ALAGAPPA UNIVERSITY

(A State University established by the Government of Tamil Nadu in 1985, Accredited with A++ Grade (CGPA 3.59) by NAAC in the Fourth Cycle under Dual Mode, Graded as Category – I University by UGC)

Karaikudi – 630 003

Tamil Nadu, INDIA

Conference Proceedings

International Conference on

RECENT TRENDS IN COMPUTER SCIENCE (RTCS 2026)

29th and 30th January, 2026

ISBN No: 978-93-49618-20-6

Prof. Padmapriya Arumugam (Ed.)

Organized by

DEPARTMENT OF COMPUTER SCIENCE

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INTERNATIONAL CONFERENCE ON RECENT TRENDS IN COMPUTER SCIENCE (RTCS 2026)

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Department of Computer Science

29th & 30th January 2026

Venue: Sir C V Raman Conference Hall

Fourth Floor, Science Campus

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Editor :
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Convener & Organizing Secretary (RTCS 2026)
Chairperson, School of Computer Science
Head, Department of Computer Science
Alagappa University
Karaikudi – 630 003
Tamil Nadu, INDIA

Padma Bhushan Dr. RM. Alagappa Chettiar

(6 April 1909 – 5 April 1957)

<u>வள்ளல் வாழ்த்து</u>

கோடி கொடுத்த கொடைஞன் குடியிருந்த
வீடும் கொடுத்த விழுத்தெய்வம் - தேடியும்
அள்ளிக்கொடுத்த அழகன் அறிவூட்டும்
வெள்ளி விளக்கே விளக்கு.

முன்பெருந் தவத்தால் தோன்றி
முயன்றெமைக் காக்கும் வள்ளல்
அன்பினால் அழகப்பாவின்
அறம்பணி போற்றி செய்வோம்.

"My Happiness is limitless because it does not consist naturally in my own Happiness, but my Happiness consists in the Happiness of the thousands of students, young and old, boy and girl who received education in our vast campus"

- Dr. RM. Alagappa Chettiar

Prof. G. RAVI, Ph. D., D. Sc.,
Vice-Chancellor
Alagappa University
Karaikudi – 630 003
Tamil Nadu, INDIA

ALAGAPPA UNIVERSITY

Alagappapuram, Karaikudi - 630 003, Tamil Nadu, India.

(A State University Established by the Government of Tamil Nadu, Recognised by UGC)

[Accredited with A++ Grade by NAAC in the Fourth Cycle under Dual Mode)

Prof. G. Ravi, Ph.D., D.Sc.,
Vice-Chancellor

Message from the Vice-Chancellor

I am delighted to know that the Department of Computer Science is organizing an International Conference on Recent Trends in Computer Science (RTCS 2026) on 29th and 30th January 2026. We, at Alagappa University, aspire to expand our innovative research horizon in all disciplines. Research and development in Computer Science is indeed the driving force behind the growth of not only IT and Communication Industry but also in all disciplines and it endeavours to change the quality of life of mankind.

Research in Computer Science is exciting, as it comprises thrust areas like Artificial Intelligence, Cyber Security, Internet of Things & Robotics, Big Data Analytics, Communication Networks, Privacy preservation, Language Models, Human Computer Interface, Business Intelligence, Education Technology, Fintech, Sustainable Computing, High Performance Computing and Quantum Computing. It is heartening to know that this conference will be addressing the challenges and solutions in the thrust areas in Computer Science. I understand that the keynote speeches, research paper presentations and poster presentations of this International Conference will focus on state-of-the-art computing technologies. This will definitely enrich the knowledge of the participants in the field of Computer Science.

I hope that this conference will be a foundation for the growth of new ideas towards the better tomorrow. I am happy to note that many international experts and delegates are attending the conference to present their papers and also deliver keynote speeches and invited talks. Such a huge conference cannot be organized without the whole-hearted commitment and involvement of faculties, research scholars and students of the Department of Computer Science and I congratulate everyone connected with this conference.

I sincerely hope that this conference (RTCS 2026) will facilitate the establishment of international joint research programs and become a forum for the exchange of research ideas. I wish the conference a grand success.

(Prof. G. Ravi)

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Prof. A. SENTHILRAJAN
Registrar
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ALAGAPPA UNIVERSITY

(A State University Established by the Government of Tamil Nadu in 1985,
Accredited with 'A++' Grade by NAAC (CGPA : 3.59) in the Fourth Cycle under Dual Mode Category)
KARAIKUDI - 630 003, TAMIL NADU, INDIA.

Dr. A. SENTHILRAJAN
Registrar

Date: 12.01.2026

Message

I am delighted to convey my best wishes to the organizers and participants of the ***International Conference on Recent Trends in Computer Science (RTCS 2026)***, organized by the Department of Computer Science, Alagappa University.

Alagappa University, founded on the visionary ideals of **Padma Bhushan Dr.R.M.Alagappa Chettiar**, has continually strived to promote excellence in higher education, research, and innovation. The University's commitment to quality education and research is reflected in its **NAAC A++** accreditation and its ever-expanding academic and research ecosystem.

The theme of this conference is highly relevant in the present technological era, where rapid advancements in computing and digital technologies are transforming education, industry, governance, and society at large. Conferences like RTCS2026 serve as vital academic forums that encourage scholarly dialogue, knowledge sharing, and collaboration among researchers, academicians, and industry experts.

I appreciate the sincere efforts of the Department of Computer Science and the Organizing Committee for taking this initiative to bring together eminent scholars and young researchers on a common platform. I am confident that the deliberations and outcomes of this conference will enrich academic pursuits and contribute meaningfully to the field of Computer Science.

I wish the conference every success and hope it achieves its intended objectives.

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ALAGAPPA UNIVERSITY
KARAIKUDI

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Prof. ARUN KUMAR SANGAIAH

International Graduate School of Artificial Intelligence (IAI)

National Yunlin University of Science and Technology (YunTech) Yunlin, Taiwan

Computer Science as a formal discipline of study is about seven decades young. We have witnessed the tremendous impacts that computing technologies have had on various aspects of the lives of vast sections of humanity in such a short time. It is energetic – there is always something fresh happening; booming – many new fields (sub-disciplines) have emerged (and continue to emerge); influential – almost all aspects of our lives have been touched; pertinent – addressing the everchanging demands of the era. It is safe to say that this is the beginning of more exciting things to come.

Many challenges and problems in today's society require attention, necessitating creative uses and applications of computing. In light of these, it is essential for academicians, industry experts, and students to actively participate in sharing and exchanging their ideas and findings from their work. Events like RTCS 2026 address these requirements.

The following personnel from Alagappa University, Karaikudi, Tamil Nadu must be commended for the planning and organization of this conference: Prof. G. Ravi, Vice-Chancellor, Prof. A. Senthilrajan, Registrar, Prof. A. Padmapriya, Head of Computer Science Department, and several others who are involved either directly or indirectly. I hope this conference would serve as a forum for the participants to engage in fruitful discussions and forging possible future collaborations. I also wish that this conference grows both in terms of the number of participants and in quality, in years to come.

Dr. MOHD AMIRUDDIN ABD RAHMAN

Deputy Director (Research Data Planning and Management),
Research Management Centre
Associate Professor (Head of Computational Intelligence Research Group),
Department of Physics, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

It gives me immense pleasure to know that the Alagappa University is organising a two days International Conference on Recent Trends in Computer Science (RTCS 2026) at its own campus during 29th and 30th January 2026. I appreciate the sincere efforts taken by the organizers and their team for organizing the event, involving the research scholars all around the world. I am very happy to know that the several eminent research scholars, scientists and technologists from all around the globe shall be meeting at RTCS 2026 to place their valuable research, innovations and experiences in various disciplines of Computer Science. It is praiseworthy to know that this conference will give an opportunity to young researchers to make presentations about their ideas and learn from the resource persons from all over the world. I sincerely hope that the two days of deliberation, discussion, interaction and proactive exchange of ideas will prove to be fruitful and contribute immensely to the mutual growth of the University. I extend my best wishes to all the participants and wish the International conference a grand success.

Dr. V. BHUVANESWARI
Professor, Department of Computer Applications
Bharathiar University, Coimbatore

I am delighted to know that department of Computer Science, Alagappa University is hosting an International Conference on Recent Trends in Computer Science (RTCS 2026) during January 29th and 30th, 2026. The wide range of topics covered in the conference helps students and research scholars to cultivate research ideas and applications of the technologies in computer science. The conference provides opportunities to interact with distinguished researchers gathered at Alagappa University in RTCS 2026. I am confident that assembling the bright research mind under single roof will help in critical evaluation of their research projects.

I congratulate the organizers and their team for efforts and their commendable work in publishing the research papers in proceedings and Journal Research articles. I extend my best wishes for the organizing team of RTCS 2026.

Mr. SUNDARARAJAN ANANTHAKRISHNAN

Cadence Design Systems, Bengaluru

I am delighted that Department of Computer Science, Alagappa University, Karaikudi is hosting the International Conference on Recent Trends in Computer Science (RTCS 2026). The RTCS has created many opportunities to explore and learn the latest trends in Information Technology, in particular, introducing a new approach to these research fields. Through this program academicians, scientists, engineers and professionals from different universities and academic institutions, (both public and private), R&D organizations and industrial concerns will get the opportunity to interact, exchange ideas, knowledge and views for enhancing mutual cooperation. I expect all participants will bring topics relevant to the needs of today's rapidly evolving IT industry. In the current world, it is important to network and extend mutual cooperation to realize our potential and using the diverse talents available in our people. By interacting with the academicians and the professionals all should mutually be able to enhance their knowledge on the state-of-the-art technology as well as the market demand. I hope, the participants of RTCS 2026 will learn many things with their active participation. I must extend my thanks and gratitude to all participants and all related people for their valuable help and continuous teamwork. I wish a grand success of this endeavour.

PREFACE

The **International Conference on Recent Trends in Computer Science (RTCS 2026)** is organized by the Department of Computer Science, Alagappa University, Karaikudi during 29th and 30th January 2026. Karaikudi is the home of two famous Institutions, **Alagappa University** and **CECRI**. This University has emerged from the Galaxy of Institutions initially founded by the Great Philanthropist and Educationist Padma Bushan **Dr. RM. Alagappa Chettiar**.

We acknowledge our Hon'ble **Vice Chancellor**, Respected **Registrar** and all the authorities for their encouragement, financial support and providing necessary infrastructure for organizing this conference. We would also like to thank members of the organizing team, who had put their hard work for the various preparatory work. We also acknowledge the support provided the technical team. We wish to thank all the members of advisory board, invited speakers, authors, reviewers, research scholars, student-volunteers and all other who have contributed in the successful organization of the conference.

The International conference on "Recent Trends in Computer Science (RTCS – 2026)" is aimed to provide a platform for researchers from all over the world from both academia as well as industry to present their research contributions and share their experiences, new ideas, and findings about the latest development in Computer Science. The Conference has a catalytic role in promoting the innovations in Computer Science, especially in the areas - Artificial Intelligence, Cyber Security, Internet of Things & Robotics, Big Data Analytics, Communication Networks, Privacy preservation, Language Models, Human Computer Interface, Business Intelligence, Education Technology, Fintech, Sustainable Computing, High Performance Computing and Quantum Computing.

Though the conference is organized within a short span of time of two months, its scope was wider. We got huge response and received about 216 papers. All papers were submitted for peer review by a team of more than 50 members and finally 151 papers are finding place in the proceedings. The scientific participants, had many fruitful discussions and exchanges that contributed for the success of the conference. Participants from Taiwan, United Arab Emirates, etc made the conference truly international in scope. A number of persons from industry and academia were participating in this conference. It is a good get-together of senior and young professionals.

There are 8 plenary lectures covering the different areas of the conference: Distinguished Professor **Prof. Arun Kumar Sangaiah** (*National Yunlin University of Science & Technology (YunTech) Yunlin, Taiwan*) on AI for Future Minds: Empowering Students Through Responsible, Explainable, and Generative Artificial Intelligence, **Dr. Mohd Amiruddin Abd Rahman** (*Universiti Putra Malaysia, Selangor, Malaysia*) on AI-Enabled Learning Ecosystems: Personalization Prediction, and Policy For Future Universities, **Prof. V. Bhuvaneswari** (*Bharathiar University, Coimbatore*) on Knowledge Graph for Semantic AI, and **Dr. A. Balu** (*Indian Institute of Information Technology (IIIT), Kottayam*) on Privacy Enhancing Techniques on the first day.

ISBN No: 978-93-49618-20-6 | Department of Computer Science, Alagappa University | 29th – 30th January, 2026

On the second day, four plenary sessions are arranged. **Dr. C. Balakrishnan** (*CHRIST University, Bengaluru*) on Seeing and Speaking AI: Vision–Language Models for Multimodal Perception and Language Understanding, **Mr. Sundararajan Ananthakrishnan** (*Cadence Design Systems, Bengaluru*) on From Code to Cognition: How AI, Systems, and Silicon are Redefining Computer Science, **Ms.Nakshatra Vinod** and **Mr. Deeti Nageswara Rao** (*Whiteboard Global Learning & Development Pvt. Ltd, Hyderabad*) on Industry Expectations from Young Professionals (SAS & Biostatistics Careers) to enlighten the participants. In order to motivate the Computer Science Department students, we arrange for a poster session. Students are going to present their poster about the Recent Trends in Computer Science.

We worked hard to produce this as a first-class technical conference. On behalf of the Organizing and Program Committees we welcome you all to Alagappa University and hope that you enjoy the pleasant surroundings and are rewarded by the Recent Trends in Computer Science. We hope that the conference will be of a great success; the participants will explore a lot and have a great time.

Prof. A. PADMAPRIYA
Editor
Convener &
Organizing Secretary
(RTCS 2026)

ABOUT THE UNIVERSITY

Alagappa University has emerged from the galaxy of institutions initially founded during 1950`s by the Padma Bhushan Dr. RM. Alagappa Chettiar. Alagappa University has been recognized under Section 2(f) and 12(B) of the UGC Act. It is a State Government University established by an Act of the Tamil Nadu State Legislature in 1985 as Unitary type later became Affiliating type during 2002. The University campus sprawls across **435.98 Acres** of lush land, (**428.15 acres** in Main Campus and **7.83 acres** in Thondi Campus) creating a highly secure, eco conscious and student friendly learning ambience.

Alagappa University ALU embodying its motto "**Excellence in Action**" stands as a paragon of transformative education and societal progress, continuously sculpting the future leaders, professionals and visionaries.

- Secured the following positions in the National Institutional Ranking Framework (NIRF) 33rd position (2021); 28th position (2022); 30th place (2023); 47th place (2024); 44th place (2025).
- Awarded the prestigious A++ Grade by NAAC (CGPA : 3.59) under Dual Mode in the Fourth Cycle of Assessment in 2025.
- Best Practices include
    1. Alagappa University's Pursuit of Skill Excellence
    2. Coastal Prosperity Initiatives of Alagappa University
    3. Alagappa University Study Circle : Facilitating Employment for Community Empowerment, and
    4. ASSURE – Alagappa Sports Supportive Utilities Reach Everyone.
- A hallmark of the University's inclusiveness is its vibrant Para-Sports Centre, which provides professional coaching and infrastructure for students with disabilities
- The University's Department of Special Education and Rehabilitation Science offers specialized programs in inclusive education, equipping teachers and professionals to serve learners with diverse needs.
- Alagappa University has been selected as the District Hub for EDII- TN for Sivagangai District under the Tamil Nadu Youth Innovation and Entrepreneurship Development Programme (TNYIEDP) Scheme to foster innovation and entrepreneurial thinking among students in higher education institutions.
- **Prof. G. Ravi, Vice-Chancellor** is selected for the Green Leadership and Environmental Stewardship Award by the 46th World Management Congress, New Delhi
- The Government of Tamil Nadu Tourism conferred the Tamil Nadu Tourism 2025 Awards (Silver Medal) to Alagappa University on 23rd October 2025 for Educational Institution for Tourism & Hospitality.
- Alagappa University received the International Excellence Award 2025 for outstanding implementation of the Right to Information Act and sustainable campus management issued by International Right to Information Act and Conference

- Alagappa University was recognized in the sub-category for Initiative Approaches through Research and Development in the Areas of DRR (Disaster Risk Reduction), Articles, Books, and Best Practices Published in Accredited Journals issued by World Congress on Disaster Management (WCDM) to recognize the significant contributions of scientists, researchers, policymakers, practitioners, and responders in the field of disaster management and risk reduction.
- The search committee of the RTI Institute of India conferred the International Higher Education Excellence Award 2024 to Alagappa University on 28th September 2024. Among the selected ten Universities, Alagappa University and the Jadavpur University are the only State Universities to receive this honour.
- The University has won "Winner Award" (RUSA Star) in the University Category in Tamil Nadu in Optimum Utilisation of Resources from RUSA 2.0 funding.
- Recognizing the extension activities, Mahatma Gandhi National Council for Rural Education (MGNCRE), New Delhi, awarded the Alagappa University as "One District One Green Champion" and a Mentor Institution for Mainstreaming Swachhta Action Plan and Jal Shakthi Abhyan in rural areas through community engagements.
- Grant of Rs. 100 crores have been sanctioned to Alagappa University under RUSA 2.0.
  - Building constructed / Action initiated through PWD under RUSA 2.0 : Over 28 Cr
  - Equipment purchased under RUSA 2.0 : 7.5 Cr
  - Purchase under pipeline under RUSA 2.0 : 5.51 Cr
  - Lab proposed under II Instalment of EIC HUB : 1.94 Cr
  - Lab proposed under II Instalment of TBRP : 1.9 Cr
  - 46 Professors from top-ranked foreign Universities viz. USA, Australia, Mexico, Canada, Switzerland, China, Singapore, Hungary, Malaysia, etc., 73 Indian experts and 35 Industry experts have participated in the Broad-Based Board of Studies.
  - Distinguished Professors from leading Universities in the United Kingdom such as the University of Oxford, Canterbury Christ Church University, Bristol University, and Loughborough University delivered a series of discourses to the research scholars and students of the Department of English and Foreign Languages.
  - 16 (14 Overseas and 2 Indian) Adjunct faculty from top ranking Foreign and Indian Universities have visited.
  - 32 International Conferences have been organized with experts from Foreign Universities.
  - 101 faculty members have been granted permission to visit foreign countries and present their research works in International Conference and Seminars
- The University has five UGC-SAP (Special Assistance Programme) and six DST-FIST (Fund for improvement of Science and Technology) supported Departments. The faculty members of Alagappa University have been sanctioned with Research projects to the tune of Rs. 430.94 lakhs during the year 2024-25, from various funding agencies like ANRF, CMRG, CSIR, MoE-STARS and UGC-Indo Norwegian.

- Nine International MoUs and 61 National MoUs were signed with international Universities and Institutes for Academic Research, Industrial training, and faculty and students exchange programmes
- Having achieved the top slot at the National level from among many State Universities, Alagappa University has been actively promoting collaboration with 14 Foreign Institutions in the countries like USA, South Korea, China, Japan, Taiwan, Malaysia and UAE. Post Doctoral / Doctoral fellowships to overseas students are being offered with an objective of promoting high-end research in the frontier areas of Science and Technology, which are urgent requirements in India.
- **Sustainable Development initiatives**
  - ✓ Alumni Eco park
  - ✓ Hydrogen Energy Pilot Plant
  - ✓ Eco paving with recycled plastics & glass
  - ✓ High Tech Sewage Treatment Plants
  - ✓ Bio Hydrogen Production
  - ✓ Green Coverage by planting nearly 10,000 number of high value tree species
- Alagappa University is one of the 10 national-level institutions selected by National Hydrogen Mission to produce cost-effective hydrogen.
- Complete Digitalization of Exam Evaluation System funded by TANII Scheme
- Installation of solar lamps throughout the campus and the use of bio-gas in hostel kitchens as part of green energy initiative.
- Alagappa University is the recipient of District Green Champion Award from the Ministry of Education.
- Under Village Extension Programme (VEP) students make contribution every year to the upgradation of villages adopted by 48 Departments of the University.
- The in-house industries are meant to support our University's research objectives, including the coordination of R&D projects between University departments and local industries in product/process development and technology transfer. Development of specialized certificate programmes for updating skills and knowledge is another main task of the Industry-Academia collaboration. The following six in-house industries function on the campus:
  1. Galaxy Research Technologies,
  2. H2Next Private Ltd,
  3. Mechstellar Private Ltd
  4. Meya Labs Private Ltd,
  5. Bogar Biobee Stores Pvt Ltd and
  6. Memfill Tech. Pvt. Ltd.

ABOUT THE DEPARTMENT

The Department of Computer Science was established in the year 2016 to facilitate teaching, learning, and research in Computing paradigms and to provide training for students in Computational techniques and Information Technology. Since its inception, the Department has been committed to teaching, learning and extension activities with programmes at the postgraduate level (M.Sc., Computer Science and M.Sc., Cyber Forensics) and research programmes at Doctoral level (Ph. D. Computer Science). At the Doctoral level, the Department focuses on advanced research in contemporary and emerging technologies, including Information Security, Data Science, Artificial Intelligence, Machine Learning, and Cyber Forensics.

The Department has an excellent multipurpose Computer Laboratory established under RUSA 1.0 scheme with modular workstations. Faculty, students, and scholars are having access to internet on 24 x 7 basis.

The Department comprises of well-experienced faculty members with research interests and expertise in Data Analytics, Machine Learning, Computer Networks, Image Processing, Information Security, Smart Agriculture and Healthcare Informatics, and Database Management. Department faculty have visited Singapore, Malaysia, and Indonesia and have international collaborations with Universities in Sri Lanka and China. The Department is undertaking research projects in the fields of IoT, Data Privacy, Health Care Research and Database Creation. The novel research findings that emerged from the coordination of the faculty members and scholars are reflected as research publications in highly reputed journals.

Vision

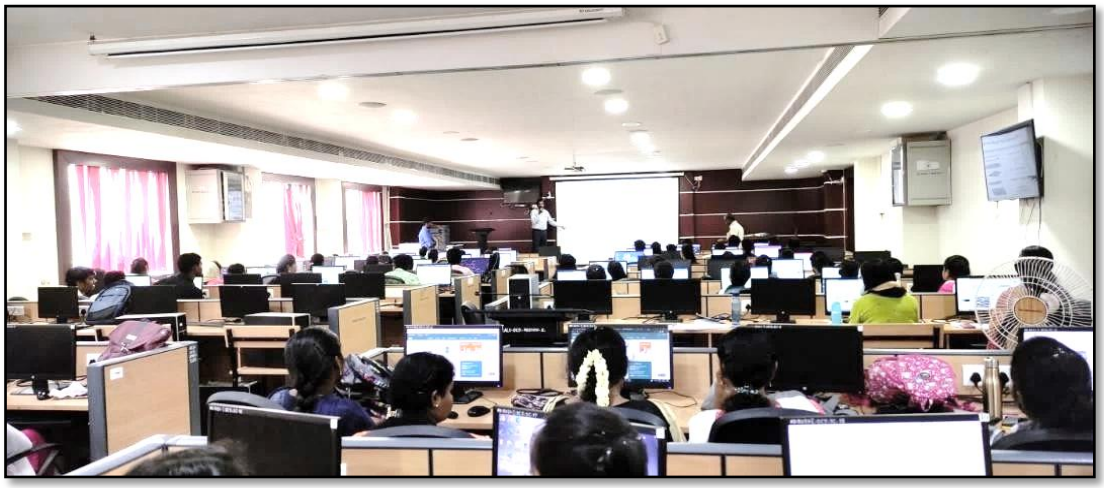
- To develop highly skilled professionals in Computer Technologies and Cyber Security, meeting the demands of Academia and Industry, and concurrently advancing research in cutting-edge Computational and Data Analytics on a global scale.

Mission

- To provide high-quality International Education and Research in Computing and Data Analytics.
- To attain expertise in both research and technology, focusing on the development of Computing tools, Smart mobile apps.
- To prioritize practical exposure to students in cutting edge technologies like Computational Intelligence, Cyber Forensics to shape their career.
- To implement a holistic approach in diverse aspects of Computing and Data Analytics for effective use of data in multi-disciplinary fields.

Science Campus

Multipurpose Computer Laboratory



Multipurpose Computer Laboratory

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CONTENTS

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Prof. G. RAVI
Vice-Chancellor
Alagappa University

Co-Patron

Prof. A. SENTHILRAJAN
Registrar
Alagappa University

Chairman

Prof. J. JEYAKANTHAN
Dean of Science

Convener & Organizing Secretary

Dr. A. PADMAPRIYA
Professor and Head
Department of Computer Science

Co-Conveners

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Mrs. K. PONNALAGU

ABOUT THE CONFERENCE – RTCS 2026

The International conference on "**Recent Trends in Computer Science (RTCS – 2026)**" is aimed to provide a platform for researchers from all over the world from both academia as well as industry to present their research contributions and share their experiences, new ideas, and findings about the latest development in Computer Science.

Conference Tracks

- Artificial Intelligence, Machine Learning & Data Science
- Networking, Communication, Cybersecurity
- Privacy-Enhancing Technologies (PETs)
- Big Data, Cloud Computing & Distributed Systems
- Natural Language Processing (NLP)
- Human-Computer Interaction (HCI)
- Robotics and Human-Robot Collaboration
- Signal Processing & Pattern Recognition
- IoT & Embedded Systems
- Smart Cyber-Physical Systems
- Software Engineering & Applications
- Low-Code, No-Code, and AI-Assisted Dev
- Quantum Computing Applications
- High Performance Computing
- e-Commerce, Business Intelligence & Fintech
- Cryptocurrency and Blockchain Technology
- Sustainable Life Sciences
- Sustainable Technology and Green Computing
- Smart Factories and Industry 5.0
- Education Technology Trends
- Technology Trends for Arts, Humanities and Social Sciences

RTCS 2026 Highlights

- ✓ Eight Plenary Sessions to the Participants by Experts from both Academia and Industry
- ✓ Prospective authors shall be able to present all aspects pertaining to their findings on recent trends in Computer Science
- ✓ Abstracts of the accepted papers will be published in the conference proceedings (ISBN 978-93-49618-20-6).
- ✓ Selected papers of the conference will be published in the Alagappa University Journal of Computing (ALUJC) after the review process
- ✓ Best paper presentation award, certificates to all Participants and Delegates
- ✓ Poster presentation on recent technologies by our students

RTCS 2026 ADVISORY COMMITTEE

- Prof. Arun Kumar Sangaiah, National Yunlin University of Science and Technology, Taiwan
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- Dr. P. Kalavathi, The Gandhigram Rural Institute (Deemed to be University), Dindigul
- Dr. K. Chandrasekar, Periyar University, Salem, India
- Dr. R. Rathipriya, Periyar University
- Dr. P.L. Chithra, University of Madras, Chennai, India
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- Dr. P. Eswaran, Alagappa University, Karaikudi
- Dr. Andrews Samraj, Mahendra College of Engineering

RTCS 2026 DEPARTMENT OF COMPUTER SCIENCE MEMBERS

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International Conference on

Recent Trends in Computer Science (RTCS 2026)

(Hybrid Mode)

PROGRAMME SCHEDULE – 29.01.2026

09.30 a.m. – 10.30 a.m. : **REGISTRATION**
Venue : Seminar Hall, Third Floor, Science Campus

10.30 a.m. – 11.30 a.m. : **INAUGURATION**

Invocation
Thamizh Thaai Vazhthu
Vallal Vazhthu
Lighting the Lamp

Welcome Address : **Prof. A. PADMAPRIYA**
Head, Department of Computer Science

Presidential Address : **Hony. Col. Sr. Prof. G. RAVI**
Vice Chancellor, Alagappa University

Inaugural Address : **Prof. ARUN KUMAR SANGAIAH**
National Yunlin University of Science & Technology (YunTech), Yunlin, Taiwan

Key Note Address : **Dr. MOHD AMIRUDDIN ABD RAHMAN**
Universiti Putra Malaysia, Selangor, Malaysia

Felicitation : **Sr. Prof. J. JEYAKANTHAN**
Member of Syndicate & Dean, Faculty of Science

Vote of Thanks : **Sr. Prof. T. MEYYAPPAN**
Co-Convener, RTCS 2026

ISBN No: 978-93-49618-20-6 | Department of Computer Science, Alagappa University | 29th – 30th January, 2026

11.30 a.m. – 11.45 a.m.	:	**TEA BREAK**
Plenary Session I 11.46 a.m. – 12.30 p.m.	:	**"AI FOR FUTURE MINDS: EMPOWERING STUDENTS THROUGH RESPONSIBLE, EXPLAINABLE, AND GENERATIVE ARTIFICIAL INTELLIGENCE"** **Prof. ARUN KUMAR SANGAIAH** National Yunlin University of Science & Technology (YunTech) Yunlin, Taiwan
Plenary Session II 12.31 p.m. – 01.15 p.m.	:	**"AI-ENABLED LEARNING ECOSYSTEMS: PERSONALIZATION, PREDICTION, AND POLICY FOR FUTURE UNIVERSITIES"** **Dr. MOHD AMIRUDDIN ABD RAHMAN** Universiti Putra Malaysia, Selangor, Malaysia
1.16 p.m. – 02.15 p.m.	:	**LUNCH** Venue : Room No. G6 & G7, Ground Floor,
02.30 p.m. – 03.30 p.m.	**:**	**Online Paper Presentation Sessions**
Plenary Session III 02.16 p.m. – 03.00 p.m.	:	**"KNOWLEDGE GRAPH FOR SEMANTIC AI"** **Prof. V. BHUVANESWARI** Bharathiar University, Coimbatore, Tamil Nadu, India
Plenary Session IV 03.01 p.m. – 03.46 p.m.	:	**"PRIVACY ENHANCING TECHNIQUES"** **Dr. A. BALU** Indian Institute of Information Technology (IIIT), Kottayam
03.46 p.m. – 04.00 p.m.	:	**TEA BREAK**
04.00 p.m. – 05.00 p.m.	**:**	**PAPER AND POSTER PRESENTATIONS**

Parallel Paper Presentation Sessions (4 Sessions)

Venue :

Sir C V Raman Conference Hall (Fourth Floor)
DCS Computer Laboratory (Ground Floor)
M. Sc Cyber Forensics I Year Classroom (IT Avenue – First Floor)
M. Sc Cyber Forensics II Year Classroom (IT Avenue – First Floor)

Poster Presentation

Venue : Seminar Hall, Third Floor, Science Campus

PROGRAMME SCHEDULE – 30.01.2026

Plenary Session V
10.15 a.m. – 11.00 a.m. : **"SEEING AND SPEAKING AI: VISION–LANGUAGE MODELS FOR MULTIMODAL PERCEPTION AND LANGUAGE UNDERSTANDING"**

Dr. C. BALAKRISHNAN
CHRIST (Deemed to be University)
Yeshwanthpur Campus, Bangalore

Plenary Session VI
11.01 a.m. – 11.45 a.m. : **"FROM CODE TO COGNITION: HOW AI, SYSTEMS, AND SILICON ARE REDEFINING COMPUTER SCIENCE"**

Mr. SUNDARARAJAN ANANTHAKRISHNAN
Cadence Design Systems, Bengaluru

11.46 a.m. – 12.00 p.m. : **TEA BREAK**

12.00 p.m. – 01.00 p.m. : Online Paper Presentation Sessions

Plenary Session VII & VIII
12.01 p.m. – 01.15 p.m. : **"INDUSTRY EXPECTATIONS FROM YOUNG PROFESSIONALS" (SAS & BIOSTATISTICS CAREERS)**

Ms. NAKSHATRA VINOD &

Mr. DEETI NAGESWARA RAO
Whiteboard Global Learning & Development Pvt. Ltd.
HITECH City Hyderabad, Telangana

1.16 p.m. – 02.15 p.m. : **LUNCH**
Venue : Room No. G6 & G7, Ground Floor

02.15 p.m. – 03.15 p.m. : PAPER PRESENTATIONS

Parallel Paper Presentation Sessions (4 Sessions)

Venue :

Sir C V Raman Conference Hall (Fourth Floor)
DCS Computer Laboratory (Ground Floor)
M. Sc Cyber Forensics I Year Classroom (IT Avenue – First Floor)
M. Sc Cyber Forensics II Year Classroom (IT Avenue – First Floor)

03.16 p.m. – 0330 p.m. : **TEA BREAK**

03.31 p.m. – 04.30 p.m.	:	**VALEDICTION**
		Invocation
Welcome Address	:	**Sr. Prof. T. MEYYAPPAN** Co-Convener, RTCS 2026
Conference Report	:	**Prof. A. PADMAPRIYA** Convener & Organizing Secretary RTCS 2026
Feedback	:	Participants
Valedictory Address	:	**Prof. A. SENTHILRAJAN** Registrar, Alagappa University
Special Address	:	**Sr. Prof. C. SEKAR** Member of Syndicate & M**r. SUNDARARAJAN ANANTHAKRISHNAN** Cadence Design Systems, Bengaluru
		Certificate Distribution
Vote of Thanks	:	**Dr. S. SANTHOSHKUMAR** Co-Convener RTCS 2026
		National Anthem

THE DISTINGUISHED SPEAKERS

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KARAIKUDI – 630 003, TAMIL NADU, INDIA

Department of Computer Science

International Conference on

RECENT TRENDS IN COMPUTER SCIENCE (RTCS 2026)

DISTINGUISHED SPEAKERS

Prof. ARUN KUMAR SANGAIAH
National Yunlin University of Science and Technology (YunTech) Yunlin 640301, Taiwan

Dr. MOHD AMIRUDDIN ABD RAHMAN
Universiti Putra Malaysia (UPM), Malaysia

Prof. V. BHUVANESWARI
Department of Computer Applications Bharathiar University, Coimbatore

Dr. A. BALU
Indian Institute of Information Technology (IIIT), Kottayam

Dr. C. BALAKRISHNAN
CHRIST (Deemed to be University) Yeshwanthpur Campus, Bangalore

Mr. SUNDARARAJAN A
Cadence Design Systems Bengaluru

Ms. NAKSHATRA VINOD
Whiteboard Global Learning & Development Pvt. Ltd, Hyderabad

Mr. DEETI NAGESWARA RAO
Whiteboard Global Learning & Development Pvt. Ltd, Hyderabad

January 29th & 30th, 2026

Sir C V Raman Conference Hall Fourth Floor, Science Campus

ISBN No: 978-93-49618-20-6 | Department of Computer Science, Alagappa University | 29th – 30th January, 2026

Prof. ARUN KUMAR SANGAIAH
International Graduate School of Artificial Intelligence (IAI)
National Yunlin University of Science and Technology (YunTech)
Yunlin, Taiwan

Prof. Dr. Arun Kumar Sangaiah is a Distinguished Professor at the International Graduate School of Artificial Intelligence, National Yunlin University of Science and Technology (YunTech), Taiwan. He is an internationally recognized researcher in Artificial Intelligence, Internet of Things (IoT), Edge Computing, Sustainable Computing, UAV-enabled sensing, and Intelligent Transportation Systems. With an extensive academic career spanning Asia and global collaborations, he has previously held faculty positions at VIT University, India, and has served as visiting professor at leading institutions across China and Taiwan.

