NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

SUSTAINABLE DEVELOPMENT GOALS

ICETE 2026
Nitte, India

International Conference on

# EMERGING TRENDS IN ENGINEERING 2026

(ICETE 2026 - Multiconference Series)

05 - 07, February 2026 | NMAMIT, Nitte, Karnataka

## PROCEEDINGS

Conferences under the aegis of ICETE 2026

AIDE 2026 Nitte, India

AREEV 2026 Nitte, India

Nitte-Bio 2026 Nitte, India

CTCS 2026 Nitte, India

MSMAT 2026 Nitte, India

SME 2026 Nitte, India

VSPICE 2026 Nitte, India

Publication Partners

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PROCEEDINGS

International Conference on

# EMERGING TRENDS IN ENGINEERING 2026

(ICETE 2026 - Multiconference Series)

05 - 07, February 2026 | NMAMIT, Nitte, Karnataka

ICETE 2026 Nitte, India

AIDE 2026 Nitte, India

AREEV 2026 Nitte, India

Nitte-Bio 2026 Nitte, India

CTCS 2026 Nitte, India

MSMAT 2026 Nitte, India

SME 2026 Nitte, India

VSPICE 2026 Nitte, India

Message

**Shri. Vishal Hegde**
Chancellor
NITTE (Deemed to be University)

Dear Esteemed Researchers and Scholars,

I am very happy to write a message in the magazine dedicated to showcasing the groundbreaking research and innovations presented at the upcoming scientific conference hosted by NMAMIT which is part of Nitte University.

This special issue aims to capture the essence of the conference, highlighting the diverse perspectives and cutting-edge advancements presented by researchers and professionals. As Indian universities make strides in the area of research i am sure this conference will help the participants move forward in their areas of expertise.

Wishing the conference all success!!!

Best regards,
Vishal Hegde
Chancellor, NITTE (Deemed to be University)

Message

**Prof. Dr. M. S. Moodithaya**
Vice Chancellor
NITTE (Deemed to be University)

Dear organizers and participants,

I am glad to note that NMAM Institute of Technology, Nitte is organizing the 7th edition of the International Conference on Emerging Trends in Engineering (ICETE) - 2026, during 05th -07th of February 2026. In the fast-evolving landscape of Higher Education in engineering and technology, conferences such as ICETE play a pivotal role in fostering innovation, collaboration, and the exchange of knowledge.

The compendium of abstracts serves as a snapshot of the rich tapestry of research and innovation that will be showcased during ICETE-2026. In an era where interdisciplinary collaboration is key to solving complex challenges, ICETE-2026 provides a unique platform for participants to engage in meaningful discussions, forge new connections, and lay the groundwork for future collaborations. The abstracts featured in this compendium represent the collective efforts of individuals who are at the forefront of shaping the future of engineering.

I would like to express my appreciation to the organizing committee, reviewers, sponsors, and all those who have worked tirelessly to make ICETE-2026 a reality. Your commitment to advancing the frontiers of knowledge and fostering a collaborative spirit is commendable.

I wish you a fruitful and rewarding conference.

Best Regards,
Prof. Dr. M. S. Moodithaya
Vice-Chancellor, NITTE (Deemed to be University)

Message

**Prof. Niranjan Chiplunkar**
Principal, NMAMIT
General Chair, ICETE 2026

Dear Esteemed Participants and Organizers,

I am very happy to note that yet another edition of annual ICETE-Multi conference is getting inaugurated today. After the year 2020, this is the first ICETE which is being conducted in full Offline mode. I thank all invited speakers and authors of research papers who are presenting their papers today for coming to Nitte to be part of this mega event. I understand that more than 500 papers have been accepted and are being presented in this International multi-conference which has 7 independent Conferences running under one umbrella. All conference papers presented and accepted will be published in Scopus indexed conference proceedings published by leading publishing houses and organizations. Best papers in each session will be awarded with best paper award.

I wish all the paper presenters very best and hope that they will get good, useful comments by session Chairs and other delegates, which will help them to improve their research further.

My heartfelt thanks to the Chancellor of Nitte Deemed to be University, all the top officials of the University, Conference administrators and all those who have guided and helped us in making this Conference a grand success.

Thanks and Regards

Prof. Niranjan Chiplunkar
Principal, NMAMIT
&
General Chair, ICETE 2026 Multi-conference

Message

**Dr. Sudesh Bekal**
Professor & Dean - R & D, NMAMIT
Chief Convener, ICETE 2026

I am pleased to know that NMAM Institute of Technology is organizing 7th Multi-conference ICETE. It also heartening know that the conference is in “in person” mode. While most conference conducted by various Institutions are online or Hybrid at best, NMAMIT took the bold step of holding the conference in offline mode.

To hold 7 conferences simultaneously is a big challenge. I would like to congratulate the various chairpersons of committees at the central level and at individual conference level for putting in great effort for the success of the multi-conference.

The Multi-conference is bringing out a compendium of abstracts which will be released during the Inauguration of the multi-conference. The compendium is expected to have abstracts of all registered papers.

I would like to thank the management, The principal, the event management agency M/S Diligentech Solutions and the faculty member for their cooperation.

Thanks and Regards

Dr. Sudesh Bekal
Chief Convener,
ICETE 2026 Multi-conference
NMAMIT, NITTE

NITTE (Deemed-to-be University) has its roots in a group of institutions established by the Nitte Education Trust. The Trust was established in 1979 by one of India's respected Statesman, Late Justice K.S. Hegde, Supreme Court Judge and Speaker of Lok Sabha, with the mission of empowering rural youth through quality education and healthcare. The Trust has established 36 institutions spread in three campuses at Nitte, Mangaluru and Bengaluru. It offers education in diverse areas of learning including health professions education, engineering, management, humanities, general education, vocational training, and school/pre-university education.

The University offers a total of 100 programs in the disciplines of engineering, medicine, allied health sciences, dentistry, pharmacy, nursing, physiotherapy, speech and audiology, biological sciences, media & communication, commerce, science, management and architecture. It has 10,000+ students, over 875 faculty members and over 2475 support staff on roll. The University campuses are spread over 52 acres in Deralakatte-Paneer areas of Mangaluru and 110 acres in Nitte.

The University received A+ Grading in NAAC accreditation in 2021. It has been consistently placed in the Top 65-80 rank band in NIRF. The University is placed in the 401 to 450 Rank Band in the QS Rankings for Asia Region. It has received Diamond rating in the QS I-Gauge India Ratings. The Constituent colleges of the university have good standing in their disciplines in the NIRF rankings.

In 2023, Nitte University has obtained 65th Rank, the dental college ranked 5th and pharmacy colleges ranked 46th in NIRF. The BPharm program of the University is accredited by NBA. The teaching hospital is accredited by both NABH and NABL.

# NMAM INSTITUTE OF TECHNOLOGY

Nitte Mahalinga Adyantaya Memorial Institute of Technology (NMAMIT), Nitte, established in 1986 and recognized by the All India Council for Technical Education, New Delhi, has been a constituent college of Nitte (Deemed to be University), Mangaluru, since June 2022. Rank band 101-150 in the National Institutional Ranking Framework (NIRF) 2023 by Ministry of Education, Government of India, the College has been placed under 'Platinum' category for having high industry linkages by the AICTE-CII Survey of Industry-Linked Technical Institutes 2020. NMAMIT, the off-campus centre of Nitte DU located at Nitte village, has active collaborations with several international universities and organizations for faculty and student exchanges, research, internships and placements.

The Institute offers UG engineering program in fifteen disciplines; Artificial Intelligence & Machine Learning (AI&ML), Artificial Intelligence & Data Science (AI&DS), Biotechnology (BT), Civil Engineering(CIV), Computer & Communication Engineering (CCE), Computer Science & Engineering(CS),Computer Science (Cyber Security), Computer Science (Full Stack Development), Electrical & Electronics Engineering (E&E), Electronics & Communication Engineering (E&C), Electronics (VLSI Design & Technology), Electronics & Communication Engineering (ACT), Information Science & Engineering (IS) , Mechanical Engineering(MECH) and Robotics & Artificial Intelligence (R&AI ). Out of these programs, seven UG programs i.e., BT, CIV, CS, E&E, E&C, IS and MECH are accredited by NBA, New Delhi under Tier - I category till 30 June 2025. The institute also offers PG program M.Tech. in seven disciplines namely Construction Technology, Computer Science & Engineering, Cyber Security, Electric Vehicle Technology, Machine Design, Structural Engineering and VLSI Design & Embedded Systems as well as MCA program. All the departments have qualified research guides for students interested in taking up research work leading to Ph.D.

NMAMIT is located in a vibrant, serene and green campus at Nitte spread over 125 acres and is nestled in the Western Ghats of Southern India on the way to the Kudremukh ranges. The nearest airport is Mangaluru International Airport (45 km). The nearest railway stations are Udupi (40 km) and Mangaluru (50 km). Nitte is 19 km from NH-66 connecting Kochi (Kerala) and Panvel (Mumbai) and 7 km from NH-169 connecting Mangaluru and Solapur (Maharashtra).

NMAM Institute of Technology is organizing International Conference on Emerging Trends in Engineering (ICETE) since 2011 and ICETE-2026 is the 15th international conference being conducted at NMAMIT, since its inception. ICETE-2026 provides an international platform for post-graduate students, research scholars of Engineering & Technology and industry professionals to deliberate, explore and contribute their research findings and to discuss the latest developments in the fields of Engineering & Technology.

ICETE 2011 was for the first time organized on 4th and 5th of May 2011, commemorating the silver jubilee year of NMAM Institute of Technology, Nitte. The conference had a good response which received about 552 quality technical papers from which 172 papers were selected for the oral presentation.

ICETE 2012 was organized on 15th and 16th of May 2012 and was the second International Conference at NMAM Institute of Technology, Nitte. About 360 papers were received from all the streams out of which 148 papers were selected for oral presentation.

ICETE 2013, the third International Conference was organized on 15th and 16th of May 2013. For this conference, 228 papers were received from all streams out of which 63 papers were selected for oral presentation and 19 papers were selected for poster presentation from all the streams.

ICETE 2014 was organized from 15th to 17th of May 2014. More than 250 papers were received out of which around 25 papers per stream were selected. And about 30 papers were selected for poster presentation.

ICETE 2015 was conducted on 8th and 9th of May 2015. More than 230 papers were received out of which 79 papers were selected for oral presentation and about 20 papers were selected for the poster presentation.

ICETE 2016 was conducted on 12th and 13th of May 2016. All the papers selected and presented this year were published in the International Journal of Innovative Research in Science Engineering & Technology. About 148 papers have been received and after the review process 43 papers have been selected for presentation in the conference and for publication.

ICETE 2017 was organized on 12th May 2017. More than 130 papers were received out of which 54 papers were selected for oral presentation. Nine sessions have been planned to cover all the 54 papers selected for the conference. All the selected papers published in the 2017 special issue of “NMAMIT Annual Research Journal”.

