastructure level, efficient cooling, dynamic voltage and frequency scaling, demand response, on-site generation, and hierarchical energy storage reduce peak demand and improve resilience. A structured taxonomy is proposed that maps optimization techniques onto five interacting layers — model/data, serving system, facility, grid interface, and storage and a quantitative synthesis of reported energy-reduction ranges is presented. The review identifies a persistent research gap: the absence of end-to-end validation that jointly measures model accuracy, latency, energy per query, power usage effectiveness (PUE), carbon intensity, grid behaviour, storage state-of-charge, degradation, and reliability under a common workload. An integrated cross-layer research framework and a multi-objective optimization formulation are proposed as a roadmap toward sustainable, grid-compatible AI infrastructure.

Keywords: *AI inference efficiency; data-centre energy consumption; electricity demand; grid stability; carbon-aware computing; power usage effectiveness (PUE); battery energy storage systems (BESS); workload scheduling; large language model serving; sustainable computing.*

A Compact and Explainable Machine Learning Framework for Breast Cancer Classification Using Metabolic Biomarkers

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Abstract

Breast cancer classification increasingly benefits from computational methods capable of combining routine clinical and biochemical measurements. However, predictive performance obtained from small medical datasets can be highly sensitive to sampling, preprocessing, and model-selection decisions. This study presents a compact, explainability-oriented machine learning framework for breast cancer classification using the Breast Cancer Coimbra dataset. The dataset contains 116 observations, comprising 64 breast cancer cases and 52 healthy controls, described by nine quantitative variables: age, body mass index (BMI), glucose, insulin, HOMA, leptin, adiponectin, resistin, and MCP-1. Logistic Regression, Support Vector Machine (SVM), Random Forest (RF), and XGBoost were evaluated under stratified 10-fold cross-validation. SVM, RF, and XGBoost were additionally combined through equal-weight probability averaging. A tree-based ranking identified glucose, BMI, resistin, age, and HOMA as the five most influential variables. With all nine variables, the hybrid ensemble obtained mean accuracy of $74.39\% \pm 17.35\%$ and mean ROC-AUC of $81.87\% \pm 17.92\%$. Using the five-feature subset, the ensemble improved to $80.45\% \pm 13.41\%$ accuracy and $84.49\% \pm 14.92\%$ ROC-AUC. The pooled out-of-fold results yielded 80.17% accuracy, 79.71% precision, 85.94% recall, 82.71% F1-score, and 84.92% ROC-AUC. The findings indicate that compact biomarker representations and heterogeneous ensembles can be useful for research-stage classification, while the large fold-to-fold variability emphasizes the need for external validation. The proposed framework should therefore be viewed as a transparent decision-support research model rather than a clinically validated diagnostic system.

Keywords: *breast cancer; machine learning; biomarkers; hybrid ensemble; SVM; Random Forest; XGBoost; explainable AI; risk stratification; clinical decision support.*

Multi-Agent Large Language Models for Content Strategy: A Review of Predictive and Generative Approaches in Social Media Intelligence

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Abstract

Social media creators accumulate detailed records of how their content performs, yet platform-native analytics remain largely descriptive: they report what happened without indicating what should be published next. Two bodies of research bear on this gap — predictive modelling of engagement, and generative AI for content production—but they have developed in parallel and are rarely connected. This paper reviews their intersection. A structured search of IEEE Xplore, SpringerLink, ScienceDirect, the ACM Digital Library and Crossref returned 214 records published between January 2022 and August 2026, from which six peer-reviewed studies were retained for detailed comparison and twenty-one further published works were used for methodological grounding; unrefereed preprints were excluded throughout. The review is organised around four research questions concerning predictive accuracy, sentiment measurement, generative quality and multi-agent coordination. We find that engagement prediction is tractable but strongly platform-dependent; that sentiment tools are sufficiently dataset-sensitive to require per-context validation; that LLM assistance raises short-term engagement while reducing informational depth and perceived authenticity; and that conditioning a multi-agent generative system on measured platform signal significantly improves output specificity. From these findings we derive three design implications for integrated creator-facing systems and identify five research gaps, the most consequential being the divergence between engagement and quality under LLM optimisation.