Prof. Sangaiah is listed among the **Clarivate Highly Cited Researchers (Top 1%)** and the **Stanford Top 2% Scientists**, reflecting his significant global research influence. His scholarly output includes a large body of high-impact publications in premier IEEE, ACM, and Elsevier journals, with exceptional citation metrics (Google Scholar h-index above 90). His research advances intelligent, secure, and sustainable AI-driven systems for smart cities, healthcare, agriculture, industrial IoT, and cyber-physical environments.

He has secured major international research funding as Principal Investigator and Co-Principal Investigator from organizations such as Taiwan's Ministry of Education and National Science and Technology Council, India's MeitY, and global healthcare research partners. His projects span Edge-IoT-UAV platforms, AI in precision agriculture, software-defined vehicular networks, generative AI in education, and AI-assisted medical technologies.

Beyond research, Prof. Sangaiah plays a prominent editorial and professional service role. He serves as Editor-in-Chief of the International Journal of Cognitive Computing and Engineering and as editor of multiple Springer, Academic Press, and CRC Press volumes in cognitive computing and sustainable AI. He is a Senior Member of IEEE societies and an active contributor to international technical committees, keynote forums, and academic exchanges. His work bridges foundational AI research with real-world societal and industrial impact.

AI for Future Minds : Empowering Students through Responsible, Explainable, and Generative AI

Prof. ARUN KUMAR SANGAIAH
International Graduate School of Artificial Intelligence (IAI)
National Yunlin University of Science and Technology (YunTech)
Yunlin, Taiwan

As artificial intelligence becomes embedded in educational ecosystems, AI literacy must evolve beyond basic tool usage toward critical, ethical, and collaborative engagement. The plenary session presents "AI for Future Minds," a forward-looking framework that defines the emerging 2026 standard for student empowerment through Generative AI, Explainable AI (XAI), and Responsible AI. The model positions learners not as passive users of AI systems but as informed co-creators capable of evaluating, guiding, and challenging algorithmic outputs.

Generative AI, supports creativity and personalized learning by enabling adaptive content creation, scaffolded problem-solving, and AI-assisted co-creation across disciplines. Explainable AI, promotes transparency and trust by helping students understand how AI systems produce decisions, thereby strengthening learner agency and technical literacy regarding input–output relationships. Responsible AI, embeds ethics, equity, and accountability into AI use, emphasizing bias awareness, data privacy, academic integrity, and inclusive access to digital resources.

Drawing on emerging global initiatives in AI literacy and AI-enhanced higher education programs, the session highlights a human-centred approach in which educators and students retain decision-making authority while AI functions not just as a tool, but as a collaborative learning partner. The session discusses about a structured model for integrating AI into curricula in ways that balance innovation with transparency, responsibility, and educational equity.

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Dr. MOHD AMIRUDDIN ABD RAHMAN
Deputy Director (Research Data Planning and Management),
Research Management Centre
Associate Professor (Head of Computational Intelligence Research Group),
Department of Physics, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

Dr. Mohd Amiruddin Abd Rahman is an academic and researcher in the field of Artificial Intelligence, data-driven systems, and intelligent computing applications, with experience spanning higher education, research, and applied technology development. He is actively engaged in advancing AI methodologies and their integration into real-world domains, with research interests that include intelligent data analytics, machine learning applications, and emerging digital technologies for complex problem-solving.

Dr. Rahman's academic career reflects a strong commitment to teaching, research supervision, and scholarly contribution. He has been involved in curriculum development, student mentorship, and interdisciplinary research initiatives, supporting the development of future professionals in computing and AI-related disciplines. His work emphasizes the translation of theoretical AI concepts into practical, scalable solutions aligned with current technological and societal needs.

In addition to his teaching and research roles, Dr. Rahman contributes to the broader academic community through research collaboration, publication, and participation in professional and scholarly activities. His profile demonstrates a balance of academic rigor, applied research orientation, and engagement with evolving trends in artificial intelligence and digital innovation

AI-Enabled Learning Ecosystems : Personalization, Prediction, and Policy for Future Universities

Dr. Mohd Amiruddin Abd Rahman
Deputy Director (Research Data Planning and Management),
Research Management Centre
Associate Professor (Head of Computational Intelligence Research Group),
Department of Physics, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

By 2026, artificial intelligence (AI) is no longer a supplementary classroom tool but a foundational layer in higher education – functioning as an institutional learning ecosystem "operating system." This shift transforms how universities design learning, support students, and govern academic processes.

AI-driven systems enable universities to move beyond the traditional one-size-fits-all model of instruction. Generative and adaptive AI continuously analyze learner interaction data to adjust content difficulty, pacing, and presentation style in real time. Students increasingly work with AI tutors or agents that provide 24/7 guidance, step-by-step scaffolding for complex tasks, and immediate feedback. Learning is delivered in multimodal formats – text, video, simulation, and immersive environments – while real-time translation expands global accessibility. This approach promotes deeper engagement, supports diverse learning needs, and empowers students to take greater ownership of their educational journeys.

Predictive analytics have become central to institutional decision-making and student support. Advanced machine learning models analyze academic, behavioral, and engagement patterns to forecast performance and retention risks. Early warning systems allow institutions to intervene before academic failure occurs, shifting from reactive to preventive support. AI also contributes to career pathway forecasting, mapping students' developing skills to labor market trends and recommending targeted micro-credentials. These predictive capabilities enhance retention, strengthen employability outcomes, and improve institutional sustainability.

As AI becomes infrastructural, governance is essential. Universities now treat AI oversight as a core policy responsibility, requiring systems to be transparent, explainable, and compliant with data protection regulations. Human-in-the-loop frameworks ensure that high-stakes academic decisions remain under human authority. Institutions also prioritize bias monitoring, fairness evaluation, and equitable access to AI tools to prevent digital divides. AI literacy for students and faculty is increasingly embedded into professional development, ensuring technology supports pedagogical goals rather than replacing human judgment.

AI-enabled learning ecosystems represent a transformative model for future universities – making education more personalized, proactive, and inclusive. However, their success depends on pairing technological innovation with strong governance, ethical safeguards, and human oversight.

Dr. V. BHUVANESWARI
Professor, Department of Computer Applications
Bharathiar University, Coimbatore

Dr. V. Bhuvaneswari is a Professor in the Department of Computer Applications at Bharathiar University, Coimbatore, with over 20 years of teaching and research experience and 5 years in software development. She holds a Ph.D. in Computer Science and qualified UGC-NET (JRF). Her research interests include Bioinformatics, Big Data Analytics, Cyber Data Analytics, and the Semantic Web. A recognized research supervisor, she has guided multiple Ph.D. and M.Phil. scholars and has published extensively in reputed journals, conferences, and book chapters, with strong citation impact across Google Scholar, Scopus, and ResearchGate. She is the author of books on Big Data Analytics and R Programming, has led and contributed to several nationally funded research projects, and holds a registered patent. In addition to her research and academic contributions, she actively serves in key university administrative roles, curriculum design, professional reviewing, and national initiatives, demonstrating sustained leadership in higher education and applied research.

Knowledge Graph for Semantic AI

Dr. V. BHUVANESWARI
Professor, Department of Computer Applications
Bharathiar University, Coimbatore

Huge volumes of business data are available as data silos in organizations in heterogeneous data formats and they are disparate and disconnected. The disconnected data becomes complex to find detail context as the data points are not chained leaving the existing technologies LLM, Generative AI to process only the surface of data. Knowledge Graphs is the technology that is used to connect the disconnected data points from the data silos. The technological giants like Google and Meta use knowledge graphs in their search engines to retrieve relevant contextual information. Business organization to have through holistic view of their products, people and business processes lack the chain of data points as tagging data manually is very complex process. Knowledge graphs address this use by connecting data point from huge data lakes providing a deepen context with semantic relations. The technologies such as deep text learning, taxonomy, ontologies with automated machine learning approaches are used to the construct the knowledge systems as Graphical data points providing unified data which can be pipelined with Artificial Intelligent services for providing better decision making and customer satisfaction.

Dr. A. BALU
Department of Computer Science
Indian Institute of Information Technology (IIIT), Kottayam

Dr. A. Balu is an Assistant Professor at the Indian Institute of Information Technology (IIIT) Kottayam, Kerala, with over 16 years of teaching experience, including service at premier institutions such as NIT Trichy and NIT Calicut. He earned his Ph.D. in Computer Science & Engineering from Alagappa University, with a research focus on secure access control mechanisms using Ciphertext-Policy Attribute-Based Encryption (CP-ABE). His academic background also includes advanced degrees in Mathematics, reflecting a strong theoretical foundation that underpins his work in cryptography.

Dr. Balu's research expertise lies in Applied Cryptography, Pairing-Based Cryptography, Attribute-Based Encryption, and Zero-Knowledge Protocols (ZK-SNARKs). His scholarly contributions include publications in reputed international journals such as Information Sciences (Elsevier) and presentations at leading international conferences published by Springer. His work primarily addresses privacy-preserving security models and expressive, provably secure encryption frameworks.

In addition to research and teaching, Dr. Balu actively contributes to academic service and professional development initiatives. He has delivered invited talks on access control and security, serves as a reviewer for international journals, and is a life member of the Cryptological Research Society of India (CRSI). He has also organized national-level workshops in emerging areas such as cybersecurity and machine learning, and currently serves as Nodal Officer for YUVA Sangam (Phase V), reflecting his engagement in institutional and national academic initiatives.

Privacy Enhancing Techniques

Dr. A. BALU
Department of Computer Science
Indian Institute of Information Technology (IIIT), Kottayam

The rapid growth of data-driven systems and artificial intelligence has intensified the need for mechanisms that enable computation on sensitive data without exposing it. Privacy Enhancing Techniques address this challenge by embedding privacy directly into system design, with modern Privacy Enhancing Techniques frameworks rooted deeply in advanced cryptographic techniques. This session presents a cryptography-centered analysis of Privacy Enhancing Techniques as foundational tools for secure, collaborative, and regulation-compliant data ecosystems.

The session discusses security guarantees under standard adversarial models, trade-offs between privacy, efficiency, and correctness, and the role of composability in complex multi-protocol systems. Implementation challenges including computational overhead, communication complexity, key management, and side-channel risks are evaluated alongside recent optimizations that improve scalability for real-world deployment in healthcare, finance, and cross-organizational analytics.

The Privacy Enhancing Techniques represent an evolution from perimeter-based security toward cryptographically enforced trust, where confidentiality, integrity, and verifiability are mathematically guaranteed rather than institutionally assumed.

Dr. C. BALAKRISHNAN
Associate Professor, Department of Computer Science
CHRIST (Deemed to be University)
Yeshwanthpur Campus, Bangalore

Dr. Balakrishnan C is an Associate Professor at the Department of Computer Science, School of Sciences, CHRIST (Deemed to be University), Bangalore Yeshwanthpur Campus, a role he has held since August 2022. In addition to teaching, he serves as the IQAC Coordinator of the department and served as PG Placement Coordinator (2022-2024). Previously, he was an Assistant Professor at the Alagappa Institute of Skill Development (Oct 2014 – Jul 2022) and at St. Joseph's College (A), Tiruchirappalli (Sep 2005 – Sept 2014).

With over 20 years of experience in teaching and research in Computer Science, including 8 years in Vocational/Skill Education, Dr. Balakrishnan has made significant contributions to his field. He holds a Master's in Computer Science from St. Joseph's College (Autonomous), Tiruchirappalli, and a PhD from Bharathidasan University, Jamal Mohamed College (Autonomous), Tiruchirappalli. He also earned an MPhil and cleared both the National Eligibility Test (NET) and State Eligibility Test (SET) in 2012.

Dr. Balakrishnan is currently the Project Coordinator for an ICSSR funded Research Programme titled 'Digitalising Chettinad Architecture and Cultural Heritage in Tamil Nadu for Sustainable Knowledge Management: An Empirical Analysis' (2024-2026) with a grant of Rs. 46.06 Lakhs. He obtained Rs. 3 Lakhs grant to organize a five-day short-term course on 'Next-Generation AgriTech: AI, Predictive Analytics, and Sustainable Farming' from the I-DAPT Hub Foundation, IIT (BHU) Varanasi, under the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS). Notably, he assisted in establishing the Entrepreneurship, Innovation, and Career Hub (EIC Hub) under RUSA 2.0 grant for Rs. 15 Cr at Alagappa University.

He has published and presented over 50 articles in international and national journals and conferences, with more than 10 indexed in SCOPUS/WOS/E-SCI databases. Dr. Balakrishnan has authored five books and numerous chapters. He is currently the Editor-in-Chief of the edited book 'Internet of Medical Things: Case Studies and Applications in Healthcare,' published by CRC Press, Taylor & Francis Group, USA. Additionally, he holds five Indian patents (2 general and 3 design) and two international patents (1 German and 2 UK).

Seeing and Speaking AI : Vision–Language Models for Multimodal Perception and Language Understanding

Balakrishnan C
Associate Professor of Computer Science
CHRIST (Deemed to be University) – Bangalore Yeshwanthpur Campus
balakrishnan.c@christuniversity.in

The rapid developments in Artificial Intelligence (AI) have enabled highly capable yet largely unimodal systems in the domains of vision and natural language processing. While large language models and advanced computer vision architectures have achieved remarkable performance independently, their isolated operation limits effective reasoning in complex, real-world environments that require integrated perception and semantic understanding. Vision–Language Models (VLMs) address this gap by enabling joint representation learning and reasoning across visual and linguistic modalities, thereby advancing multimodal artificial intelligence.

This session presents a research-oriented overview of Vision–Language Models, examining their conceptual foundations, architectural design, and emerging research trends. The discussion begins with an analysis of the progression from traditional machine learning and deep learning paradigms to large-scale vision and language models, highlighting the limitations of unimodal approaches. Building on this motivation, VLMs are positioned as a natural convergence of visual perception and language understanding, supported by advances in multimodal learning and transformer-based architectures.

The core architectural components of VLMs—including vision encoders, text encoders, multimodal fusion mechanisms, and large language model–based decoders—are systematically analyzed. Particular emphasis is placed on cross-attention, contrastive alignment, and shared embedding spaces that enable effective interaction between visual and textual representations. The capabilities of VLMs in zero-shot learning, visual reasoning, and contextual grounding are discussed, along with representative applications in document intelligence, medical imaging, education, autonomous systems, and creative media.

The current state of prominent VLM architectures and benchmark evaluations is reviewed, followed by an examination of critical research challenges, including hallucination, bias propagation, interpretability, data efficiency, and computational scalability. The abstract concludes by outlining open research directions and future possibilities, including real-time multimodal agents, embodied intelligence, and integration with robotic and cyber-physical systems. This session aims to provide researchers and practitioners with a coherent understanding of Vision–Language Models as a foundational technology for advancing multimodal perception and language understanding in AI.

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Mr. SUNDARARAJAN ANANTHAKRISHNAN

Cadence Design Systems

Bangalore

Sundararajan Ananthakrishnan is an accomplished professional with extensive experience in the semiconductor and systems verification sectors. Currently serving as AE Architect/Director of the Systems Verifications Group at Cadence Design Systems since April 2010, Sundararajan has previously held positions as Senior Principal AE and Technical Lead at Xilinx. Earlier career roles include Senior Design Engineer at CMC and Design Engineer at Elgi Software and Technologies Limited, focusing on creating reference designs for industrial automation and telecommunications. Sundararajan began the career at Dgipro as an Engineer, specializing in high-speed IP development. Educational achievements include advanced programs in strategy, leadership, and project management from Wharton Executive Education and the Indian Institute of Management, along with a Master of Technology in MicroElectronics from Birla Institute of Technology and Science.

With over 24+ years of experience, Sundararajan Ananthakrishnan serve as a Verification Architect in the Systems Verification Group, where he contributes to the System-level Verification Technology space in the semiconductor industry, driving the latest cutting-edge AI/ML Verification Solutions for Cadence at some of the Top Semiconductor Companies in the world.

His role involves working with the Top Brains in the Semiconductor Industry, including some of the industry stalwarts, Technical Architects, Directors, DV Champions and defining and driving the Latest Cutting-Edge Verification Methodologies for the Industry.

From Code to Cognition : How AI, Systems, and Silicon are Redefining Computer Science

Sundararajan Ananthakrishnan
AE Architect / Director- Systems Verifications Group
Cadence Design System
Bangalore

Computer Science is undergoing a profound transformation. What began as a discipline focused on algorithms and deterministic software has evolved into the engineering of large-scale intelligent systems that learn, adapt, and operate autonomously. This keynote explores how recent advances in Artificial Intelligence particularly machine learning, deep learning, and generative AI are fundamentally reshaping the computing stack, from software architectures to hardware design. The talk provides a systems-level perspective on modern AI, explaining how data, algorithms, cloud platforms, and specialized semiconductor accelerators work together to deliver real-world products at massive scale. Drawing from industry experience and Indian startup case studies, the session illustrates how AI is being deployed in domains such as fintech and healthcare, highlighting both technical challenges and societal impact. The keynote also emphasizes the growing convergence of Computer Science with semiconductor technology, where performance, energy efficiency, and hardware software co-design have become critical to AI innovation. Finally, the talk offers guidance for students and educators on the skills, mindset, and interdisciplinary knowledge required to thrive in the next decade where strong fundamentals, system thinking, and responsible innovation will define successful computer scientists.

Ms. NAKSHATRA VINOD
Founder & Sr. Director Operations
Whiteboard Global Learning & Development Pvt. Ltd
HITECH City Hyderabad, Telangana

Nakshatra Vinod is a seasoned industry professional and thought leader in corporate training, workforce upskilling, and industry–academia collaboration, with a strong focus on upskilling, and employability-driven learning.

She is a key member of the leadership team at Whiteboard Global Learning & Development Private Limited (The Whiteboard), where she plays a pivotal role in designing and delivering industry-aligned training programs for graduates, working professionals, and corporate teams. Her work bridges the gap between academic learning and real-world industry expectations, enabling learners to transition confidently into technology-driven roles.

Nakshatra has been actively involved in collaborating with universities, colleges, corporates, and global certification bodies, helping institutions modernize curricula, adopt role-based learning models, and improve graduate employability outcomes. She regularly engages with CXOs, HR leaders, faculty members, and students, sharing insights on future skills, career pathways, and ethical professional growth.

As a speaker, she is known for her practical insights, clarity of thought, and learner-centric approach, making complex topics accessible and relevant. Her sessions emphasize career readiness, continuous learning, and aligning personal growth with organizational and societal impact.

Beyond her professional role, Nakshatra is deeply committed to personal growth and social responsibility. She actively supports environmental initiatives such as tree adoption and sustainability awareness, and practices Sahaja Yoga meditation as a foundation for mindful leadership, emotional resilience, and ethical decision-making.

She believes that true leadership balances professional excellence with inner well-being and service to society.

Industry Expectation from Young Professionals

Ms. NAKSHATRA VINOD
Founder & Sr. Director Operations
Whiteboard Global Learning & Development Pvt. Ltd
HITECH City Hyderabad, Telangana

The accelerating pace of digital transformation has significantly reshaped industry expectations from emerging computer professionals. Beyond foundational programming competence, employers increasingly seek graduates who combine technical expertise with problem-solving ability, adaptability, ethical awareness, and collaborative skills. This session examines the evolving competency profile required for industry readiness in computing disciplines and identifies key areas where academic preparation must align with professional demands.

It highlights the continued importance of strong technical foundations in programming, data structures, cloud technologies, cybersecurity, and artificial intelligence, while emphasizing that conceptual understanding and system-level thinking are valued more than tool-specific familiarity. Industry also prioritizes analytical and solution-oriented mindsets, where professionals can translate theoretical knowledge into practical, optimized solutions for real-world challenges. In parallel, adaptability and lifelong learning have emerged as critical traits, given the rapid evolution of frameworks, platforms, and interdisciplinary technologies.

Practical exposure through internships, live projects, and open-source engagement is recognized as a major employability factor, enabling graduates to contribute effectively from the outset. Communication skills, teamwork, and documentation practices are equally essential in collaborative development environments.

The need of the hour is a holistic model of industry preparedness that integrates technical mastery, experiential learning, soft skills, and ethical responsibility. Such an approach ensures that young computer professionals are equipped not only to meet current industry needs but to adapt to future technological disruptions.

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Mr. DEETI NAGESWARA RAO
Founder & Managing Director
Whiteboard Global Learning & Development Pvt. Ltd
HITECH City Hyderabad, Telangana

Nageswara Rao brings over 20 years of extensive industry experience across Business Development, Operations, Team Management, and Life Sciences delivery, with a strong specialization in Statistical Programming Services Organizations. Throughout his career, he has played a pivotal role in building, scaling, and leading high-performance delivery and talent teams within the life sciences ecosystem.

A significant area of Nageswara's expertise lies in staffing and recruitment services, particularly in identifying, developing, and deploying job-ready talent for clinical research, biostatistics, and statistical programming roles through structured hire–train–deploy and staff augmentation frameworks. He has successfully led end-to-end hiring strategies, including workforce planning, niche talent acquisition, competency assessment, onboarding, and client-aligned deployment models. His ability to align right talent with right roles has consistently enabled organizations to meet project timelines, quality benchmarks, and regulatory expectations.

Having served in diverse roles ranging from general management to consulting, Nageswara combines deep technical domain knowledge with strategic and operational leadership. His comprehensive understanding of life sciences, statistical programming, and hiring dynamics allows him to design scalable staffing models that address both immediate project needs and long-term workforce sustainability.

At The Whiteboard, Nageswara plays a critical leadership role in strengthening training-to-deployment pipelines, ensuring that candidates are not only technically skilled but also industry-ready. His commitment to excellence, ethical practices, and talent empowerment fosters an environment where individuals, teams, and organizations continuously grow and succeed.

SAS & Biostatistics Career

Mr. DEETI NAGESWARA RAO
Founder & Managing Director
Whiteboard Global Learning & Development Pvt. Ltd
HITECH City Hyderabad, Telangana

SAS and Biostatistics together form a powerful career pathway at the intersection of data science, healthcare, and research analytics. With the rapid expansion of clinical research, pharmaceuticals, public health analytics, and evidence-based decision-making, professionals skilled in statistical analysis and SAS programming are in high demand globally.

SAS (Statistical Analysis System) is a leading software suite used for advanced analytics, data management, and statistical modeling. It is widely adopted in pharmaceuticals, clinical trials, healthcare analytics, banking, and government research due to its reliability, regulatory acceptance, and strong data handling capabilities.

Biostatistics applies statistical methods to biological, medical, and public health research. It plays a crucial role in Clinical trial design, Drug development and validation, Epidemiology studies, Disease modelling and Healthcare data analysis. Biostatisticians ensure that medical research findings are statistically valid, ethically conducted, and scientifically reliable.

Professionals in this field can work in roles such as

- **Clinical SAS Programmer** – Designs and validates statistical programs for clinical trial data.
- **Biostatistician** – Develops statistical models and analyzes biomedical data.
- **Statistical Analyst** – Interprets healthcare or research data for decision-making.
- **Clinical Data Analyst** – Manages and analyzes clinical databases.
- **Regulatory Data Specialist** – Prepares statistical reports for regulatory agencies (FDA, EMA, etc.).

This career is having (i) High global demand and job stability, (ii) Opportunities to contribute to life-saving research, (iii) Competitive salaries, (iv) Scope for international career mobility and (v) Combination of analytics and social impact. For students interested in data-driven problem solving and contributing to medical advancements, this field provides a stable, meaningful, and globally recognized professional pathway.

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RTCS 2026 – ACCEPTED PAPERS LIST (Oral Presentation)

S. No.	Paper ID	Title of the Paper	Author(s)
1	10	SoyNet+: Hybrid Deep Learning Architecture for Precision Weed Segmentation in Soybean Cultivation Using Dual-Backbone Feature Extraction	Gamage Dilshani Chamodi Palihapitiya Arun Kumar Sangaiah Alkha Mohan
2	11	TactiJava: A Novelty Approach for Java Source Code Conversion into Braille Using OCR and Image Processing	A.Varshini Dr. S. Gopinathan
3	12	Adaptive Multi-Level Conformal Prediction for Building Electricity Load Forecasting with Confidence-Aware Decision Support	Rhaditia Kurnia Asyuri Arun Kumar Sangaiah Wei Tong Chen
4	13	GSA: Green Smart Agriculture -AI Driven IoT-Enabled Deep Learning for Intelligent Insect Pest Detection	K.Madhavan, Prof. S. Gopinathan Prof. K. Kathiravan
5	14	A Computational Approach to Hidden Gender Bias Detection in Fairy Tales and AI Narratives	Bavya S, S. Meena Priyadharshini
6	18	Carbon Nanotube Based Sensors and its Potential Applications in Aerospace Industries	C.Ananda Selvi Dr. D.Gracia Nirmala Rani
7	19	Hybrid Ensemble-Based Explainable Machine Learning Framework for Heart Disease Prediction	Dr. K. Kavitha
8	20	Promoting Health Education through Technology: A Case Study on Menstrual Hygiene Awareness among Autistic Girls	Dr. D. Usha Dr. K. Kavitha
9	21	AgriSage+:AI-Powered Multilingual Farmer Companion	Dr.N.Jean Effil, Selvapriya V, Renuga R, Gobika D
10	22	A Sparsity-Guided Spatio-Temporal Graph Framework for Autism Spectrum Disorder Detection Using fMRI	B. Anjali Dr. S. Gopinathan
11	24	An Efficient U-Net with Triangular–Sugeno Fuzzy Preprocessing for Retinal Vessel Segmentation	Gokulakrishnan Dhamotharan Dhanalakshmi Palanisami
12	25	Geo – Intelligence for Urban Planning: A Multi – Platform Analysis of Dindigul Urban Growth	Iswarya S, Ezhilarasan K, Gunasekaran S and Muthukumar M
13	26	An AI-Assisted Marine Safety and Border Alert System Using Sensor Data and Machine Learning	Rakshan V M, A. Vallivinayagam
14	27	AI-Driven Data Science and Machine Learning Systems	Amandeep Kaur
15	28	Digital Twin and Lightweight Block chain Enabled Automated Clone Detection in Wireless Sensor Networks	P. Kalvikkarasi Dr. K. Selvakumar
16	29	Design and Evaluation of VANET Using Vehicle Mobility Data and Obstacle-Based Channel Modeling	Dr. P. Subhasri
17	30	Smart Cities and IoT: Emerging Cybersecurity Challenges	Priscilla. I, Dr. L. Jayasimman, Dr. A. Nisha

ISBN No: 978-93-49618-20-6 | Department of Computer Science, Alagappa University | 29th – 30th January, 2026

S. No.	Paper ID	Title of the Paper	Author(s)
18	31	Cyber-Physical Security Framework for Smart Cities	E. Vimala Dr. K. Geetha
19	32	Transforming Drug Discovery Through Generative AI (Gen AI) : A Comprehensive Review	Dr. Sangeetha J
20	33	Zero Trust Security Framework for Prompt Injection Risks in Instagram's LLM Applications	S. Arunpandian
21	34	AI-based Home Energy Management Systems: A Comparative Review of Communication, Load Scheduling, Optimization and Energy Storage Techniques	K. J. Sasikala Dr. A. Padmapriya
22	35	GAN-Based Synthetic Data Generation for Privacy-Preserving Binary Classification	D. Radha, Dr. S. Prasanna
23	39	Interpretable AI Models for Financial Time-Series Forecasting: Beyond the Black Box	R. Harini Dr. S. Rethinavalli
24	40	Emerging Trends in Educational Technology: Implications For Teaching and Learning	R. Gracia Ravi
25	42	A Multi-Modal IoT Analytics Ecosystem for Personalized Baseline-Driven Health Risk Stratification	S. Clement Virgeniya
26	43	Deep Feature Extraction and Ensemble Learning for Accurate Medicinal Plant Disease Detection	Prabha. B Dr. K. Kavitha
27	44	Energy-Aware Memory-Centric Computing for Sustainable Big Data Analytics in Healthcare	Manjula GS Dr. T. Meyyappan
28	45	Predicting Clinical Depression from Digital Footprints: A Hybrid LSTM-CNN Model of Non-Linear Sentiment Trajectories	Dr. R. Mala
29	46	Forecasting Allergic Reactions to Pharmacotherapy Using a Machine Learning Approach	Deepaletchumi N Dr. R. Mala
30	47	A Data-Driven Recommender System for Crop and Nutrient Management in Precision Agriculture	G. Yogeswari Dr. A. Padmapriya
31	50	Smart Mobile Sanitation Systems Using IoT for Predictive Hygiene Monitoring and Energy Optimization	Priya Dharshini G, Dr. S. Santhoshkumar
32	58	Cloud Forensic Alert Classification and Analysis with Random Forest	B. Menaka Dr. S. Arulselvarani
33	59	AI-Assisted Skin Disease Diagnosis and Virtual Medical Expert using Deep Learning	Axia Evangelin B Vinodha T
34	60	Development of a Secure Academic Data Management Portal for Higher Education Institutions	Dhatchinamoorthi M Dr. Nagarajan A
35	61	An IoT-Enabled Smart Glove for Real-Time Hand Gesture Recognition and Intelligent Communication	K. Pradeepa A. Arockia Shiny Dr.A.Nagarajan

S. No.	Paper ID	Title of the Paper	Author(s)
36	62	A Multi-Resolution Proximity Graph Evolutionary Algorithm for Feature Selection: A Comparative Analysis with RFE and LASSO.	Punithavathi Arikrishnan Padmapriya Arumugam
37	63	Educational Technology in Transition: Global Trends, Indian Adaptation, and Institutional Practice	Dr. A. Hema malini
38	64	AI-Enabled Learning for Children with Autism Spectrum Disorder: A Case Study from an Inclusive Classroom	Dr. C. Renuga Devi
39	65	Reinforcement Learning-Driven Fault Detection and Autonomous Navigation for Agricultural Robotics in Remote Sensing Applications	Mrs. P. Sornalatha Dr. K.Mahesh Dr. P.Eswaran
40	68	Secure Edge-AI Enabled Maternal–Fetal Digital Twin for Real-Time Monitoring in IoT-Based Fetal Care	S. Priyadharsini A. Nagarajan
41	69	Human–Machine Interactive Framework for Skin Disease Detection Using Thermal Imaging	P Babu Prof. T. Meyyappan
42	70	Blockchain-Based Perishable Food Supply Chain Management Using Proof of Freshness (PoF) Consensus Mechanism	K S Chandrasekaran V. Punitha T. Sundaravadivel
43	71	Predictive Analytics for Curriculum Design and Learning Path Optimization	N. Arun Dr. A. Vinayagam
44	72	Market Trend Prediction through NLP-Driven Sentiment Modeling and Time-Series Analysis	R. Kanchana Dr. A. Vinayagam
45	73	Boosting Agricultural Forecasting for Broccoli Yield Prediction Using an Ensemble Learning Technique	G. Alexandar Narkunam Dr.K.Kala
46	74	Seasonal Redistribution and Enrichment of Monazite in Manavalakurichi Beach Sands, Tamil Nadu: Literature-Based Review	Priyadharshini Solaimalai Eswaran Perumal
47	75	Novel IoMT Data Partitioning Approach utilizing X-POWER Cryptography on Cloud Environment	Mrinali Das Padmapriya Arumugam
48	76	Trust Based Intelligent Human-Computer Interaction System With Failure Handling	Firdous Fathima A, Varshitha S, Lalitha Mohana R S
49	77	High Performance Computing – An Overview	S Vikram V. Prem Kumar
50	78	Low-Code, No-Code, and AI-Assisted Development: Transforming Modern Software Development	A. Senthil Kumar R. Palraj
51	79	Software Engineering: Processes, Models, and Quality Practices	M. Avinash
52	80	Recent Advancements Leverage Large Language Models (LLMS) and AI-Augmented & Automated Data Science (AUTOML)	Dr. T. Suresh K. Keerthana