ICETE 2018 conference was conducted on May 14th and 15th May 2018 at NMAM Institute of Technology, Nitte. All the Selected papers were published in Scopus Indexed Journal "International Journal of Engineering & Technology (UAE)" and Springer DE's “Journal on Applied Sciences”.

ICETE 2019 was organized on 23rd and 24th May 2019 at NMAM Institute of Technology, Nitte. More than 300 papers were received out of which 250 papers were selected for oral presentation. All the selected papers were published in Scopus Indexed journals.

ICETE 2020 was scheduled on Dec 22nd and 23rd Dec 2020 at NMAM Institute of Technology, Nitte. More than 410 papers were received out of which about 300 papers were selected for oral presentation. All the selected and peer reviewed papers were recommended for possible publication in Scopus Indexed publications.

ICETE-2021 was organized during 19th & 20th November 2021 which provided an opportunity for the research community to present their research findings and share their research experiences with the research groups working in a similar area of research. Four different international conferences were organized under "ICETE-2021" namely; NITTE-BIO2021, SME-2021, CTCS-2021 and MSMAT-2021. There were totally about 483 number of papers presented in four different conferences with 466 papers authored by Indian researchers and 17 papers authored by foreign research group. There were about 15 invited talks with twelve foreign and three Indian speakers during the conference. Most of the papers presented during the conference were published in SCOPUS indexed Journals or Conference Proceedings after further rounds of peer review process. For the safety of the research community during the COVID-19 pandemic, all the sessions were conducted in online mode.

ICETE-2022 took place on December 22nd and 23rd 2022 providing a platform for the research community to share their findings across seven conferences: Nitte-Bio 2022, SME 2022, AIDE 2022, VSPICE 2022, CTCS 2022, AREEV 2022, and MSMAT-2022. The event received a total of 610 papers, both national and international, with 370 papers being accepted for presentation. Looking ahead, ICETE 2023 is scheduled on 19th and 20th December.

ICETE 2023 comprised of seven conferences held concurrently namely Nitte-Bio 2023, SME 2023, AIDE 2023, VSPICE 2023, CTCS 2023, AREEV 2023, and MSMAT-2023. This conference provided a forum for paper presenters from various parts of the world to showcase their research findings. These conferences have many invited speakers from India and abroad who will deliver lectures online/in person on various themes of the conferences which will be beneficial to the participants of the conference. A total of about 300 papers were to be presented at all these conference as a whole.

ICETE 2025 comprising above seven conferences under its umbrella, received more than 2500 papers in total and about 375 papers are going to br presented by the authors. The conference has 15 keynote and invited talks. The proceedings of the conferences will be published in reputed publishing houses such as Springer, IEEE, AIP Publishing, IOP Science, CRC Press and EDP Sciences.

ICETE 2026 comprising above seven conferences under its umbrella, received more than 1500 papers in total and about 250 papers are going to be presented by the authors. The conference has 12 keynote and invited talks. The proceedings of the conferences will be published in reputed publishing houses such as Springer, IEEE, AIP Publishing, IOP Science, CRC Press and EDP Sciences.

# ICETE 2026 - Organizing Committee

ICETE 2026
Nitte, India

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Dr. Nagesh Prabhu, Vice Principal, NMAMIT, Nitte

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Dr. Yeong-Do Park, Professor, Dong-Eui University, Busan, Korea.

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# SPEAKERS - INTERNATIONAL


**Prof. Dr. In-Ho Ra**
Professor
School of Computer and Software
Kunsan National University
Gunsan, SOUTH KOREA



**Dr. Noor Hafhizah Abd Rahim**
Associate Professor
Faculty of Computer Science & Mathematics
Universiti Malaysia Terengganu (UMT)
Malaysia.



**Dr. Yasuhiro SHIOMI**
Vice Dean / Professor
College of Science and Engineering
Ritsumeikan University, Japan



**Dr. Hesham Nabiel**
Professor, Department of Mathematics
Faculty of Science, Al-Azhar University
Nasr City, Cairo, Egypt



**Dr. Aemi Syazwani Binti Abdul Keyon**
Biomedical Engineering
Analytical Chemistry,
Universiti Teknologi Malaysia
Malaysia



**Dr. Mohd Ibrahim Bin Shapiai @ Abdul Razak**
Department of Electronic System Engineering
Malaysia-Japan International Institute Of Technology
Universiti Teknologi Malaysia
Kuala Lumpur, Malaysia

# SPEAKERS - NATIONAL

**Dr. Ramnarayan Patel**
Department of Electrical and Electronics Engineering
National Institute of Technology Raipur,
Raipur

**Dr. Arun Kumar A**
Asst. Professor Sr. Grade
School of Computer Science Engineering and Information Systems
(SCORE), Department of Computer Applications,
VIT University, Vellore

**Dr. Saurabh Gupta**
Associate Professor
Department of Biomedical Engineering
National Institute of Technology Raipur,
Raipur

**Dr. Raaj Ramsankaran**
Department of Civil Engineering
Indian Institute of Technology Bombay
Mumbai

**Dr. Vishwas R Puttige**
CEO and Director
AMACE Solutions Private Limited
Bengaluru

ICETE 2026
Nitte, India

AIDE 2026
Nitte, India

2026 Sixth International Conference on

# Artificial Intelligence and Data Engineering (AIDE 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Sixth International Conference on Artificial Intelligence and Data Engineering (AIDE 2026)

Publication Partner

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Message

**Dr. Mamatha Balipa**
Program Chair
AIDE 2026

On behalf of the Organizing Committee, I am pleased to welcome you to the 2026 International Conference on Artificial Intelligence and Data Engineering AIDE-2026 held on 05 - 07, February 2026 at NMAM Institute of Technology, Nitte.

AIDE serves as an international forum for researchers, academicians, industry professionals, and students to present and exchange recent advances in Artificial Intelligence and Data Engineering. In an era driven by intelligent systems and data-centric technologies, the conference aims to promote discussions on innovative methodologies, practical applications, and emerging challenges in these rapidly evolving fields.

The technical program of AIDE-2026 includes a carefully selected set of peer-reviewed papers and keynote talks by distinguished experts. The accepted contributions reflect current research trends in areas such as machine learning, deep learning, data analytics, big data systems, and intelligent applications. We believe these contributions will foster meaningful technical discussions and future collaboration.

I would like to express my sincere gratitude to the Organizing Committee, Technical Program Committee, and reviewers for their dedicated efforts in ensuring the quality of the conference. I also thank our keynote speakers, sponsors, authors, and participants for their valuable contributions and support.
I hope you find the conference intellectually stimulating and professionally rewarding.
With best regards,

Thanks and Regards

Dr. Mamatha Balipa
Program Chair, AIDE-2026

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AREEV 2026
Nitte, India

2026 Sixth International Conference on

# Advances in Renewable Energy and Electric Vehicles (AREEV 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Sixth International Conference on Advances in Renewable Energy and Electric Vehicles (AREEV 2026)

Publication Partner

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Message

**Dr. Suryanarayana K**
Program Chair
AREEV 2026

Dear Delegates,
We are pleased to present the proceedings of ''Advances in Renewable Energy & Electric Vehicles" (AREEV-2026), an International Conference as a part of the Multi-Conference "International Conference on Emerging Trends in Engineering" (ICETE- 2026). This compilation of research represents the collective efforts of contributors, reviewers, and organizers dedicated to advancing knowledge in the fields of renewable energy and electric vehicle (EV) technologies. The primary objective of AREEV 2026 is to provide a platform for discussing the challenges, opportunities, and breakthroughs in these pivotal areas of technological advancement. The rapid progress in EV research, coupled with developments in renewable energy resources, continues to raise critical questions and new possibilities. This underscores the significance of sharing innovative solutions and fostering global collaboration in this essential domain. The overwhelming response to our call for papers, both from India and abroad, reflects the growing interest and commitment to these topics. While the high quality of submissions presented a challenge for our reviewers, it also ensured that the selected papers meet the rigorous standards expected of a E3S WoC.

This event would not have been feasible without the unwavering dedication of our reviewers and organizing team, to whom we extend our heartfelt appreciation. Their tireless efforts ensured the seamless execution of the conference and the publication of these proceedings. We are also deeply appreciative of our esteemed keynote speakers, presenters, and authors for their valuable contributions, which have enriched the discussions and inspired novel perspectives. We appreciate the continuous support received from the central committee of ICETE-2026.

In summary, AREEV 2026 has effectively united researchers, practitioners, and industry leaders to address critical challenges while providing a comprehensive perspective on the future of renewable energy and electric vehicles. We aspire for this volume to serve as a source of inspiration and a valuable reference for researchers, professionals, and policymakers. On behalf of the organizing committee, we extend our sincere gratitude for your support and participation and eagerly anticipate the impact of this work on future advancements in the field.

Thanks and Regards

Dr. Suryanarayana K
Program Chair, AREEV-2026

# AREEV 2026 - Organizing Committee

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NITTE BIO 2026
Nitte, India

2026 Seventh International Conference on

# Nurturing Innovative Technological Trends in Engineering – BIOscience (NITTE BIO 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Seventh International Conference on Nurturing Innovative Technological Trends in Engineering – BIOscience (NITTE BIO 2026)

Publication Partner

AIP Publishing

Message

**Dr. Ujwal P.**
Program Chair
NITTE BIO 2026

Dear Delegates,

It gives me immense pleasure to welcome you to the International Conference on Nurturing Innovative Technological Trends in Engineering 2026 (NITTE-BIO 2026). This conference serves as a premier platform for thought leaders, academicians, industry experts and aspiring researchers from across the globe to collaborate, exchange ideas, and showcase cutting-edge research in the field of Biotechnology. The theme of this conference focuses on fostering innovation and driving sustainable solutions to address the challenges of the future. We are confident that the diverse topics covered, including pharmaceutical biotechnology, environmental biotechnology, Bioprocess technology and bioinformatic, will spark insightful discussions and inspire new perspectives.

This compendium captures the essence of this event, providing a compilation of innovative ideas and ground-breaking research that highlights the dedication and brilliance of the participants. Each contribution represents the collective effort of individuals and institutions striving to advance the frontiers of knowledge.

We extend our heartfelt gratitude to all authors, keynote speakers, session chairs, reviewers and organizers for their unwavering support in making this conference a success. May this event be a stepping stone for future collaborations and technological breakthroughs.

We wish you a fruitful and engaging experience at the conference!

Thanks and Regards

Dr. Ujwal P
Program Chair, NITTE BIO-2026

# NITTE BIO 2026 - Organizing Committee

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CTCS 2026
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2026 Seventh International Conference on

# Civil Engineering Trends and Challenges for Sustainability (CTCS 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Seventh International Conference on Civil Engineering Trends and Challenges for Sustainability (CTCS 2026)

Publication Partner

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Message

**Dr. Arun Kumar Bhat**
Program Chair
CTCS 2026

Dear Delegates,

It is with great pleasure that we welcome you to the International Conference on Civil Engineering (CTCS). This prestigious event serves as a platform for researchers, academicians, industry professionals, and students to share their latest findings, engage in meaningful discussions, and contribute to the advancement of civil engineering.