Keywords: *Social media analytics, large language models, multi-agent systems, engagement prediction, sentiment analysis, content intelligence, creator economy.*

Transfer Learning-Based Deep Learning Approach for Papaya Leaf Disease Classification

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Abstract

Papaya leaf diseases can have a major impact on crop yield and plant growth. Effective crop management thus depends on early and accurate disease diagnosis. In this paper, a machine-learning-based method for automatically classifying papaya leaf diseases using digital leaf pictures is presented. The suggested approach consists of feature extraction, model training, classification, and image preprocessing. A number of machine-learning methods are assessed using F1-score, accuracy, precision, and recall. The findings show that machine learning methods can help early disease detection and successfully differentiate between healthy and sick papaya leaves. The proposed strategy offers farmers a fast and easy way to help them manage diseases.

Keywords: *Papaya leaf disease, deep learning, transfer learning, image classification, precision agriculture.*

Deep Learning-Based Severity Classification of Spaceflight Associated Neuro-Ocular Syndrome (SANS) Using Synthetic Retinal Fundus Imaging

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Abstract

Spaceflight-Associated Neuro-Ocular Syndrome (SANS) is a physiological condition observed in astronauts during long-duration microgravity exposure, characterized by optic disc edema, choroidal folds, globe flattening, and hyperopic refractive shifts. Confirmed, imaged SANS cases are extremely rare, so no severity-graded SANS fundus dataset exists for supervised learning. This paper's contribution is threefold: (i) a deterministic, parametric pipeline that procedurally injects graded optic-disc, choroidal, and globe-shape changes onto real (non-SANS) fundus photographs from a public diabetic-retinopathy corpus, yielding a four-class (Normal/Mild/Moderate/Severe) benchmark of 39,137 images from about 2,446 source photographs; (ii) a systematic comparison of deep learning architectures on this benchmark; and (iii) identification and quantification of a data-leakage risk specific to synthetic-derivative datasets, in which augmented per-class variants of the same base photograph can appear on both sides of a naive file-level train/test split. Three architectures were trained to completion — Xception, the CNN+ViT hybrid, and EfficientNet-B0 v2 with test-time augmentation (TTA). Under the original file-level split, Xception reached 99.25% test accuracy (macro-F1 0.9925), the hybrid 98.48%, and EfficientNet-B0+TTA 93.19%; since this split does not prevent near-duplicate variants from crossing between train and test, these figures are upper bounds under a leakage-prone protocol, not validated generalization estimates, and a corrected group-aware split is described. All experiments use synthetic imagery only, and real astronaut images were not used. So this study establishes technical feasibility rather than a clinically validated screening tool.

Keywords: *Spaceflight-Associated Neuro-Ocular Syndrome; Synthetic Medical Imaging; Retinal Fundus Imaging; Deep Learning; Convolutional Neural Networks; Vision Transformer; Data Leakage; Multi-Class Classification.*

Low-SNR Weak Target detection in Remote Sensing: A Review of Image Enhancement, Deep Learning, and FPGA-Based Approaches

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Abstract

Low-Signal-to-Noise Ratio (SNR) weak-target detection is a challenging problem in remote sensing because target signatures may occupy only a few pixels and can be obscured by noise, clutter, and environmental variations. This paper reviews representative approaches for weak-target detection, with emphasis on multi-frame processing, image enhancement and denoising, deep-learning-based object detection, and FPGA acceleration. The review examines trade-offs among detection capability, computational complexity, latency, hardware resources, and suitability for real-time edge deployment. Particular attention is given to Track-Before-Detect and multi-frame methods, FPGA optimized preprocessing, deep-learning-based denoising, YOLO-based detection, and FPGA implementations of filtering and object-detection algorithms. Based on the identified limitations, a recommended FPGA-AI processing framework combining Contrast Limited Adaptive Histogram Equalization (CLAHE), Wiener filtering, and YOLOv8 is presented as a conceptual direction for low-SNR target detection. The framework is derived from the reviewed literature as a conceptual research direction and has not been experimentally implemented or validated in this paper. Key challenges for future hardware implementation are identified.