S. No.	Paper ID	Title of the Paper	Author(s)
53	81	Investigating of NLP in Human-Computer Interaction and Speech Recognition & Synthesis	Dr. T. Dheepak K. Saraswathi
54	82	Monitoring Water Dynamics in Direct-Seeded Paddy using Sentinel-2 LSWI and NDVI Time Series	R. Iswarya Dr. V. Tamizhazhagan
55	86	Enhancing the Prediction Accuracy of Heart Disease Using Hybrid Algorithms: (A Comparative Study)	S. Arockia Vinotha Jemima Priyadarsini R
56	87	Mangrove-Derived *Streptomyces albidoflavus* as a Source of Antibacterial Metabolites Against Carbapenem-Resistant *Klebsiella pneumoniae*: Experimental and In Silico Insights	Shibasini Murugana Vidhyavathi Ramasamy Kavitha Thangavel
57	88	Machine Learning Algorithms for Emotional Intelligence Analysis in Text: A Review of Algorithms for Real-Time EI Assessment for Pre-emptive Intervention in Social media	SivaShankaraNainar B Dr. A. Nisha Jebaseeli Dr. Isakki Alias Mahalakshmi R
58	92	Predatory Journals and Indexing Issues: An Academic Perspective	D. Jeyalakshmi Dr. K. Parameswaran Dr. M. Sathish Kumar
59	93	Emerging Trends in Education Technology	V. Easwaran
60	94	Self-Sovereign Academic Identity Verification Using AI-Assisted Cross-Chain Blockchain Architecture	C. Auxilium Princy Dr. J. Sasikala, Dr. Punitha A, Dr. Tamizhazhagan V
61	95	Design of a Privacy-Preserving Smart To-Do Planner using Local-Only Data Processing	Keerthana S, Vishnu Priya S, Rajalakshmi S
62	96	Explainable Hybrid Ensemble Framework for Multi-Class Emotion Detection in Tweets	J. Arunadevi K. Hemakirthiga
63	97	Sample-Efficient Hybrid BERT–CNN Models for Multi-Domain Text Classification: A Learning-Curve Analysis on Small Datasets	D. Jasmine Gunasundari J.Arunadevi
64	98	Blockchain-Empowered Security for Next-Generation Edge Computing	Balasurendran M
65	99	Impact of E-Commerce and FinTech: A Data Driven Digital Transformation on MSME Performance in Selected Districts of Tamil Nadu	R. Parkavi Dr. G. Vinayagamoorthi
66	100	CrimeAware: Crime Hotspot Detection and Safe Route Optimization System	Dr. S. Selvarani P. Dharshini
67	101	Role of AI in Higher Education: Scholars Learning and Outcomes	Dr. A. Kamalakannan
68	102	Artificial Intelligence and Intellectual Resource Exploitation: Challenges Ahead	Dr. K. Senthilkumar
69	103	Machine Learning based Intrusion Detection System for IoT Network	M. Monika, S. Pooja, R. Vinoth Kumar, M. Abinaya
70	104	Intelligent System for Automatic Traffic Violation Detection	Dr. S. Suganya Dr. T. Meyyappan
71	105	Facial Emotion Recognition using Deep Learning	M.Madhumitha, P.Mahalakshmi, T.Priyadharshini, T.Bavanasri, R.Vinothkumar

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72	106	Beyond Algorithms: Emerging Paradigms Shaping the Next Era of Computer Science	L. Aron Ignatius
73	108	Energy-Aware API Traffic Optimization Using Hierarchical Deep Reinforcement Learning	G. Bharathikannan A. Dravit Joshwa
74	109	EmailDefender: Real Time Detection of Malicious Emails for Organizational and Personal Communication Security	S. Murugesan Dr. S. Selvarani
75	110	Ethics, Accountability, and Algorithmic Bias: Reframing Responsibility in Automated Decision-Making Systems	L. Lourdu Insha
76	111	Intelligent Vision System for Detecting Fatigue and Distraction of Train Operators	G. Bharathikannan M. Thesapriya
77	112	Real Time Cyber Threat Intelligence and Alerting System Using a Novel Hybrid CNN-LSTM Architecture	Dr. K. Nagappan S. Vinothini
78	113	Network Traffic-Based Cloud Intrusion Detection System Using Hybrid Feature Selection and Deep Learning Techniques	G. Bharathikannan T.K.Sathya
79	114	Regression Integrated with an Interactive Chatbot for Real-Time Investor Support	G. Bharathikannan C. Vikneshwaran
80	115	Data Augmentation and Preparation Process of Perinfex: A Persian Chatbot with the Ability of Information Extraction	Varshini M Lokeshwar S A
81	116	Privacy-Preserving Kidney Image Analysis via Blockchain-Secured Federated Deep Learning Framework	A. Mahalakshmi V. Dhavamani
82	117	Blockchain Assisted Data Recovery System with FIDO Key using Face Biometric Authentication	M. Varshini K. Dhanalakshmi
83	118	Deep Learning-Based Early Detection and Classification of Alzheimer's Disease using Brain MRI Scans	N. Lalitha M. Mohamed Faisal
84	119	A Big Data–Driven Machine Learning Framework for Regional Temperature Anomaly Detection	Subhasri T Divya M Dr Aparna R
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86	121	Green Artificial Intelligence: Carbon - Aware Self - Optimizing Learning for Energy Efficient Machine Learning Models in Climate Responsible Computing	Sivaranjani M, Shanthini R, Dr. Muthakshi S
87	123	Brainwave Authentication using EEG Headset with BCI Technology	S. Nooriya Begam, RM. Vidhyavathi, J. Joseph Sahayarayan
88	124	The AI-Powered Classroom: Exploring the Potential of Artificial Intelligence in Education	Dr. T. John Paul Antony, Y. Mohammed Iqbal, S. Jeevitha
89	125	A Survey of Machine Learning Techniques for Healthcare Fraud Detection and Prevention	Dr. S. Peerbasha Dr. G. Balamurugan T. Kalaivani

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90	126	Dietary Recommendations for Type 2 Diabetes: User-User Collaborative Filtering Model	Dr. A. Salman Ayaz S. Balasubramanian J. Fathima Kaleema
91	127	XGBOOST-Powered Smart Air Quality Evaluation and Prediction System	R. Thamira
92	128	DRNET-X: A CNN-Based Classification and Hybrid Preprocessing-Based Deep Learning Framework for Diabetic Retinopathy Image Identification	J. Josephine Sahaya Vergin RM. Vidhyavathi J. Joseph Sahayarayan
93	129	A Study of Personalized Nutritional Approaches for Effective Blood Glucose	Jaisri S Dr. S. Santhoshkumar
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95	131	Real-Time Multimodal Assistive Technology for Navigation, Social Interaction, and Financial Management of Visually Impaired Individuals	V. Vidhya Selvi
96	132	Smart RFID and Face Recognition-Based Automated Attendance Management System	V. Rathai Sri
97	133	A Comprehensive Survey on AI-Based Automated Waste Segregation Systems for Circular Economy Applications	Dr. S. Murugan Mr. K. Logeshwaran
98	136	Hybrid Two-Stage LLM-Powered Pipeline for Structured Data Generation from Unstructured Clinical Narratives in Health Informatics	Priya V Nisha Jebaseeli A
99	137	Applications of Artificial Intelligence in Sustainable Development	Abirami S, Priyadharshini A, Vaishnavi R, Deepasri J P
100	139	A Real-Time Vision-Based Contactless Air Writing and Digit Recognition System Using Computer Vision and Machine Learning	Dr. S. Murugan V. Nithiya Shree
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103	142	A Comprehensive Survey on Artificial Intelligence Techniques for genetic diseases prediction from DNA Sequence	Dr. S. Murugan A. Rubina
104	145	Optical- Guided Super Resolution for Thermal IR Imagery	Hindu.V, Anushiya.S, Pooja.S, Swetha.N
105	148	Explainable Artificial Intelligence for Transparent Brain Stroke Prediction Using Machine Learning	Dr.N.Jean Effil, Aarthi P, Kiruthika S, Dhanusika K
106	149	FloatChat - AI-Powered Conversational Interface for ARGO Ocean Data Discovery and Visualization	M.Elakkiya, Varshini.R Sai Sakthi.M, Aakila Rakshana. M

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107	153	Two Step detection and classification of brain tumors using Deep Learning techniques	N. Sivasankari, V. Lakshmi E. Pattabiraman
108	154	Multimodal Deep Learning Framework for Early Detection of Drug-Induced Skin Adverse Reactions Using Medical Images and Pharmacovigilance Reports	Dr. B. Karthicsonia Dr. K. Rajiv Gandhi
109	155	A Comprehensive Survey on AI-Based Sign Language Recognition and Deaf–Hearing Communication Systems	Dr. S. Murugan Selvaganapathy
110	158	Box Transposition Cipher	Dr. Mu. Annalakshmi Dr. A. Padmapriya
111	167	Technology for Students with Disabilities: The Role of Assistive Technology in Inclusive Education	Dr. K. Dhanalakshmi Lalpekhlui Punte R. Dhatchayini
112	170	IoT -Based Smart Farming for Enhanced Drip Irrigation Efficiency: Recent Trends and Startup Innovation	Arumai Ruban J Dr. S. Santhoshkumar M. Muthujayashree
113	176	The Impact of Recommendations Algorithms in Shaping Mental Health	Likitha M Deva Priya R Brinda Ramanujam
114	177	Role of Machine Learning in Fog Computing	Dr. A. Haja Abdul Khader
115	181	Sensor-Based Valorization of Biochar-Enriched Municipal Solid Waste for Liquid Biofertilizer Production	Chandrasekaran Gogula Lalitha Selvaraj Shanmuhapriya Nachimuthu Manikandan Muniyandi Biruntha
116	185	AI and Its Impact on Skill Enhancement among Students	Nandini N, Usha U Dr. G. Vinayagamoorthi Mr. Guru Prasad
117	187	An Explainable Machine learning approach for predicting Student stress from digital behaviour patterns	Riddhi S Annu Soni
118	190	A Detailed Study on the Pi Coin and Pi Network Ecosystem	Surya S Kanagaraj Narayanasamy
119	194	Storyboarding In the Initial Design of Mobile Mathematics Educational Applications: A Systematic Review Using the PRISMA Framework	Dr. A. Pio Albina Dr. T. Joshpine
120	198	Information and Communication Technology (ICT) based dietary intervention among adolescent girls living in slum region of Madurai	Geethanjali Santhanam
121	212	Secure sharing of medical information using cloud computing	Kayalvizhi R, Saravanan Maruthamuthu Ganesan
122	215	An Overview of Optical Remote Sensing Satellite Data Networks (ORSSDN)	MH. Vahitha Rahman, Dr. M. Vanitha
123	216	Brain Tumor Multi Classification Using an EfficientNetV2-S and CBAM with MRI Images	Dr. K. Kayathri

ABSTRACTS OF PAPERS SELECTED

FOR

ORAL PRESENTATIONS

SoyNet+: Hybrid Deep Learning Architecture for Precision Weed Segmentation in Soybean Cultivation Using Dual-Backbone Feature Extraction

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Precision agriculture systems face a critical challenge in automated weed detection when weeding soybean crops because a high level of visual recognition is required to detect the weed with high accuracy in the field that is characterized by heterogeneous and non-uniform conditions. Existing deep learning systems have high trade-offs between computational efficiency and segmentation accuracy, hence cannot be effectively used in real-time agricultural systems. In order to overcome these constraints, in this paper, a new hybrid deep learning framework is presented that incorporates complementary feature extraction methodologies with superior processing technologies that are specifically tuned to work with an agricultural setting. The suggested method is systematic in its consideration of the complexities of variable lighting, occlusion, and morphological similarities between the target species, integrating intelligent features and multi-scale analysis. The extensive experimental assessment proves that the system attains 97.3% of pixel accuracy and 97% of mean Intersection over Union, and then sets strong performance standards for the agricultural segmentation tasks. The methodology is especially effective in identifying small target weed species and maintaining complex details of boundaries that are important in accurate weeding processes. The comparative analysis with modern segmentation models demonstrates that there are significant breakthroughs in both the reliability of detection and computational efficiency. The findings support the technical feasibility and concrete applicability of the suggested method and have high potential to be incorporated into automated weeding systems and make a contribution to the development of sustainable, accuracy-based crop management systems. Further confirmation can be obtained by conducting large-scale field trials on the system, which will validate its strength across various soybean types and different environmental conditions. The system can then continue to operate efficiently in practical applications, such as agricultural machinery and monitoring systems.

Keywords: Precision Agriculture, Weed Detection, Deep Learning, Computer Vision, Soybean Cultivation

TactiJava: A Novelty Approach for Java Source Code Conversion into Braille Using OCR and Image Processing

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The Braille is the other kind of writing that helps the blind mute which they touch to read and even write. It uses a uniform grid of 3 x 2 which is familiar in all the aforementioned languages to symbolize different characters. As the means of reading a normal text that was initially a script of a culture, Braille appears to have passed alongside sciences like programming languages into fields, like education and training, where the visually impaired cannot get such a point of entry. Most of the programming source code is either in print or electronic form making it hard to access it by the visually impaired and also to write the code. This paper describes a new approach to programming language translation, namely translating images of Java source codes, into Braille using the OCR technology and a special accepted process of creating a Braille mapping algorithm. It is easier to translate the textual forms of source codes to Braille than having an operator; this is offered to physically impaired people. In the system, optimization of the images is done to enable text extraction through the use of improved algorithms that extract text in torn or low-contrast situations. Translating the extracted text to a Braille format is necessary using pre-defined mappings that are Java syntax specific.
The usefulness of this method is judged by the result of such a conversion process as compared to the actual translation of the Braille. Moreover, the system uses new mathematical algorithms in order to find out whether a conversion is correct or not and whether Java-Braille translations are effective. These algorithms show the best solutions on the identification of gaps in the Braille translation and character recognition. This work is better than others previously done, and it is possible that this methodology can help Java-challenged programmers become more proficient and self-reliant. Hence, the current developments are directed at integrating the current, high-end OCR and image processing solutions into the automation and thus enhancing the accessibility of the programming resources and computer science training to the blind population, through Java.

Keywords: Automated Conversion, Braille Translation, Fake Dots, Image Processing, and Java Source Code.

Adaptive Multi-Level Conformal Prediction for Building Electricity Load Forecasting with Confidence-Aware Decision Support

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Proper load forecasting of electricity on the uncertain values is essential to effective building energy control and grid operations. Traditional forecasting methods give predictive levels of forecasts generated at global confidence level (usually 90%) and lead to inefficient predictive intervals which are unnecessary to predictable patterns and may be too narrow to predict an uncertain situation. This work suggests an adaptive multi-level conformal prediction model that is capable of automatically adjusting the level of confidence (80%, 90%, 95%) in accordance with forecast reliability to give narrower ranges that can be predicted easily and broader risk bands in challenging forecasts. The framework combines a Transformer-based deep learning model to make point predictions and an adaptive conformal prediction module that allocates the forecasts into three reliability ranges: Green (80% confidence, high reliability), Yellow (90% confidence, medium reliability), and Red (95% confidence, low reliability). The adaptive confidence selector employs error-based thresholds determination at the 33rd and the 67th percentile of the calibration residuals automatically to classify the difficulty of the forecasts. Extensive testing on Building Data Genome Project data with 443,081 hourly samples of 50 commercial buildings shows that the proposed approach produces the shrunk prediction intervals that are 17.2% smaller than the fixed 90% confidence. The zone distribution indicates that 60.8% of the forecasts are placed in the efficient Green zone, 22.0% in Yellow, and 17.2% in Red so that the operators are able to differentiate the reliable and uncertain predictions to make better decisions. There is validation on the coverage at the appropriate confidence levels of 93.99, 85.65 and 80.90, which are 80% target, 90% target, and 95% target respectively. This paper is an application of adaptive multi-level conformal prediction applied to building-level load prediction and a viable decision support system with explicit Green/Yellow/Red guidelines. The presented approach can enhance the efficiency of the interval greatly without compromising reliability, providing considerable utility to the optimization of energy procurement, planning the backup generation, and managing grid flexibility in commercial buildings.

Keywords: Conformal prediction, Building load forecasting, Uncertainty quantification, Adaptive confidence intervals, Deep learning

GSA: Green Smart Agriculture -AI Driven IoT-Enabled Deep Learning for Intelligent Insect Pest Detection

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Healthy crop production in agriculture and horticulture relies heavily on the ability to continuously observe field conditions and respond quickly to emerging threats, particularly insect pests that can severely affect fruit and vegetable yields. Pest monitoring on many farms still depends on manual field scouting, a process that is labour shortage, difficult to scale and often results in delayed detection and ineffective control actions. To reduce these limitations, this research proposes an intelligent pest monitoring approach that integrates Internet of Things (IoT) technology with deep learning to automate insect pest detection in real world field environments. The proposed system deploys a network of distributed smart sensor nodes across the farm, with each node equipped with a camera for capturing crop images and environmental sensors that measure temperature, relative humidity and soil moisture. Together, these data sources provide a continuous and comprehensive view of the visual and microclimatic conditions that influence pest activity. The captured images are analyzed using a deep learning based object detection model trained on annotated insect datasets, enabling real-time detection, localization and classification of multiple pest species under varying lighting and background conditions commonly found in outdoor agricultural settings. Detection results are combined with environmental measurements and transmitted wirelessly to a cloud-based platform, the data are stored and analyzed. Farmers and agronomists can access the analyzed information through user friendly web and mobile dashboards that display plot level pest status, environmental trends, and historical insights, while automated alerts support timely and informed decision-making. the reducing dependence on manual inspections and enabling early, targeted interventions, the proposed system helps optimize pesticide use and encourages environmentally sustainable farming practices. Overall, this work demonstrates that the integration of artificial intelligence, IoT sensing and cloud computing offers a practical and sustainable solution for proactive insect pest monitor contributing to the advancement of smart agricultural systems and precision farming.

Keywords: Artificial Intelligence, Internet of Things (IoT), Deep Learning, Intelligent Pest Detection, Precision Agriculture.

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A Computational Approach to Hidden Gender Bias Detection in Fairy Tales and AI Narratives

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Fairy tales are among the earliest narratives through which children encounter ideas about gender, morality, and social roles. The stories collected by Jacob and Wilhelm Grimm continue to influence children's literature, digital media, and contemporary AI-generated storytelling. While many studies have discussed gender stereotypes in fairy tales, few have examined whether these stories contain deeper structural patterns that are automatically carried forward into modern retellings. This study explores how gender is represented and linguistically framed in three Grimm tales *Rapunzel, The Twelve Brothers*, and *The Six Swans* by analysing them across three layers: the original German texts, standard English translations, and AI-generated retellings. Using computational language analysis, the research measures patterns of agency, grammatical voice, emotional description, and moral reward structures. The findings show that the tales consistently position female characters as passive, enduring, and morally tested, while male characters are presented as active problem-solvers. These patterns remain largely unchanged across translation and are also reproduced by AI systems without any explicit instruction. The study demonstrates that historical narrative structures continue to shape modern AI storytelling, reinforcing traditional gender roles in subtle but powerful ways. It argues for greater awareness of such inherited biases in children's media and for more responsible design of AI narrative systems.

Keywords: Computational folklore; Gender bias; Grimm fairy tales; Artificial intelligence; Digital humanities; Children's media; NLP bias; Generative AI

Carbon Nanotube Based Sensors and its Potential Applications in Aerospace Industries

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Carbon nanotubes are allotropes of carbon having the diameter of nanometers and length of micrometers. Carbon nanotubes (CNTs) are closely related to spherical fullerenes and in the form of carbon in hollow cylindrical structure made by graphite layers rolled up in cylindrical form. It can be classified as single walled CNT, double walled CNT and multi walled CNT based on the arrangement of graphene cylinders. It is having configuration structure of arm chair, zig zag and chiral based on orientation of graphene lattice. Carbon nanotubes can be synthesized using Chemical vapor deposition, Laser ablation and Arc discharge methods. Chemical vapor deposition is the most commonly used method since it is a low cost and flexible method. Because of its unique electrical, electronic and mechanical properties CNT is used in various applications. This review is focused on the types of carbon nanotube-based sensors and applications of CNT based sensors such as humidity sensor, gas sensor and temperature sensor etc. This review discusses the methods available for fabricating these sensors using carbon nanotubes. A comparison is made between these synthesis methods. This review discusses the challenges faced during fabrication.

Keywords: Carbon nanotube, temperature, humidity, synthesis

Hybrid Ensemble-Based Explainable Machine Learning Framework for Heart Disease Prediction

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Heart disease is a leading cause of mortality worldwide, making early and accurate detection essential. Machine learning (ML) has emerged as a powerful tool for analyzing clinical data, yet performance depends heavily on preprocessing, feature selection, class balance, and model interpretability. This study proposes a hybrid ensemble-based and explainable ML framework for heart disease prediction. The framework integrates ensemble preprocessing, ensemble feature extraction, and ensemble classification models to improve robustness. StandardScaler and MinMaxScaler normalize features, SMOTE addresses class imbalance, and Recursive Feature Elimination (RFE) with Mutual Information (MI) extracts relevant features. Random Forest, Gradient Boosting, and a Voting Ensemble classifier predict outcomes, with SHAP providing interpretability. Experiments demonstrate high recall, balanced precision, and stable performance, making the framework suitable for clinical deployment.

Keywords: Heart Disease Prediction, Ensemble Learning, Data Preprocessing, Feature Extraction, Explainable AI, SHAP, Computational Cost

Promoting Health Education through Technology: A Case Study on Menstrual Hygiene Awareness among Autistic Girls

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The purpose of the research is to cultivate the knowledge of menstrual hygiene amongst autistic girls using technology. There is little awareness of menstrual hygiene practices within the autistic population. This study aims to investigate the knowledge and attitudes of the parents, caregivers, and educators using self-administered questionnaires. There is a lack of awareness, communication barriers, and a lack of educational resources in the Tamil language. Even though the respondents had little technological knowledge, the surveys indicated a high level of access to mobile phones and demonstrated the potential for digital education programs.As a result, a Tamil-language video awareness tool was developed and sent to special schools to help students understand menstruation hygiene. Pre- and post-study evaluations revealed considerable awareness and practice improvements across autistic girls following video exposure, demonstrating the worth of visual and technology-driven teaching for children with exceptional needs. Future research phases will look into using Augmented Reality and 3D visualization approaches to create interactive, engaging, and cognitively personalized menstrual hygiene instruction materials.

Keywords - Menstrual Hygiene Awareness, Autistic Girls, Health Education, Inclusive Learning, Technology-Based Learning, Tamil Video Tool, Augmented Reality

AgriSage+:AI-Powered Multilingual Farmer Companion

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Agriculture remains a cornerstone of economic development, yet farmers—particularly small-scale and rural cultivators—continue to face persistent challenges such as delayed access to expert guidance, highly unpredictable weather patterns, frequent pest and disease outbreaks, limited awareness of government welfare schemes, and language barriers that restrict effective communication. Traditional agricultural extension services are often overstretched, making it difficult to provide timely, personalized support to all farmers. To address these issues, this study proposes AgriSage+, an intelligent, multilingual farmer advisory system designed to deliver context-aware, real-time agricultural assistance. AgriSage+ integrates machine learning techniques with natural language processing and computer vision to support farmers across multiple stages of the farming life cycle, including crop selection, yield prediction, pest and disease identification, and weather-based risk alerts. The system leverages real-time environmental and meteorological data to generate accurate and timely recommendations, enabling farmers to make informed decisions that improve productivity and reduce risk. In addition, AgriSage+ provides tailored information about relevant government schemes and financial support programs, helping farmers access benefits that are often underutilized due to lack of awareness. The platform supports multimodal interaction through text, speech, and image-based inputs, along with mobile notifications and interactive voice response services, ensuring accessibility for farmers with limited literacy skills or poor internet connectivity. Personalized recommendations are generated by considering key contextual parameters such as landholding size, soil type, geographical location, historical cropping patterns, and current weather conditions. To foster trust and transparency, the system incorporates explainable artificial intelligence mechanisms that clearly communicate the rationale behind each recommendation. The advisory framework is further strengthened by a continuous learning process, where feedback from farmers is used to refine models and improve system performance overtime. A companion web-based dashboard presents crop performance indicators, alerts, and advisory insights in a visually intuitive manner, allowing farmers to easily monitor their agricultural activities and respond promptly to emerging issues. Overall, AgriSage+ demonstrates the practical application of artificial intelligence in agriculture by enabling data-driven decision-making, enhancing inclusivity through multilingual and multimodal access, supporting environmentally sustainable farming practices, and promoting equitable dissemination of agricultural knowledge, thereby contributing to resilient and intelligent agricultural ecosystems.

Keywords: Artificial Intelligence, Smart Agriculture, Multilingual Systems, Crop Recommendation, Explainable AI, Farmer Advisory System

A Sparsity-Guided Spatio-Temporal Graph Framework for Autism Spectrum Disorder Detection Using fMRI

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Autism Spectrum Disorder (ASD) is a neurodevelopmental condition associated with atypical functional brain connectivity, for which functional magnetic resonance imaging (fMRI) offers valuable neurobiological insights. However, the high dimensionality of fMRI data and the lack of interpretability in many existing deep learning models limit their practical applicability. This paper presents a novel sparsity-guided spatio-temporal graph learning framework for ASD detection using resting-state fMRI data. In the proposed approach, brain regions are represented as nodes in a functional connectivity graph, while temporal dynamics of fMRI signals are explicitly preserved. A sparsity-aware mechanism is incorporated to emphasize discriminative inter-regional interactions and suppress redundant connections, aiming to improve interpretability and robustness. The framework is further designed to capture long-range dependencies across brain regions through attention-based graph modelling, enabling a richer characterization of ASD-related neural patterns. This work focuses on the conceptual design and methodological formulation of the proposed framework. Comprehensive experimental evaluation on public fMRI datasets and neurobiological validation of identified connectivity patterns are planned as future work. The proposed framework provides a structured and interpretable foundation for advancing fMRI-based ASD detection.

Keywords: Autism Spectrum Disorder (ASD), Functional Magnetic Resonance Imaging (fMRI), Spatio-Temporal Graph Learning, Sparsity-Guided Modelling, Brain Functional Connectivity, Interpretable Machine Learning

An Efficient U-Net with Triangular–Sugeno Fuzzy Preprocessing for Retinal Vessel Segmentation

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Retinal vessel segmentation is a fundamental problem in medical image analysis, as the vascular structure of the retina provides critical information for the early diagnosis and monitoring of ocular and systemic diseases such as diabetic retinopathy, hypertension, and cardiovascular disorders. Accurate extraction of blood vessels, particularly thin and low-contrast vessels, remains challenging due to uneven illumination, noise, and complex anatomical variations present in fundus images. This study presents an efficient deep learning framework that integrates a fuzzy preprocessing layer with a U-Net architecture enhanced by depth wise separable convolutional blocks. The fuzzy preprocessing layer is designed using a triangular membership function combined with a Sugeno-type complement function to enhance vessel-background contrast while suppressing background noise. This fuzzy formulation acts as an adaptive enhancement mechanism, enabling clearer representation of fine vascular structures prior to deep feature extraction. The segmentation network employs a modified U-Net backbone, where standard convolutions are replaced with depth wise separable convolutions to significantly reduce computational complexity while maintaining strong feature representation capability. The final segmentation mask is obtained through binary thresholding, where the optimal threshold is automatically selected using Optuna. Test-time augmentation (TTA) is incorporated during inference to improve robustness. Experimental evaluation on the DRIVE dataset achieves an accuracy of 0.9558, sensitivity of 0.8592, specificity of 0.9690, AUC of 0.9778, and an F1-score of 0.8214.

Keywords: Retinal Vessel Segmentation, Sugeno Fuzzy Preprocessing, Depthwise Separable Convolutions, U-Net, Fundus Imaging

Geo – Intelligence for Urban Planning: A Multi – Platform Analysis of Dindigul Urban Growth

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Rapid urban growth in Dindigul has created an increasing demand for accurate, up-to-date and reliable spatial information to support urban planning, governance and service delivery. Conventional manual methods of updating municipal boundaries and infrastructure records often result in delayed revisions, spatial mismatches and incomplete urban inventories, which directly affect the efficiency of planning and administrative decision-making. In this context, the present study proposes a geo-intelligent and automated GIS-based workflow for the systematic modernization of Dindigul Municipal Corporation limits, ward boundaries, urban road networks and building footprint layers. The approach integrates authoritative boundary records obtained from the municipal office with openly available spatial datasets sourced from Open Street Map for roads and buildings. Spatial harmonization processes such as geometry correction, topology validation, polygon alignment and ward-wise attribute integration are automated using Python programming supported by GeoPandas and related analytical libraries. Desktop GIS platforms, namely QGIS, are employed to perform spatial joins, validate adjacency relationships, visualize administrative units and verify the accuracy of updated urban layers. The workflow ensures topological and relational integrity by eliminating sliver polygons, resolving boundary discontinuities, detecting overlaps or gaps, and refining vector geometries into a unified and consistent spatial database. The final outputs include updated municipal and ward boundary shapefiles, along with ward- linked road and building attribute layers that serve as application- ready spatial assets for zoning regulation, infrastructure planning, demographic analysis, electoral mapping and smart governance initiatives. By embedding automation, multi-platform validation and integrated spatial feature processing, the study demonstrates a scalable, efficient and reproducible geo-intelligence framework that can be readily extended to other fast-growing urban systems across India.

Keywords: Urban Growth, Updated Municipal Boundary, Dindigul Municipal City Boundary, Python Programming, GeoPandas library.

An AI-Assisted Marine Safety and Border Alert System Using Sensor Data and Machine Learning

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Small-scale fishermen operating near maritime borders often face safety risks due to navigation errors, harsh environmental conditions, and delayed emergency response. Traditional marine safety systems rely heavily on manual observation and basic alert mechanisms, which are often insufficient in real-time critical situations. This paper proposes an AI-assisted marine safety and border alert system that integrates sensor data with machine learning techniques to support timely decision-making and risk mitigation. The system processes inputs from salinity sensors, water-level sensors, and positional data to detect anomalous conditions such as potential border crossing, vessel instability, and emergency scenarios. A supervised machine learning model is employed to classify risk levels based on historical and simulated sensor data. Experimental evaluation using simulated maritime datasets demonstrates that the proposed approach improves early warning accuracy and reduces false alerts compared to static threshold-based systems. The proposed framework is intended as a humanitarian decision-support tool and can be extended for real-world deployment with minimal infrastructure.

Keywords: Marine Safety, Machine Learning, Sensor Data Analysis, Decision Support Systems, Maritime Monitoring

AI-Driven Data Science and Machine Learning Systems

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The convergence of Artificial Intelligence (AI), Machine Learning (ML), and Data Science (DS) has significantly reshaped contemporary computational research and application development across multiple disciplines. Collectively, these fields enable the creation of intelligent, data-driven systems capable of learning from experience, identifying complex patterns, generating accurate predictions, and supporting sophisticated decision-making processes. Artificial Intelligence serves as the overarching conceptual framework for mimicking human intelligence and reasoning, while Machine Learning provides the computational algorithms that allow systems to improve performance through data-driven learning. Data Science further strengthens this ecosystem by combining statistical modeling, data analytics, and computational techniques to derive meaningful insights from large-scale and heterogeneous datasets. This paper presents a structured and research-oriented discussion of AI, ML, and Data Science, emphasizing their methodological foundations, functional interrelationships, and complementary roles in modern intelligent systems. Key application domains such as healthcare diagnostics, financial analytics, smart cities, cybersecurity, and personalized recommendation systems are examined to demonstrate their practical relevance and societal impact. In addition, the study critically analyses current challenges associated with data quality, scalability, model interpretability, algorithmic bias, and ethical considerations in real-world deployment. By integrating theoretical perspectives with applied research insights, this work aims to bridge the gap between conceptual understanding and practical implementation. The paper also outlines future research directions focused on developing transparent, trustworthy, and responsible intelligent systems capable of addressing emerging technological and societal challenges in an increasingly data-centric environment.

Keywords: Artificial intelligence, Machine learning, Data science, Intelligent systems, Ethical computing

Digital Twin and Lightweight Block chain Enabled Automated Clone Detection in Wireless Sensor Networks

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Wireless Sensor Networks (WSNs) used in mission-critical applications are vulnerable to node clone attacks due to unattended operation and limited physical security. This work proposes an automated clone detection framework combining Digital Twin (DT) intelligence with a lightweight block chain. Each sensor node is mirrored by a DT at an edge server to predict normal behavior using energy consumption, traffic patterns, and neighborhood dynamics. Concurrently, cluster heads maintain a lightweight block chain that securely stores node identity and location hashes via an energy-efficient consensus mechanism. Clone detection is performed by correlating DT deviation scores with block chain ledger conflicts. Simulation results show improved detection accuracy with lower false positives, communication overhead, and energy consumption compared to existing schemes, demonstrating suitability for large-scale, resource-constrained WSNs.