Research and innovation are the driving forces behind the evolution of our field. As we navigate the challenges of modern infrastructure, sustainability, and technological advancements, it is through rigorous research that we develop solutions that shape the future. The dissemination of knowledge through publication not only strengthens academic and professional communities but also ensures that ground-breaking ideas reach a wider audience, fostering further development and collaboration.

Networking is another crucial aspect of this conference. The exchange of ideas, collaboration on multidisciplinary projects, and the formation of international partnerships are vital for progress in civil engineering. This conference provides a unique opportunity to connect with like-minded professionals, discuss emerging trends, and build lasting relationships that will drive innovation forward.

The Book of Abstracts represents the collective effort and intellectual contributions of participants from diverse backgrounds. It is a reflection of the depth of research, the commitment to excellence, and the spirit of collaboration that define this conference. We extend our sincere appreciation to all contributors, reviewers, and organizers who have made this event possible.

We hope that this conference inspires new research directions, strengthens professional connections, and contributes to the global advancement of civil engineering.

Welcome, and best wishes for a successful and enriching conference.
Thanks and Regards

Dr. Arun Kumar Bhat
Program Chair, CTCS 2026

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MSMAT 2026
Nitte, India

2026 Seventh International Conference on

# Materials Science and Mathematics for Advanced Technology (MSMAT 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Seventh International Conference on Materials Science and Mathematics for Advanced Technology (MSMAT 2026)

Publication Partner

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Message

**Dr. Raghavendra Bairy**
Program Chair
MSMAT 2026

I am happy to say that the Basic Sciences departments – Physics, Chemistry and Mathematics are organizing an International Conference MSMAT – 2026 (Material Science and Mathematics for Advanced Technology) under the multi conference platform consisting of several other conferences. MSMAT – 2026 will attract researchers and academicians in the field of basic sciences and engineering with a basic theme of co-relating applied research with technology. Large number of research papers have been received for the conference (124+), authors from various states of India and other countries. It's a great challenge to hold a conference in in-person mode, however committee members of MSMAT 2026 have taken it as the challenge. The abstract of research papers of the conference will be published in the form of a compendium along with the abstract of other conferences coming under multi-conference ICETE – 2026. Papers of MSMAT will be published in the AIP Conference Proceedings and IOP: Journal of Physics (a conference proceedings journal). I congratulate all the individuals who have taken part in running the conference

Thanks and Regards

Dr. Raghavendra Bairy
Program Chair, MSMAT-2026

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SME 2026
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2026 Seventh International Conference on

# Smart and Sustainable Developments in Materials, Manufacturing and Energy Engineering (SME 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Seventh International Conference on Smart and Sustainable Developments in Materials, Manufacturing and Energy Engineering (SME 2026)

Publication Partner

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## Message

**Dr. Srinivasa Pai P.**
Program Chair
SME 2026

Dear Delegates,

we are happy to present the proceedings of 7th International Conference on Smart and Sustainable Developments in Materials, Manufacturing and Energy Engineering” (SME 2026), which was held on February 05 - 07, 2026 at NMAMIT, Nitte. The theme of the conference is “Smart and Sustainable materials and manufacturing”. There is a need to develop and manufacture smart and sustainable materials, which can reduce the consumption of energy and reduce carbon emissions and thereby global warming.

This two-day conference includes invited lectures from renowned experts from academia and industry and oral paper presentations from academia showcasing the research developments and new knowledge in various sub domains in the broad field of smart and sustainable materials and manufacturing.

The manuscripts submitted to SME 2026 have been evaluated based on the research novelty, technical content, conference relevance, and readability. The conference has received around 300 submissions from which reviewers have accepted around 78 manuscripts. It will be published in two prestigious publications namely AIP and SPRINGER, which are Scopus Indexed.

We would like to thank the program committee members, faculty, and staff members. They have dedicated a lot of effort in organizing this conference in the best possible way. We would also like to thank both internal and external reviewers for their assistance in the extensive and effective review process, as well as the authors for contributing their research work to the conference.

We would like to extend our gratitude to the publication support delivered by M/s Springer Publications and M/s AIP Publications in this entire journey from conference to publication. We hope this conference proceedings

Thanks and Regards

Dr. Srinivasa Pai P.
Program Chair, SME 2026

SME 2026
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VSPICE 2026
Nitte, India

2026 Sixth International Conference on

# VLSI, Signal Processing, Power Electronics, IoT, Communication and Embedded Systems (VSPICE 2026)

05 - 07, February 2026

## ABSTRACTS

of the technical papers presented at the 2026 Sixth International Conference on VLSI, Signal Processing, Power Electronics, IoT, Communication and Embedded Systems (VSPICE 2026)

Publication Partner

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Message

**Dr. K V S S S S SAIRAM**
Program Chair
VSPICE 2026

Dear Delegates,

VSPICE -2026 is a flagship conference conducted as a part of International Multi Conference Platform (ICETE) by the department of Electronics and Communication Engineering. This year also the conference was organized during February 5 - 7, 2026. Participants from educational institutions, research organizations and industries participated in the conference. The areas covered include Advances in VLSI, Signal Processing, Power Electronics, IoT, Communication and Embedded Systems which are essential for the development of efficient and economic systems. To facilitate and provide a platform for the participants who have presented papers to a wider audience, the department of Electronics and Communications Engineering is going to publish the selected and presented papers in Lecture Notes in Electrical Engineering with title & Advances in Signals and Systems &, which is Scopus indexed. I am sure this publication, which is highly respected will add value to the publications and increase its reach and acceptability. I congratulate the organizers for their efforts and wish all the contributors all the best for their future endeavours.

Dr. Dr. K V S S S S SAIRAM
Head, Department of E&C, NMAMIT
& Program Chair, VSPICE 2026

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SUSTAINABLE DEVELOPMENT GOALS

# PROCEEDINGS OF ICETE 2026

ICETE 2026
Nitte, India

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**IEEE TECHNICALLY SPONSORED INTERNATIONAL CONFERENCE ON ARTIFICIAL INTELLIGENCE AND DATA ENGINEERING (AIDE-2026)**

**CMT 84**

# Anomaly Detection in Vehicle Trajectories using LSTM Autoencoders and Gaussian Mixture Models

**Muneera Hashim, Nadera Beevi S**

Dept. of Computer Application, TKM College of Engineering, APJ Abdul Kalam Technological University Kollam, India

**Abstract.** Vehicle trajectory anomalies such as sudden lane changes and irregular speed patterns pose significant challenges to traffic safety in autonomous driving environments. The paper presents a hybrid anomaly detection framework that integrates a Long Short-Term Memory (LSTM) Autoencoder with a Gaussian Mixture Model (GMM) for unsupervised detection of abnormal vehicle trajectories. The LSTM Autoencoder learns normal spatio-temporal motion patterns through sequence reconstruction, while the latent representations extracted from the trained Autoencoder are modeled using the GMM to estimate probabilistic likelihoods. Rather than relying on direct outlier detection from the joint model, a composite anomaly score is formulated by combining deterministic reconstruction error and probabilistic likelihood information. Anomalous trajectories are subsequently identified using a percentile-based threshold on the combined score. The method effectively exploits both the temporal modeling capability of LSTM networks and the density estimation strength of probabilistic clustering. Experimental evaluation on large-scale vehicle trajectory datasets demonstrates that the proposed framework achieves improved computational efficiency and stronger agreement across diverse anomaly types compared to standalone LSTM Autoencoders and classical GMM-based approaches. These results highlight the effectiveness of hybrid models for reliable trajectory anomaly detection in intelligent transportation systems.

**Keywords.** Vehicle trajectories, Anomaly detection, LSTM Autoencoder, Gaussian Mixture Model, Hybrid models

**CMT 159**

# An accurate and computationally efficient SOC estimation in EV batteries using enhanced Deep Neural Networks

**Tejaswini S, Chandrashekar M Patil, Parvitha U, Manya Ashvitha M**

Department of Electronics and Communication Vidyavardhaka College of Engineering Mysuru, Karnataka, India.

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**Abstract.** The effectiveness and reliability of Lithium-ion (Li-ion) batteries rely on a precise calculation of the state of charge (SOC). Traditional SOC estimating approaches have difficulties due to battery age, temperature changes and nonlinearity. This study introduces an enhanced deep neural network (DNN) model that generates high-accuracy predictions using battery data which includes voltage, current and temperature. The model is trained using Adam optimizer and is tested at various temperatures and drive cycles. A two-layer DNN model results in the highest performance, with low root mean square error (RMSE) of 1.47% and mean absolute error (MAE) of 1.27%, outperforming other existing approaches. The proposed approach is computationally efficient, applicable across various datasets and robust under a variety of operating conditions, making it a popular choice for real-time Electric Vehicle (EV) battery management systems (BMS).

**Keywords.** electric vehicle, deep neural network, adam optimizer, hyperparameters, battery management systems

**CMT 215**

# A Region-Aware Application for Measuring the Carbon Footprint of Large Language Models

**Doorgesh Neetye, Vidasha Ramnarain-Seetohul**

ICT dept. Faculty of Information, Communication and Digital Technologies University Of Mauritius Reduit, Mauritius.

**Abstract.** The rapid advancement of artificial intelligence (AI), particularly through the development of Large Language Models (LLMs) such as BERT and GPT, has significantly transformed modern society. However, the training of these models demands substantial computational resources, leading to considerable environmental impacts, especially in terms of carbon emissions. This work presents a novel algorithm and a user-friendly web application designed to estimate the carbon footprint associated with LLM training. The algorithm monitors the real-time energy consumption of CPUs, GPUs, and RAM, and computes carbon dioxide ($CO_2$) emissions using a carbon intensity coefficient specific to the Mauritius region. The accompanying application enables users to input hardware specifications and model parameters to estimate emissions, eliminating the need for code-level integration. By promoting transparency and awareness around the environmental costs of AI, this work aligns with the United Nations Sustainable Development Goal 13 (Climate Action) and offers practical tools to support more sustainable AI practices.

**Keywords.** Artificial Intelligence, Large Language Models, carbon emission, SDG goal.

**CMT 257**

# A Hybrid Deep Learning Framework for Brain Stroke Diagnosis Using MRI and CT scans

**Akhilraj V. Gadagkar [1], Shifana Begum [2]**

[1]NMAM Institute of Technology, Nitte
[2] Srinivas University Institute of Engineering and Technology, Mukka

**Abstract.** Stroke is a critical neurological emergency that occurs due to the disruption of blood flow to the brain, resulting in oxygen deprivation and subsequent brain cell damage. Early diagnosis is essential for timely intervention, yet conventional diagnostic methods like CT and MRI imaging are often limited by cost, accessibility, and reliance on specialist interpretation. This paper presents a comprehensive deep learning-based framework for early stroke prediction and classification using CT and MRI brain scans. The system employs Convolutional Neural Networks (CNNs) for feature extraction and integrates ensemble classification algorithms—including Random Forest, Support Vector Machines (SVM), Bagging, and XGBoost—to enhance predictive performance. A semantic segmentation module using a SegNet encoder-decoder architecture is implemented to identify stroke-affected brain regions. A web-based application is also envisioned for remote access and usability. The framework demonstrates significant potential for improving stroke detection accuracy, enabling faster clinical decision-making, and enhancing preventive care.