Keywords: *Weak Target Detection, Low-SNR Detection, Remote Sensing, CLAHE, Wiener Filter, YOLOv8, FPGA Acceleration, Edge AI*

A Dynamic 6×6 Playfair Cipher Based on Machine Learning for secure end to end communication

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Abstract

In the digital era, information security has become increasingly important as most services, including e-transactions, online banking, cloud computing, and information sharing, rely on digital communication networks. Protecting sensitive data from unauthorized access and cyber threats also called as confidentiality is therefore a major challenge. Although the classical Playfair cipher is a lightweight encryption algorithm, its static key matrix and predictable encryption process make it vulnerable to cryptanalytic attacks. In this paper we propose a machine learning based approach to enhance the security of the Playfair cipher by dynamically generating the encryption matrix based on plaintext characteristics. The proposed approach improves ciphertext randomness, key sensitivity, and resistance to frequency analysis while maintaining low computational overhead. In this paper we evaluated encryption time, decryption time, entropy, avalanche effect, throughput, and memory usage. Experimental results demonstrate enhanced security and efficient performance, making the proposed approach suitable for secure mobile communication and other resource-constrained applications.

Keywords: *Playfair Cipher, Security, Machine Learning, Encryption, Resource-Constrained apps*

Securing the Agentic Frontier: A Systematic Review of Security Architectures, Guardrails, and Runtime Sandboxing for Autonomous

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Abstract

Autonomous AI agents powered by Large Language Models (LLMs) are moving beyond conversational assistance. They are self-sufficient for independent reasoning, multi-step planning, tool invocation, code execution, persistent memory, and collaboration with other agents. These expanded capabilities introduce security challenges, including prompt injection, tool-call hijacking, memory poisoning, goal drift, privilege escalation, and multi-agent collusion which extend beyond conventional LLM safety. Existing research remains fragmented across artificial intelligence, cybersecurity, software engineering, systems security, and AI governance. This review synthesizes published studies into a Unified Security Lifecycle Framework spanning threat modeling, preventive guardrails, runtime sandboxing, identity and access control, monitoring, and governance. This paper introduces existing solutions of Agentic AI, connecting attack vectors to mitigations, comparing existing approaches across five evaluation dimensions, attack-surface coverage, autonomy preservation, runtime overhead, failure containment, and adaptability. This review concludes with a research agenda centered on composable, risk-adaptive security architectures for trustworthy, next-generation agentic AI.

Keywords: *autonomous AI Agents, Agentic AI Security, Large Language Models, Security Architecture, Guardrails, Runtime Sandboxing, Prompt Injection, Multi-Agent Systems, AI Safety.*

IRIS: Intelligent Real-Time Interactive System for Enhanced Visual Comprehension and Accessibility

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Abstract

This research introduces IRIS (Intelligent Real-time Interactive System), a multi-modal AI framework developed to bridge the gap between raw visual data and a meaningful, and human-like interpretation. Contemporary models are great at single tasks, but IRIS fuses real-time object detection, context-aware image captioning and Visual Question Answering (VQA) into a single pipeline. Using a fine-tuned YOLOv8 architecture for high-speed detection and BLIP (Bootstrapping Language-Image Pre-training) for natural language generation, the system turns pixels into actionable intelligence. Our results show a mean Average Precision (mAP@0.5) of 82% in detecting potholes, along with real-time audio narration to improve accessibility for the visually impaired.

Keywords: *Computer Vision, Assistive Technology, Human-Computer Interaction, Real-Time Image Processing, Visual Comprehension Systems.*

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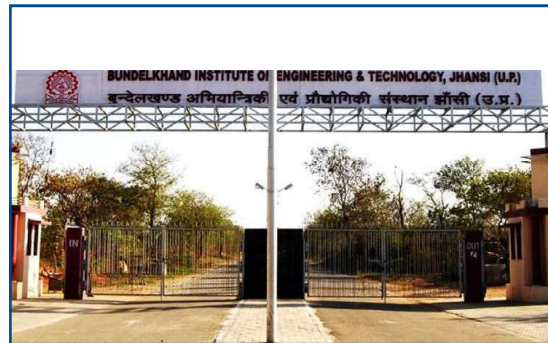
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