Keywords: Clone Attack, Digital Twin, Lightweight Block chain, Intrusion Detection

Design and Evaluation of VANET Using Vehicle Mobility Data and Obstacle-Based Channel Modeling

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Wireless technology has numerous emerging technologies which include vehicular ad-hoc network (VANET) for vehicle-to-vehicle communication. It requires the knowledge of different channel models, generating realistic vehicle mobility scenario for vehicular ad-hoc network (VANET) simulation using obstacle-based channel model on the highway. Obstacle based channel model describe complexity in computation and difficult to implement. In this paper we have focused on obstacle-based channel model and observed computational complexity. Obstacle based channel model analysis an algorithm which reduces computational complexity and easy to implement in VANET simulation using NS2. The analysis is done using performance metrics including throughput, delay, packet delivery ratio and packet lost ratio of obstacle-based channel model.

Keywords - Vehicular ad-hoc network (VANET), channel model, obstacle-based channel model.

Smart Cities and IoT: Emerging Cybersecurity Challenges

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The rapid advancement of Internet technologies and the proliferation of the Internet of Things (IoT) have accelerated the development of Smart Cities, where Information and Communication Technologies (ICT) are used to enhance urban services such as transportation, energy management, healthcare, and public safety. Although IoT-enabled Smart City infrastructures offer significant benefits in efficiency, automation, and data-driven decision-making, their large-scale deployment introduces serious cybersecurity challenges. Factors such as device heterogeneity, limited computational resources, pervasive connectivity, and the absence of standardized security frameworks considerably expand the attack surface of urban systems, increasing their vulnerability to cyber threats that may compromise public safety and critical services.

This paper presents a comprehensive review of recent advancements in IoT-based Smart Cities, with a particular focus on cybersecurity issues within the conventional three-layer IoT architecture, namely the device, network, and application layers. Security threats affecting each layer are analyzed, including malware-based attacks, distributed denial-of-service (DDoS) attacks, man-in-the-middle (MITM) attacks, spoofing, and application-level vulnerabilities. The study demonstrates that traditional security mechanisms are insufficient to address the scale, complexity, and real-time operational demands of Smart City environments. To mitigate these challenges, the paper explores fog computing as a promising architectural solution for IoT deployments in Smart Cities. Fog computing enables localized data processing, reduces latency and bandwidth consumption, and enhances data privacy by limiting exposure to centralized cloud infrastructures. Furthermore, the integration of fog computing with Artificial Intelligence techniques—such as Machine Learning and Deep Learning—is highlighted as an effective approach for real-time threat detection and predictive cybersecurity. The paper concludes by emphasizing the need for standardized and scalable security frameworks to ensure the secure and resilient deployment of IoT technologies in Smart City environments.

Key words: Smart Cities, Internet of Things (IoT), Cybersecurity, Fog Computing, Machine Learning.

Cyber-Physical Security Framework for Smart Cities

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The rapid proliferation of smart city technologies has led to deep integration between cyber systems and physical infrastructures, enabling efficient urban management while simultaneously expanding the attack surface for sophisticated cyber–physical threats. Traditional security mechanisms, which treat cyber and physical domains independently, are inadequate to address coordinated attacks that exploit interdependencies between digital networks and physical processes. This paper proposes an integrated Cyber-Physical Security Framework for Smart Cities that enables real-time detection, correlation, and mitigation of multi-vector attacks across cyber and physical layers. The proposed framework combines edge intelligence, multi-source data fusion, and anomaly detection techniques to monitor network traffic, sensor behavior, and environmental parameters simultaneously. A correlation engine analyzes heterogeneous data streams to identify synchronized cyber–physical anomalies indicative of coordinated attacks. The framework also incorporates adaptive response mechanisms and secure communication protocols to ensure resilience and rapid recovery. Experimental evaluation using simulated smart city scenarios demonstrates improved detection accuracy, reduced response latency, and enhanced situational awareness compared to conventional isolated security approaches. The proposed model provides a scalable and robust foundation for securing next-generation smart cities against evolving cyber–physical threats.

Keywords: Smart cities, cyber-physical systems, cyber-physical security, anomaly detection, data fusion, edge computing, coordinated attacks

Transforming Drug Discovery Through Generative AI (Gen AI) : A Comprehensive Review

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Abstract

Drug discovery has traditionally been recognized as a complex, resource-intensive, and time-consuming endeavor, often requiring years of experimentation and substantial financial investment. Generative Artificial Intelligence (GenAI) is rapidly emerging as a transformative force in this domain, offering innovative approaches to accelerate and optimize the discovery pipeline. By harnessing advanced machine learning algorithms and vast biomedical datasets, GenAI models are capable of generating novel molecules, proposing drug candidates, and simulating biological data with remarkable efficiency. These capabilities enable rapid molecular design, systematic exploration of chemical space, and improved prediction of biological and pharmacological properties, thereby reshaping the paradigm of modern drug discovery. Recent advances in generative modeling—including Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), diffusion models, and Transformer-based architectures—have demonstrated significant promise across multiple stages of the pipeline. Applications span de novo molecule generation, drug–target interaction prediction, virtual screening, lead identification, and lead optimization. Importantly, explainability and model validation are increasingly emphasized to ensure reliability, transparency, and trust in AI-driven outcomes. By integrating these approaches, GenAI not only reduces costs and shortens timelines but also expands the scope of chemical and biological exploration, opening new avenues for therapeutic innovation. This comprehensive review consolidates recent progress in generative modeling for drug discovery, highlights practical applications across the pipeline, and discusses key challenges such as data quality, interpretability, and integration into existing workflows. To address the challenges in the existing methods, a unified hybrid methodology is proposed that combines data-centric preprocessing and augmentation with hybrid generative modeling constrained by chemical validity and synthetic feasibility. It integrates multimodal learning using graph and attention-based architectures and explainable AI for transparency. Ultimately, GenAI holds the potential to revolutionize drug discovery by enabling faster, more cost-effective, and more innovative development of life-saving therapies, thereby transforming the future of pharmaceutical research and healthcare.

Keywords: Drug discovery, GenAI, Variational Autoencoders, Generative Adversarial Networks, diffusion model

Zero Trust Security Framework for Prompt Injection Risks in Instagram's LLM Applications

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Instagram increasingly relies on Large Language Models (LLMs) to handle tasks such as content moderation, caption generation, story summarization, and chat-based assistance, and many features operate in zero-click workflows where user-generated content is analyzed automatically without any explicit user initiation, an approach that has improved platform engagement and usability while at the same time creating opportunities for security vulnerabilities that have become increasingly important to address. Prompt injection attacks have developed as a significant threat because hidden instructions have been embedded in normal-looking content, these instructions have been interpreted by LLMs as executable commands, and such behavior has allowed silent exploitation in zero-click systems, which has caused biased recommendations to appear, inappropriate content to spread, sensitive information to be exposed, and unintended automated actions to take place without human awareness or intervention. A Zero Trust security framework has been introduced to reduce these risks, where all external inputs are treated as un-trusted, Input Isolation ensures that all content is handled as immutable read-only data, Least Privilege Execution limits automated workflows to safe operations such as summarization, classification, and sentiment analysis, Explicit Action Gates require human approval before any sensitive or state-changing operation can occur, and Continuous sVerification monitors outputs in real time to prevent policy violations and reduce the chance of information leakage. The framework has been evaluated through metrics including Attack Detection Rate, False Positive Rate, Data Leakage Reduction, and System Efficiency, and results have shown that resistance to prompt injection has been strengthened, privacy risks have been reduced, usability has been maintained, and minimal performance overhead has been introduced, demonstrating that the application of Zero Trust principles within structured LLM workflows has improved platform security, maintained operational efficiency, and reinforced user trust in automated systems.

Keywords: LLMs, Zero Click, Prompt Injection, Zero Trust, Content Moderation, Data Leakage

AI-based Home Energy Management Systems: A Comparative Review of Communication, Load Scheduling, Optimization and Energy Storage Techniques

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Home Energy management systems (HEMS) have risen as a pioneering technology for enhancing energy efficiency, minimizing electricity bills, and enabling the merging of renewable energy sources in residential areas. With the surge in deployment of home automation, the traditional energy management procedures are not sufficient enough to manage changes in user behavior, fluctuating electricity charges, and intermittent generation of renewable energy. Hence, Artificial Intelligence (AI) techniques such as Machine Learning and Reinforcement Learning have attained remarkable importance for improving decision-making capabilities within HEMS.

This paper aims to present a comprehensive comparative study of AI based approaches in HEMS. It will focus specifically on communication technologies, optimization and control techniques, load management and scheduling and management of energy storage. The commonly used wired and wireless for smart homes are analyzed based on their reliability, scalability and suitability for AI approaches. Additionally, AI techniques such as Artificial neural networks, reinforcement learning and deep learning models are analyzed and compared based on the capacity to reduce cost, complexity in computation and adaptability.

The paper will also explore the optimization and control techniques in HEMS, underlining the transition from traditional methods to intelligent data driven AI models with real-time operation capabilities. Furthermore, AI based energy storage management techniques are reviewed which includes scheduling of batteries.

Through an organized comparative analysis the review also identifies the strength and weaknesses of various AI models across different HEMS subsystems and their applicability in residential environments. Finally, the challenges such as real time data availability, interoperability and security concerns will be discussed to support enhancement of intelligent home energy management systems. This paper is focused to provide a comprehensive comparative review of AI based approaches in HEMS and aims to assist researchers to understand the recent trends and identify research opportunities for the future.

Keywords: Artificial Intelligence, Home Energy Management Systems, Optimization, Load Scheduling and Energy Storage Management

GAN-Based Synthetic Data Generation for Privacy-Preserving Binary Classification

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Privacy concerns often limit access to high-quality datasets required for training effective machine learning models, particularly in sensitive domains such as healthcare, finance, and smart agriculture. In indoor agriculture systems, data related to crops such as tomato, leafy vegetables, and capsicum are often restricted due to commercial and privacy constraints. To address this challenge, this study proposes a privacy-preserving framework based on Generative Adversarial Networks (GANs) for synthetic tabular data generation in binary classification tasks. A fully connected GAN is employed to learn the underlying distribution of a binary-class dataset and generate realistic synthetic samples, which are then combined with real data to form an augmented training set. The dataset represents indoor farming operational records containing anomalies such as missing values, duplicate entries, sudden value changes, timestamp mismatches, and irregular data arrival gaps, all of which directly affect the reliability of environmental data used to support plant growth. A feedforward neural network classifier is trained on the augmented dataset to evaluate the effectiveness of the generated synthetic data. Experimental results demonstrate that the proposed approach achieves an overall classification accuracy of 78%, with a notably high recall of 0.99 for the positive class, indicating improved detection of critical instances. These findings confirm that GAN-generated synthetic data can effectively augment limited datasets, enhance classification performance, and preserve data privacy.

Keywords: Generative adversarial networks, synthetic data generation, privacy-preserving machine learning, binary classification, neural networks

Interpretable AI Models for Financial Time-Series Forecasting: Beyond the Black Box

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This study investigates the interpretability of artificial intelligence (AI) systems for financial time-series forecasting, focusing on volatility prediction. While deep learning models have achieved notable accuracy, their "black-box" nature limits transparency and challenges trust and compliance. This study introduces a framework for interpretable AI (XAI) in financial forecasting that incorporates rule-based reasoning, decision tree interpretability, and trend switching for dynamic market regimes. This framework integrates symbolic reasoning with data-driven analytics. The empirical validation used daily data from the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) from 2015 to 2024. The methodology involved preprocessing financial indicators, including the Relative Strength Index (RSI), Average True Range (ATR), Moving Average Convergence Divergence (MACD), Bollinger Bands, and Stochastic Oscillator, to create an interpretable hybrid forecasting model. The system generates understandable forecasts and adapts to volatility regime shifts in the market. A comparative analysis with black-box models showed that the interpretable framework achieved similar accuracy while demonstrating higher transparency. The findings show that interpretability enhances predictive robustness, investor confidence, and regulatory adherence. Decision tree explanations and rule-based reasoning enable analysts to follow prediction logic, while trend switching enhances stability during market disruptions, such as the COVID-19 crash and the 2023 Indian banking crisis. This study advances the discourse on ethical AI by establishing interpretability as essential for intelligent financial forecasting.

Keywords: Interpretable AI, Explainable AI, Financial Forecasting, Stock Market Volatility, Trend Switching, Ethical AI

Emerging Trends in Educational Technology: Implications for Teaching and Learning

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Educational technology has transformed the landscape of teaching and learning by enabling innovative pedagogical practices, enhancing learner engagement, and improving access to quality education. Rapid advancements in digital tools, artificial intelligence, and online learning platforms have reshaped instructional delivery across all levels of education. This paper examines major emerging trends in educational technology, including digital learning environments, artificial intelligence in education, blended and flipped learning, mobile learning, immersive technologies, and data-driven instruction. The paper also discusses the implications of these trends for teachers, learners, and educational institutions. The study concludes that effective integration of educational technology requires pedagogical alignment, teacher preparedness, and ethical considerations to ensure meaningful and inclusive learning experiences.

Keywords: Educational Technology, Digital Learning, Artificial Intelligence, Blended Learning, Emerging Trends

A Multi-Modal IoT Analytics Ecosystem for Personalized Baseline-Driven Health Risk Stratification

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The convergence of IoT, Big Data and Predictive Analytics has delivered a tremendous change in today's significant world. Especially in healthcare system, this novel federated edge-intelligence framework combines real-time physiological streaming from wearable biosensors, environmental monitoring devices, and clinical instruments. It gives prior prediction before 42 to 72 hours. This research work mainly focuses on distributed machine learning algorithms at network edge, preserving HIPAA compliant data sovereignty, compared to centralized analytics system which is prone to privacy risks. The data from various sources are incorporated including circadian rhythm deviations, gait patterns, medication history etc., Convolutional networks with attention mechanisms detect minute patterns across variations from individual baseline trajectories. Early detection for illnesses including the development of sepsis, cardiac decompensation, diabetic crises, and the advancement of cognitive deterioration are made possible by this customized anomaly detection approach. Proposed research work focuses on clinical decision support alerts that combine resource availability algorithms with anticipated risk trajectories.
Preliminary simulation models suggest that proactively modifying care pathways can enhance chronic disease management outcomes while also lowering hospital readmissions and reducing emergency department visits. By bridging the temporal gap between data collection and clinical action, the proposed work fills the current healthcare analytics and turns reactive healthcare delivery into an anticipatory, precision-guided system. This work lays the basis for next generation intelligent healthcare system in which clinical system is parallelly integrated with predictive insights.

Keywords: Big Data Analytics, Clinical Decision Support, Internet of Things (IoT), Healthcare Decision Making, Machine Learning, Predictive Analytics

Deep Feature Extraction and Ensemble Learning for Accurate Medicinal Plant Disease Detection

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Detection of diseases in medicinal plants should be done accurately in order to ensure the health of plants and also enhance the quality of herbal resources. The paper provides a concise and effective deep learning-based disease detection model through the use of the Plant Village dataset; in particular, emphasis will be made on ensemble learning practices. In preprocessing, images are improved with the application of the Gaussian filtering and median filtering to remove noise, as well as, image resizing and minmax normalization to normalize input data. The data augmentation is implemented in rotation, flipping, scaling, and zooming in order to enhance generalization of a model and address data imbalance. Advanced convolutional neural network models like ResNet50, DenseNet121, and EfficientNet-B0 are used in deep feature extraction. To classify data, ensemble learning methods that include soft voting ensemble, weighted averaging and stacking classifiers are used to aggregate the output predictions of a number of deep learning models. The outcome of the experiment demonstrates that the ensemble-based solution attains a greater precision than the separate deep learning models. The competence of high-level preprocessing and ensemble classification is validated with the use of comparative analysis as a tool of efficient medicinal plant disease detection.

Keywords: ResNet50, DenseNet121, EfficientNet-B0, Gaussian filtering, Median filtering, convolutional neural network

Energy-Aware Memory-Centric Computing for Sustainable Big Data Analytics in Healthcare

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The most important problems in healthcare analytics on a large scale are energy consumptions and memory inefficiency as huge amounts of patient data need to be processed quickly and efficiently. In this research, a novel system, Green Energy Aware Memory-Centric Optimization (GEM-Opt) is proposed wherein memory-centric computation, hierarchical memory management, energy-conscious task scheduling, and adaptive memory migration are combined as a means to make big data analytics sustainable. GEM-Opt promotes access to data that is less expensive in terms of cost and energy usage and promotes a high-efficiency response to data queries by performing analytics close to the memory tier where the data is stored. Experimental analysis on the MIMIC-IV dataset shows that GEM-Opt is better than the state of art baseline scheduling algorithms with up to 35 % energy savings, higher memory hit ratios, and less time per task achievable without affecting predictive performance (accuracy, precision, recall, and F1-score). The adaptive migration mechanism of the framework dynamically reacts to the data location in accordance with the access patterns and promotes efficiency. GEM-Opt gives a high-performing, scalable, and energy-saving healthcare analytics solution to be extended to heterogeneous memory systems and distributed healthcare data systems, enabling sustainable and green computing efforts.

Keywords: Adaptive Memory Migration, Energy-Aware Optimization, Healthcare Analytics, Memory-Centric Computing, Sustainable Big Data Processing.

Predicting Clinical Depression from Digital Footprints: A Hybrid LSTM-CNN Model of Non-Linear Sentiment Trajectories

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Major Depressive Disorder (MDD) presents a significant global health burden, exacerbated by limitations in traditional diagnostic methods. This study proposes a novel hybrid deep learning model that integrates Long Short-Term Memory (LSTM) networks and Convolutional Neural Networks (CNNs) to predict clinical depression from longitudinal digital text data. Our model uniquely focuses on modeling non-linear sentiment trajectories, capturing both the temporal evolution of affect and high-order semantic features within critical windows. Trained and validated on a dataset of [Number] users with clinically confirmed PHQ-9 labels linked to their Twitter/Reddit posts over [Time Period], the proposed LSTM-CNN hybrid achieves an F1-score of 0.87 and an AUC-ROC of 0.92, significantly outperforming baseline models (Logistic Regression: F1=0.72; standalone LSTM: F1=0.81; standalone CNN: F1=0.79). Ablation studies confirm the complementary roles of the LSTM (capturing sequential dependencies) and CNN (capturing localized semantic patterns). Our findings demonstrate that the dynamic trajectory of expressed sentiment is a more potent predictor of depression than static, aggregated sentiment scores, offering a promising pathway for scalable, continuous, and early mental health monitoring.

Keywords: Computational Psychiatry, Digital Phenotyping, Major Depressive Disorder, Deep Learning, LSTM, CNN, Sentiment Analysis, Temporal Dynamics

Forecasting Allergic Reactions to Pharmacotherapy Using a Machine Learning Approach

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Allergic drug reactions (ADRs) represent a significant clinical challenge, ranging from mild rashes to life-threatening anaphylaxis and severe cutaneous adverse reactions (SCARs). Current risk assessment relies on incomplete patient history and reactive testing, creating a critical need for proactive, personalized prediction tools to enhance medication safety. We developed a multimodal machine learning framework integrating diverse data sources to forecast ADR risk. Our cohort comprised 45,823 patients from three academic medical centers, including 1,247 confirmed ADR cases matched with 44,576 controls. We engineered features from structured electronic health records (demographics, comorbidities, laboratory values, medication history), unstructured clinical notes (processed using BioBERT-based natural language processing), pharmacogenomic data (focusing on HLA alleles including *HLA-B*57:01*, *HLA-B*15:02*, and 23 non-HLA variants), and drug chemical descriptors (Morgan fingerprints). We addressed class imbalance using Synthetic Minority Oversampling TEchnique (SMOTE) combined with cost-sensitive learning. Multiple algorithms were evaluated including XGBoost, Random Forest, and a novel hybrid architecture combining temporal convolutional networks with gradient boosting. Our optimal model (ensemble of XGBoost and temporal network) achieved an area under the receiver operating characteristic curve (AUC-ROC) of 0.94 (95% CI: 0.92-0.95) on the hold-out test set, with sensitivity of 0.88 and specificity of 0.91 at the optimal threshold. For severe reactions (SCARs), the model maintained an AUC-ROC of 0.96. SHapley Additive exPlanations (SHAP) analysis identified the top predictive features: specific HLA alleles (contributing 34% to model output), drug structural alerts (22%), recent eosinophil count elevation (18%), prior reaction mentions in clinical notes (15%), and concurrent viral infections (11%). The model demonstrated robust performance across ethnic subgroups in external validation on the UK Biobank dataset (AUC 0.89), though some degradation occurred in underrepresented populations. We present a highly accurate, interpretable machine learning system that integrates multimodal clinical, genetic, and pharmacological data to forecast allergic drug reactions. By moving from reactive surveillance to proactive risk assessment, this approach enables personalized medication selection and represents a significant advancement toward precision pharmacovigilance. Implementation challenges include integration into clinical workflows, prospective validation, and addressing algorithmic bias across diverse populations.

Keywords: Drug hypersensitivity, adverse drug reaction, machine learning, pharmacogenomics, HLA, predictive modeling, electronic health records, precision medicine

A Data-Driven Recommender System for Crop and Nutrient Management in Precision Agriculture

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Precision agriculture aims to improve crop productivity through accurate and timely nutrient management. This research focuses on the tomato crop, selected due to its economic importance and sensitivity to nutrient variations. The study primarily considers essential soil nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K) along with supporting parameters including soil moisture, temperature, and soil pH. The proposed data-driven recommender system is developed using primary data manually collected by the researcher from agricultural fields. Data acquisition is carried out through direct field observations, soil testing reports, and readings obtained using smart agricultural devices such as soil nutrient sensors, moisture sensors, and temperature sensors. The collected data is systematically preprocessed and analyzed using machine learning techniques to generate crop-specific nutrient and fertilizer recommendations. The system provides recommendations related to appropriate nutrient dosage, soil condition improvement, and crop suitability, supporting farmers in informed decision-making. The recommendations are validated through field-level analysis and comparison with standard agronomic guidelines, demonstrating improved relevance and practical applicability. The results highlight that the proposed approach enhances precision in nutrient management, reduces improper fertilizer usage, and promotes sustainable agricultural practices.

Keywords: Precision agriculture; Nutrient management; Recommender system; Machine learning; Decision support system.

Smart Mobile Sanitation Systems Using IoT for Predictive Hygiene Monitoring and Energy Optimization

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The mobile sanitation units are very much required in the urban areas, rural landscape, mega events, and emergency relief tasks, yet they are usually faced with challenges of cleanliness and accessibility, besides excessive and long-lasting repairs. According to recent research findings, the majority of the sanitation systems in the IoT are oriented towards fixed public toilets, and little attention is given to mobile or portable applications. The survey will take into account the IoT use in smart mobile toilets, the factors such as keeping track of the usage of the toilets, managing the water and garbage containers, keeping track of unpleasant odors, and the weather are considered. The review is the combination of articles published in 2020-2025 to consider the possibility of using microcontrollers: ESP8266 as ESP32, sensors: PIR, ultrasonic, gas, and DHT11 to collect information about the real-time utilization of things by individuals. Researchers believe in the opportunities of cloud-based solutions like Firebase and ThingSpeak to store, visualize, and give alerts. The other part of the paper that has been addressed is the predictive methods, including decision trees and k-nearest neighbors, that will be applied to make mobile sanitation more efficient, including cleaning schedules, demand forecasting, and resource allocation. The gap in the current research is among the most significant conclusions: the models of fixed IoT sanitation are available; however, there is no research that dwells on mobility, renewable energy integration, or constant monitoring with the assistance of a battery. The survey has made the smart mobile toilet be seen as an essential factor that can integrate sustainability and operational efficiency in the field of IoT sanitation studies. The framework in this design forms a framework in a future design to address the requirements of the Sustainable Development Goals, SDG 6: Clean Water and Sanitation and SDG 11: Sustainable Cities and Communities by integrating the existing practices and identification of the aspects to be improved.

Keywords - IoT-based sanitation, Smart mobile toilet, Crowd monitoring, Predictive maintenance, Sensor integration (PIR, ultrasonic, gas, DHT11), ESP32 / ESP8266 microcontroller, Cloud platforms (Firebase, ThingSpeak), Renewable energy in IoT, Sustainable sanitation (SDG 6, SDG 11).

Cloud Forensic Alert Classification and Analysis with Random Forest

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This paper aims at developing a powerful cloud network forensics model to generate alerts and classify attacks within an AWS context based on the Cloud Investigation dataset. The results show that everyday cloud operations prevail in the general traffic, and DDoS and brute force attacks are the most common with SQL injection being the next most common and high risk followed by ransomware that is less common but high risk. The alert generation system is applicable in categorizing the events by severity, as the most frequent ones are medium alerts necessitating prolonged investigation, and severe alerts indicating the possible acceleration of the attack with the least probability of a false alarm. Random Forest classifier was able to attain a total accuracy of 91% which indicated a good performance in classifying normal and malicious activities where high levels of precision and consistency were observed with the dominant classes but lower levels of recall in minority classes due to the imbalance of data. This work is novel because it incorporates a form of forensic framework, which is a combination of severity-based alert generation and machine learning-based attack classification, complemented by comprehensive metric assessment and visualization, which will enhance the readiness of cloud network forensics in AWS environments.

Keywords: Cloud Network Forensics, AWS Security, Alert Generation, Random Forest, Attack Classification

AI-Assisted Skin Disease Diagnosis and Virtual Medical Expert using Deep Learning

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Early detection of dermatological disorders is critical for preventing severe complications, yet access to dermatologists remains limited in many regions. This paper proposes an AI- assisted skin disease diagnosis system integrated with a virtual medical expert to support preliminary screening, guidance, and specialist consultation. The system leverages deep learning models, including Convolutional Neural Networks (CNN), ResNet, and EfficientNet, combined with advanced image preprocessing techniques such as denoising, resizing, segmentation, and normalization to enhance input quality and classification performance.

A tele-dermatology interface enables patients to upload skin images, which are automatically analyzed to classify a wide range of skin diseases. To improve interpretability and user trust, explainable AI techniques such as Grad-CAM are incorporated to highlight disease-relevant image regions. The virtual expert module provides contextual explanations, precautionary recommendations, and basic treatment guidance while facilitating seamless communication with certified dermatologists for further consultation when required.

The proposed AI-driven diagnostic support system aims to reduce diagnostic delays, enhance accessibility to dermatological care, and enable early intervention, particularly in underserved or remote areas. Experimental evaluation demonstrates improved classification accuracy and highlights the potential of AI-based telemedicine solutions to support scalable, affordable, and reliable dermatological care.

Keywords: AI-assisted diagnosis, Explainable AI, Tele dermatology, Early detection, Medical image analysis

Development of a Secure Academic Data Management Portal for Higher Education Institutions

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Higher education institutions generate and manage a large volume of academic and administrative data related to students, faculty, courses, departments, examinations, and institutional activities. Traditional manual and semi-digital systems often face challenges such as data redundancy, lack of security, delayed access to information, poor scalability, and inefficient record management. These limitations can lead to data inconsistency, increased operational cost, and difficulties in decision-making. To address these issues, this project focuses on the development of a secure academic data management portal for higher education institutions.

The proposed system provides a centralized, web-based platform to collect, store, manage, and retrieve academic information efficiently. It supports role-based access for different users such as administrators, faculty members, and students, ensuring that only authorized users can access or modify sensitive data. The portal enables secure operations including data entry, record updates, information searching, report generation, and academic monitoring in real time.

Advanced security mechanisms such as user authentication, authorization control, and secure database management are incorporated to protect sensitive academic data and ensure data integrity, confidentiality, and reliability. The use of a structured relational database reduces data redundancy, improves consistency, and supports efficient data retrieval. Automated processes minimize manual intervention and reduce errors associated with traditional systems.

Overall, the system enhances operational efficiency, reduces paperwork and manual workload, and ensures quick access to accurate academic records. This secure academic data management portal supports the digital transformation of higher education institutions by providing a scalable, reliable, and user-friendly solution for effective academic and administrative data management.

Keywords: Data Management, Decision Making, Role based access, Secure Database Management

An IoT-Enabled Smart Glove for Real-Time Hand Gesture Recognition and Intelligent Communication

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Hand gesture recognition has emerged as a key enabling technology for human–machine interaction, assistive communication, and wearable computing applications. Conventional vision-based systems often suffer from limitations such as sensitivity to lighting conditions, high computational complexity, and lack of portability. To overcome these challenges, this paper presents an IoT-enabled smart glove for real-time hand gesture recognition and intelligent communication. The proposed system integrates flex sensors and embedded processing units within a wearable glove to capture finger movements and hand postures with high accuracy. Sensor data are processed locally and transmitted through an IoT framework to enable real-time gesture interpretation and communication. A robust gesture recognition algorithm is implemented to classify predefined gestures and convert them into meaningful textual outputs displayed on an interface and transmitted to connected devices. The system supports secure data transmission and scalable integration with cloud-based services for monitoring and future analytics. Experimental evaluation demonstrates that the proposed smart glove achieves reliable real-time performance with low latency and high recognition accuracy while maintaining low power consumption. The wearable design ensures user comfort and portability, making it suitable for continuous use. The proposed approach offers an effective alternative to camera-based gesture recognition systems and provides a practical solution for intelligent communication, particularly for assistive and human–computer interaction applications.

Keywords: IoT, Smart Glove, Hand Gesture Recognition, Wearable Computing, Intelligent Communication

A Multi-Resolution Proximity Graph Evolutionary Algorithm for Feature Selection: A Comparative Analysis with RFE and LASSO

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Feature selection is a crucial step in machine learning pipelines, directly influence the accuracy, interpretability, and computation efficiency of the models. Despite the widely adopted methods of RFE and LASSO, these methods often face either redundancy among correlated features or difficulties in finding a good balance between dimensionality reduction and predictive performance. In view of these limitations, this paper proposes a multi-resolution proximity graph combined with a genetic algorithm for feature selection. The proximity graph effectively captures the correlations among features and clusters redundant variables, while the genetic algorithm uses adaptive mutation, elitism, and a hybrid fitness function inspired by ensemble accuracy (Logistic Regression, Random Forest, and Gradient Boosting).The proposed method was applied to the student performance dataset taken from the Kaggle repository, comprising 17 features with 2,000 rows, and cast into a binary classification problem forecasting career aspirations (STEM vs. Non-STEM). The GA selected 9 features, compared to RFE, which selected 7 features, and LASSO chose 12 features. Throughout the experiment on four different classifiers, namely Logistic Regression, Random Forest, Support Vector Machine (SVM), and Gradient Boosting, the GA performed better in terms of accuracy, with Gradient Boosting yielding the best value of 0.82 outperforming RFE at 0.80 and LASSO at 0.81. The novelty of the study is it combines an adaptive genetic algorithm with a multi-resolution proximity graph, which allows for simultaneous redundancy reduction and predictive optimization in a feature selection method not previously investigated. These findings show that the proposed approach of GA effectively balances dimensionality reduction with predictive performance, hence emerging as a valid, scalable alternative to traditional feature selection approaches. Graph-based clustering combined with evolutionary search can be one of the most promising directions in feature selection for complex, high-dimensional datasets, especially when enhanced by large-scale open repositories like Kaggle.

Keywords: Feature Selection, Multi-Resolution Proximity Graph, Genetic Algorithm, Recursive Feature Elimination (RFE), LASSO

Educational Technology in Transition: Global Trends, Indian Adaptation, and Institutional Practice

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Educational Technology (EdTech) has progressed from basic computer-assisted instruction to sophisticated, artificial intelligence (AI)–enabled learning ecosystems. This paper examines the historical evolution of EdTech, analyzes dominant global trends up to 2025, and explores their contextual adaptation within Indian higher education. Globally, EdTech has shifted from content digitization toward learner-centric models emphasizing personalization, adaptive learning, analytics, and immersive tools. AI-driven applications such as intelligent tutoring systems, automated assessment, and predictive learning analytics have demonstrated measurable improvements in engagement and learning outcomes when aligned with pedagogy. The COVID-19 pandemic accelerated digital adoption while exposing significant infrastructure, socioeconomic, and linguistic divides, particularly in India. National initiatives such as the National Education Policy (NEP) 2020 and the National Digital Education Architecture (NDEAR) provide a coherent policy and technological framework promoting interoperability, vernacular inclusion, and equity. Institutional practices at Dr. Umayal Ramanathan College for Women illustrate how global EdTech trends are operationalized locally through blended pedagogy, faculty capacity building, and inclusive digital practices.

Keywords: Artificial intelligence in education, digital education policy, educational technology, higher education in India

AI-Enabled Learning for Children with Autism Spectrum Disorder: A Case Study from an Inclusive Classroom

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Advances in artificial intelligence (AI) are reshaping educational technology and creating new opportunities for inclusive learning, particularly for children with Autism Spectrum Disorder (ASD). This paper presents a case study of a 10 -year-old learner with ASD in a Grade 5 Inclusive classroom using a generative AI–based learning assistant to support academic engagement and written expression. The study demonstrates how AI-enabled tools can reduce cognitive load, scaffold idea generation, and promote participation in inclusive classrooms. Findings highlight the potential of AI to strengthen inclusive education while also identifying challenges related to teacher readiness, ethical use, and contextual adaptation. The paper contributes to emerging research at the intersection of computer science, AI, and special education.