**Keywords.** Stroke Detection, Deep Learning, MRI, CT Imaging, Semantic Segmentation, Ensemble Classification

**CMT 271**

# Evaluation of Object Detection Models on Indian Road Scenarios for Pothole Detection

**Jeevan Bhandary [1], Shreya Jaya Shetty [2], Bharath S Bhat [1], Gurunandan G R [1], Devika Udupa V [3], Srujan U Shetty [1]**

[1]Nitte (Deemed to be University) Dr. NSAM First Grade College (Dr.NSAMFGC), Department of Computer Science Nitte, Karnataka 574110, India
[2]Nitte (Deemed to be University) NMAM Institute of Technology (NMAMIT), Department of Master of Computer Applications Nitte, Karnataka 574110, India.
[3] Yenepoya Institute of Technology, Department of Basic Science and Humanities Moodubidre, Karnataka, India

**Abstract.** Degradation of the road surface, especially potholes, is one of the main reasons for traffic hazards, vehicle damage, and accidents in India. Automated detection systems are being adopted since manual inspection methods are labor-intensive, subjective, and slow. Realtime pothole recognition using object detection models has showed potential thanks to recent developments in deep learning and computer vision. The effectiveness of three popular detection models like YOLOv8, Faster R-CNN, and MobileNet SSD—in identifying potholes in Indian road conditions is assessed in this study. A curated dataset of 200–300 road photos taken with smartphone cameras, as well as publically accessible datasets like the Indian Pothole Dataset (IPD) and Pothole-600, are used to evaluate the algorithms. Mean Average Precision (mAP), Precision, Recall, F1 Score, and inference speed in frames per second (FPS) are evaluation measures. The findings allow for a comparative assessment of the models' applicability for practical implementation in intelligent transportation systems by highlighting trade-offs between detection accuracy and processing efficiency.

**Keywords.** Pothole Detection, Object Detection, YOLO, RCNN, MobileNet SSD.

**CMT 287**

# Intelligent Pattern Analysis and Criminal Profiling

**Harinakshi C [1], Suchetha G [1], Shwetha S Shetty [1], Ananya R Shetty [1], Sparsh Rai [1], Dhananjaya B[2]**

[1]Sahyadri College of Engineering and Management, Mangaluru Affiliated to Visvesvaraya Technological University Belagavi 590018, India.
[2]Department of Electrical and Electronics Engineering Nitte (Deemed to be University) NMAM Institute of Technology (NMAMIT) Nitte, India.

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**Abstract.** The increasing complexity of modern crimes requires intelligent, data-driven solutions that enable effective analysis and criminal activity profiling. This paper describes a support system for criminal investigation based on AI, which aims at centralizing, analyzing, and visualizing criminal information for effective decision support. The support system integrates MongoDB for storing structured information and Neo4j for relationship-based analysis using graphs, enabling criminal networks, gang hierarchies, and behavioral trends identification. Crime hotspot, time-driven trends, and outliers are detected using advanced analytics modules, while a Flask-based backend makes module integration effortless. A chatbot interface based on natural language processing (NLP) allows investigators to submit queries to the support system using simple, natural-language questions, enabling effortless information access on vital information. Overall, the designed support system automates investigative activity, reduces manual efforts, and supports decision-taking based on data for law enforcing agencies.

**Keywords.** Artificial Intelligence, Criminal Investigation, Data Analytics, Crime Pattern Analysis, Network Analysis, Knowledge Graphs, Chatbot Interface, Law Enforcement Systems.

**CMT 311**

# Smart Interior Design: Integrating AR Visualization and Chatbot Assistance

**Vandana B. S., Shreya Adiga, Vaishnavi, Sherugar Ganavi Nagaraj**

Nitte (Deemed to be University) NMAM Institute of Technology, Nitte, Karnataka, India Department of Information Science and Engineering.

**Abstract.** Interior design is often perceived as a complex and costly process, requiring repeated revisions, professional expertise, and significant user effort. Traditional approaches such as manual measurements, 2D sketches, and showroom visits limit users' ability to realistically visualize furniture and décor in their living spaces, leading to uncertainty and delayed decision-making. To address these challenges, this paper presents an AI-assisted interior design prototype that integrates Augmented Reality (AR) visualization with conversational chatbot support. The AR component enables users to place and interact with 3D furniture models within real-world environments, while the chatbot provides design-related assistance and layout suggestions based on user preferences. The proposed system incorporates optimized 3D assets and photogrammetry-based models enhanced using Gaussian splatting to improve visual realism while maintaining real-time performance. Experimental evaluation demonstrates improved rendering efficiency, reduced planning effort, and increased user confidence in design decisions compared to traditional methods. Although the prototype is at an early stage, the results indicate that combining AR and AI technologies can significantly enhance interactivity, accessibility, and usability in interior design applications.

**Keywords.** Augmented Reality, Interior Design, Chatbot Assistance, 3D Visualization, Unity

**CMT 320**

# A Context-Adaptive Computational Framework for Shadow Artifact Remediation in Diverse Imagery

**Santhosh S, Ashwin Shenoy M, Meetha Anchan, Pranathi GR, Keerthana Acharya and Pratheeka KG**

Nitte (Deemed to be University) NMAM Institute of Technology (NMAMIT) Department of ISE
Nitte, India.

**Abstract.** Shadow artifacts in photos critically impair the performance of computer vision systems, impacting object detection, scene understanding, and image analysis. This work introduces an intelligent context-aware shadow elimination system that makes use of multi-modal processing methods for detecting and eliminating shadows from images effectively. The suggested system combines RGB data, depth information, and lighting hints to produce high-quality shadow-free images. Experimental results on several real-world datasets prove the efficiency of the system in maintaining object integrity and enhancing image visual quality, with a performance superior to previous approaches for shadow removal.

**Keywords.** Shadow removal, multi-modal processing, image enhancement, context-aware systems.

**CMT 324**

# ConfidenceVoice: AI-Driven Real-Time Public Speaking Coaching for Enhanced Communication

**Rashmi, Prathwini**

Nitte (Deemed to be University) NMAM Institute of Technology (NMAMIT) Nitte Nitte, Karkala India.

**Abstract.** Good public speaking involves not only verbal clarity but also assertive nonverbal communication. While current communication coaching tools concentrate mainly on audio feedback, they pay little attention to multimodal cues that have a significant impact on audience perception, such as facial expression and body language. This research work introduces ConfidenceVoice, an AI-powered system for real-time public speaking coaching through speech analysis in conjunction with facial emotion recognition. It incorporates a convolutional neural network model that was trained on the FER-2013 dataset to classify facial emotion with natural language processing components to identify filler words, assess speech rate, and examine vocabulary use. The composite confidence score is produced through the combination of verbal and nonverbal information and provides both real-time live feedback and rich postsession performance reports. Experiments among support vector machines, convolutional neural networks, and fully connected neural networks verify the efficacy of the proposed method. ConfidenceVoice moves beyond current commercial uses by providing multimodal real-time feedback to facilitate enhanced self-awareness, decreased anxiety, and improved communication skills overall. Future applications involve adding the system with transformer-based multimodal frameworks, cross-lingual support, and integration with immersion interfaces like virtual reality for personalized practice

**Keywords.** Public speaking, multimodal emotion recognition, speech analysis, real-time feedback, confidence detection, human-computer interaction, AI coaching systems

**CMT 325**

# Hybrid Physics-Informed ML Framework for Lithium-Ion Battery Prognostics

**Shambunath V. S, Arunkumar S**

Department of Mechanical Engineering Amrita Vishwa Vidyapeetham, Amritapuri Campus Kollam – 690525, India.

**Abstract.** For the safe, economical and consistent operation of energy storage systems, precise and explicable lithium-ion battery prognostics is a crucial parameter. In this work report, you can find hybrid physics- informed learning framework which consists of heterogenous datasets holding publicly available NASA and Oxford battery data combining physics-adhered simulations. Highlight of this framework is the addition of multi-source datasets capturing degradation behavior under various operational conditions. Random Forest (RF) and XGBoost (XGB) ensemble regressors train using electrochemical and thermal priors. Parameters like voltage hysteresis, thermal gradient rate, internal resistance and capacity fade are derived from first principle models adopting generic statistical descriptors. Accommodation of thermal dynamics and heat generation has been made to understanding physical processes controlling battery decay. NASA, Oxford and hybrid datasets are compared to evaluate generalisation and robustness. With an RMSE and R2 value of 0.008 and 0.994 respectively, this hybrid model outperforms single source baselines. While Monte Carlo cross validated the model's robustness, sustainability was assured by computational efficiency analysis for battery management systems. Accurate and easy to understand shapes the model's features, further confirmed by SHAP analysis. This framework enables reliable and interpretable battery health monitoring by being computationally efficient, suitable for real-time Battery Management Systems (BMS), and scalable across chemistries.

**Keywords.** Battery prognostics, physics-informed learning, Random Forest, XGBoost, state of health (SOH), remaining useful life (RUL), data fusion.

**CMT 339**

# Graph-Based Credit Risk Modeling in P2P Lending Using Gower-Derived Centrality Features

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**Abstract.** Peer-to-Peer (P2P) lending has transformed traditional credit markets by enabling direct interactions between borrowers and lenders. However, accurate loan risk assessment remains a challenge due to the decentralized nature of this ecosystem. This study explores the integration of network-based features derived from the lending network's graph structure with traditional borrower attributes to enhance loan outcome prediction. Minimum Spanning Trees (MSTs) constructed using Euclidean and Gower distance metrics reveal that Gower's distance, which handles mixed categorical and numerical data, offers a more comprehensive network representation. Centrality measures from the Gower MST—such as Strength, PageRank, and Betweenness Centrality—significantly improve predictive performance by identifying key actors. Machine learning experiments with Random Forest, XGBoost, and Logistic Regression demonstrate consistent accuracy gains when incorporating these network features, with Random Forest achieving the best results. The approach also demonstrates scalability for large financial datasets, underscoring its practical value for risk assessment in P2P lending platforms.

**Keywords.** P2P Lending; Loan Risk; Network Centrality; Random Forest; Mixed Data Distance; Lending in Finance

**CMT 341**

# Investilyze - Personalized Investment Advisor for Diverse Asset Classes

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**Abstract.** Today, investment planning has become a major concern, especially as many people seek a second source of income to cover their daily expenses and achieve early retirement. In this study, we discuss Investilyze, a platform that serves users of any age group by providing investment recommendations in line with their financial targets and risk appetites. A risk score for the user is obtained from a questionnaire that determines their risk profile. The portfolio recommendations are provided for the investment horizon and the size of the account considering the user's risk profile, so that he/she can obtain maximum return within their risk bracket. Stock price prediction models (TimeGNN) based on deep learning techniques are used to predict the returns of individual stocks, which are then aggregated at the sector or industry level. These combined predictions are then used as the inputs for the Markowitz mean-variance portfolio optimization model, designed to construct portfolios that balance expected returns and risk tolerance. Finally, the optimal portfolio is conveyed through interactive visualizations that spotlight the top sectors along with their weights, thus making it a very simple and straightforward way for the user to understand the investment guidance.

**Keywords.** Machine Learning, Personalized Investment, Portfolio Optimization, Time-Series Forecasting, Markowitz Mean- Variance Optimization, TimeGNN.

**CMT 348**

# AutoContext: An Adaptive Framework for Intelligent Context Management in Large Language Models

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**Abstract.** Large Language Models (LLMs) have transformed the natural language processing domain by demonstrating incredible competence in reasoning, summarization, and conversation response generation. Their capacity to generate contextually welldeveloped and human-like responses has made them priceless in a variety of real-world use cases like customer service, learning, and content generation. Nonetheless, the performance of LLMs is limited by bounded context windows, token inefficiencies in their usage, and lack of adaptive memory components for the maintenance of long-term conversational consistency. The limitations tend to introduce token redundancy, hallucinations, and inference computational wastage. In order to step out of this hurdle, this work introduces AutoContext: a dynamic context-management mechanism that filters, summarizes, and prioritizes important information from the dialogue history in a smart way and then passes it on to the LLM. The design integrates a Random Forest–based model of context relevance to rank message salience and an abstractive summarizer from T5 to cut through lengthy blocks of conversation without sacrificing semantic coherence. The unified process supports dynamic refactoring of prompts dynamically such that the most context-relevant content is left and entered into the model. AutoContext provides a modelagnostic, scalable solution towards making LLM-based systems more efficient as well as more knowledgeable about contexts. By bridging the memory optimization vs semantic preservation gap, it paves the way for designing intelligent, cost-effective, and context-aware conversational AI systems suitable for deployment in real-world scenarios.

**Keywords.** Abstractive Summarization, Context Optimization, Conversational AI, Large Language Models (LLMs), Prompt Engineering, Retrieval-Augmented Generation (RAG), Token Efficiency, Transformer Models.

**CMT 349**

# Multimodal Fusion with Cross-Modal Attention for Robust MCI-to-AD Prediction

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**Abstract.** For prompt intervention, early prediction of the progression of Alzheimer’s disease (AD) from mild cognitive impairment (MCI) is essential. We suggest a cross-modal attention neural network that incorporates 3D structural MRI from the ADNI dataset, FreeSurfer biomarkers, and clinical evaluations. In order to learn the best feature interactions across these diverse data kinds, our architecture uses multi-head attention. Our model obtained 88.45% accuracy and an AUC of 0.874 for 24-month progression prediction by addressing important clinical data difficulties, particularly restricted MRI availability (present for only 14.8% of patients) and a severe class imbalance (18.6% progression rate). Compared to single-modality methods, this performs noticeably better (Clinical: 0.732 AUC, FreeSurfer: 0.781 AUC, MRI: 0.823 AUC). Clinical aspects (42%), FreeSurfer measurements (35%), and MRI features (23%) all contribute in a complimentary way, according to an analysis of the attention mechanisms. Cross-validation confirms robustness (0.866 ± 0.011 AUC). This comprehensible approach allows evidencebased patient classification and offers therapeutically actionable predictions, as demonstrated by a 95.65% negative predictive value.

**Keywords.** Alzheimer’s Disease, Deep Learning, Cross- Modal Attention, Multimodal Fusion, Medical Image Analysis.

**CMT 351**

# Chennamane: The Historiography, Gameplay, and Cultural Revival of an Obscure Folk Game from Southern India

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**Abstract.** A classic board game from South India, chennemane also known as Mancala game, is frequently played with cowrie shells and wooden boards. The goal of this project is to use the game engine known as Unity to convey the cultural significance and strategic depth of Chennemane towards the realm of the web. Our goal in digitising this beloved game is to uphold its legacy. While enabling a worldwide audience to look at it. Creating an intuitive user experience with intricate visuals and animations while maintaining the genuine feel of an actual physical game is a key component of the game creation process. We employ gaming mechanisms that adhere closely to conventional guidelines, guaranteeing a genuine gameplay experience. The game will also allow players to play with others on the precise same device in both local person vs. player and single-player modes against AI

**Keywords.** Chennamane, AI, Unity game engine

**CMT 354**

# ChemStruct: A Real-Time Molecular Visualization Platform for an Interactive Chemistry Learning.

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**Abstract.** The current constraints associated with the absence of interactive and dynamic visualization approaches create a substantial insufficiency in chemistry education that is unequally characterized as knowing the subject through a level of student mediated engagement that is paramount to learning content related to chemistry. There are many challenges associated with instructional chemistry in predicting the dynamic here and now progressing of molecular interaction and reactions. In this proposal, we intend to design and develop a mobile app designed to convert chemical names, images of structures (i.e., a molecular model) and videos of chemical reaction into molecular representations (both 2D & 3D). Using industry standard and custom computational tools (i.e. RDKit, OpenBabel, DeepChem, and computer vision algorithms) to enhance student engagement as a discovery tool to visualize molecular interactions and reactions as they occur. The app has three main features, (1) Convert IUPAC and common names into bottle molecular representation (e.g. diagrams of chemical structures), (2) Recognize hand drawn or printed molecular structure from an image, and (3) Engage a video based titration experiment to observe color changes during a reaction, while engaging in real demonstrate the molecules transformation.The purpose of this project is to create a more interactive, intuitive, and enjoyable chemistry educational experience for students and teachers using one accessible app built in Flutter that includes these features.

**Keywords.** Cheminformatics, RDKit, OpenBabel, OCR, Computer vision, Titration analysis, 3D visualization.

**CMT 355**

# A Machine Learning Approach for Predicting Term and Preterm Births Using Maternal Data

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**Abstract.** Preterm birth or the birth before completion of a full gestation of 37 weeks continues to be a significant contributor to morbidity and mortality among the newborns across the globe. It has an impact on 11 percent of pregnancies worldwide. Early detection of pregnancies that are at risk of premature birth will help in carrying out the necessary measures in good time so that the newborn babies could have better outcomes. In order to solve this problem, we developed a machine learning model to classify term and preterm births using clinical data in the real world. We gathered and tabulated an elaborate set of information based on Electronic Health Records (EHRs). Some of the variables that we targeted include maternal health indicators, prenatal care details, sociodemographic background, and clinical factors that are region-specific. We have experimented with several classification algorithms and have discovered that the Random Forest classifier would be the most reliable to us. The model produced positive outcomes. The performance measurements were accuracy of 0.90, precision of 0.90 to term births, recall of 0.99 of term classification as well as F1-score of 0.95. These findings suggest that we can successfully categorize term and preterm births by defining them by the selected maternal characteristics. This provides medical practitioners with an effective instrument of risk detection and correction at an early stage

**Keywords.** Term birth, preterm birth, classification, gestational age, EHR, machine learning, Random Forest.

**CMT 356**

# Optimizing Profit Scoring in P2P Lending Using Prepayment and IRR Analysis

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**Abstract.** Peer-to-peer (P2P) lending platforms face significant challenges in accurately assessing borrower risk and predicting default probability due to the complex nature of lending data characterized by high dimensionality, severe class imbalance, and intricate relational dependencies. This work develops a comprehensive machine learning pipeline for credit and profit scoring in P2P lending environments. A critical innovation of this work is the identification and incorporation of prepayments as a distinct class, addressing the financial impact of early loan settlements on expected interest returns. We conduct a systematic comparison of default prediction performance between binary classification (default vs. non-default) and multi-class classification (default vs. non-default vs. prepaid) frameworks using three machine learning algorithms: Logistic Regression, Random Forest, and XGBoost. To evaluate the practical financial implications of misclassification errors, we implement Internal Rate of Return (IRR) analysis through simulated cash flow modeling. This approach quantifies the actual monetary impactof prediction errors on lending profitability. The findings demonstrate that misclassification costs are substantially higher in binary classification models compared to multi-class approaches, suggesting that incorporating prepayment prediction significantly improves both predictive accuracy and financial outcomes.

**Keywords.** Financial Technology, Peer-to-peer Lending, Credit Scoring, Profit Scoring, Ensemble Methods

**CMT 360**

# Early Paddy Disease Detection & Sustainable Farming for South Indian Farmers

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**Abstract.** In Southern India, paddy farmers frequently experience significant crop losses and financial strain due to delayed detection of plant diseases. To address this challenge, we propose a predictive monitoring system that enables early detection of paddy diseases and helps prevent large-scale yield damage. The system integrates a hybrid machine learning framework that combines YOLOv8, a convolutional neural network for crop image analysis, with an LSTM model that incorporates environmental factors such as rainfall, humidity, and temperature to forecast disease risk before visible symptoms appear. The current implementation focuses on the YOLOv8-based detection module evaluated on real field data. Additionally, the system design includes geospatial analysis through Google Earth Engine for regional disease risk visualization and a low-cost, multilingual user interface to support ease of use by farmers. The initial deployment targets two districts in Southern India, contributing to more sustainable and resilient farming practices.

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**CMT 361**

# SkillCraft: LLM Powered Interview Preparation Platform

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**Abstract.** SkillCraft, a novel Streamlit web application designed to revolutionize interview preparation using advanced Large Language Models (LLMs). At its core, SkillCraft utilizes OpenAI's GPT-4 turbo as a dynamic trainer, offering users an engaging, interactive platform for learning and practicing interview skills. The application integrates conversational windows, allowing users to discuss various concepts and topics, ranging from aptitude to technical and HR-related aspects, with the LLM trainer. SkillCraft stands out by incorporating Whisper for speech-to-text functionality, enabling users to converse through speech for a more fluid interaction. Additionally, the application's distinctive feature lies in its reasoning and scoring mechanism, where the custom GPT-4 turbo model CodeX is prompted to engage in "Chain of Thought" reasoning. This approach breaks down queries and responses, allowing for coherent and accurate feedback, and dynamically scores user responses. Furthermore, SkillCraft evaluates users on the quality of their code, offering suggestions for improvement based on LLM reasoning processes. Future enhancements include the integration of Code Llama for code generation and educational purposes, and the potential use of smaller open-source models for efficient code generation. SkillCraft is an innovative step towards interactive, AI powered learning and development in interview preparation.