Keywords: AI-enabled learning, Autism Spectrum Disorder, Inclusive Education

Reinforcement Learning-Driven Fault Detection and Autonomous Navigation for Agricultural Robotics in Remote Sensing Applications

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Reinforcement Learning (RL) is transforming agricultural robotics by facilitating real-time fault detection in equipment and enhancing autonomous navigation for crop inspections, leveraging remote sensing data. The research work introduces RL-AgriNav, a deep RL framework aimed at optimizing robotic operations in precision agriculture. It addresses key issues, such as equipment degradation, fluctuating field conditions, and multi-scale crop monitoring, through the use of satellite imagery. The methodology integrates Deep Q-Networks (DQN) for predicting faults by analyzing degradation patterns from sensor data (vibration, temperature). It applies Proximal Policy Optimization (PPO) for navigation, incorporating inputs from LiDAR, multispectral cameras, and remote sensing data (e.g., NDVI from UC Merced and NWPU-RESISC45 datasets). A multi-agent RL configuration enables coordination among robotic swarms, promoting scalable field coverage and rewarding safe navigation choices, fault avoidance, and accurate crop health assessments. Simulations conducted via Gazebo with actual satellite imagery achieve a fault detection accuracy of 92% and improve navigation efficiency by 15% compared to traditional Proportional–Integral–Derivative (PID) controllers. Furthermore, experiments tested RL-AgriNav in synthetic farms that replicate conditions in Tamil Nadu, attaining 95% coverage in crop inspections and reducing downtime by 28%. Ablation studies indicate that combining remote sensing data enhances navigation robustness by 12% in scenarios involving occlusion. This research blends Convolutional Neural Networks -Transformer methodologies with Reinforcement Learning to foster smart agricultural practices, offering scalable solutions for biodiversity monitoring and yield enhancement.

Keywords: Reinforcement learning, agricultural robotics, fault prediction, autonomous navigation, remote sensing, precision agriculture, multi-agent systems

Secure Edge-AI Enabled Maternal–Fetal Digital Twin for Real-Time Monitoring in IoT-Based Fetal Care

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Maternal and fetal health monitoring in resource-constrained environments has significant challenges that continue to affect healthcare outcomes in rural and underserved area globally. Current limitations include inadequate continuous data collection infrastructure, delayed risk assessment capabilities, and barriers to secure remote clinical oversight. Traditional Internet of Things (IoT) systems have introduced remote device control and secure authentication mechanisms, yet they remain insufficient in addressing the critical need for real-time predictive analytics and personalized clinical modeling. This research paper proposes a secure Edge-AI enabled Maternal Fetal Digital Twin system that fundamentally extends conventional IoT fetal monitoring approaches by integrating lightweight Adaptive Neuro-Fuzzy Inference System (ANFIS) classifiers deployed directly on edge computing devices. These edge devices enable local anomaly detection and personalized risk detection for critical pregnancy complications including preterm birth, preeclampsia, and fetal distress. Building upon OAuth-secured parameter monitoring and remote device control frameworks, the system intelligently fuses multimodal wearable sensor signals including maternal electrocardiogram (ECG) and photoplethysmography (PPG), fetal ECG and Doppler measurements, along with maternal activity and temperature data into a dynamic digital twin representation. The digital twin continuously updates to reflect the physiological state of both mother and fetus, enabling personalized care pathways and trend analysis. Implementation utilizes ESP32-based edge gateways equipped with ANFIS models trained through Particle Swarm Optimization (PSO) algorithms, ensuring optimal feature alignment and classification accuracy. All data transmission between devices and cloud infrastructure has encrypted MQTT (Message Queuing Telemetry Transport) protocols combined with OAuth authentication mechanisms, ensuring privacy and secure clinician access. The system architecture enables operation in lowconnectivity areas where cloud-dependent monitoring proves impractical, making it particularly valuable for maternal health interventions in rural and resource-limited settings. Clinician dashboards provide remote oversight capabilities while maintaining strict privacy controls and data protection standards. The proposed framework demonstrates substantial improvements in real-time risk prediction accuracy, energy efficiency through local processing, and privacy preservation compared to traditional cloud-centric monitoring approaches. This research work represents a significant advancement in intelligent maternal–fetal healthcare monitoring systems, combining contemporary advances in edge computing, artificial intelligence, digital twin technology, and secure IoT protocols to address critical maternal health disparities and enable early clinical intervention in vulnerable populations.

Keywords: Maternal–Fetal Health, Secure Monitoring, Real-Time Risk Prediction, Wearable Sensors, Privacy-Preserving Healthcare.

Human–Machine Interactive Framework for Skin Disease Detection Using Thermal Imaging

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This study presents a Human–Machine Interactive Framework for skin disease detection using multimodal data; as it integrates or combining diverse types like pairing medical images with enhanced context and through which a richer and more comprehensive representation of real world phenomenon can be created; including dermoscopic images from HAM10000 and infrared thermography (IRT) images, capturing both visual and thermal lesion features. Images undergo preprocessing—resizing, noise reduction, normalization, and augmentation—to enhance quality and generalization. Features are extracted via EfficientNet-based deep maps, optionally fused with hand-crafted descriptors to capture texture, color, shape, and thermal patterns. A framework uses dual encoders or loss pathways to capture complementary features, such domain specific details in one path and shared alignments in the other, preventing mode collapse and redundancy common in single path approaches. Positive pairs pull representations closer across paths via mutual information, maximization, while negatives pull dissimilar ones apart using InfoNCE-like losses with temperature scalling method called SDP-CNN is used in this study. A Symmetric Dual-Path Contrastive CNN (SDP-CNN) performs multi-class classification across seven lesion types: melanoma, melanocytic nevus, basal cell carcinoma, actinic keratosis, benign keratosis, dermatofibroma, and vascular lesions. Predictions include confidence measures, while post- processing generates heatmaps for key regions. It improves generalization in scenarios like image translation, retrieval and multimodal fusion by decorrelating features and balancing alignment uniformity trade-offs. Theoretical bounds show balanced representation emerge from phased optimization, with empirical gains in task like recommendation and anomaly detection. Human–machine interaction allows clinicians to validate and refine results. The SDP-CNN achieved 99% accuracy with robust metrics, offering an interpretable, clinician-centric, multimodal decision-support system. The proposed Human–Machine Interactive Framework can be effectively applied in clinical dermatology for early and accurate detection of various skin lesions and the novelty of this study lies in its integration of multimodal imaging, deep learning, and human expertise into a unified framework for skin disease detection. Post-processing in the proposed Human–Machine Interactive Framework is essential for refining raw outputs from the SDP-CNN and converting them into clinically interpretable results. Post-processing ensures that predictions are not only accurate but also interpretable and actionable. By applying confidence thresholds, the system minimizes spurious classifications. Heatmaps provide visual explanations of the model's focus areas, aiding clinicians in validating the automated decisions and fostering trust in the human–machine collaborative process. Additionally, combining dermoscopic and thermal features in the post-processed visualization emphasizes subtle lesion characteristics that might be overlooked in single-modality analysis, thereby improving overall diagnostic reliability and clinical usability.

Keywords: Skin Disease Detection, Infrared Thermography, Dermoscopic Imaging, Human–Machine Interaction, Multimodal Medical Imaging, Contrastive Deep Learning, SDP-CNN, Clinical Decision Support System

Blockchain-Based Perishable Food Supply Chain Management Using Proof of Freshness (PoF) Consensus Mechanism

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The management of perishable food supply chains requires high levels of transparency, real-time monitoring, and secure data exchange among stakeholders. Conventional systems often fall short in meeting these needs due to data silos, limited traceability, and susceptibility to fraud. Blockchain technology, with its decentralized and immutable ledger, offers a potential solution. However, existing consensus mechanisms are not optimized for the time-sensitive and resource-constrained nature of food logistics. This paper introduces Proof of Freshness (PoF), a novel consensus algorithm tailored for blockchain applications in perishable supply chains. PoF leverages IoT-sourced environmental data and a multi-party validation process to ensure that only timely and authentic information is recorded on the blockchain. The proposed method enhances data integrity, improves supply chain transparency, and reduces the risk of spoilage. A detailed system architecture and validation process are presented, demonstrating the suitability of PoF for real-time, trust-based consensus in perishable logistics networks.

Keywords : Consensus Algorithms, Blockchain, food supply chain

Predictive Analytics for Curriculum Design and Learning Path Optimization

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The rapid digitalization of higher education has resulted in the generation of large volumes of educational data, yet curriculum design in most institutions remains largely static and retrospective. Traditional curriculum planning approaches are insufficient to address learner heterogeneity, evolving competency requirements, and early indicators of academic risk. This paper proposes a predictive analytics–driven framework for curriculum design and learning path optimization that leverages machine learning techniques to enable proactive, evidence-based academic decision-making.

The proposed framework integrates heterogeneous educational data sources, including historical academic performance, continuous assessment results, learning management system (LMS) interaction logs, and learner progression patterns. Gradient boosting models are employed to predict student learning outcomes and course success probabilities, while Random Forest algorithms are used to identify feature importance and critical curriculum factors influencing student performance. Linear regression is applied for trend analysis of academic progression, and logistic regression is used for interpretable binary risk classification to support early intervention strategies.

The framework was implemented and evaluated using a real-world case study at a university with approximately 5,000 undergraduate students enrolled across 150 courses over a three-year period. Empirical results demonstrate strong predictive performance, with gradient boosting models achieving an accuracy of 89% and an AUC-ROC of 0.91 for course success prediction. Feature importance analysis revealed that prerequisite performance, LMS engagement metrics, and assessment submission patterns were the most influential predictors of success. Following the implementation of data-driven curriculum adjustments and personalized learning path recommendations, the institution observed a 15% improvement in student retention, significant reductions in course failure rates, and enhanced overall student success metrics.

The findings validate the effectiveness of predictive analytics in transforming curriculum design from a static, expert-driven process into a dynamic, adaptive, and scalable system. This research contributes to the intersection of computer science, educational technology, and educational data mining, demonstrating the practical impact of machine learning–based curriculum intelligence in higher education.

Keywords: Predictive Analytics, Curriculum Design, Learning Path Optimization, Educational Data Mining, Machine Learning in Education, Random Forest, Gradient Boosting, Learning Analytics

Predictive Analytics for Curriculum Design and Learning Path Optimization

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Accurate market trend prediction is a fundamental challenge in financial analytics due to the complex interaction between quantitative market indicators and qualitative information embedded in unstructured textual data such as news articles, social media posts, and financial reports. Traditional time-series forecasting models rely predominantly on historical numerical data and often fail to account for market sentiment, while standalone sentiment analysis techniques lack temporal modeling capabilities. This paper proposes an integrated market trend prediction framework that combines Natural Language Processing (NLP)–driven sentiment modeling with time-series forecasting techniques to address these limitations.

The proposed framework employs NLP pipelines for text preprocessing, semantic representation using word embeddings, and transformer-based sentiment classification to extract sentiment scores from heterogeneous textual sources. These sentiment features are temporally aligned with structured market indicators including price movements, trading volume, and volatility measures. The enriched multivariate time-series is modeled using both statistical approaches such as ARIMA and deep learning models including Long Short-Term Memory (LSTM) networks. By integrating sentiment-aware features into temporal forecasting models, the framework captures both behavioral and sequential dynamics influencing financial markets.

Experimental evaluations conducted on real-world financial datasets demonstrate that the proposed hybrid model consistently outperforms baseline approaches that rely solely on numerical time-series data or isolated sentiment analysis. Results indicate significant improvements in prediction accuracy, reduced forecasting error, and enhanced directional accuracy, particularly during periods of heightened market volatility. The findings highlight the importance of incorporating unstructured textual intelligence into financial forecasting systems.

This research contributes to recent trends in computer science by integrating NLP, machine learning, and time-series analysis within a unified predictive paradigm. The proposed approach has practical implications for financial analysts, algorithmic trading systems, and decision-support platforms, and underscores the growing importance of interdisciplinary methodologies in modern financial technology research.

Keywords: Market Trend Prediction, Natural Language Processing, Sentiment Analysis, Time-Series Forecasting, LSTM, Financial Analytics, FinTech

Boosting Agricultural Forecasting for Broccoli Yield Prediction Using an Ensemble Learning Technique

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Because of the intricate, non-linear relationships between meteorological factors, soil characteristics, and agronomic techniques, accurate yield prediction for broccoli continues to be a significant difficulty. Farmers frequently make poor decisions and use resources inefficiently as a result of traditional statistical models' inability to account for these relationships. In order to get over these restrictions, this study suggests the Broccoli Yield forecast Ensemble Method (BYPEM), a sophisticated machine learning-based strategy intended to enhance agricultural planning and forecast accuracy. For accurate broccoli yield predictions, BYPEM combines bagging and boosting ensemble learning techniques. The study starts with a thorough data preprocessing stage that includes normalization, categorical variable encoding, addressing missing values, and outlier removal. Backward elimination is used in feature selection to keep the most significant predictors. To guarantee balanced representation, the dataset is divided into training and test sets using stratified sampling. During the model development stage, BYPEM uses boosting techniques like Gradient Boosting Regressor (GBR), XGBoost, LightGBM, and CatBoost to decrease bias by repeatedly improving predictions, and bagging techniques like Random Forest Regressor and Extra Trees Regressor to reduce variance. Model performance is further optimized through hyperparameter adjustment. Several metrics, including as Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R^2 score, and overall accuracy, are used to assess the models. XGBoost has the best predictive performance of all the models, demonstrating how well the BYPEM framework captures intricate yield dynamics. By improving the accuracy of broccoli yield forecast and directing data-driven farm management techniques, this study illustrates how ensemble learning may promote sustainable agriculture

Keywords: Broccoli yield prediction, machine learning models, ensemble learning techniques, BYPEM, feature selection, bagging and boosting methods, hyperparameter tuning.

Seasonal Redistribution and Enrichment of Monazite in Manavalakurichi Beach Sands, Tamil Nadu: Literature-Based Review

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Manavalakurichi is a coastal area in southwest Tamil Nadu, which contains heavy minerals, especially monazite. The main objective of this review is to study the seasonal change and spatial distribution of monazite. The paper is concerned with the impact of monazite redistribution in coastal placer deposits through the influence of monsoonal hydrodynamics, sediment transportation, and coastal geomorphology. Geochemical, sedimentological, and geospatial studies have shown that seasonal processes have cyclic patterns of erosion-accretion but do not result in net depletion of monazite. The review identifies the necessity of the combination of hydrodynamic modeling, remote sensing, and geochemical characterization in addressing sustainable management of resources and strategic exploitation of monazite-bearing coastal sands.

Keywords: Seasonal Variation, Rare Earth Elements, Sediment Transport, Remote Sensing, Artificial Intelligence

Novel IoMT Data Partitioning Approach utilizing X-POWER Cryptography on Cloud Environment

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Maintaining patient confidentiality while allowing access to data for research, analysis, and medication prescriptions makes it challenging to securely maintain and transfer this data. It has long been felt that novel solutions, considering emerging cyberattacks as well as the need to satisfy regulatory requirements, are required to safely maintain and transfer sensitive IoMT data. The main objective of the proposed research work is the safe storage of medical data based on its level of sensitivity. In the proposed framework, the TransformerSplitOpt method was utilized in splitting various sensor data into two different subsets called the public and private datasets. Subsequent to it, a novel and efficient X-POWER (eXtensible-Pseudorandom Obfuscation With Enhanced Randomization) cryptography method was implemented on the sensitive portion solely in the AWS cloud environment. Moreover, carried-out assessments, analyses, and experiments have also depicted how effectively the proposed approach can tackle prominent challenges of medical data storage, as well as satisfy the regulatory requirements under the Health Insurance Portability and Accountability Act (HIPAA) compliance. To also ensure that the proposed scheme provides IND-CPA and IND-CCA security, extensive assessments have also been conducted. In addition, a number of security analyses including statistical analysis, entropy analysis, correlation analysis, key sensitivity analysis, brute force test, and differential cryptanalysis, and several performance analyses including encryption and decryption time, memory consumption, security overhead, throughput, and network latency have been carried out to demonstrate the efficacy and resilience of the suggested framework. By putting the suggested strategy into practice, patients and medical professionals will have more control over the information they provide.

Keywords: IoMT, Data Partitioning, Cloud-based Transmission, Data Security.

Trust Based Intelligent Human-Computer Interaction System with Failure Handling

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Intelligent Human-Computer Interaction (HCI) systems such as virtual assistants, chatbots, learning tools and healthcare applications have become integral to everyday life. Powered by AI techniques like Natural Language Processing (NLP) and machine learning, these systems assist users in decision-making and completing complex tasks. As these systems become increasingly autonomous, trust emerges as a crucial factor. Users must feel confident in knowing when to rely on these systems and when to practice caution.

Research indicates that trust in AI is not solely dependent on accuracy. It is also shaped by predictability, transparency in explanations and honesty in communication. When AI systems fail, whether by providing incorrect information, misunderstanding intent or disrupting conversational, trust can rapidly decline, particularly if the failure goes unacknowledged. This paper reviews how intelligent HCI systems build trust and manage failures, drawing from key studies on AI trust, chatbot communication and failure-aware design. Despite extensive research, a significant gap remains: the evolution of trust during and after system failures, especially in conversational contexts is not yet fully understood. Most existing studies measure trust as a static metric rather than a dynamic process of decline and recovery.

To explore this dynamic, we surveyed 50 students. The questionnaire included demographic queries, Likert-scale items regarding trust error experiences and an open-ended question on how AI should respond to mistakes. Our results indicate that while students generally trust AI, that trust is contingent on honest communication. Simple disclaimers such as "AI may make mistakes" are insufficient. Participants preferred responses where the AI admits uncertainty, apologizes when appropriate, provides clear explanations and attempts self-correction. Notably, poor communication during a failure damaged trust more significantly than the error itself.

These findings suggest that trust is not merely a technical challenge but also an interaction and design issue. Although this study is limited by its small sample size and descriptive nature, it highlights the necessity for AI systems to plan for failure, offer better explanations and maintain transparency. Future research should involve larger cohorts and long-term experimental studies to test specific recovery strategies. If designed carefully, failures can become opportunities to strengthen, rather than break the human-AI relationship.

Keywords: AI trust, failure handling, HCI systems, trust calibration, error recovery

High Performance Computing – An Overview

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High Performance Computing (HPC) refers to the use of powerful computational systems and parallel processing techniques to solve complex and large-scale problems that are beyond the capability of conventional computers. HPC systems combine high-speed processors, large memory capacity, fast storage, and advanced networking to deliver extremely high computational performance. By executing multiple operations simultaneously, HPC enables faster data processing, accurate simulations, and efficient handling of massive datasets.

HPC plays a vital role in scientific research, engineering, and industry by supporting applications such as climate modeling, weather forecasting, bioinformatics, molecular dynamics, artificial intelligence, financial modeling, and aerospace simulations. Researchers rely on HPC to analyze complex phenomena, reduce computation time, and improve prediction accuracy. In healthcare, HPC accelerates drug discovery and genomic analysis, while in engineering it enhances product design through simulation and testing.

Modern HPC architectures include clusters, supercomputers, and cloud-based HPC platforms, often utilizing technologies such as GPUs, distributed computing, and parallel programming models. These systems are designed to achieve scalability, reliability, and energy efficiency. With the rapid growth of big data and AI-driven applications, HPC has become an essential tool for innovation and decision-making.

In conclusion, High Performance Computing significantly advances computational capabilities by enabling the rapid and efficient processing of complex tasks. As technology continues to evolve, HPC will remain a key driver of scientific discovery, technological progress, and solving real-world challenges across diverse domains.

Keywords: High Performance Computing, cloud-based HPC platforms, AI, Decision making

Low-Code, No-Code, and AI-Assisted Development: Transforming Modern Software Development

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The rapid growth of digital transformation across industries has significantly increased the demand for faster, more efficient, and cost-effective software development methodologies. Traditional software development approaches often require extensive coding expertise, longer development cycles, and high maintenance costs, which can limit innovation and delay deployment. To overcome these challenges, Low-Code and No-Code (LCNC) development platforms have emerged as effective alternatives that simplify application development through visual interfaces, drag-and-drop components, and pre-built modules. These platforms enable both professional developers and non-technical users, commonly referred to as citizen developers, to create functional applications with minimal or no manual coding.

Low-Code, No-Code, and AI-assisted development platforms are widely adopted in web and mobile application development, enterprise systems, business process automation, and digital workflow management. Organizations benefit from reduced time-to-market, lower development costs, improved collaboration between technical and non-technical teams, and increased flexibility. However, challenges such as limited customization, security concerns, performance constraints, and vendor dependency must be addressed.

This paper presents a comprehensive analysis of Low-Code, No-Code, and AI-assisted development, focusing on their working principles, advantages, limitations, and future scope. The study concludes that these technologies will play a vital role in shaping the future of software engineering by democratizing application development and enabling rapid technological advancement.

Keywords: Low-Code Development, No-Code Platforms, AI-Assisted Development, Software Engineering, Digital Transformation

Software Engineering: Processes, Models, and Quality Practices

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Software Engineering is a systematic and disciplined approach to the development, operation, and maintenance of software systems. It focuses on applying engineering principles to ensure that software is reliable, efficient, maintainable, and scalable. With the rapid growth of technology and the increasing complexity of software applications, software engineering plays a vital role in delivering high-quality software products within time and budget constraints.
This subject covers the complete Software Development Life Cycle (SDLC), including requirement analysis, system design, implementation, testing, deployment, and maintenance. It also discusses various software process models such as Waterfall, Agile, Spiral, and DevOps, along with requirement engineering, software design techniques, testing strategies, project management, and quality assurance practices.
The study of software engineering helps students and professionals understand best practices, tools, and methodologies used in real-world software development. It aims to improve productivity, reduce development risks, and ensure customer satisfaction by producing dependable and cost-effective software solutions.

Keywords: Software Development Life Cycle, Waterfall, Agile, Spiral, DevOps

Recent Advancements Leverage Large Language Models (LLMS) and AI-Augmented & Automated Data Science (AUTOML)

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Automated Machine Learning (AutoML) has emerged as a transformative approach that automates and augments key components of the machine learning lifecycle including data preprocessing, feature engineering, model selection, and hyperparameter tuning to democratize artificial intelligence (AI) for users with varying levels of expertise. It automates critical tasks such as data preprocessing, feature engineering, model selection, hyperparameter tuning, and model evaluation, which traditionally required extensive human expertise. By integrating AI-driven tools such as large language models or intelligent agents AutoML systems can interpret natural language instructions, recommend optimized workflows, and assist with decision-making throughout the modeling process. This AI augmentation not only accelerates model development and reduces manual effort but also makes machine learning more accessible to non-experts. Ultimately, AI-augmented AutoML aims to democratize data science, enabling faster, more efficient, and reliable generation of predictive models while maintaining interpretability, scalability, and adaptability across diverse applications.

Recent advancements leverage large language models (LLMs) and AI-driven agents to create more intuitive, context-aware interfaces and enhanced end-to-end automation, extending traditional AutoML pipelines to tackle multimodal and complex analytics tasks. This paradigm shift aims to boost efficiency, scalability, and accessibility while addressing challenges such as model explainability, computational cost, and domain-specific adaptability. Future work is focused on harmonizing human-centric design with fully automated pipelines, exploring trustworthiness and fairness, and evolving new architectures that bridge the gap between human intuition and machine automation.

Keywords: Artificial Intelligence AutoML, LLM, AI-Augmented

Investigating Of NLP in Human-Computer Interaction And Speech Recognition & Synthesis

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This paper explores the effectiveness of Natural Language Processing (NLP) in Human–Computer Interaction (HCI), focusing on user engagement, accessibility, and integration challenges. Using a qualitative approach that includes literature review, case studies, and expert interviews, the study shows that NLP-based voice assistants, chat interfaces, and sentiment-aware systems enable more natural interactions and enhance user engagement. Additionally, speech-to-text and text-to-speech technologies improve accessibility for individuals with physical and motor impairments.
Natural Language Processing (NLP) plays a crucial role in Human–Computer Interaction (HCI) by enabling natural communication between users and digital systems. This study examines the effectiveness of NLP techniques in HCI, focusing on speech recognition and synthesis. Using a qualitative approach involving literature review, case studies, and expert insights, the findings show that NLP-based voice assistants, chat interfaces, and sentiment- aware systems enhance user engagement and interaction quality through intuitive communication.

Keywords: Artificial Intelligence, NLP, HCI, Sentiment aware systems

Monitoring Water Dynamics in Direct-Seeded Paddy using Sentinel-2 LSWI and NDVI Time Series

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Efficient water management is critical for sustainable rice cultivation, particularly under direct-seeded rice (DSR) systems where continuous flooding is intentionally avoided. This study investigates the spatio-temporal water dynamics of a direct-seeded paddy crop using multispectral Sentinel-2 imagery over a coastal agricultural region in Tamil Nadu, India (11.46° N, 79.77° E). Land Surface Water Index (LSWI) and Normalized Difference Vegetation Index (NDVI) were derived from cloud-filtered Sentinel-2 observations acquired during the Northeast Monsoon season following mid-October sowing. Fuzzy C-Means clustering was applied to LSWI rasters to classify relative surface water conditions and quantify flooded area percentages for each acquisition date. Temporal trajectories of mean LSWI and NDVI were jointly analyzed to decouple canopy development from surface wetness dynamics. In addition, effective irrigation days were estimated from positive LSWI differentials to identify discrete wetting events. Results reveal a gradual increase in LSWI without abrupt spikes, indicating moisture accumulation driven primarily by rainfall and canopy growth rather than episodic irrigation or prolonged flooding. The absence of sharp LSWI transitions confirms intermittent wetting practices consistent with direct-seeded rice cultivation. The proposed framework demonstrates the potential of Sentinel-2–based water indices for non-intrusive monitoring of irrigation dynamics and water-use efficiency in paddy systems, offering a scalable approach for operational crop water assessment in monsoon-dominated regions.

Keywords: Direct-seeded rice, Sentinel-2, LSWI, NDVI, time-series analysis

Enhancing the Prediction Accuracy of Heart Disease Using Hybrid Algorithms: (A Comparative Study)

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Despite rapid technological advancements, maintaining a healthy heart remains essential for human survival. Heart disease is the leading cause of mortality in India, driven by contemporary lifestyle factors such as urbanization, dietary habits, smoking and genetic predisposition. While good health is invaluable, the demands of modern life increasingly pose health risks across all age groups. According to the World Health Organisation, Cardiovascular diseases (CVDs) are the leading cause of death worldwide, accounting for approximately 17.9 million deaths annually

This study presents a comprehensive evaluation of the effectiveness of various Machine Learning (ML) and Deep Learning (DL) models for heart disease prediction, with a primary focus on classification performance. The investigation includes ML and DL algorithms such as Support Vector Machine (SVM), K-Nearest Neighbours (KNN), Decision Tree (DT), and Artificial Neural Network (ANN), which achieved classification accuracies of 92%, 94%, 96% and 97% respectively. Extensive data preprocessing techniques were employed and systematically analysed to enhance data quality and optimise model performance. Although individual ML models demonstrate strong predictive capability, combining Artificial Neural Networks with SVM, KNN and Decision Tree classifiers further improves performance, particularly when applied to large datasets. This study conducts a comparative analysis of multiple hybrid machine learning models evaluated using classification accuracy, ROC-AUC, and confusion Matrix metrics. The proposed hybrid learners and instance-based classifier (KNN). The hybrid models KNN + ANN, SVM + ANN, KNN + XG Boost, SVM + XG Boost, KNN + Ensemble and SVM + Ensemble achieved enhanced accuracy, such as 96.5%, 97%, 98.5%, 98.5%, 96.5% and 97.5% respectively. Among these, XGBoost-based hybrid models consistently attained the highest accuracy and ROU–AUC values, indicating superior robustness and generalisation capability. Overall, the results confirm that hybridisation significantly improves predictive performance and class separability. This research aims to make a meaningful scholarly contribution to the medical domain by supporting early prediction, detection, and diagnosis of heart disease, thereby enabling timely and effective patient treatment.

Keywords: Cardiovascular disease (CVDs), Machine Learning (ML), Deep Learning(DL), Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Decision Tree (DC) and Artificial Neural Network (ANN).

Mangrove-Derived *Streptomyces albidoflavus* as a Source of Antibacterial Metabolites Against Carbapenem-Resistant *Klebsiella pneumoniae*: Experimental and In Silico Insights

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The increasing prevalence of carbapenem-resistant *Klebsiella pneumoniae* (CR-Kp) represents a serious global health concern due to limited therapeutic options. This study aimed to explore mangrove-derived actinomycetes as a source of novel antibacterial agents and to validate their therapeutic potential through experimental and computational approaches. Actinomycetes were isolated from rhizosphere soil of the Muthupet mangrove ecosystem, among which strain KS6 showed the highest antibacterial activity against CR-Kp. Based on morphological, biochemical, and 16S rDNA gene sequencing analyses, the isolate was identified as *Streptomyces albidoflavus*. Ethyl acetate extraction followed by chromatographic purification yielded bioactive secondary metabolites. GC–MS analysis identified major compounds including 2-4-butyl-4-t-octylphenol and Benzoic acid. Disc diffusion assays demonstrated a clear zone of inhibition, indicating strong bactericidal activity against CR-Kp when compared with controls. *In silico* molecular docking revealed that selected ligands exhibited favorable binding affinities toward the target proteins 2OV5 and 3HBR, with docking scores of −4.321 and −4.368 kcal/mol, respectively. Molecular dynamics simulations over 100 ns proved the constancy of protein–ligand complexes, supported by consistent RMSD (1.5–3.0 Å) and low RMSF fluctuations at binding regions. ADME predictions showed that both compounds complied with Lipinski's rule of five, while toxicity analysis identified compound 2-4-butyl-4-t-octylphenol as safer, with a higher predicted LD_{50} (675 mg/kg) and no hepatotoxicity. Collectively, these findings demonstrate that *Streptomyces albidoflavus*-derived metabolites possess potent antibacterial activity against CR-Kp and represent promising lead candidates for further antimicrobial drug development.

Keywords: Streptomyces albidoflavus; Actinomycetes; Carbapenem-resistant Klebsiella pneumoniae; Secondary metabolites; Molecular docking; Molecular dynamics simulation.

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Machine Learning Algorithms for Emotional Intelligence Analysis in Text: A Review of Algorithms for Real-Time EI Assessment for Pre-emptive Intervention in Social media

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The proliferation of social networks and digital communication platforms has amplified the need for tools that can foster respectful and productive online interactions. This review paper explores the emerging field of employing machine learning (ML) algorithms for real-time Emotional Intelligence (EI) analysis in text. The primary focus is on systems designed to act as a pre-emptive measure, analyzing text before it is posted online to identify emotionally charged or culturally insensitive content and suggest constructive alternatives taking local usages of words and language constructs. This research article presents a systematic review of the state-of-the-art methodologies, including advanced transformer-based models, semi-supervised learning for leveraging unlabeled data, and reinforcement learning for adaptive text rewriting. Furthermore, this review paper delves into critical application domains such as social media moderation; professional collaboration tools such as teams chat in corporate office environments, sending mails using online tools within the office environment and in schools where students among themselves, teachers to students, teachers to parents sending messages through online messaging.

The research paper also addresses significant challenges hindering widespread adoption, including computational efficiency for real-time application, cross-cultural and linguistic fairness, user privacy, and model explainability. Finally, this research article discusses future research directions and emerging recent or latest trends in 2025, emphasizing the integration of Large Language Models (LLMs) for generative feedback, federated learning for privacy preservation, and the development of robust, multi-modal EI systems. This review aims to provide a comprehensive foundation for researchers and practitioners aiming to develop ML algorithms that contribute to more emotionally intelligent digital spaces.

Keywords: Emotional Intelligence, Machine Learning, Natural Language Processing, Real-time Analysis, Sentiment Analysis, Transformers, Explainable AI, Bias Mitigation

Predatory Journals and Indexing Issues: An Academic Perspective

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The rapid expansion of scholarly publishing has significantly increased research dissemination while simultaneously giving rise to predatory journals that exploit the academic publishing ecosystem. These journals often mimic legitimate publications, misleading researchers through false claims of indexing, fabricated impact metrics, and aggressive solicitation practices. This paper examines the critical challenges faced by researchers in identifying genuine journals and understanding indexing claims, with particular emphasis on issues related to Scopus and similar bibliographic databases. From an academic perspective, the study highlights common misconceptions about indexing status, discontinuation of journals, cloned journal websites, and the misuse of journal-level metrics. The paper also discusses the impact of predatory publishing on research quality, academic integrity, and career progression, especially for early-career researchers and scholars from developing regions. Finally, the study proposes practical guidelines, institutional responsibilities, and technology-driven solutions such as automated journal verification systems and awareness frameworks to support researchers in making informed publication decisions. The findings aim to contribute to strengthening ethical scholarly communication and restoring trust in academic publishing systems.