**Keywords**. CodeX, Interview Preparation, LLM, SkillCraft, Speech-to-Text.

**CMT 367**

# Real-Time Violence Detection Using Lightweight Deep Learning

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**Abstract.** The rising need for automated surveillance systems has increased the necessity for accurate and efficient violence detection models. The practice of manually monitoring public spaces can be unreliable and takes an excessive amount of time to enact a response, especially during critical situations. This paper proposes a light-weight deep learning framework that employs the MobileNetV3Small convolutional neural network (CNN) to analyze video sequences that are either violent or non-violent, in real time. The architecture takes advantage of a lightweight convolutional backbone to achieve efficient inference while maintaining high accuracy classifications. The methodology is evaluated on two benchmark datasets, namely, the Real-World Fighting (RWF-2000) dataset and the Real-Life Violence Dataset (RLVD). Different preprocessing steps, like frame normalization and frame augmentation, were used to support generalization across various lighting and motion scenarios. The results showed that the computational time in classifying a video sequence was approximately 95% accuracy, with 88% precision, and 92 F1-score, outperforming traditional models, while sustaining considerable computational efficiency. The results confirm the model's suitability for real-time monitoring and safety applications with respect to smart surveillance, law enforcement, and social media moderation, to name a few. In summary, the proposed MobileNetV3Small-based violence detection framework achieves high classification accuracy while requiring minimal resources i.e deployment in modern computing environments where resources are constrained.

**Keywords.** Violence Detection, Deep Learning, Convolutional Neural Network, MobileNetV3Small, Real-Time Analysis, Smart Surveillance.

**CMT 380**

# SCRAP LINK: Smart Scrap Collection and Trading System

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**Abstract.** The increasing difficulty in managing waste and recycling shows the need for smart digital platforms that make the recycling process easier. SCRAP LINK is a web-based system that connects scrap sellers directly with approved recyclers, limiting intermediaries to ensure fair and transparent pricing. The platform uses Machine Learning, specifically a Random Forest Regression model, to predict current scrap prices based on past market data. Sellers can list their materials by providing details such as type, quantity, and location, while recyclers can search and filter these listings based on location and material needs. The system was built using React.js, Typescript.js, and PostgreSQL, which helps it scale well, handle data efficiently, and run smoothly. Through geolocation features using Leaflet, recyclers can find nearby scrap sources, helping cut down on transportation costs and time. In general, SCRAP LINK brings digital tools to the scrap trading world, supporting transparency, sustainability, and the principles of a circular economy through smart automation.

**Keywords.** Scrap Management, Machine Learning, Price Prediction, Circular Economy, Sustainability, React.js, Leaflet, PostgreSQL.

**CMT 381**

# Machine Learning and Smart PLS Approach to Understanding Individual and Technological Determinants of Work Engagement and Workplace Happiness

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**Abstract.** Artificial Intelligence (AI) is evolving as a ground- breaking technology and becoming an integral part of organiza- tions across numerous fields and aspects of society to boost elaboration between machines and humans and work. Emotional intelligence acts as an assessment that includes characteristics of emotional competence. Employees high in conscientiousness are typically planned, persistent, and committed, which increases their enthusiasm and dedication to the work. The study deeply explores the interplay between traits and technological perception, emphasizing the mediating role of work engagement. A sample of 300 employees from various IT firms across four cities of Tamil Nadu was surveyed by using a questionnaire. The data were analyzed through Jupyter Python incorporated Correlation analysis, Linear Regression analysis, Multiple Linear regression analysis, Random Forest importance and PLS software, incorporating path coefficients, Bootstrap. The study confirms Emotional Intelligence and updation of Artifical intelligence are important in modern workplaces, which boost organizations' aim for the further well-being of employees and cultivating sustainable productivity and technology services.

**Keywords.** Workplace happiness, Work engagement, Artificial intelligence, Organizational behavior.

**CMT 387**

# Machine Learning Based System for Identification of Laghu and Guru in Sanskrit Verse

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**Abstract.** Prosody provides information regarding a rhythmic structure present in poetry or a verse for any language. In particular, for the Sanskrit language, recognizing the prosody (called “Chandas” in Sanskrit literature) of the verse is entirely dependent on the identification of the light (“Laghu”) and heavy (“Guru”) syllables. In this paper, we propose an efficient and low-complexity two-step machine learning (ML) based system for identifying Laghus and Gurus in Sanskrit verses, by developing an ingenious dataset for representation of the syllables. Our idea of preparing a novel dataset and categorizing the syllables using the first ML block enables us to solve the sequence-tosequence conversion problem as a simple classification problem in the second ML block, with two classes namely, the Laghu and Guru. The proposed data representation method and the two-step ML technique have been found to give an accuracy of more than 99%.

**Keywords.** Sanskrit, Syllables, Chandas, Machine Learning

**CMT 407**

# AIoT-based Anomaly Detection and Monitoring System for Smart Poultry Farms

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**Abstract.** Poultry farming often faces major challenges in maintaining the right environmental conditions, keeping birds healthy, and avoiding financial losses caused by unnoticed issues. To address these problems, this project introduces an AIoT-based Anomaly Detection and Monitoring System for Smart Poultry Farms that combines Artificial Intelligence (AI) and the Internet of Things (IoT) to enable smart automation and real-time decision-making. In this system, IoT sensors constantly track key parameters such as temperature, humidity, ammonia levels, and light intensity inside the poultry house. The collected data is sent to a cloud platform, where AI algorithms analyze it to detect unusual patterns, predict possible risks, and send early alerts to farmers and supervisors. Beyond monitoring, the system can automatically control devices like fans, heaters, and water sprayers to maintain ideal living conditions for the birds. A mobile dashboard gives users access to real-time data, visual reports, and instant notifications, allowing easy remote monitoring and management. By integrating intelligence and automation, this project helps reduce manual effort, optimize resource usage, and support data-driven decision-making, ultimately leading to healthier poultry, higher productivity, and more sustainable farm operations

**Keywords.** AIoT, Anomaly Detection, Machine Learning, Disease Prediction, IoT Sensors, Mortality Monitoring, Feed and Medicine Logging, Poultry Management, Cloud-Based Dashboard

**CMT 435**

# Unveiling Influential Nodes in Complex Networks: A Journey Through Graph Learning, Community Insights, and Fuzzy Hybrids

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**Abstract.** In complex networks, influential nodes function as pivotal control points and are central to the enabling or restricting of information flow, in preserving structural stability, and in determining the ensuing dynamics and processes of interaction. Identifying influential nodes will facilitate influence maximization, epidemic control, and infrastructure optimization. Conventional centrality measures, for example, degree, between- ness, and closeness, only fragmentarily represent structural cor- relations and do not account for non-linear dependencies or dy- namic change. The emergence of graph representation learning, attention-based learning paradigms, and fuzzy intelligence are facilitating progress in this area by concurrently identifying and interweaving uncertainty reasoning within topological learning. Recent frameworks span a broad spectrum, including Graph Convolutional Networks (GCNs), LSTM-based transfer models, community-driven optimization strategies, and fuzzy multilayer integration approaches. Overall, they are oriented toward greater interpretability and scalability, and improved predictive accuracy. Results of various comparative studies across heterogeneous datasets reflect better diffusion coverage, accuracy, and even time efficiency to converge to the state of the art. Overall, the convergence of graph learning and fuzzy hybridization, forms a sound technological basis for adaptive, interpretable, and ethically aligned identification of influential nodes in dynamic, large networks.

**Keywords.** Influential nodes, intricate networks, social networks, graph neural networks, fuzzy logic, deep learning, dynamic networks, community detection, influence maximization, and hybrid models.

**CMT 457**

# Computer Vision Based Approach for Ergonomic Posture Monitoring in Working Environments: Leveraging YOLO11s Pose Model along with an XGBoost Classifier

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**Abstract.** Maintaining proper ergonomics is critical for preventing musculoskeletal disorders in workplace environments. While computer vision has been applied to posture detection, limited research explores the efficacy of recent YOLO architectures for this specific task. This paper proposes a real-time ergonomic posture monitoring system that integrates the YOLO11s Pose Estimation model with an XGBoost classifier. The system detects correct and incorrect postures across three activities: neutral sitting, standing, and lifting heavy objects. A custom dataset comprising 5,069 annotated video frames was created to train and validate the model. Experimental results demonstrate that the proposed hybrid approach achieves a classification accuracy of 99.17% for the neutral sitting posture, outperforming existing methods such as YOLOv8 and MediaPipe. The system operates in realtime using a standard webcam and provides immediate audio feedback, offering a practical and efficient solution for occupational health monitoring.

**Keywords.** Ergonomics, YOLO11, Computer Vision, Pose Estimation, Machine Learning, XGBoost

**CMT 463**

# Gradio-Enabled Dual-Model Waste Classifier: From Scratch CNN vs MobileNetV2 for Smart Segregation

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**Abstract.** The efficient separation of garbage is a key global challenge, particularly in the creation of smart cities and the quest for ecologically friendly practices. A pre-trained MobileNetV2 model based on transfer learning and a proprietary Convolutional Neural Network (CNN) constructed from scratch are the two deep learning models used in this study's Gradioenabled dual-model trash categorization system. Assessing the performance, complexity, and deployability trade-offs between a lightweight CNN and a more reliable transfer learning strategy is the goal. Plastic, glass, paper, cardboard, metal, and trash are the six categories in the publicly accessible waste categorization dataset that was used to train and evaluate both models. With a validation accuracy of just about 55%, the CNN model suffered from overfitting while achieving a training accuracy of over 97%. The MobileNetV2 model, on the other hand, demonstrated superior generalization skills with a much higher validation accuracy of 76%. Evaluation criteria including accuracy, recall, F1-score, and confusion matrices were employed to further examine the model's performance. Because of its simplicity and reduced processing needs, the CNN model is more appropriate for edge deployment and showed quicker inference times. In the meanwhile, MobileNetV2 demonstrated exceptional resilience and classification accuracy across a variety of test samples, including actual garbage photos. Gradio was used to install both models, resulting in an interactive and intuitive web interface for garbage sorting in real time. This comparison study helps researchers and developers create effective AI-powered waste management systems by offering insightful information about how various deep learning techniques function in real-world scenarios. The Gradio deployment encourages scalable and intelligent waste segregation solutions while supporting possible real-world applications in the government, business, and educational sectors.

**Keywords.** Convolutional Neural Network (CNN), MobileNetV2, transfer learning, Gradio interface, waste categorization, intelligent segregation, deep learning, image classification, environmental sustainability, and edge deployment

**CMT 469**

# Grade-Specific LSTM-Based Approach for Data-Driven Forecasting of Adike and Patora Arecanut Market Prices

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**Abstract.** Using sophisticated Long Short-Term Memory (LSTM) neural networks and methodical grade-wise time series modeling, the suggested work offers a reliable framework for arecanut price prediction. In order to capture temporal dependencies in both Adike and Patora pricing data, the methodology uses windowed input sequences, stringent data preprocessing, and MinMax normalization. The models' effectiveness is demonstrated by extensive trials on historical datasets, which provide coefficients of determination (R2) of 0.8843 for Adike and 0.8202 for Patora, coupled with mean absolute errors of 1026.11 and 837.96 Rs. /Quintal, respectively. Real-time inference and smooth integration with agri-market advising platforms are made possible by the predictive system's scalable RESTful API deployment. The findings demonstrate the framework's capacity to produce accurate, useful projections for interested parties, facilitating effective decision-making in agricultural planning and trading. The difficulties posed by sudden shifts in the market and sparse data are examined, along with suggestions for using exogenous features and adaptive models. In the field of agritech, this study offers a scalable and very useful method for data-driven commodity price predictions.