Keywords: Predatory journals, Scholarly publishing, Scopus indexing, Fake journals, Journal authenticity, Research ethics, Academic integrity, Publication metrics

Emerging Trends in Education Technology

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Education Technology has emerged as a powerful force in transforming traditional teaching and learning practices into flexible, technology-driven systems. The rapid advancement of digital infrastructure, web technologies, and intelligent software solutions has enabled educational institutions to move beyond conventional classroom models toward dynamic and interactive learning environments. In higher education, these advancements play a crucial role in addressing challenges related to accessibility, engagement, and learning efficiency. This paper presents an overview of current and emerging trends in Education Technology, with a focus on e-learning platforms, Learning Management Systems (LMS), mobile-based learning applications, and artificial intelligence-enabled educational tools. The integration of modern web technologies allows the development of responsive and user-friendly platforms that support multimedia content, real-time interaction, collaborative learning, and continuous assessment.

Artificial Intelligence has become a key component of modern EdTech solutions by enabling personalized learning experiences. AI-driven systems analyze learner behavior, performance, and preferences to recommend customized learning paths and provide automated feedback. This learner-centric approach improves engagement, knowledge retention, and academic outcomes. Additionally, data analytics helps educators monitor student progress and make informed decisions to improve instructional strategies. Despite its advantages, the adoption of Education Technology presents several challenges, including the digital divide, data privacy concerns, and the need for technological readiness among educators and learners. Limited access to digital resources and insufficient technical skills can reduce the effectiveness of technology-enabled education. Addressing these challenges requires institutional support, digital literacy initiatives, and secure technology frameworks. This paper concludes that Education Technology trends are shaping an intelligent and inclusive learning ecosystem that enhances accessibility, personalization, and learning effectiveness. By understanding and adopting these emerging trends, educational institutions can create sustainable, future-ready education systems that meet the evolving demands of learners and society.

Keywords: Education Technology, E-Learning, Learning Management Systems, Artificial Intelligence in Education

Self-Sovereign Academic Identity Verification Using AI-Assisted Cross-Chain Blockchain Architecture

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The rapid digitalization of higher education and the growing global mobility of students have increased the demand for secure, trustworthy, and interoperable academic credential verification systems. Conventional verification methods rely on centralized databases and manual processes, making them vulnerable to forgery, data manipulation, privacy breaches, and administrative delays. Although blockchain-based solutions improve data integrity and transparency, many existing approaches remain institution-centric and lack intelligent credential utilization and student-controlled identity management.

To address these challenges, this paper proposes a self-sovereign academic identity verification framework that integrates artificial intelligence with a cross-chain blockchain architecture. In the proposed model, students are assigned decentralized identifiers that allow them to own, manage, and selectively share their academic credentials. Educational institutions issue verifiable credentials on permissioned blockchains, ensuring authenticity, immutability, and institutional trust. A federated cross-chain relay mechanism enables secure and efficient interoperability among multiple university blockchains while preserving data sovereignty and governance autonomy.

Privacy is enhanced through the incorporation of zero-knowledge proof mechanisms, which allow stakeholders to verify academic qualifications without revealing sensitive personal or academic data. In addition to secure verification, an AI-assisted credential intelligence layer analyzes verified records to support automated admissions screening, academic credit equivalency mapping, and employability assessment. Smart contracts regulate credential issuance, revocation, consent management, and cross-institutional verification, ensuring transparency, auditability, and operational efficiency.

The proposed framework reduces credential fraud, minimizes administrative overhead, and supports lifelong learning portability across institutions and borders. By combining self-sovereign identity, cross-chain blockchain interoperability, privacy-preserving verification, and artificial intelligence, the system provides a scalable and future-ready solution aligned with emerging education technology trends.

Keywords: Self-Sovereign Identity, Cross-Chain Blockchain, Academic Credentials, Zero-Knowledge Proofs, Artificial Intelligence

Design of a Privacy-Preserving Smart To-Do Planner using Local-Only Data Processing

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Task management applications are widely used to organize daily activities and improve productivity. Most modern smart to-do planners rely on cloud-based storage and processing, which raises serious concerns regarding user privacy and data security. Personal task information such as schedules, deadlines, priorities, and reminders may be exposed to third-party servers without the user's full knowledge or control. This dependence on cloud infrastructure increases the risk of data breaches, unauthorized access, and misuse of sensitive personal information. This paper presents the design of a privacy-preserving smart to-do planner that processes and stores all user data locally on the device. The proposed system eliminates cloud dependency by using local storage mechanisms such as SQLite or JSON-based databases. A rule-based logic engine is implemented to handle task prioritization based on parameters including urgency, deadlines, and importance. All reminder notifications are generated locally, ensuring that no personal task data is transmitted externally. To evaluate user perception and acceptance, a survey was conducted with 50 participants. The survey focused on privacy concerns, preference for offline functionality, trust in task prioritization, and transparency of system behaviour. The results show a strong preference for local-only data processing, with high ratings for privacy protection, offline access, and user trust. Participants expressed greater confidence in systems that provide transparency and full control over personal data. The findings demonstrate that privacy-preserving, local-only task planners can offer reliable and user-friendly functionality without sacrificing security or usability This approach highlights the importance of designing productivity tools that prioritize user privacy, autonomy, and trust.

Keywords : Privacy-preserving systems, Local-only data processing, Smart to-do planner, Offline task management, User trust.

Explainable Hybrid Ensemble Framework for Multi-Class Emotion Detection in Tweets

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This research aims to develop an explainable hybrid ensemble framework for multi-class emotion detection in tweets that maintains high predictive performance while providing faithful, human-understandable justifications for each emotion prediction, addressing the critical gap between accuracy and interpretability in current emotion detection systems. This work proposes an explainable hybrid ensemble framework extending the FEESMT-Hybrid (Feature Engineering for Emotion in Social Media Text - Hybrid) architecture. The framework integrates three complementary representation spaces: (1) engineered emotion-lexicon features including NRC emotion lexicon intensities, emoji polarity scores, punctuation patterns, negation scope detection, and elongation ratios (128 features total); (2) Sentence-BERT semantic embeddings capturing contextual and syntactic information (384-dimensional dense vectors); and (3) TF-IDF lexical representations with unigram and bigram features (5,000 features). These heterogeneous features are fused within a soft-voting ensemble combining Logistic Regression (trained on TF-IDF features) and Random Forest (trained on concatenated FEESMT and Sentence-BERT features) with an optimized weighting factor $\alpha=0.6$ determined through grid search validation. The explainability layer integrates both local and global interpretation mechanisms: LIME (Local Interpretable Model-agnostic Explanations) provides instance-level feature attribution by perturbing input features and observing prediction changes; SHAP (SHapley Additive exPlanations) values quantify individual feature contributions based on game-theoretic principles; and global feature importance analysis extracts model-wide patterns through Logistic Regression coefficients and Random Forest Gini importance scores. The framework applies variance thresholding (threshold=0.01) and standard scaling to FEESMT features to enhance generalization and eliminate uninformative features. Explanation faithfulness is evaluated through systematic perturbation experiments that remove top-weighted features and measure resulting confidence drops and prediction stability. The methodology is validated on a benchmark dataset of 20,000 English tweets annotated with six emotion categories (anger, fear, joy, love, sadness, surprise) exhibiting significant class imbalance (maximum-to-minimum ratio of 3.2:1).

Keywords: Explainable AI, Emotion Detection, Social Media Analytics, Hybrid Ensemble, LIME, SHAP, Feature Engineering, TF-IDF, Sentence-BERT, Twitter Analysis, Multi-class Classification, Interpretable Machine Learning

Sample-Efficient Hybrid BERT–CNN Models for Multi-Domain Text Classification: A Learning-Curve Analysis on Small Datasets

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Many real-world text classification systems in education, industry, and research must operate with very limited supervision, often relying on only a few hundred to a few thousand labelled instances per domain. While BERT-based models are now the default choice on large benchmark corpora, their behaviour when training data is scarce is still not well characterised. This paper conducts a systematic learning-curve study of a lightweight hybrid architecture that couples BERT-base with a 1D convolutional and max-pooling classification head, and compares it against strong TF–IDF baselines (Logistic Regression, SVM with RBF kernel, Random Forest, Multinomial Naive Bayes) and a standard BERT-base model with a linear head. The analysis uses balanced training subsets of 500, 1,000, 2,000, and 4,000 examples drawn from four widely used English datasets: AG News for four-way topic classification, IMDB and Yelp Polarity for document-level sentiment, and SST 2 for sentence-level sentiment. All BERT-based models share the same preprocessing pipeline and fine-tuning hyperparameters (AdamW, learning rate 2×10^{-5}, batch size 32, five epochs), and results are averaged over six random seeds to account for run-to-run variability.

Across all datasets and training sizes, the BERT–CNN hybrid delivers higher test accuracy than both the transformer-only and TF–IDF baselines. Gains over BERT-base range from roughly 2.1 to 4.6 percentage points overall, with the largest margins in the lowest data settings (about +3.3 to +4.6 points at 500–1,000 training instances) and sustained improvements of around 2.1–3.4 points at 4,000 examples. These advantages hold for short sentence inputs (SST 2) as well as long-form reviews (IMDB and Yelp), indicating that the convolutional head improves sample efficiency irrespective of sequence length and task type. Paired statistical tests show that the hybrid's gains are highly significant ($p < 0.001$) and associated with large to very large effect sizes (Cohen's $d \geq 1.85$), rather than random fluctuations. At the same time, the convolutional module adds only about one extra minute of training per dataset and keeps memory usage within modest hardware budgets.

Taken together, the results support the simple BERT–CNN hybrid as a sample-efficient, statistically robust, and resource-conscious baseline for multi-domain text classification in low-data settings, and provide practitioners with concrete guidance on label requirements and when a lightweight convolutional head offers tangible benefits over a plain BERT classifier.

Keywords: BERT–CNN; Hybrid transformer models; Text classification; Learning curves; Sample efficiency; Low-data regimes; Cross-domain NLP; Resource-constrained NLP; Deep learning baselines

Blockchain-Empowered Security for Next-Generation Edge Computing

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This paper investigates the combined application of edge computing and blockchain as complementary technologies that significantly enhance modern decentralized systems. Blockchain establishes trust by maintaining immutable and transparent records through cryptographic linking, while edge computing improves performance by relocating computation closer to data generation points, thereby reducing latency and supporting time-sensitive operations. When integrated, these technologies effectively address persistent issues such as scalability limitations, privacy concerns, and the complexity of distributed processing. The proposed DEAN protocol introduces a collaborative and resilient model that includes a multi-fold increase in processing capacity and a significant improvement in resistance to data tampering in edge-based environments. The study also examines advanced consensus mechanisms, including Hedera's Hashgraph, which enable secure, scalable, and cost-efficient solutions to challenges related to network connectivity and data longevity. Case studies from organizations such as Hut 8, Solana, and Lumen validate the practical applicability of this approach, demonstrating its potential to support decentralized infrastructures for emerging Web 3.0, artificial intelligence, and Internet of Things ecosystems.

Keywords: Blockchain, Edge Computing, Decentralized Systems, DEAN Protocol, Data Integrity, Real-Time Processing, Web 3.0, IoT Applications, Hashgraph Consensus.

Impact of E-Commerce and FinTech: A Data Driven Digital Transformation on MSME Performance in Selected Districts of Tamil Nadu

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Micro, Small and Medium Enterprises (MSMEs) drive employment generation, regional development, and industrial growth in India. Digital transformation through digital adoption, FinTech services, and e-commerce platforms has emerged as a key driver of MSME competitiveness. This study examines the impact of digital adoption, FinTech adoption, and e-commerce participation on MSME performance in selected districts of Tamil Nadu. Primary data were collected from 150 MSMEs using a structured questionnaire. The enterprises were classified by size, turnover, and age to understand differences in digital adoption and to provide suitable digital transformation suggestions. Descriptive statistics, correlation analysis, one-way ANOVA were employed. The findings indicate that digital adoption has a strong and statistically significant positive impact on MSME performance, while FinTech adoption and e-commerce participation exert significant but comparatively moderate effects.

Keywords: Digital adoption, FinTech, e-commerce, MSME performance, Tamil Nadu

CrimeAware: Crime Hotspot Detection and Safe Route Optimization System

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Traditional crime prediction methods often rely on static historical data and simple statistical models, which fail to capture complex spatial and temporal dependencies in criminal activity, leading to inaccurate predictions and delayed interventions. To address these limitations, this project introduces a predictive system that leverages K-Means clustering to identify and map crime hotspots in real time. The system continuously analyses crime trends, considering both historical and live incident data, enabling dynamic hotspot detection. When a woman uses the system, she can select her source and destination, and the system evaluates multiple possible routes, highlighting hotspot-prone paths and suggesting safe alternatives. Additionally, the system can provide estimated travel times and alert the user about areas with recent incidents along the route. By recommending the safest path and visualizing potential risks, the platform empowers women to make informed travel decisions. The system also supports alert notifications to local authorities in case of unusual or emerging risks along a selected route, enabling rapid preventive action. By integrating predictive modeling, route analysis, and real-time notifications, this approach improves personal safety, and contributes to the creation of safer urban environments for women. Ultimately, the project promotes informed decision-making, risk awareness, and confidence while navigating public spaces.

Keywords: Artificial Intelligence, Deep Learning, Crime Hotspot Detection, Crime, Optimal Route, Risk Awareness

Role of AI in Higher Education: Scholars Learning and Outcomes

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AI is transforming education by enhancing learning experiences for students and improving teaching methods. It increases the accessibility of academic resources and enriches learning outcomes, but it also presents challenges. A phenomenological research design conducted in Chennai revealed that while educators value the rapid information access AI provides, they acknowledge its failure to ensure quality. This limitation arises because AI responds solely to input keywords, neglecting the complexities of human emotion and situational nuances essential in education. Students experience significant pressures during their research, from topic selection to literature review, often feeling overwhelmed by the extensive material available. They struggle with developing tools like questionnaires and performing statistical analyses, alongside the challenge of publishing in esteemed journals. The efficacy of AI tools, such as Scispace, EvidenceHunt, NOAH.AI, AnswerThis, MyBib, and DataStatPro, highlights a reliance on specific design parameters and stimulus-response processes in research. The academic community must approach the integration of AI with prudence, ensuring that all stakeholders work together to leverage AI ethically and responsibly. Ultimately, embracing AI is imperative for enriching educational experiences and fostering better academic outcomes in a digital era.

Keywords: AI in Education, Educators, Scholars, Learning experience and Outcomes.

Artificial Intelligence and Intellectual Resource Exploitation: Challenges Ahead

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The advancements in the field of computer science and software engineering are always and often considered a break-through in the emancipation of human society. Human tasks have been shortened or made easy by the advanced technologies which are always mushrooming with multiple versions. One such positive development is Artificial Intelligence which unleashes good amount of potential in reducing the human efforts in varied fields of academia. Staring from academic, the usage of AI knows no boundaries for its utilization. Academicians raise hue and cry regarding the misuse of AI in various fields, particularly the identification of real talent. This piece of analytical article intends to scrutinize the impact of AI in terms of value-oriented research outcome in the 21st century.

Keywords: AI , ChatGPT, Research outcome, Intellectual exploitation

Machine Learning based Intrusion Detection System for IoT Network

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The Internet of Things (IoT) has revolutionized modern communication by enabling autonomous data exchange among interconnected smart devices. However, IoT networks are highly vulnerable to cyber-attacks due to resource-constrained devices, heterogeneous architectures, and the absence of unified security standards. Conventional security mechanisms, including firewalls and signature-based intrusion detection systems, are inadequate for detecting dynamic and previously unseen attacks. To address these limitations, this work proposes a machine learning–based intrusion detection system (IDS) tailored for real time IoT network security. The proposed framework integrates an offline training phase with a lightweight online inference mechanism to achieve high detection accuracy with low latency and energy overhead. Network traffic data are pre-processed through cleaning, encoding, and normalization, followed by feature selection techniques to reduce dimensionality and computational complexity. Supervised machine learning classifiers, including Decision Tree, Random Forest, Support Vector Machine, and K-Nearest Neighbour, are trained and evaluated using benchmark intrusion detection datasets. Experimental results demonstrate that ensemble-based learning, particularly Random Forest, achieves superior detection accuracy, while Decision Tree models provide lower inference latency and energy consumption, making them suitable for resource-constrained environments. The proposed IDS framework effectively balances detection performance and computational efficiency, demonstrating its applicability for real-time intrusion detection in IoT networks. latency and energy consumption, making them suitable for resource-constrained environments. The proposed IDS framework effectively balances detection performance and computational efficiency, demonstrating its applicability for real-time intrusion detection in IoT networks.

Keywords: Machine Learning, IOT, IDS, Artificial Intelligence, Anomaly detection, Network security

Intelligent System for Automatic Traffic Violation Detection

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Traffic violations are one of the leading causes of road accidents and traffic congestion in urban areas. Conventional traffic monitoring systems rely on manual observation, which is inefficient and often inaccurate. This project proposes an Intelligent System for Automatic Traffic Violation Detection that utilizes computer vision and machine learning techniques to automatically monitor traffic and detect violations in real time. The system processes video data captured from traffic surveillance cameras to detect and track vehicles. Image processing algorithms are used to identify various traffic violations such as red-light jumping, over-speeding, lane violations, and illegal parking. Upon detecting a violation, the system records evidence and generate alerts for traffic authorities. The proposed system minimizes human intervention, improves detection accuracy, and supports efficient traffic law enforcement. It contributes to enhanced road safety and forms an essential component of intelligent transportation and smart city systems.

Keywords: Traffic Violation Detection, Computer Vision, Machine Learning, Intelligent Transportation System, Video Surveillance.

Facial Emotion Recognition using Deep Learning

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Facial emotion recognition constitutes a core challenge in affective computing and human–computer interaction, requiring robust extraction of discriminative facial features under real-time constraints. This paper proposes a real-time facial emotion recognition framework based on Convolutional Neural Networks (CNNs). The proposed system processes live video streams by performing face localization, standardized image preprocessing, and end-to-end deep feature learning to classify facial expressions into seven emotion categories: angry, disgust, fear, happy, sad, surprise, and neutral. In contrast to conventional approaches that rely on handcrafted geometric or appearance based descriptors, the CNN model autonomously learns hierarchical facial representations directly from normalized pixel intensities. Experimental validation conducted on the FER-2013 benchmark dataset achieves an overall classification accuracy of 88.9% with an average inference latency of 18.6 ms per frame, demonstrating the effectiveness and real-time suitability of the proposed approach for practical affect-aware systems.

Keywords: Facial Emotion Recognition, Convolutional Neutral Networks, Real-Time Systems, Deep Learning, Affective Computing

Beyond Algorithms: Emerging Paradigms Shaping the Next Era of Computer Science

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Computer science is undergoing a profound transformation, evolving from traditional algorithm-driven systems into intelligent, decentralized, and human-centric computing paradigms. Recent advancements in artificial intelligence, cybersecurity, quantum computing, cloud–edge architectures, human–computer interaction, and blockchain technologies are reshaping the foundations of modern computation. This paper presents a thematic and conceptual analysis of these emerging trends, emphasizing their real-world applications, technological challenges, and potential research opportunities. By synthesizing current developments across multiple sub-domains, the study highlights how the convergence of these technologies is driving innovation, efficiency, and societal impact. The paper aims to provide a comprehensive yet accessible overview that supports researchers, academicians, and students in understanding the future direction of computer science research and practice.

Keywords: Computer Science, Artificial Intelligence, Cyber security, Quantum Computing, Cloud Computing, Emerging Technologies

Energy-Aware API Traffic Optimization Using Hierarchical Deep Reinforcement Learning

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Digital advertising infrastructure represents a substantial component of global computing resources, with significant environmental impact due to its massive energy consumption and carbon footprint. This work addresses the sustainability challenges posed by inefficient API traffic management in large-scale advertising systems, where conventional static approaches lead to resource overprovisioning and energy waste. We propose AdaptiveGate, a sustainability-oriented hierarchical reinforcement learning framework that dynamically optimizes API traffic flows to enhance resource efficiency and reduce environmental impact. The proposed methodology employs a constrained Markov Decision Process formulation with a multi-objective reward function explicitly designed to balance system performance with resource efficiency. Our framework implements a two-tier architecture of twin delayed Deep Deterministic Policy Gradient agents: global agents minimize cross-datacentre energy expenditure through intelligent traffic routing, while local agents maximize resource utilization through service-specific load balancing. Empirical evaluation on production advertising systems processing over 2.5 million requests per second reveals significant sustainability improvements: 42.3% reduction in tail latency, 35.7% increase in throughput, and 18% decrease in overall energy consumption compared to state-of-the-art methods. The system demonstrates exceptional adaptability across diverse traffic conditions and operational scales, providing compelling evidence that AI-driven methods can substantially improve digital infrastructure sustainability. This work contributes to sustainable computing by establishing a framework that optimizes computational resource allocation, minimizes energy waste, and advances environmentally responsible high-performance computing systems, aligning with multiple Sustainable Development Goals including responsible consumption and affordable clean energy.

Keywords: Reinforcement learning, API traffic management, digital advertising, hierarchical decision making, adaptive systems.

EmailDefender: Real Time Detection of Malicious Emails for Organizational and Personal Communication Security

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Email is a widely used communication tool for personal, corporate, and governmental purposes, but it is increasingly targeted by malicious activities such as spam, phishing, harassment, and fraud. Traditional rule-based systems and conventional machine learning models struggle to handle large-scale datasets and evolving threats, often resulting in misclassification and delayed response. To address the growing challenges of malicious emails, this project presents a RoBERTa based email classification framework designed to automatically categorize incoming emails into four distinct classes: Normal, Fraudulent, Harassment, and Suspicious. The system leverages RoBERTa's, which allow it to understand nuanced semantic relationships and contextual cues within email content. The framework is trained on a labelled dataset consisting of these four classes, ensuring that it learns the unique characteristics of each category. During real-time operation, incoming emails are analysed instantly, allowing the system to make immediate classification decisions. Emails flagged as Fraudulent, Harassment, or Suspicious are automatically removed from the user's inbox to prevent exposure to potentially harmful content. At the same time, the user receives a notification regarding the detected email, and a secure copy of the message is stored within the framework. This secure storage enables traceable record-keeping, allowing for later auditing, forensic investigation, or compliance checks without exposing the user to danger. By reducing the user's exposure to spam, phishing attempts, and harassment, the framework improves productivity and workflow efficiency. Additionally, the modular and scalable design of the system allows it to be integrated into enterprise email security infrastructures, offering the framework establishes a highly reliable, efficient, and scalable system for modern email security.

Keywords: Email, Spam, Machine Learning, Forensic investigation

Ethics, Accountability, and Algorithmic Bias: Reframing Responsibility in Automated Decision-Making Systems

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The increasing reliance on algorithmic decision-making systems across critical domains such as healthcare, criminal justice, finance, employment, and public administration has raised significant ethical concerns worldwide. While algorithms are often promoted as objective, neutral, and efficient, growing empirical and theoretical research demonstrates that they can reproduce and amplify existing social inequalities through biased data, opaque decision processes, and weak accountability mechanisms. This paper critically examines the ethical dimensions of algorithmic bias and the challenge of accountability in automated systems. It argues that algorithmic bias is not merely a technical malfunction but a socio-technical and moral issue embedded within historical data practices, institutional priorities, and power structures. The paper further explores the responsibility gap created by automated decision-making and proposes a human-cantered, ethically grounded framework for accountable and fair algorithmic governance. By emphasizing transparency, inclusivity, and global ethical standards, the study contributes to ongoing international debates on responsible artificial intelligence and democratic oversight of algorithmic power.

Keywords: Algorithmic Bias, Ethics of AI, Accountability, Automated Decision-Making, Fairness, Global Governance

Intelligent Vision System for Detecting Fatigue and Distraction of Train Operators

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Train accidents caused by operator drowsiness and distraction have become a major concern in railway safety, leading to significant property damage, service disruption, and, in severe cases, loss of life. Continuous monitoring of locomotive drivers is essential to ensure safe and efficient railway operations. Traditional physiological monitoring systems (such as EEG, ECG, and heart rate sensors), though effective, are intrusive, expensive, and impractical for long-term use in railway environments. To overcome these limitations, this project proposes a real-time, non-intrusive, AI-powered Railway Driver Monitoring System using computer vision and deep learning techniques

Keywords: EEG, ECG, Locomotive Drivers, Monitoring

Real Time Cyber Threat Intelligence and Alerting System Using a Novel Hybrid CNN-LSTM Architecture

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In today's digital era, the frequency and sophistication of cyber threats are increasing at an alarming rate, posing serious challenges to data security and network reliability. Conventional cyber threat monitoring systems that rely on rule-based or signature-based approaches often fail to detect new and evolving attacks due to their static nature. To overcome these limitations, this project proposes an intelligent Cyber Threat Intelligence Monitoring System that integrates Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) models. The CNN component efficiently extracts spatial patterns from cyber threat data, identifying anomalies in traffic flow, malicious URLs, and abnormal system behaviour. Meanwhile, the LSTM component captures temporal dependencies and evolving sequences of threat patterns, enabling the system to recognize emerging or previously unseen attacks. The proposed hybrid CNN-LSTM model is trained using a Cyber Threat Monitoring dataset, which includes diverse threat indicators such as phishing domains, malware traces, and other network-based anomalies. The system follows a structured pipeline involving data acquisition, preprocessing, feature extraction, and classification, allowing for accurate detection and prediction of cyber threats. By combining the strengths of CNN's spatial analysis and LSTM's temporal learning, the model achieves a deeper understanding of both static and dynamic threat
characteristics. Evaluation through metrics such as accuracy, precision, recall, and F1-score demonstrates the system's superior performance compared to traditional machine learning-based monitoring tools. Ultimately, this system contributes to building a robust, adaptive, and intelligent cybersecurity framework capable of real time threat detection and proactive defence.

Keywords: Cyber Threat Intelligence, Cybersecurity, Intrusion Detection System, Deep Learning, Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM)

Network Traffic-Based Cloud Intrusion Detection System Using Hybrid Feature Selection and Deep Learning Techniques

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Network Traffic anomaly detection system is designed to monitor system or network activities and identify malicious behavior to ensure secure data transmission and storage. With the rapid growth of the internet, systems face threats such as viruses, worms, and hackers who exploit vulnerabilities like weak passwords and unencrypted data. IDS plays a crucial role in multiple domains including insurance, healthcare, credit card fraud detection, and network management. The study compares several machine learning and deep learning techniques such as Back Propagation, Feed Forward, Recurrent Neural Network (RNN), and Multilayer Perceptron (MLP) using datasets like IDS and UNSW. The proposed IDS system, implemented using Python, analyzes performance through metrics such as accuracy and error rate to evaluate its effectiveness.

Keywords: Network Traffic, IDS, RNN, MLP

Regression Integrated with an Interactive Chatbot for Real-Time Investor Support

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Stock price prediction plays a vital role in the financial sector by enabling investors and traders to anticipate future market movements and make informed investment decisions. However, traditional prediction techniques such as moving averages and linear regression often fail to handle the highly volatile and nonlinear nature of stock market data. To overcome these limitations, this project focuses on the application of Long Short-Term Memory (LSTM) regression models, which are well suited for time-series forecasting due to their ability to learn long-term temporal dependencies from historical stock price data. The model is trained using past stock prices and evaluated using performance metrics such as Mean Squared Error (MSE) and R-squared to ensure accurate and reliable prediction of future stock prices. In addition to predictive analytics, the project integrates a chatbot-based interactive system to enhance user engagement and accessibility. The chatbot acts as a conversational interface that allows users to query stock price forecasts, trends, and related market information in real time, using predictions generated by the LSTM model. By incorporating Natural Language Processing (NLP) techniques, the chatbot can understand user queries and provide meaningful responses in a user-friendly manner. Furthermore, the system includes an expert query feature that enables users to seek advanced insights from stock market professionals. By combining LSTM-based stock price prediction with conversational AI, the proposed system delivers a comprehensive solution that improves forecasting accuracy while offering an intuitive and interactive platform to support smarter investment decisions.

Keywords: Artificial Intelligence, Chatbot, LSTM, NLP

Data Augmentation and Preparation Process of Perinfex: A Persian Chatbot with the Ability of Information Extraction

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In recent years, advancements in artificial intelligence have paved the way for innovative applications in storytelling and visual representation. This project introduces an AI-powered chatbot designed to generate sequential visual representations of a given story. By accepting textual inputs containing story content, the chatbot leverages deep learning techniques to create a series of images that visually depict the narrative. Developed using Python and powered by Convolutional Neural Networks (CNNs), the system translates textual inputs into corresponding visual concepts. The model is trained on a curated dataset of stories and their associated imagery, ensuring accurate and meaningful image generation. The chatbot processes story content by analyzing and extracting key narrative elements, transforming them into visual outputs, and organizing these outputs into a coherent sequence that represents the story's flow. This research work bridges the gap between textual and visual storytelling, offering a creative and interactive platform for education, entertainment, and creative industries. By integrating machine learning and image synthesis, the chatbot demonstrates the potential of AI in enhancing narrative experiences and fostering engagement.

Keywords: CNN, Chatbot, Information Extraction, Data Augmentation, Natural Language Processing (NLP), Text Preprocessing

Privacy-Preserving Kidney Image Analysis via Blockchain-Secured Federated Deep Learning Framework

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In the current scenario, the healthcare industry faces increasing challenges in accurately diagnosing kidney diseases while ensuring patient data privacy and maintaining system efficiency. With the rapid rise in medical imaging technologies and electronic health records, vast amounts of sensitive data are generated daily across hospitals and laboratories. In the modern era of digital healthcare, the early detection and accurate diagnosis of kidney disease have become increasingly vital due to the growing global burden of renal disorders. Chronic kidney disease (CKD) affects millions of individuals worldwide, often going undiagnosed until it reaches advanced stages. Early identification can significantly improve patient outcomes, yet the process requires precise analysis of diverse medical data, including imaging modalities like ultrasound and MRI, as well as structured clinical datasets containing patient health parameters. Traditional centralized diagnostic systems rely heavily on aggregating this sensitive information to a central location for model training and analysis, which introduces major concerns regarding data privacy, ownership, and security. Furthermore, such centralized models often fail to perform efficiently when dealing with heterogeneous data sources collected from multiple healthcare institutions with varying equipment, formats, and patient demographics. However, traditional centralized diagnostic systems require data aggregation at a single server, raising severe privacy, security, and data ownership concerns. Moreover, differences in data formats, imaging techniques, and diagnostic parameters across healthcare institutions often degrade the performance of centralized machine learning models. To address these challenges, this project introduces a decentralized and privacy-preserving framework using Federated Learning (FL), which allows multiple healthcare institutions to collaboratively train models without sharing raw patient data. The system intelligently adapts to different input modalities if the input is image-based medical data, a Convolutional Neural Network (CNN) is employed for disease classification, while for structured dataset inputs, a Multi-Layer Perceptron (MLP) is utilized for accurate analysis. After local model training, each institution encrypts its trained model using Elliptic Curve Cryptography (ECC) to ensure secure transmission and prevent unauthorized access to sensitive model parameters. The encrypted models are then uploaded to a Blockchain-integrated federated server, which provides an immutable and transparent ledger to record transactions, verify model integrity, and enhance system accountability. The Blockchain mechanism also prevents model tampering and facilitates trust among collaborating nodes. By combining CNN and MLP models under a unified federated architecture with ECC encryption and Blockchain security, the proposed framework delivers a comprehensive, privacy-preserving, and accurate solution for Kidney Disease Diagnosis. This hybrid model not only strengthens security and transparency but also enhances diagnostic reliability across diverse data types, ultimately supporting early detection and improved patient care in the modern healthcare ecosystem.

Keywords: Federated Learning, CNN, Multi-Layer Perceptron, Kidney disease

Blockchain Assisted Data Recovery System with FIDO Key using Face Biometric Authentication

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In the modern enterprise environment, safeguarding sensitive data and ensuring rapid recovery from credential loss or compromise are vital for maintaining operational continuity and trust. Traditional recovery mechanisms such as email or SMS-based password resets are highly susceptible to phishing, SIM swapping, and unauthorized access, making them both insecure and inefficient. To overcome these vulnerabilities, this project proposes a Blockchain-Assisted Data Recovery System that seamlessly integrates FIDO keys, face biometric authentication, and QR code scanning. The use of FIDO-compliant hardware keys eliminates the dependence on passwords, enabling standardized and phishing-resistant password less authentication. Simultaneously, face biometric verification ensures that only legitimate users can initiate the recovery process, adding a powerful layer of identity assurance. The system's QR-based access mechanism provides a simple and secure way for users to link to their encrypted recovery credentials, streamlining the overall user experience. Furthermore, the proposed system leverages blockchain technology to enhance data integrity, transparency, and trustworthiness. All recovery credentials, access logs, and audit trails are stored in a decentralized and tamper-proof ledger, ensuring traceability and accountability across all recovery operations. This decentralized design prevents manipulation or unauthorized modifications to sensitive recovery records. By combining biometric verification, hardware authentication, and blockchain-backed security, the platform provides enterprise-grade protection while maintaining scalability and user-friendliness. Ultimately, the proposed solution delivers an efficient, traceable, and secure data recovery framework, capable of meeting the evolving demands of modern enterprises and significantly advancing the standards of cyber security and credential management.

Keywords: Blockchain Security, Passwordless Authentication, Biometric Verification, Decentralized Recovery System, Credential Management

Deep Learning-Based Early Detection and Classification of Alzheimer's Disease using Brain MRI Scans

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Alzheimer's Disease (AD) is a progressive neurodegenerative disorder that primarily affects memory, cognitive abilities, and daily functioning, posing a significant challenge to global healthcare systems. As the disease advances silently over several years, early and accurate diagnosis is critical for initiating timely treatment, slowing disease progression, and improving patients' quality of life. Conventional diagnostic techniques depend largely on clinical assessments and manual interpretation of magnetic resonance imaging (MRI) scans by experts, which can be time-consuming, subjective, and prone to inter-observer variability. Hence, there is a strong need for reliable automated diagnostic solutions. This project proposes a deep learning–based framework for the early detection and stage-wise classification of Alzheimer's Disease using structural brain MRI images. The proposed system employs a 3D Convolutional Neural Network (3D-CNN), which effectively captures spatial and volumetric features from three-dimensional MRI data, enabling more accurate representation of brain structural changes associated with AD. The model is trained using the Best Alzheimer's MRI Dataset, incorporating both real and Generative Adversarial Network (GAN)–augmented images to address data imbalance and improve generalization across four cognitive stages: no impairment, very mild impairment, mild impairment, and moderate impairment. Comprehensive preprocessing techniques, including skull stripping, intensity normalization, and uniform resizing of MRI volumes to 128×128×64 dimensions, are applied to ensure data consistency and enhance learning efficiency. The performance of the proposed framework is evaluated using standard metrics such as accuracy, precision, recall, F1-score, and Area Under the Receiver Operating Characteristic Curve (AUC-ROC). Experimental results demonstrate high classification performance, achieving an AUC value greater than 0.93, indicating strong discriminative capability. Overall, this study highlights the effectiveness of deep learning models in improving the accuracy, consistency, and reproducibility of Alzheimer's Disease diagnosis. The proposed system offers a robust, scalable, and deployment-ready solution that can assist neurologists and clinicians in early detection and informed clinical decision-making, thereby contributing to improved patient care and outcomes.

Keywords: Classification, Early detection, Alzheimer, CNN, GAN, MRI

A Big Data–Driven Machine Learning Framework for Regional Temperature Anomaly Detection

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Climate change reveals significant historical temperature patterns, making the identification of abnormal thermal behavior increasingly important at regional and national scales for planning and mitigating environmental risks. Advances in large multimodel climate datasets have enabled the generation of generalized climate scenarios; however, relatively few studies focus on large-scale regional temperature anomaly detection with systematic machine learning evaluation. Most existing anomaly detection research relies on satellite image–based or single-model approaches, with limited emphasis on long-term, regionally interpretable climate analysis. In this study, we propose a big data–driven, unsupervised machine learning framework for regional temperature anomaly detection using ERA5 near-surface air temperature reanalysis data spanning 1940–2023, with anomaly detection experiments conducted on monthly aggregated data for the period 2000–2022. It includes seasonal unit root correction, multivariate spatial feature construction, isolation forest for anomaly detection, and PCA for visualization and region of interest intensity analysis. It was able to pick 14 months (~5.1%) where it classified months as anomalies, marking its rarity. Although the rate at which anomalies occur was similar for both regions, their magnitude was greater in the north than in central or southern parts of India. The originality of the proposed study resides in the development of a scalable and interpretable unsupervised methodology that unifies seasonal component removal and region-specific temperature anomaly derivation on the reanalysis datasets. Contrary to previous works on the topic, the proposed methodology allows the analysis of temperature anomaly intensity on a region-specific level and does not encompass short-term or image-driven analysis. Further, region-specific anomalies derivation allows the preparation stage of a disaster due to its rare nature.

Keywords: Climate Change, Temperature Anomaly Detection, Machine Learning, Big Data Analytics, ERA5 Reanalysis Data.

Security Challenges in Large Language Model Applications

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Large Language Models (LLMs) have rapidly transitioned from experimental research artifacts to core components of real-world software systems, including conversational assistants, retrieval-augmented generation (RAG) systems, automated decision-support platforms, software development tools, and enterprise workflows. While LLMs deliver substantial improvements in flexibility and usability, their reliance on probabilistic language generation introduces security challenges that differ fundamentally from traditional deterministic software. Unlike conventional programs governed by explicit rules, LLM-based applications interpret and generate outputs based on statistical patterns learned from data, making their behavior context-dependent and non-deterministic. This shift disrupts long-standing security assumptions related to trust boundaries, input validation, and control flow. A major focus of the study is instruction manipulation, particularly indirect prompt injection attacks. In RAG-based systems, external documents are retrieved and added to the model's context. Since the model processes all text equally, malicious instructions hidden in these documents can influence system behavior, leading to unauthorized actions or information leakage. Real-world incidents show that such attacks exploit architectural weaknesses rather than simple prompt design errors. Beyond instruction manipulation, the paper analyzes additional threat categories actively explored in recent years. Training data poisoning attacks compromise model integrity by introducing malicious samples into training or fine-tuning datasets, potentially embedding persistent backdoors or biases that are difficult to detect after deployment. Model extraction attacks threaten intellectual property by enabling adversaries to approximate proprietary models through repeated querying. Privacy-related threats, including model inversion and training data extraction, raise serious concerns when LLMs are trained on sensitive personal, medical, or proprietary data, as memorized information may be exposed through carefully crafted queries. These threats are amplified as LLMs are embedded within complex, autonomous, or tool-integrated systems. When models are capable of invoking APIs, accessing databases, or performing actions on behalf of users, security failures can escalate from incorrect outputs to unauthorized operations and large-scale data exposure. This underscores the limitations of relying solely on prompt design, alignment tuning, or output filtering as security controls. Based on this analysis, the paper outlines forward-looking design considerations for future LLM-based applications, including explicit separation between trusted instructions and untrusted data, layered defensive architectures that externalize security enforcement from the model itself, and security-by-design approaches that treat LLMs as potentially untrusted components operating within constrained environments. Rather than proposing finalized solutions, this work consolidates current knowledge of LLM security threats, contextualizes them using recent real-world failures, and establishes a conceptual foundation for developing new architectural approaches to address structural vulnerabilities in modern LLM deployments.

Keywords: ***LLM Security, Prompt Injection, Indirect Prompt Injection, Data Poisoning, Retrieval-Augmented Generation (RAG)***

Green Artificial Intelligence: Carbon - Aware Self - Optimizing Learning for Energy Efficient Machine Learning Models in Climate Responsible Computing

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The growing use of Artificial Intelligence (AI) has led to more energy consumption, which significantly adds to carbon emissions from data centers and smart systems. Although Green Artificial Intelligence seeks to reduce this impact, current solutions mainly depend on static optimization methods like model compression and hardware efficiency. This paper introduces a Carbon-Aware Self-Optimizing Learning framework aimed at energy-efficient and climate-friendly machine learning. The proposed system works in four phases: monitoring carbon intensity in real-time, scheduling workloads with carbon awareness, adapting through self-optimizing learning, and evaluating the trade-off between performance and carbon impact. By adjusting model complexity, training schedules, and inference tasks based on real-time carbon data, the framework reduces environmental harm while keeping predictive performance high. What makes this work unique is its focus on integrating carbon awareness into the learning process. This allows for ongoing autonomous adjustments instead of just fixed efficiency improvements. Experiments using publicly available datasets on green energy and sustainability show significant cuts in energy consumption and carbon emissions. These results were assessed based on accuracy, energy use, CO_2 emissions, and execution time metrics. The framework is ideal for cloud computing, edge intelligence, smart cities, and Industry 5.0 applications.

Keywords: Green AI, Sustainability, Self-Optimizing, Carbon-Aware Learning, Machine Learning

Brainwave Authentication using EEG Headset with BCI Technology

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Biometric authentication methods, such as facial recognition or fingerprints, are now considered the most secure ways to verify identity, addressing the limitations of traditional password and PIN-based systems. While biometrics offer enhanced security, they also have drawbacks. Advanced technology can be used to replicate or fake biometric traits, such as fingerprints or facial features, since they're visible and tangible. The vulnerabilities of existing biometrics have sparked interest in brainwave-based security, a novel approach that leverages individual brain patterns for authentication. Studies are exploring Electroencephalography (EEG) signals for biometric identification, leveraging BCI technology and techniques like feature extraction and classification to achieve high accuracy in recognizing unique brainwave patterns. This paper introduces a novel signal acquisition strategy for capturing and recording brainwaves, specifically designed for authorization and authentication purposes in BCI systems. Users can securely authenticate by mentally picturing a specific image, with their brain activity used to verify their identity. In conclusion, brainwave variability with mental tasks presents authentication challenges, optimal signal acquisition and processing strategies can yield high accuracy, supporting the use of brain signals as a reliable biometric security measure.

Keyword: Brain Computer Interface, Electroencephalography EEG, Brain-wave, Facial Recognition

The AI-Powered Classroom: Exploring the Potential of Artificial Intelligence in Education

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Artificial Intelligence (AI) is transforming the education sector by providing innovative tools and systems that revolutionize traditional teaching and learning methods. This study explores the multifaceted role of AI in education, highlighting its potential to enhance learning through personalization, intelligent tutoring, and data-driven insights. The findings suggest that AI systems can facilitate customized learner-instructor collaboration on a large scale, but also raise concerns about social norms, accountability, authority, and monitoring issues. Despite these challenges, AI systems have been praised for increasing feedback volume and quality, providing immediate support, and improving interaction. To ensure the effective development and implementation of AI systems, it is essential to prioritize simplicity, human involvement, and comprehensive data collection and presentation. Ultimately, our research highlights the potential of AI to augment human efforts in education, maximizing efficiency and supporting innovative teaching faculty members. By leveraging AI, educators can create more effective learning environments that promote academic achievement and student success. Our study contributes to the development of an educational framework that integrates AI in a way that enhances teaching and learning.

Keyword: Artificial Intelligence, Innovative Tools, Intelligent Tutoring, Data-Driven.

A Survey of Machine Learning Techniques for Healthcare Fraud Detection and Prevention

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The increasing complexity of healthcare systems has led to a significant challenge in detecting and preventing healthcare fraud. This study provides a comprehensive review of machine learning (ML) techniques and their applications in healthcare fraud detection. We examine various ML approaches, including supervised learning, unsupervised learning, deep learning, and hybrid models, and discuss their strengths and limitations. Our review highlights the importance of feature selection, data quality, and model interpretability in ML-based fraud detection. Our findings provide actionable insights for policymakers, healthcare providers, and insurance companies, presenting a comprehensive framework for enhancing real-time healthcare fraud detection through self-learning, interpretable, and secure ML infrastructures. This study contributes to the development of more effective ML-based solutions for healthcare fraud detection, ultimately improving the integrity and sustainability of healthcare systems. The insights from this study can inform the development of robust, scalable, and secure fraud detection infrastructure.

Keyword: Machine Learning, Healthcare Fraud Detection, Deep Learning, Supervised Learning

Dietary Recommendations for Type 2 Diabetes: User-User Collaborative Filtering Model

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A well-balanced diet is essential for maintaining good health, and researchers in India are working tirelessly to understand the impact of nutrition on various diseases. This study seeks to identify key diseases that are influenced by dietary factors, highlighting the importance of nutrition-based food in preventing and managing health conditions. Managing Type 2 Diabetes Mellitus (T2DM) requires a personalized approach to dietary planning, taking into account individual characteristics, preferences, and lifestyle habits. Our research proposes a novel food and nutrition recommendation system using User-User Collaborative Filtering Algorithm (UUCFA) to deliver tailored dietary guidance for T2DM patients. By analyzing similarities among users based on demographic attributes, clinical parameters, and food consumption patterns, our system recommends nutritionally suitable foods that cater to individual needs and preferences. The collaborative filtering approach enables the system to learn from the experiences of similar users, providing personalized recommendations that are more effective than traditional rule-based systems. Our evaluation demonstrates the potential of user-user collaborative filtering to improve recommendation accuracy, user satisfaction, and dietary adherence, ultimately contributing to better T2DM management and improved health outcomes.

Keywords: Dietary Factors, Diabetes Mellitus, Collaborative Filtering Algorithm, Clinical Parameters, Food Consumption Patterns

XGBoost-Powered Smart Air Quality Evaluation and Prediction System

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Predicting the concentration of air pollution is a key objective as it can help improve our quality of life. The adverse impact of air pollution on people as a result of being exposed to its many toxic components is severe. The rapid growth of Urbanisation in developing countries globally, has made air pollution a serious environmental and social issue. Individuals are affected by both particulate matter, and gaseous constituents (NO_2, CO, O_3 and SO_2). The effects of air pollution on the health of people may occur acutely, but also over time, with younger and older people affected. The use of machine learning algorithms with large-scale optimisation on large datasets, is one of the more popular ways to develop and train a model for predicting the future concentrations of air pollutants. To date, a limited number of studies have been published that have applied machine learning methods for predicting air quality. However, almost all previous research on this topic has utilised a limited number of years of data, and the majority of studies have employed simple regression models (linear or nonlinear). Due to the computational and temporal limitations of machine learning, researchers have identified significant difficulties with the algorithms used in this field. To improve the current approaches, we have developed a strategy that utilizes a merging of deep distributed fusion networks (DDFN) and Spatial Transformation Components (STC) through the application of XGBoost. DDFN is a means of transforming sparsely distributed air quality data into a uniform input format so that pollution sources can be modelled based on the spatial correlation of air pollutants. We will be able to evaluate how effectively our systems can predict air quality index accuracy as we would have access to every attribute within our datasets through Air Datasets.

KEYWORDS: Air Quality Prediction, Air Pollution Monitoring, XGBoost, Machine Learning, Air Quality Index (AQI), Gaseous Pollutants, Smart Air Quality System

DRNET-X: A CNN-Based Classification and Hybrid Preprocessing-Based Deep Learning Framework for Diabetic Retinopathy Image Identification

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In the world, Diabetic Retinopathy is a complication of diabetes and one of the leading causes of blindness. Early diagnosis is crucial in order to minimize the risk of blindness. This paper proposes a novel Deep Learning (DL)-reliant diagnostic model DRNet-X directly diagnosing Retinopathy Image Detection (DRID) in Macula Diabetic fundus Images (MFI). The proposed method includes a hybrid preprocessing algorithm based on CLAHE (Contrast Limited Adaptive Histogram Equalization) and Gaussian filter in order to enhance module visibility and reduce noise. The proposed U-Net-based segmentation the vessels isolates pathological parts of the retina, particularly focused on microaneurysms, exudates, andhemorrhage spots. Feature extraction is performed by using a DR-specific image feature-oriented modification and fine-tuning of ResNet50, denoted asDR-ResNet50X. A hybrid feature selection method Hippo Master Optimization (HMO) is introduced to reduce the dimensionality and spare the optimal discriminating features through Masterpiece Optimization Algorithm (MOA), and Hippopotamus Optimization (HO). In the proposed DRNet-X, a stacked CNN-LSTM hybrid model is introduced to capture spatial and sequential patterns in the images, while VI sion transformer (ViT) model is employed for them to be classified at last. To ensure a reliable assessment of the model's performance, the dataset is split into 20% for testing and 80% for training. The results of the experiment demonstrate that the accuracy, sensitivity, and specificity are significantly higher than those of the traditional CNN techniques. The proposed DRNet-X framework offers an accurate and comprehensive solution for early-stage DR recognition and grading.

Keywords: Diabetic retinopathy, Macula fundus images, CNN-LSTM, Optimization algorithm

A Study of Personalized Nutritional Approaches for Effective Blood Glucose

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Controlling blood sugar is very important for people with Type 2 diabetes to stay healthy. Generally, dietary advice is the same for everyone, but people are unique. Age, weight, activity, and food habits all change the blood sugar reaction. This study aims to determine whether personalized diet plans are more effective than standard diets. Adults with Type 2 diabetes were included. Each person's age, body weight, daily activity level, food preferences, and past blood sugar readings were recorded. Then, a diet plan was made just for them. Another group followed the regular diabetes diet. Blood sugar levels were checked for both groups. People who followed personalized plans had smaller spikes after meals. Their blood sugar stayed more stable during the day. They also felt it was easier to follow the diet because it matched what they liked and their daily routine. This shows that a single diet does not suit all. Paying attention to each person's needs can really help control blood sugar. People on personalized plans were more motivated to stick to the diet and take care of themselves. In the long run, this approach may help them form better eating habits and manage diabetes more easily. Doctors and dietitians should think about individual factors when giving advice. Tools like blood sugar monitors or apps could make personalized plans even more useful. In short, diet plans that fit a person's body, lifestyle, and habits can improve blood sugar control, make diets easier to follow, and reduce the risk of diabetes problems.

Keywords: Diabetes management, Blood sugar control, Personalized nutrition, Type 2 diabetes, Glycemic management, Lifestyle-based diet, Dietary patterns

AI-Driven X-Ray Diagnosis System for Accurate Disease Detection and Prescription Support

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The purpose of this contribution is to develop an intelligent system that can analyze medical X-ray images using Artificial Intelligence (AI) and provide diagnostic assistance and prescription suggestions. The mobile application CSC uses machine learning and image processing to automatically detect abnormalities in X-rays such as pneumonia, tuberculosis, or lung opacity. This project integrates a trained deep learning model with an Android application, enabling users to scan or upload X-rays directly from their phones. The system processes the image using the embedded AI model and returns an analysis result within seconds. The aim is to make early diagnosis faster, more accurate, and more accessible to both doctors and patients, especially in remote area. The CSC app allows users to upload or scan X-rays using their mobile camera. The AI system automatically processes the image, identifies abnormalities, and displays the diagnosis result with a suggested prescription. This project aims to simplify the diagnostic process and make it faster, affordable, and accessible though technology. In rural areas or small clinics, not every patient can get immediate access to a radiologist. Sometimes patients need to wait for hours or even days for X-ray interpretation. This delay can be dangerous for critical illnesses. Health diagnosis is an important and complex process that requires careful analysis of symptoms, test results, and imaging data. One of the most commonly used diagnostic tools in the medical field is the X-ray. It provides an internal view of the body and helps doctors detect conditions like lung infections, bone fractures, and tumors. The CSC app allows users to upload or scan X-rays using their mobile camera. The AI system automatically processes the image, identifies abnormalities, and displays the diagnosis result with a suggested prescription.

Keywords : Artificial Intelligence (AI), X-Ray Image Analysis, Convolutional Neural Network, Prescription Support, Deep learning.

Real-Time Multimodal Assistive Technology for Navigation, Social Interaction, and Financial Management of Visually Impaired Individuals

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Blind or visually impaired people encounter a lot of difficulties when it comes to everyday living. The majority of these people have trouble when it comes to finding obstacles, knowing whether other people are familiar to them and completing financial transactions. The loss of daily independence as a result of some of these challenges can be daunting and make it difficult to build confidence in completing activities required by blind or visually impaired persons. Traditional assistive devices such as white canes and guide dogs provide only minimal assistance, as these types of devices only help provide basic physical navigation. Additionally, they also do not provide real-time updates about their users' environment. Most of the currently available digital support products could also be better integrated into one complete system(s), as most of the current digital support products are not adaptable to constantly changing conditions. Therefore, there is a significant need for an innovative, intelligent, and comprehensive assistance system to better support the full range of challenges faced by visually impaired individuals. The proposed assistance system is a novel artificial intelligence (AI) powered interface that enhances the safety and independence of visually impaired individuals through the incorporation and integration of features for identifying people, detecting obstacles, and identifying currency in one, compact product. Additionally, the proposed assistance system uses artificial intelligence and specialized image processing algorithms to use a camera to collect video/image data. Once processed, the assistance system generates real-time audio feedback to the user that contains contextual information from the environment detected via the camera. Using AI, computer vision, and wearable technology, this product allows consumers to easily navigate their environment, connect with others, and handle banking tasks without assistance from an outside source. By providing a more affordable alternative to assistive devices currently on the market, this technology creates a new dimension of independence, security, and self-confidence for people who are visually impaired.

Keywords: Assistive Technology, Artificial Intelligence, Obstacle Detection, Face Recognition, Currency Recognition, Wearable Devices, Audio Feedback System.

Smart RFID and Face Recognition-Based Automated Attendance Management System

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An RFID Face Attendance System automates and streamlines the manual recording methods for student attendance traditionally used in schools or universities. Traditional attendance marking methods (i.e. recording on paper or in books) are lengthy and accumulate numerous errors over time, making the process less effective than the RFID Attendance System with face recognition technology. With the RFID card linked to a student's personal information, the RFID Face Attendance System will check for the smile on the student's face to confirm that they are present in the class when they arrive. This technology provides greater accuracy than traditional methods of confirming someone's identity by using two forms of verification (RFID Card and Facial Recognition) that eliminate the possibility of proxy attendance. With a digital record of attendance data, faculty/administrators have the capability of accessing, analyzing, and creating reports from these records with ease. In turn, this frees up valuable instructional time, creates less work for teachers/faculty, and ensures data integrity. Faculty/admin will also be able to calculate students' average attendance automatically and provide real-time monitoring of student engagement and participation. Faculty/admin will have the ability to integrate the RFID Face Attendance System with any academic portal they choose, allowing them to share information regarding each student's attendance via email seamlessly. This technology provides institutions with improved transparency, decreased administrative burden, and improved classroom management. The RFID Attendance System for Face Recognition provides a state-of-the-art, streamlined and secure method of tracking attendance. This system replaces traditional, outdated manual processes with new technology; the automation used in this system meets the requirements of the current digital education environment.

Keywords: RFID Technology, Face Recognition, Automated Attendance System, Biometric Authentication, Student Attendance Management, Digital Attendance Records, Real-Time Monitoring

A Comprehensive Survey on AI-Based Automated Waste Segregation Systems for Circular Economy Applications

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Rapid urbanization and industrial expansion have led to a substantial increase in heterogeneous solid waste, creating significant challenges in efficient segregation, recycling, and sustainable resource management. Conventional waste management systems largely rely on manual sorting processes, which are labor-intensive, error-prone, and inadequate for handling large-scale waste streams. Improper segregation results in contamination of recyclable materials, reduced recycling efficiency, and increased environmental pollution, thereby hindering the adoption of circular economy practices.

This study presents a comprehensive survey and system-level analysis of AI-based automated waste segregation approaches designed to support circular economy applications through intelligent material identification and reuse guidance. The proposed framework employs the EfficientNet-B7 convolutional neural network (CNN) for high-accuracy multi-class waste classification, owing to its optimized trade-off between classification performance and computational efficiency. The system classifies waste into five major categories: plastic bottles, glass bottles, cardboard, aluminum cans, and cloth waste. Implementation is carried out using Python, with TensorFlow for deep learning model development, OpenCV for image acquisition and preprocessing, and Flask for real-time web-based deployment and user interaction.

In addition to automated classification, the system generates intelligent reuse and repurposing recommendations based on identified waste categories, thereby promoting sustainable resource reutilization and reducing landfill dependency. The automated approach enhances segregation accuracy, minimizes human intervention, and improves overall recycling throughput. By integrating deep learning, computer vision, and web-based interfaces, the proposed system demonstrates strong potential for deployment in smart city waste management infrastructures. Furthermore, this study highlights key challenges related to dataset diversity, computational requirements, and real-world environmental variability, providing valuable insights for future research in AI-driven circular economy solutions.

Keywords: Artificial Intelligence, Automated Waste Segregation, Deep Learning, Computer Vision, EfficientNet, Multi-Class Waste Classification, Circular Economy, Smart Waste Management, Resource Reutilization, Smart City Applications, Survey.

Hybrid Two-Stage LLM-Powered Pipeline for Structured Data Generation from Unstructured Clinical Narratives in Health Informatics

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The unstructured clinical narratives that are integrated in Electronic Health Records (EHRs) contain useful information, but their usefulness is hindered by the analytical inaccessibility that is arachnoid due to non-structured format. The novelty of the paper is based on a hybrid and two-step pipeline, which combines rule-based preprocessing with large-language-model (LLM)-driven structuring and outperforms the current clinical natural language processing (NLP) systems in quality, scheme compliance, and cost-effectiveness. To overcome these shortcomings, we suggest a hybrid pipeline in which the LLMs will produce structured representations based on clinical text. Pipeline includes two successive steps, namely rule-based preprocessing and structuring by the LLM. During the preprocessing phase, entity recognition, normalization, and section segmentation are carried out to make the text ready to be processed by the downstream processing. LLM phase then performs a complicated relation extraction and attribute argumentation and presents the output of this step as map to the Observational Medical Outcomes Partnership (OMOP) Common Data Model. The step involves integration of formal engineering and orientation focus aimed at increasing accuracy and efficiency. An empirical comparison of a sample of 5,000 MIMIC-III ICU notes revealed that the pipeline significantly outperformed cTAKES, ClinicalBERT and GPT-4 zero-shot with a macro F1 of 0.89 on entity extraction and F1 of 0.85 on relation extraction. The level of schema adherence was 0.95, and the use of GPT-4 tokens was reduced by about 40 percent. These findings imply that the hybrid model can reduce the occurrence of hallucination and increase the stability of the structured data generation compared to the LLM-only strategies, thus making the pipeline an effective framework to convert unstructured clinical text into the structured forms that can be used in the future by clinical researchers and decision-support systems. In addition, the lowered consumption of tokens gives cost-efficiency to deployment.

Keywords: Large Language Models, Clinical Natural Language Processing, Structured Data Extraction, Electronic Health Records, OMOP Common Data Model

Applications of Artificial Intelligence in Sustainable Development

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Artificial Intelligence has gained significant attention in recent years due to its increasing use across various development-oriented sectors. The ability of AI systems to analyze data, support planning, and improve operational efficiency has encouraged their adoption in areas connected with sustainable development. Sustainable development focuses on balancing social well-being, economic growth, and environmental protection, and Artificial Intelligence has shown potential to support these objectives. This paper examines the applications of Artificial Intelligence in healthcare, agriculture, and education, which are key sectors influencing long-term development and human welfare. In the healthcare sector, Artificial Intelligence is applied in disease diagnosis, patient monitoring, and digital health services. AI-based diagnostic tools help medical professionals identify health conditions more accurately and at earlier stages. Predictive analysis supports treatment planning and resource allocation in hospitals. Remote monitoring systems and teleconsultation services improve access to healthcare, particularly in rural and underserved regions where medical facilities are limited. These applications help reduce workload on healthcare professionals and improve the overall quality of care. In agriculture, Artificial Intelligence supports better farm management and efficient use of natural resources. AI-based systems assist farmers in monitoring crop conditions, analyzing soil data, predicting weather patterns, and planning irrigation activities. Advisory platforms provide guidance on crop selection, pest management, and fertilizer usage based on environmental conditions. These applications contribute to improved productivity, reduced resource wastage, and enhanced food security, supporting sustainable agricultural practices. In the education sector, Artificial Intelligence plays a supportive role in teaching, learning, and administration. Personalized learning systems adapt study materials according to student performance and learning pace. Automated assessment tools assist teachers in evaluating student progress, while AI-based administrative systems support tasks such as attendance tracking and scheduling. These applications help make education systems more accessible, flexible, and efficient for both learners and institutions. Despite the advantages offered by Artificial Intelligence, several challenges limit its large-scale adoption for sustainable development. Issues related to data quality and availability affect system performance and reliability. Inadequate infrastructure, limited internet connectivity, privacy concerns, ethical issues, algorithmic bias, shortage of skilled professionals, and high implementation costs remain significant barriers. This paper reviews existing studies, reports, and policy documents to highlight both the benefits and challenges of AI applications in these sectors. The discussion emphasizes the importance of responsible implementation, ethical considerations, capacity building, and supportive policies. When used carefully and aligned with sustainability goals, Artificial Intelligence can contribute meaningfully to long-term sustainable development.

Keywords: Artificial Intelligence, Sustainable Development, Healthcare Applications, Agriculture Technology, Education Systems

A Real-Time Vision-Based Contactless Air Writing and Digit Recognition System Using Computer Vision and Machine Learning

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Recent advancements in human-computer interaction have accelerated the development of contactless input systems that minimize dependence on physical devices and enhance user convenience. Among these, hand gesture-based interaction has emerged as an intuitive and effective approach for enabling touch-free communication between humans and machines. This paper presents a real-time Air Canvas system that enables contactless air drawing and handwritten digit recognition using computer vision and machine learning techniques. The proposed system addresses the limitations of traditional hardware interfaces by allowing users to draw digits or freehand sketches in the air using simple finger movements, without requiring any physical input device. The primary objective of this project is to create a robust and accurate digital writing interface. Live video input is captured through a standard webcam, and hand landmarks are detected using MediaPipe to achieve precise finger tracking. A significant enhancement in this updated system is the integration of a Kalman Filter. This algorithm is employed to address the problem of hand jitter and environmental noise, ensuring that the trajectory of the index finger mapped onto the virtual canvas is smooth and accurate. For the digit recognition component, the air-drawn image undergoes preprocessing, including grayscale conversion and resizing to a fixed resolution of 28 x 28 pixels. Unlike previous iterations that relied solely on a single classifier, this project performs a comprehensive comparative analysis of three distinct algorithms: Random Forest (RF), K-Nearest Neighbors (KNN), and Convolutional Neural Networks (CNN). These models are trained and validated on the MNIST dataset to predict the drawn digits. The significance of this comparative study is to identify the optimal balance between computational speed and recognition accuracy. While KNN and RF offer simplicity, the CNN model is evaluated for its superior ability to extract deep features from image data. Experimental results demonstrate that the inclusion of the Kalman Filter significantly improves the user experience by reducing tracking errors, while the multi-algorithm analysis provides a clear pathway for selecting the best model for real-time deployment. The scope of the proposed system extends to educational environments, interactive learning tools, and assistive technologies, offering a low-cost and hygienic alternative to touch-screens.

Keywords : Air Canvas, Kalman Filter, Convolutional Neural Networks (CNN), Random Forest, KNN, Contactless Interaction, Machine Learning.

Real-Time Vision-Based Silent Emergency Detection and Alert System using Machine Learning and Computer Vision

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Ensuring personal safety during emergency situations has become a critical concern, particularly when individuals are unable to speak, shout, or actively seek help due to physical, medical, or situational constraints. This paper presents a Real-Time Vision-Based Silent Emergency Detection and Alert System that leverages Machine Learning and Computer Vision techniques to identify emergency situations through hand gesture recognition. The proposed system focuses on detecting a raised-hand gesture as an intuitive and reliable silent distress signal, enabling timely assistance without verbal communication or manual device interaction. The system continuously captures live video streams using a webcam and processes each frame using computer vision techniques. Hand landmark features are extracted in real time using the MediaPipe framework, and the resulting numerical feature vectors are organized into a structured dataset. A supervised machine learning model based on the Random Forest Classifier is trained to classify gestures into emergency and non-emergency categories. The Random Forest algorithm is chosen for its robustness, high classification accuracy, resistance to noise, and ability to model nonlinear feature relationships, making it suitable for real-world conditions involving varying illumination, hand orientations, and backgrounds.

To reduce false alarms, the system confirms an emergency only when the hand-raised gesture is detected continuously for a predefined duration. Upon confirmation, a multi-level automated alert mechanism is triggered, which includes generating an audible emergency alert, sending an instant WhatsApp notification to a predefined emergency contact, capturing and storing a visual snapshot as evidence, logging event details into a CSV file, and updating a real-time monitoring dashboard. This integrated alert pipeline ensures rapid response while minimizing user involvement.

The proposed system is particularly applicable to women safety, elderly care, physically challenged assistance, and other silent emergency scenarios where verbal communication may not be feasible. The system is implemented using Python, with OpenCV for video processing, MediaPipe for hand landmark detection, and Scikit-learn for model training and evaluation. Experimental observations demonstrate that the system offers a low-cost, contactless, scalable, and efficient solution for silent emergency detection. Future work will focus on incorporating multi-gesture recognition, fall detection, and contextual awareness to further enhance reliability and real-world applicability.

Keywords: Machine Learning, Computer Vision, Hand Gesture Recognition, Random Forest Classifier, Silent Emergency Detection

A Comprehensive Survey on AI-Driven Maritime Surveillance Systems for Threat Prediction and Fishermen Safety

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Maritime border security and the safety of coastal fishing communities have emerged as critical global concerns due to the growing incidence of unauthorized vessel movements, smuggling activities, piracy, and rapidly changing hazardous weather conditions. Conventional maritime surveillance systems often face limitations in continuous monitoring, timely threat detection, and effective dissemination of safety alerts, resulting in delayed responses and increased vulnerability of fishermen at sea. This survey presents a comprehensive review of recent advancements in artificial intelligence (AI)–driven maritime surveillance systems with a specific focus on threat prediction and fishermen safety. It systematically examines existing approaches for vessel monitoring, trajectory prediction, boundary violation detection, and environmental hazard forecasting using machine learning and deep learning techniques, including recurrent neural networks and Long Short-Term Memory (LSTM) models. The survey also analyzes the role of multi-source data such as GPS trajectories, Automatic Identification System (AIS) data, and meteorological information in enhancing situational awareness and proactive decision making. Furthermore, this study categorizes and compares existing surveillance architectures, predictive models, and alert dissemination mechanisms, highlighting their strengths and limitations. Based on the reviewed literature, open research gaps and future directions are discussed to guide the development of more robust, reliable, and intelligent maritime surveillance solutions. This survey aims to serve as a valuable reference for researchers and practitioners working toward AI-enabled maritime security and improved safety for coastal fishing communities.