**Keywords.** Arecanut, Price Prediction, LSTM, Time Series analysis, Data Analysis

**CMT 474**

# A Comprehensive Survey of Deep Learning-Based PCB Defect Detection Techniques

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**Abstract.** Deep learning has become the most popular for Automated optical inspection (AOI) paradigm of printed circuit boards, offering more accuracy and scalability than conventional rule-based or manually designed feature methods. As summary of fourteen recent research that were published in the year between 2019 and 2025, which tackles the problem of detecting PCB defects utilizing both transformer-based and convolutional architectures. We classify methodologies into hybrid CNN–Transformer models, including GAN-based synthesis and semi-supervised learning, lightweight designs for edge deploy management and augmentation strategies, and one-stage and two-stage detectors. The survey in many instances, performs better than state-of-the-art solutions, highlighting other enduring difficulties like detecting minute flaws, interpretability, class imbalance, and generalization across datasets. We wrap up by suggesting a few areas for further study, such as explainable AI frameworks for dependable industrial adoption, effective transformer adjustments, standardized evaluation procedures, and physics-informed synthetic data generation.

**Keywords.** CNN, RNN, AOI, Transformers, GAN, PCB inspection, flaw detection, deep learning, and Yolo

**CMT 480**

# System Integrated Global Machine Automation OS (SIGMA OS)

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**Abstract.** SIGMA OS is a modular intelligent operating system interface designed to automate common computing tasks via natural language commands. We do this all while keeping everything local where there are no connections to external clouds. Users engage at the interface layer where the user's story or problems they produce using the interface - either typing or using voice - gets processed by locally hosted language models (LLMs) that structure the execution blueprint based on what the user input. Once structured, the blueprint is transformed into commands to be executed by the automation engine securely. The SIGMA OS system includes a Change Manager for shortcut rollbacks and version control behaviours, as well as a Feedback Loop Module to improve the prediction of future errors based on user input, that is if the user includes the input. SIGMA OS is built with AI-based micro-agent orchestration, enabling contextual understanding and secure task automation. SIGMA OS is designed to enable and merge human-computer interaction with functional autonomy. The underlying architecture provides privacy, extensibility, and offline execution which makes it perfect for modern users looking for intelligent help in a contained, selfcontained system.

**Keywords.** Intelligent Operating Systems, Local LLMs, Offline AI, Natural Language Interfaces, Micro-Agent Orchestration, Secure Automation, Privacy-Preserving Systems, Human– Computer Interaction

**CMT 492**

# EEG-Based ADHD Classification Using Machine Learning and Boosting Algorithms

**Debasish Phukan, Daisy Das, and Nabamita Deb**

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**Abstract.** Attention-Deficit/Hyperactivity Disorder (ADHD) is acommon neuro developmental disorder, and EEG-based biomarkers may help support clinical diagnosis. In this study, EEG data from 61 children with ADHD and 60 healthy controls (ages 7–12) were analyzed using multiple machine learning models. The signals were preprocessed using bandpass filtering (1–40 Hz), 50 Hz notch filtering, standardization, and ICA. Features were extracted using spectral and nonlinear methods, including band power, Katz fractal dimension, detrended fluctuation analysis, and Lempel–Ziv complexity. Twelve classifiers were evaluated using an 80:20 stratified train–test split, where 80% of the data were used for training and 20% for testing and performance was measured using accuracy, sensitivity, specificity, and AUC. Among all methods, boosting models performed best, with XGBoost achieving the highest accuracy (92.81%), followed by Gradient Boosting (92.69%). KNN (90.30%) was the strongest traditional model, while Gaussian Na¨ıve Bayes showed the lowest performance (51.02%), likely due to its simplifying feature-independence assumption. Overall, boosting models showed strong potential, but testing on larger and more diverse datasets is still needed.

**Keywords.** EEG, ADHD, Machine Learning, XGBoost, Gradient Boosting, Ensemble Learning, Classification, Signal Processing, Feature Extraction.

**CMT 500**

# A Comprehensive Review on Handwritten Descriptive Answer Script Evaluation.

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Department of CSE Sri Dharmasthala Manjunatheshwara Institute of Technology Ujire, India.

**Abstract.** The evaluation of handwritten descriptive answer scripts remains a complex and resource-intensive task in education. While manual assessment offers depth, it is timeconsuming, prone to bias, and difficult to scale. Recent advances in artificial intelligence (AI)—particularly in optical character recognition (OCR), natural language processing (NLP), and deep learning—have fueled growing interest in automated grading systems. This review synthesizes current research and proposes a structured taxonomy encompassing application stages, computational techniques, and language domains. Key findings indicate that transformer-based models significantly improve semantic understanding and grading reliability, while hybrid frameworks integrating visual and linguistic features outperform traditional OCR–NLP pipelines. Despite notable progress, challenges such as dataset scarcity, Hand writing variability, and the absence of standardized benchmarks persist. By consolidating existing methodologies and identifying research gaps, this study provides a comprehensive foundation for the development of scalable, robust, and ethically sound automated systems for evaluating handwritten answer scripts.

**Keywords.** Optical Character Recognition, Machine Learning, Deep Learning, Large Language Model

**CMT 512**

# AI-Powered Voice-Enabled Real-Time Product Ordering System

**Sandeep Kini M [1], Sujal V Kanchan [1], Ranganatha K [1], Srushti G V [1], Sarika S Gatty [1], Shreesha H Prabhu [1] and Ashwin Prabhu [2]**

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**Abstract.** Product ordering workflows in small and medium-sized businesses (SMEs) conventionally depend on person-to-person methods like phone calls, physical handwritten documentation, and verbal acknowledgements. This manual approach frequently results in miscommunication, mistakes in orders, and considerable operational inefficiencies. This article introduces an AI-Powered Voice-Enabled Real-Time Product Ordering System, engineered to simplify and automatically manage the ordering interactions between shopkeepers and suppliers (stockholders). The architecture incorporates sophisticated speech recognition, natural language processing (NLP), and automated invoicing capabilities to facilitate precise order submission via spoken commands. The suggested methodology is built upon a five-part modular design: modules for voice interaction, understanding natural language, order handling, invoicing and notifications, and user permission control. The system's technical implementation relies on a Python Flask server, specialized speech recognition Application Programming Interfaces (APIs), and a MongoDB data store, secured by role-based authentication. Initial evaluations confirm effective conversion of speech to text, reliable interpretation of voice instructions, and smooth operational flow across all system components. Furthermore, the system is equipped to offer smart stock recommendations based on past sales records, perform automatic calculations for GST and discounts, and issue immediate order confirmations through email and SMS. The final data shows substantial gains in operational speed, precision, and ease of use compared to older, manual ordering systems, proving its high utility for small and medium enterprise settings.

**Keywords.** Artificial intelligence, automated billing, inventory management, natural language processing, small and medium enterprises, speech recognition, voice assistant, voice commerce.

**CMT 513**

# Advancements and Challenges in Historical Language Restoration: A Comprehensive Review of Techniques, Text Generation, Preservation Strategies, and Ethical Considerations

**Harish Kundar, Tejashwini Shailendra Murdeshwar, Raksha D R, Meghana D G, Danesh M Kolavi**

Department of Artificial Intelligence and Machine Learning Alva's Institute of Engineering and Technology Mangalore, Karnataka, India.

**Abstract.** Historical language restoration plays a vital role in preserving cultural heritage and enabling modern society to access ancient knowledge. This paper reviews recent advances and persistent challenges in the restoration of historical languages using cutting-edge technologies. We explore techniques such as Optical Character Recognition (OCR), Natural Language Processing (NLP), and Generative AI models while addressing the challenges of data scarcity, language evolution, and ethical dilemmas. The study also discusses strategies for text preservation and highlights ethical considerations in balancing authenticity with technological intervention. It provides insight into future directions for research and collaboration in these interdisciplinary fields.

**Keywords.** Historical Language Restoration, Text Generation, Preservation Strategies, Ethical Considerations, Artificial Intelligence

**CMT 516**

# Conference Paper Acceptance Prediction with Quality Assessment using Machine Learning

**Pratheek H, ShreyaKulal, Dhanya Ramesh Shetty, Soujanya Mahesh Patgar, Surya N M**

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**Abstract.** The growth in scientific publications has increased the time and difficulty in reviewing conference papers. Human subjective reviews usually introduce subjectivity, inconsistency, and even bias. On the other hand, there is an imminent need for an objective, automated system for quality assessment. This paper discusses a machine learning-based framework for predicting the acceptance of a conference paper, the quality of the submission, and recommending suitable conferences for publication. The research articles collected from OpenReview (ICLR) and the Proceedings of Machine Learning Research (ICML) are preprocessed using Optical Character Recognition (OCR) and are structured with the assistance of a Large Language Model (LLM) to detect the abstract, introduction, methodology, and conclusion. Each section is embedded into a 768-dimensional vector using SciBERT and projected into a low dimension using the UMAP algorithm. Other features like section coherence, plagiarism detection, and completeness of the structural parts are infused into the model. A supervised Autoencoder is trained on accepted papers to capture patterns of high quality and anomalies that are highly likely to lead to rejection. Also, based on the paper content and domain similarity, it suggests appropriate conferences for submission. It is an effective framework that brings more consistency, efficiency, and fairness to the review process and provides an explainable, data-driven approach toward the evaluation of papers and conference selection.

**Keywords.** Conference paper acceptance, Research paper quality assessment, Large Language Models (LLMs), SciBERT, UMAP, Autoencoder, Machine learning, Natural language processing (NLP), Plagiarism detection

**CMT 517**

# Melanoma Classification using Adaptive Nutcracker Optimization-based Dense Residual Dual-Shuffle Attention Network using skin images

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**Abstract.** Melanoma is formed by the uncontrollable growing of melanocytes. The occurrence of melanoma has increased due to factors, like radiation exposure, excessive Ultraviolet (UV), and genetic susceptibility. Moreover, it poses a severe threat to human health and causes a high mortality rate. The timely classification of melanoma is essential to provide effective treatment and improve the survival of patients. Still, the diagnostic process suffers from inter-observer variability and demands long training times, as well as high computational power. For addressing such issues, the hybrid model named Adaptive Nutcracker Optimization-based Dense Residual Dual-Shuffle Attention Network (ANO_DRDA-Net)-based Melanoma classification is developed in this paper. Initially, the hairline detection and removal processing of skin image is carried out by the Artificial Intelligence-based Hairline Removal (AI-HR) method. The B-spline-based active contour model is employed for segmenting the lesion. Finally, the disease classification is done by DRDA-Net, and the devised ANO trains its hyperparameters. In addition, the accuracy, True Positive Rate (TPR), and True Negative Rate (TNR) metrics are used for estimating the performance of ANO_DRDA-Net, and it yields the corresponding values of 96.39%, 96.63%, and 95.44%.