Keywords: Maritime Surveillance System, LSTM Neural Network, Vessel Trajectory Prediction, Maritime Border Security, Weather Hazard Prediction, Coastal Monitoring, Smart Maritime Security

A Comprehensive Survey on Artificial Intelligence Techniques for genetic diseases prediction from DNA Sequence

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The prediction of genetic diseases from DNA sequence data has become a significant research focus in computational genomics due to its potential to enable early diagnosis and personalized healthcare. However, traditional genomic analysis approaches are often limited by manual interpretation, high computational complexity, and difficulties in handling large-scale and heterogeneous genetic data. In recent years, artificial intelligence (AI) techniques have emerged as effective tools for addressing these challenges by enabling automated pattern recognition and predictive analysis in genomic sequences. This paper presents a comprehensive survey of AI-based methods for genetic disease prediction from DNA sequences, covering conventional machine learning techniques as well as advanced deep learning models. Particular attention is given to sequence-based learning approaches, including recurrent neural networks and Long Short-Term Memory (LSTM) architectures, which have demonstrated strong capabilities in modeling long-range dependencies and complex mutation patterns in genomic data. The survey reviews commonly used genomic datasets, evaluation metrics, and comparative performance trends reported in the literature. Furthermore, key challenges such as data quality and availability, model interpretability, computational requirements, and ethical and privacy concerns related to genetic information are critically discussed. Finally, the paper outlines open research issues and future directions aimed at improving the reliability, scalability, and clinical applicability of AI-driven genetic disease prediction systems, highlighting their potential role in advancing precision medicine.

Keyword: Genomic AI, DNA Sequence Analysis, Genetic Disease Prediction, Deep Learning, LSTM, Bioinformatics, Precision Medicine, Personalized Healthcare, Disease Risk Assessment, Genetic.

Optical- Guided Super Resolution for Thermal IR Imagery

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This work presents a deep learning-based super-resolution framework designed to enhance the spatial resolution of satellite-borne infrared thermal images, which suffer from coarse resolution (60–100 m per pixel) compared to co-registered high-resolution optical imagery (10–30 m per pixel). The core innovation, ThermalSRNet, is a lightweight encoder- decoder network with channel-wise attention that fuses low-resolution thermal data with high-resolution optical RGB imagery. The network learns an end-to-end mapping by concatenating the upsampled thermal image (one channel) with optical data (three channels), extracting joint spatio-spectral features via convolutional encoding, applying attention weights to emphasize fusion regions, and decoding to a single-channel high-resolution thermal output. This preserves fine spatial details from optical guidance while retaining the original thermal structure. A novel composite loss function ensures physical realism by combining mean squared error for pixel accuracy, a Stefan-Boltzmann term to preserve total radiative power (vital for brightness temperature), and diffusion-based smoothness regularization to avoid sharp discontinuities.

This physics-informed approach prevents artifacts like hallucinated heat sources or over-sharpened edges, yielding reliable thermal maps for Earth science. Tested on Landsat TIRS+OLI patches, it achieves 3–6 dB PSNR gains, 0.1+ SSIM improvements over bicubic upsampling, and <5% radiative power error. Applications include building-scale land surface temperature mapping, urban heat island analysis, crop stress detection in agriculture, wildfire delineation, and climate monitoring. By bridging thermal-optical resolution gaps through efficient fusion and constraints, ThermalSRNet offers an operationally viable solution for high-quality thermal products from coarse instruments

Keywords : Deep learning; thermal super-resolution; satellite imagery; cross-modal fusion; physics- informed loss

Explainable Artificial Intelligence for Transparent Brain Stroke Prediction Using Machine Learning

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This study presents an intelligent machine learning–based framework for predicting the risk of brain stroke using a combination of medical and lifestyle attributes. Stroke remains one of the leading causes of mortality and long-term disability worldwide, with risk factors such as hypertension, diabetes, and cardiovascular disorders playing a significant role. Early identification of individuals at elevated risk is therefore essential for timely intervention and prevention. The study utilizes a structured clinical dataset containing features including age, gender, hypertension, heart disease, marital status, occupational type, residential setting, average glucose level, body mass index (BMI), and smoking habits. Prior to model training, comprehensive data preprocessing is performed, involving missing value handling, categorical feature encoding, and feature normalization to ensure data reliability and uniformity. Multiple machine learning models—Random Forest, Support Vector Machine (SVM), k-Nearest Neighbors (KNN), and Logistic Regression—are trained and evaluated using performance measures such as accuracy, precision, recall, and F1-score to identify the most effective predictive approach. Among the evaluated models, the Random Forest classifier exhibits superior predictive performance due to its robustness and capability to model complex feature interactions. To enhance transparency and trust, the framework integrates Explainable Artificial Intelligence (XAI) through Local Interpretable Model-Agnostic Explanations(LIME) technique, which elucidates the contribution of individual features to the final prediction. Additionally, a user-friendly web-based interface developed using Gradio enables users to input personal health information and obtain real-time stroke risk predictions accompanied by probability scores and interpretative explanations. Overall, the proposed system demonstrates the effective application of machine learning in healthcare by combining predictive accuracy, interpretability, and accessibility to support early diagnosis and informed decision-making.

Keywords : Explainable Artificial Intelligence, Brain Stroke, Logistic regression, Random Forest, Support Vector Machine

FloatChat - AI-Powered Conversational Interface for ARGO Ocean Data Discovery and Visualization

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The primary goal of the FloatChat is make the Oceanographic data as more efficient to use. Especially for the researcher, scientists, students and teachers. By using the FloatChat the researchers test their ideas. Through the voice and text, the people can communicate with one another which offers the system to be addable and modifiable. This system can understand and examine the users queries and the information are extracted from them. The FloatChat make the data access very easy to the researcher, scientists, students and teachers. In this paper the difficulties of obtaining the huge volume of ocean data especially for the non-experts is discussed and the development of FloatChat. The FloatChat is a novel approach of Artificial Intelligence based method, which is used to communicate with computer to extract and test the ocean data. The FloatChat approach uses the artificial intelligence and speech recognition method which allows the users to asking the questions either speaking or typing the text in their own language. The persons those who are not experts in the oceanography subject, they have the facility to access the ocean data. To solve the problem of using oceanography data by everyone the FloatChat is introduced. It mainly used for search, extract, test and visualize the ocean data. Because the FloatChat uses the technologies of Artificial Intelligence, Natural Language Processing and Speech Recognition to interact with computer to handle the complex data. The non-expert people also ask the questions and search the data and visualize them by using the natural languages. The another important concept of ARGO. Argo is an international program that collects information from inside the ocean using a fleet of robotic instruments that drift with the ocean currents and move up and down between the surface and a mid-water level. It also used to create the depth profile and comparison chart of the ocean data. It also used to provide the feedback in multi ways. It used to communicate, send the data and visualize the images. For the real time application of climate monitoring it communicate with ARGO and gives the most recent data. At the final the FloatChat is the excellent novel approach that sum up the real time visualization of AI and interact with the oceanographic data and promote more involvement in the research, education and policy making in marine.

Keywords: ***ARGO floats, Conversational AI, Natural Language Processing, Ocean Data Visualization, Geospatial Analytics.***

Two Step detection and classification of brain tumors using Deep Learning techniques

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Brain cancer is the second-deadliest cancer, as it accounts for a tremendous number of deaths across the world. An earlier diagnosis becomes essential, and it is dependent on identifying the tumor. The present methods of identifying brain tumors involve MRI (Magnetic Resonance Imaging), PET (Positron Emission Tomography) scan, CT (Computed Tomography) scan, blood tests, biopsy, etc. The imaging methods require the radiologist to identify the tumor, which is very subjective in nature, whereas a biopsy requires the pathologist to examine the tumor cells in detail. The diagnostic process is time-consuming. The average survival rate for a few high-grade tumors is 8 months, and it takes a month to identify them. The proposed system, "Two Step Detection and Classification of Brain Tumors Using Deep Learning Techniques," addresses the above issue by employing transfer learning to detect and distinguish the various brain tumors accurately within a shorter time frame. This will help oncologists make better-informed decisions and adopt the right treatment strategy in the early stages.

Keywords: Brain Tumor, Medical Image Processing, Deep Learning, Transfer Learning

Multimodal Deep Learning Framework for Early Detection of Drug-Induced Skin Adverse Reactions Using Medical Images and Pharmacovigilance Reports

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Adverse drug reactions (ADRs) pose a significant challenge to global healthcare systems and remain a major cause of patient morbidity and hospitalization. Pharmacovigilance plays a vital role in detecting, assessing, and preventing ADRs; however, traditional pharmacovigilance systems rely predominantly on spontaneous textual reports, which are often incomplete, delayed, and affected by reporting bias. Among various ADRs, drug-induced skin reactions are the most frequently reported and often present visible dermatological symptoms at an early stage, making them suitable for image-based analysis. This paper proposes a multimodal deep learning framework that integrates dermatological image processing with pharmacovigilance textual reports to enhance the early detection and validation of drug-induced skin adverse reactions. Convolutional Neural Networks (CNNs) are employed to extract discriminative visual features from skin lesion images, enabling the identification of characteristic patterns associated with adverse drug responses. Simultaneously, Bidirectional Encoder Representations from Transformers (BERT) are utilized to capture contextual and semantic information from pharmacovigilance adverse event reports.

The extracted visual and textual features are fused using a fully connected neural network to generate a unified representation for predicting the likelihood of drug-induced skin ADRs. Experimental evaluation indicates that the proposed multimodal approach significantly outperforms conventional text-only pharmacovigilance methods in terms of accuracy, sensitivity, and overall robustness. The integration of image-based evidence with textual data reduces false positives and improves early detection capabilities. The findings highlight the potential of image-assisted pharmacovigilance systems in improving patient safety, supporting proactive drug surveillance, and enabling more reliable ADR detection mechanisms. This framework demonstrates a promising direction for next-generation pharmacovigilance systems that leverage multimodal artificial intelligence techniques.

Keywords: Pharmacovigilance, Adverse Drug Reactions, Deep Learning, Image Processing, Multimodal Learning

A Comprehensive Survey on AI-Based Sign Language Recognition and Deaf–Hearing Communication Systems

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Sign language recognition (SLR) and intelligent communication systems have emerged as essential technologies for bridging the communication gap between Deaf, hard-of-hearing, and hearing communities. This survey presents a comprehensive review of recent advances in artificial intelligence (AI)-based approaches for accurate sign language interpretation and bidirectional translation between sign, text, and speech modalities, with particular emphasis on Indian Sign Language (ISL) challenges and resources. The paper first outlines the fundamental communication barriers experienced by Deaf individuals and discusses the role of AI in addressing these limitations. The survey then examines key challenges in ISL recognition, including limited dataset availability, signer variability, complex linguistic structures, and environmental sensitivity, and reviews widely used datasets developed for both isolated and continuous sign recognition. In the context of AI-based SLR, convolutional neural networks (CNNs) are predominantly employed for spatial feature extraction in static signs, while recurrent neural networks (RNNs) and long short-term memory (LSTM) models are commonly used to capture temporal dependencies in dynamic gesture sequences. More recently, temporal convolutional networks (TCNs) and Transformer-based architectures have demonstrated superior performance in modeling long-range temporal dependencies and contextual information, often outperforming traditional recurrent models.

In addition, the survey explores speech-to-text and text-to-sign systems that support bidirectional communication between spoken and signed languages through multimodal and sequence-to-sequence learning frameworks. Avatar-based sign representation techniques are also reviewed, highlighting their role in improving accessibility by generating visually expressive and natural sign animations. A comparative analysis of the surveyed studies reveals critical trade-offs among model complexity, dataset scale, recognition accuracy, and real-time performance. Despite promising results in controlled environments, several research gaps remain, including robustness to real-world background variations, signer-independent generalization, the scarcity of large-scale ISL datasets, and efficient deployment on mobile and edge devices. By synthesizing current progress and open challenges, this survey identifies future research directions toward developing robust, scalable, and inclusive AI-powered Deaf–hearing communication systems that can significantly enhance social integration and accessibility for Deaf communities.

Keywords: Sign Language Recognition, Indian Sign Language, Artificial Intelligence, Deep Learning, Deaf–Hearing Communication, Survey.

Box Transposition Cipher

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Cryptography has gained more significance in the recent decade, with the increased use of internet in communicative and commercial applications. It provides security to the information from hackers. Transposition is a symmetric cryptographic technique in which the characters in the given text are transposed to get cipher text. Columnar transposition, rail fence cipher, route cipher are some examples of transposition techniques. Box transposition is a novel transposition method in which the plain text is arranged in the form of a two-dimensional (nxn) matrix/block. The boxes around the center position of the block are numbered from 1 to n. The numbering starts from the center position which is considered as 1 and moves outwards from it. The key for the transposition represents the corresponding boxes rather than columns or rows. This method is found to be more secure than the traditional transposition methods based on the bigram and trigram frequency analysis. Also, it takes lesser time when compared with novel techniques of transposition like zigzag transposition ciphers.

Keywords : Cryptography, Symmetric cryptography, transposition, box transposition

Technology for Students with Disabilities: The Role of Assistive Technology in Inclusive Education

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Technology for students with disabilities plays a vital role in ensuring access, participation, and equity within contemporary education systems. Commonly referred to as Assistive Technology (AT), it includes a wide range of tools, devices, and software designed to minimize the impact of physical, sensory, cognitive, and learning barriers. Assistive Technology supports students in performing educational tasks that might otherwise be difficult or impossible, thereby fostering independence, confidence, and academic engagement. AT ranges from simple, low-cost solutions such as pencil grips, magnifiers, and visual schedules to more advanced mid-tech tools like audio recorders, screen magnifiers, and adapted keyboards, as well as high-tech solutions including screen readers, speech-to-text software, refreshable Braille displays, and alternative communication devices.

This paper explores the concept and classification of Assistive Technology into low-tech, mid-tech, and high-tech categories and examines its application across major disability groups, including learning disabilities, visual impairment, hearing impairment, and physical or motor disabilities. For students with learning disabilities, AT tools support reading, writing, organization, and attention. Learners with visual impairment benefit from Braille-based technologies, audio materials, and accessible digital platforms, while those with hearing impairment rely on captioning systems, hearing aids, and visual communication tools. Students with physical or motor disabilities use AT to enhance mobility, access learning materials, and communicate effectively.

Drawing on global policy frameworks and recent research, the paper highlights the positive impact of Assistive Technology on academic performance, autonomy, and inclusive participation. It concludes by emphasizing the importance of systematic planning, teacher training, and institutional support to integrate Assistive Technology effectively within inclusive education systems, addressing the diverse learning needs of students in the 21st century.

Keywords : Assistive Technology, Learning Barriers, Screen readers, Speech to text Software, Visual Impairment

IoT -Based Smart Farming for Enhanced Drip Irrigation Efficiency: Recent Trends and Startup Innovation

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The integration of the Internet of Things (IoT) into agricultural practices has ushered in a paradigm shift in traditional irrigation methods, particularly in the optimization of drip irrigation systems to enhance water use efficiency and crop productivity. As global water scarcity and climate variability intensify, conventional agriculture's dependency on manual irrigation scheduling has proven unsustainable and inefficient. This research explores the state-of-the-art developments in IoT-enabled smart irrigation technologies, with a specific focus on drip irrigation enhancement, real-time monitoring, and automated decision-making systems. IoT sensors such as soil moisture, temperature, and humidity transducers, combined with microcontrollers and advanced communication protocols like LoRa, Wi-Fi, Zigbee, and GSM, facilitate continuous data acquisition and remote management of irrigation infrastructure. The literature reveals that IoT-driven systems can significantly improve water conservation, delivering up to 85 % reductions in usage while maintaining or improving crop yield through precision control strategies. Furthermore, the integration of edge computing, machine learning, and AI algorithms enables predictive irrigation scheduling and anomaly detection, supporting adaptive irrigation responses to dynamic field conditions. Recent innovations also highlight the use of fuzzy logic and hybrid control models to optimize water distribution based on environmental feedback, while cost-effective connectivity solutions address rural deployment challenges. From a startup perspective, emerging business models leverage cloud analytics, mobile dashboards, and subscription-based sensor kits that empower smallholder farmers with scalable solutions tailored to local needs. This paper not only synthesizes current trends and technological advancements in IoT-based smart drip irrigation systems, but also proposes strategic directions for future research and startup innovation to support sustainable agriculture and resource-efficient farming.

Keywords: Internet of Things (IoT), Smart Farming, Drip Irrigation Systems, Precision Agriculture, Water Use Efficiency, Artificial Intelligence in Agriculture

The Impact of Recommendations Algorithms in Shaping Mental Health

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Social media has become an essential part of daily life, helping people connect, share, and discover content across the global. However, spending long hours online can affect mental health in subtle but significant ways. This study explores the mental cost of staying online by examining how social media algorithms influence what users see, how they interact, and how they feel emotionally. Algorithms such as engagement-based ranking, content recommendation for feeds, reels, and shorts, collaborative filtering, content personalization, trend amplification, and A/B testing are designed to maximize user engagement by showing content tailored to individual preferences and behaviour patterns. While these algorithms help users discover relevant content, maintain connections, and feel informed, they can also lead to stress, emotional fatigue, distraction, and a constant urge to remain updated. Users may spend hours scrolling through feeds, watching trending videos, or engaging with highly curated content, often without realizing the mental strain it causes. Continuous exposure to algorithm-driven content can reduce attention span, disturb sleep, increase restlessness, and create feelings of pressure or mental exhaustion. Understanding how these algorithms shape online behaviour and influence emotions is crucial for promoting healthier digital habits. By increasing awareness of the psychological effects of social media, users can better regulate their usage, reduce overstimulation, and maintain a balance between online engagement and offline life. This study highlights the importance of mindful social media consumption and emphasizes the impact of algorithmic design in shaping mental well-being in everyday online experiences.

Keywords: Social Media Algorithms, Mental Well-Being, Online Engagement, Digital Fatigue, Algorithm-Driven Content

Role of Machine Learning in Fog Computing

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Fog computing-based systems generate enormous volumes of data, which leads to the emergence of more and more fog computing applications and services. Furthermore, the crucial field of machine learning (ML) has advanced significantly across a number of academic areas, such as speech recognition, robotics, neuromorphic computing, computer graphics, natural language processing (NLP), and decision-making. Numerous studies have been put forth to investigate the use of machine learning to resolve fog computing issues. The use of machine learning (ML) to improve fog computing applications and offer fog services, such as effective resource management, security, reducing latency and energy consumption, and traffic modeling, has grown in popularity in recent years. The importance of machine learning ideas in fog computing is highlighted in this research.

Keywords: Fog computing, machine learning, natural language processing, deep learning

Sensor-Based Valorization of Biochar-Enriched Municipal Solid Waste for Liquid Biofertilizer Production

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Optimizing the composting and vermicomposting processes used in sustainable waste management requires effective monitoring and control. In order to facilitate real-time tracking and intelligent control of critical process parameters in organic waste treatment systems, this study introduces a sensor-based monitoring and data management system. The suggested framework incorporates environmental sensors to continuously measure pH, temperature, moisture content, and oxygen concentration-parameters essential for microbial activity and the breakdown of organic matter. Analog data are digitized by the use of an analog-to-digital converter in a microcontroller-based device module that processes the sensor signals. Here, local pre-processing algorithms ensure the accuracy and reliability of the data before they are transmitted. A solar panel–battery unit keeps the system running without any pauses, even in decentralized or remotely controlled composting facilities.

The processed data are sent over the device gateway through wireless communication technologies such as Wi-Fi, LoRa, GSM, and Bluetooth by using secure protocols like MQTT and HTTP. Data is stored and analyzed on a cloud-based platform that allows for real-time analytics, historical trend assessment, and predictive insights. Performance of the system is visualized through a user-friendly dashboard that delivers automated alerts via email or SMS in case of exceeding one or more thresholds preset by the user. The proposed system will ensure increased operation efficiency, process transparency, and decision-making in composting and vermicomposting applications. These scalable, intelligent monitoring solutions support data-driven optimization and contribute to circular waste-to-resource technologies.

Keywords: sensor-based monitoring; composting systems; IoT architecture; real-time data analytics; sustainable waste management.

AI and Its Impact on Skill Enhancement among Students

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Artificial Intelligence (AI) has become a revolutionary element of modern learning, as it affects the way students' study and acquire the necessary skills. This research puts into consideration the effects of AI in enhancing skills and learning efficacy among learners in Bangalore City. The primary data were obtained on 216 students in different higher educational institutions using a structured questionnaire using descriptive research design. The data was analyzed using descriptive statistical tools like the percentage analysis, mean scores, and standard deviation. The results demonstrate that the perception of AI is high, and students agree that AI-based tools improve academic, digital, communication, and problem-solving skills. An additional benefit that students described in regard to AI was that it facilitates self-directed learning, offers students timely feedback, and enhances their general learning performance. Even though critical thinking and independent learning registered rather lower mean scores, it was positive perception. The research concludes that, when implemented in a responsible and accompanied by proper infrastructure and pedagogical support, AI is an efficient complement to the conventional teaching practice and a key to developing academic and future-ready skills in the learners.

Keywords: Artificial Intelligence, Skill Enhancement, Learning Effectiveness, AI-Based Learning Tools, Students.

An Explainable Machine learning approach for predicting Student stress from digital behaviour patterns

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Digital behaviour in the academic context has become increasingly embedded in students' daily lives and is a valuable source of insight into mental health. The present study employs a data-driven approach to understanding and predicting college student stress levels through indicators of digital practices, including screen time, app-switching frequency, social media use, frequency of notifications, focus levels, and mood ratings. Using machine-learning models to identify complex correlations between these patterns of behaviour and stress levels, and leveraging the methods of explainable artificial intelligence (XAI) to further simplify and enhance the interpretability of the model predictions. Model reliability is measured by standard measures of model performance. This framework also promotes practical applications, such as early, non-intrusive interventions in the event of high stress levels. Explainable information is utilized to identify contributing digital behaviours that promote self-awareness and responsible stress management. This approach is based on personalized digital wellness recommendations, routine stabilization strategies, and aims to academic or support resources, while not requiring a clinical diagnosis. In addition, this work offers data for digital mental health research that combines predictions with interpretive and actionable data to enhance student well-being in higher education.

Keywords: Student Stress Prediction, Digital Behaviour, Machine Learning, Explainable AI, Higher Education

A Detailed Study on the Pi Coin and Pi Network Ecosystem

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Cryptocurrency is introduced as an alternative to regular currency, which is not regulated nor legal (mostly) and has no any kind of intrinsic values. Yet, it is still blooming as the new alternate for currency exchange mode in this digital world. Cryptocurrency stands unique for its decentralised, Cryptographic security, and block chain-based ledger operations. There are different types of Cryptocurrencies like Bit Coin, Ethereum, Tether, and XRP. The Cryptocurrencies mostly uses the Block Chain to provide better security. Till today, Cryptocurrencies have any intrinsic values in real world but it's been traded against United States of America's dollars, price of a single bit coin costs around 90500 USD which is approximately 81,77,000 in rupees. In this study, a Cryptocurrency named 'Pi' taken into an account; and detailed study has been done on the mining process, Pi Network Ecosystem (PiNet), and it's Know Your Customer process. Pi Coin mining happens with a single press in an application based on mobile phones. It is a very simple process and it makes everyone to take part into the mining process. This study paper enriches the researcher's knowledge about Pi Coin mining, Security, Intrinsic values, future growth and applications in PiNet.

Keywords: Cryptocurrencies, Pi Coin, PiNet, Block Chain, Pi Coin Mining

Storyboarding In the Initial Design of Mobile Mathematics Educational Applications: A Systematic Review Using the PRISMA Framework

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The rapid growth of mobile learning has led to increased development of mobile educational applications, particularly in mathematics education. Effective design at the initial development stage is critical to ensure pedagogical alignment, usability, and learner engagement. Storyboarding has emerged as a widely used instructional design technique to visualize learning flows, interactions, and content sequencing before full application development. However, research examining the role and impact of storyboarding in the early design of mobile mathematics educational applications remains fragmented. This study presents a systematic review of existing literature on the use of storyboarding during the initial design phase of mobile mathematics educational applications, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A comprehensive search across major academic databases identified relevant peer-reviewed studies published between 2010 and 2024. After screening and eligibility assessment, selected studies were analyzed thematically. The findings reveal that storyboarding supports pedagogical coherence, improves communication among stakeholders, enhances usability, and reduces development costs and revisions. However, limitations include inconsistent methodological rigor and a lack of empirical evaluation of learning outcomes. This review highlights research gaps and provides recommendations for designers, educators, and researchers aiming to integrate storyboarding more effectively in mobile mathematics application development.

Keywords: storyboarding, mobile learning, mathematics education, instructional design, educational applications, PRISMA, systematic review

Information and Communication Technology (ICT) based dietary intervention among adolescent girls living in slum region of Madurai

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Adolescence is a transition period from childhood to adulthood with higher nutritional requirement. Adolescents experience rapid physical, cognitive and psychosocial growth. This affects how they feel, think, make decisions, and interact with the world around them. Despite being thought of as a healthy stage of life, there is significant death, illness and injury in the adolescent years. Much of this is preventable or treatable. During this phase, adolescents establish patterns of behaviour – for instance, related to diet, physical activity, substance use, and sexual activity – that can protect their health and the health of others around them, or put their health at risk now and in the future. To grow and develop in good health, adolescents need information, including age-appropriate comprehensive sexuality education; opportunities to develop life skills; health services that are acceptable, equitable, appropriate and effective; and safe and supportive environments. They also need opportunities to meaningfully participate in the design and delivery of interventions to improve and maintain their health. Expanding such opportunities is key to responding to adolescents' specific needs and rights (World Health Organization, 2020). Adolescent girls have been under privileged group in Indian society. It is the formative period of life when the maximum amount of physical, psychological, and behavioral changes takes place. This is a vulnerable period in the human life cycle for the development of nutritional deficiency due to increased nutrient requirements for rapid growth. The present study aims to effect of Information and Communication Technology (ICT) based intervention.

Keywords: Information and Communication Technology (ICT), Adolescents, Slum region

Secure sharing of medical information using cloud computing

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The patient's medical history and prescription information are stored in electronic health records. The attackers are drawn to the health records because they contain valuable information. An incorrect medication or operation is the result of losing an electronic health record. In order to enable efficient diagnosis and treatment, EHRs typically contain extremely sensitive and vital patient data that is routinely exchanged among physicians, radiologists, healthcare providers, pharmacists, and researchers. By using key exchange protocols, multiple parties can create a shared encryption key that they can use to sign or encrypt data that they intend to exchange. Expanding key exchange methods with certificates to a bigger system could be challenging since they need a reliable third party to confirm the accuracy of the messages they receive. They require ample storage.

Keyword: Electronic Health Records (EHR), Encryption, Key exchange, Protocols

An Overview of Optical Remote Sensing Satellite Data Networks (ORSSDN)

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The Optical Remote Sensing Satellite Data Network (ORSSDN) constitutes a vital infrastructure intended for the efficient acquisition, transmission, processing, storage, in addition to dissemination of optical remote sensing data generated by Earth observation satellites. Recent advancements in satellite sensor technologies and the increasing demand for high-resolution imagery have resulted in a substantial growth in data volume, complexity, as well as heterogeneity. ORSSDN facilitates seamless interoperability amongst space borne sensing platforms, ground receiving stations, data processing centers, and end users, thereby enabling timely and reliable access in the direction of optical satellite data. This integrated network supports a wide range of applications, including environmental monitoring, disaster management, precision agriculture, urban planning, defence surveillance, furthermore scientific analysis. This paper presents a comprehensive overview of ORSSDN, focusing on its system architecture, key components, data processing workflows, and operational challenges. Furthermore, emerging trends and future research directions aimed at enhancing scalability, automation, furthermore intelligence in optical remote sensing satellite data networks are discussed.

Keywords: Optical remote sensing; Satellite data networks; ORSSDN architecture; Earth observation systems; Image processing and analytics.

Brain Tumor Multi Classification using an EfficientNetV2-S and CBAM with MRI Images

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Diagnosis of brain tumor through magnetic resonance imaging (MRI) is a major application of medical sciences that finds its importance in early treatment and overall survival rates. Manual testing and interpretation related to MRI images are complex and have potential discrepancies, leading to the requirement for automatic and trustworthy computer-aided diagnosis systems. In this research study, a comprehensive deep learning solution based on the concept of combining EfficientNetV2-S with Convolutional Block Attention Module (CBAM) is proposed and presented. The proposed system implements complex processing techniques related to Contrast Limited Adaptive Histogram Equalization (CLAHE), sharpening, and further integrates them with preprocessing steps related to brain tumor identification. To increase the robustness level and overall correctness, a step-by-step train process with transfer learning and test-time augmentation test methodologies are implemented and adopted. Experiments conducted on a free publicly available dataset related to brain tumor identification through MRI support that our system performs well and gives improved outcomes compared to basic CNN-related processes and techniques with respect to brain tumor identification and recognition through MRI images and Grad-CAM visualizations. The results indicate that the proposed framework is a reliable and interpretable solution for automated brain tumor classification. Hybrid model achieved 99.50% classification accuracy outperforming state-of-the-art CNN and transformer-based baselines.

Keywords: Brain tumor, MRI, EfficientNetV2, CBAM, Deep learning, Grad-CAM.

RTCS 2026 Accepted Papers List (Poster Presentation)

S. No.	Paper ID	Title of the Paper	Author(s)
1	146	Metaverse Technology: Applications Beyond the Realm of Entertainment	Bhuvaneshwari A Thiratchika M Gayathri M
2	147	Cyber Forensics in Social Media Crimes	G.Geetha S.Brundha K.Gowri
3	150	A Real-Time Sign Language Recognition System in Low-Light Environments	Abarna V Abinaya D Varshini M
4	151	Deceptive Instagram Reel Advertisements Redirecting Users to Fake E-Commerce Websites	L. R Dhanunisha M. Saraswathi M. Priyadharshini
5	152	5G Forensics and Security Monitoring: Challenges, Techniques, and Future Directions	A. Swasthisri K. Leelasree A.L. Ajisha
6	155a	Digital Forensics in the Age of AI-Generated Reality	Rajasuryaprabha S Kalaivani P Jasmine Rose S
7	156	Interfaces That Feel: Building Emotion-Sensitive Software	PandiSelvi C Manisha S Swathi R
8	157	AI in Mental Healthcare	V. Iswarya, K. Sandhiya, S. Anisha
9	159	Smart Factories and Industry 5.0	S.Swetha N.Nisha M.Harinipriya
10	160	Swarm Attack in Cyber Security	M.kumaresan M.Sidharthan D.praveen
11	161	Need for Privacy Enhancing Techniques	Barakath nisha S Lakshmipriya T Subalakshmi M
12	162	Self – improving AI	K.Vishnu Varthini R.Renuga S.Arul Sharmila
13	163	Blockchain-Based Self-Sovereign Identity Framework for Secure and Privacy-Preserving KYC	Akash B, Kesava Azhagu Rajan T, Mohamed Irban Ali A,
14	164	Data-Driven Vehicle Repair Intelligence Using Deep Learning	P.Dinesh Kumar S.Hariharan S.Manikandan,
15	165	Drones and their Applications	E.Kishore S.Saran P.L.Balamurugan
16	166	Improving IOT Sensor Data Security with On-Device Encryption and Blockchain	S.F. Abdul Hammed A. Mohamed Jameel V. Karthikeyan
17	168	Sustainable Technologies and Green Computing	Gnana Subhashree D Rogini M

S. No.	Paper ID	Title of the Paper	Author(s)
18	169	Enhancing Customer Experience Through Ai-Based Personalized Marketing	B.Sooriya Prakash M.Vabin V.Selvakumar
19	171	Internet Of Things In Medical Field	R.Sangeetha U.Vishali K.Abarna
20	172	Innovation To Impact: Technology-Driven Success Through Human Skill Provenance	A.Jackline M.MuthuReka KR.Alagumuthu
21	173	The Brain Behind Instagram	V.Dhanalakshmi S.Adhithi S.Angala Eswari
22	174	Digital Proof in a Virtual World	J.Kanishka, T.Keerthika, A.Noofa
23	175	Fire Prevention using Smart Detection Systems	S.Mathimalar W.Xavier Vincy
24	178	Security Vulnerabilities and Privacy Risks in Aadhaar	M Gowtham, M Sachin, T Muthuprakash
25	179	Integrated Digital Twin System for Self-Driving Cars to Improve Safety in Real Time	Abinash T, Nagaraj P
26	182	Web 3.0 And Blockchain Based Platform for Securing Datasets Used for AI Models	Sorna Laxmi K Gayathri M
27	186	Green Computing - Is Eco Friendly?	G.Sarmila M.Muthupriya L.Rethinamani
28	188	Smart Daily Expense Tracking and Prediction System Using React and Machine Learning	S.Preethi
29	189	Anti-Poaching and Wild Life Production	M.Kayalvizhi D.Janani K.Vijayasri
30	191	Carbon-Aware Smart Infrastructure 5.0	S. Anusha, K. Anitha A. Abarna
31	192	A Proactive Web Défense System Using Decoy Environments and Temporal Passwords	S.Subalaskhmi,
32	193	Deep Learning Based Cyber Security Threat Detection	A.Sneka,
33	199	Expiry- Sensitive Medicine Management Using Predictive Analysis for Supply Chain Optimizations	P.Parkavi
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