**Keywords.** Melanoma, Artificial Intelligence-based Hairline Removal, B-spline-based active contour, Dense residual dual-shuffle attention network, Nutcracker Optimization Algorithm

**CMT 518**

# Human Karyotype Analysis Using Deep Learning with Chatbot Assistance

**Vandana B.S [1], Akiko Hanai [2], Ashwini B [1], Aashna Mathias [1], Dhruva Shedbalkar [1], Dhriti Shetty [1], Dhyanchand [1]**

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**Abstract.** Automated chromosome identification in karyotype image is essential for clinical diagnosis but this remains challenging due to its structural complexity of metaphase. The proposed system utilizing the YOLOv8m architecture for accurate chromosome analysis, integrated with a diagnostic chatbot by using Natural Language Processing (NLP). The YOLOv8m model was trained on an extensive dataset to classify 24 distinct chromosome classes (autosomes 1-22, X, Y) as well as numerical (trisomy, monosomy) and structural abnormalities(deletion). The overall accuracy of the detection Model, quantified by Mean Average Precision (mAP), is 99.2%. After detecting an abnormality, the NLP-driven chatbot processes and diagnose through its knowledge bases by curating and structuring information from validated cytogenetic databases, scientific literature, and external resources. This chatbot accurately answers the queries human gene system. Proposed system provides users with medical context including syndrome names, associated genes, and phenotypic effects with good accuracy in both detection and clinical interpretation.

**Keywords.** YOLOv8, Karyotyping, Natural Language Processing (NLP), Chromosome Analysis, Clinical Diagnostics.

**CMT 521**

# Building a Multilingual, Voice-First Banking Assistant: Architecture and Implementation for the OpenMF Ecosystem

**Priyanshu Tiwari, Akshat Sharma, Himanshu Tiwari, Rishabh Raj, Rahul Goel, Edward Cable, David Higgns**

Mifos Initiative

**Abstract.** This paper introduces a voice-driven banking assistant leveraging Gemini and custom GPT-4o LLMs for natural language understanding, achieving 94.5% intent recognition accuracy and 91% end-to-end task success. The system integrates Whisper for speech-to-text and MMS for textto- speech within a FastAPI backend, featuring voice authentication and a deepfake detection module with 96.2% security accuracy. Supporting multilingual financial operations with stateful conversations, this domain-specific AI agent demonstrates secure, reliable banking assistance through advanced LLM and voice authentication capabilities.

**Keywords.** Voice AI, Conversational Banking, Multilingual Interface, Financial Inclusion, OpenMF Ecosystem, LLM in Finance (Large Language Model), Speech Recognition, AIpowered Banking Assistant.

**CMT 530**

# Exploring Automated Conversion of 2D Blueprints to 3D Models for Civil Applications using Deep Learning Approaches

**Alakananda K, Aditya Gupta, Aman Shetty, Praneeth Ganesh, Sathwik Krishna N**

Dept. of Computer Science and Engineering Sahyadri College of Engineering & Management Mangalore, India.

**Abstract.** Manually converting 2D architectural blueprints to 3D models is incredibly time-consuming and labor-heavy, making it unreliable for urgent scenarios like disaster relief or tactical missions. We developed a straightforward, modular workflow that employs U-Net deep learning to identify and segment floor plan components, followed by automated 3D reconstruction into PTH format, then OBJ via SVG intermediates, with browserbased previews using HTML, CSS, and JS. Benchmarks across tools on the CubiCasa5K dataset reveal key performance gaps, alongside deployment notes for real-world civil engineering tasks; full code, diagrams, and replication steps are included for easy setup.

**Keywords.** Blueprint parsing, semantic segmentation, deep learning, U-Net, 3D reconstruction, floor plan dataset, civil engineering, computer vision

**CMT 551**

# Virtual Chemistry Lab: Exploring Chemical Reactions through Immersive VR Technology

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**Abstract.** Virtual reality has been recognized as a powerful tool to simulate real-world environments for safe, repeatable, and cost-effective learning in the field of education. Safety concerns often restrict exposure to real experiments, but VR component addresses the challenges faced in school-level chemistry labs. Using VR-compatible hardware, Meta Quest software and Unity, the Virtual Chemistry Lab allows students to perform chemistry experiments in a fully immersive and safe environment. Textbook chemistry with hands-on experience connected by VR. Students can observe real-time correlations between practical reactions and theoretical equations such as observing the rate of reaction while adjusting temperature. In this system a Virtual Chemistry lab is setup to allow users to perform virtual chemistry experiments in a safe and interactive 3D lab environment using VR. Three different experiments are conducted and step by step procedure is given and snapshots of intermediate results and final results are discussed.

**Keywords.** Virtual reality, Augment reality, Meta Quest, virtual chemistry lab, Education.

**CMT 558**

# Acoustic Based Real-Time Monitoring and Alert System for Illegal Logging Detection

**Prajna U R, Adhishri P, Manikrishna V Gaonkar,Prajwal K R , Sathwik K**

Department of Information Science & Engineering Sahyadri College of Engineering & Management Mangaluru, India.

**Abstract.** Illegal logging is a major issue in maintaining a sound environment, especially in countries that are rich in forests, such as India. It leads to issues of biodiversity, climate change, and unbalancing of the environment. The traditional method of monitoring forests involves human surveillance and satellite monitoring, which are expensive, time-consuming, and less efficient in real-time monitoring. Keeping this in view, this paper proposes a cost-effective, efficient, and energy-efficient system of monitoring illegal logging in forests in real-time. The system will incorporate Internet of Things (IoT) technology along with LoRa communication, which will allow efficient monitoring of forests in real-time. The sound signals will be picked up through various nodes, and Mel-Frequency Cepstral Coefficients (MFCCs) will be employed for classification, along with a simple Support Vector Machine (SVM) model. The experiment has shown satisfactory results through software-based validation, indicating that this system will work efficiently in real-time monitoring of forests.

**Keywords.** Terms—Illegal Logging Detection, Acoustic Monitoring, Internet of Things (IoT), Mel-Frequency Cepstral Coefficients (MFCC), Support Vector Machine (SVM)

**CMT 563**

# Student Feedback Sentiment Analysis on Textual Data: Comparing Machine Learning and Transfer Learning Approaches in Face-to-Face Courses

**Ashwin Shenoy M, Neves Binza Tunga**

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**Abstract.** Student feedback is an essential indicator for assessing teaching quality and improving the overall learning experience. However, the subjective and unstructured nature of textual feedback makes large-scale analysis a challenging task. Sentiment analysis, an important application of Natural Language Processing (NLP), provides an automated mechanism to extract opinions and emotional polarity from student comments, enabling institutions to better understand learners' perspectives. This study conducts a comparative evaluation of sentiment classification techniques applied to authentic feedback collected from classroom-based teaching environments. The work contrasts conventional supervised machine learning models with modern transfer learning approaches. Classical classifiers, including Logistic Regression, Support Vector Machines (SVM), Random Forest, and Na¨ıve Bayes, are evaluated alongside transformerbased pre-trained models such as BERT, DistilBERT, and RoBERTa. Prior to model training, the dataset undergoes standard preprocessing steps including tokenization, stopword elimination, and feature representation. Model effectiveness is assessed using precision, recall, F1-score, and accuracy metrics. The experimental analysis reveals that SVM delivers the highest accuracy of 85% among traditional machine learning techniques, while Logistic Regression records an accuracy of 68%. In the category of transfer learning, DistilBERT achieves the best performance with an accuracy of 86%, exhibiting strong recall for both positive and negative sentiment classes. Furthermore, hybrid configurations improve classification outcomes, with the Logistic Regression–BERT model attaining an overall accuracy of 83%. These findings demonstrate that transfer learning and hybrid methodologies offer notable advantages over conventional approaches, particularly in capturing nuanced linguistic patterns present in student feedback.

**Keywords.** Sentiment analysis, student feedback, machine learning, transfer learning, educational data mining

**CMT 564**

# AI-Driven Liver Disease Prediction: A Machine Learning and LSTM-Based Approach with Clinical Data

**Ashwin Shenoy M [1], Santhosh S [1], Thillaiarasu N [2] and Sharanya S Suresh [1]**

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**Abstract.** Liver disease is a critical global health issue, contributing significantly to morbidity and mortality. Early detection is essential for timely clinical intervention. This study aims to develop and evaluate multiple machine learning (ML) models for predicting liver disease using clinical and biochemical patient data. The dataset underwent preprocessing, including normalization, missing value handling, and feature selection to improve model performance. Five ML techniques were compared: Support Vector Machine (SVM), Decision Tree (DT), K-Means Clustering, Long Short-Term Memory (LSTM), and Recurrent Neural Network (RNN). SVM and DT were chosen for their effectiveness with structured data; K-Means for unsupervised clustering to identify hidden patient patterns; and LSTM and RNN to capture temporal trends in patient records. Results showed that LSTM achieved the best performance with 91.2% accuracy, an F1-score of 0.89, and an AUC-ROC of 0.93, demonstrating strong temporal learning capability. RNN followed closely, while DT achieved 85.7% accuracy with high interpretability. SVM also performed well in high-dimensional space. K-Means revealed meaningful patient groupings but lacked predictive strength. This comparative analysis demonstrates that deep learning models, particularly LSTM, are highly effective for liver disease prediction and suggests that hybrid approaches may further enhance diagnostic accuracy and clinical decisionmaking.

**Keywords.** Liver Disease Prediction, Machine Learning Models, Deep Learning (LSTM, RNN), Clinical and Biochemical Data, Comparative Model Evaluation

**CMT 567**

# Speech Response Latency Analysis in Children for Early Autism Detection

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**Abstract.** Children with neurodevelopmental or auditory processing disorders (e.g., autism spectrum disorder (ASD) as well as Cormorant syndrome) are commonly diagnosed using behavioral or accuracy-based testing (e.g., based on observation and word recognition scores). However, those methods do not take into account the efficiency of the central auditory system in processing information. The authors of this study found evidence indicating that there is an objective and quantitative way to represent the speed at which the auditory cognitive motor process occurs (i.e., auditory processing) through what will be hereafter identified as Vocal Reaction Time (VRT).The anticipated results of this study will show that children diagnosed with Auditory Processing Disorder (APD) and those diagnosed with ASD will demonstrate significantly longer VRTs in response to auditory stimuli than those typically developing children (TD); However, this increase in VRT will be more pronounced as the cognitive or phonetic demands of the auditory stimulus increases. In addition, the authors plan to use VRT as a more sensitive measure of the auditory processing deficits that exist in Amplitude and speed of processing than behavioral measures used to determine the overall speed of auditory processing. The authors anticipate using VRT as a valuable screening tool for the diagnosis of APD/ASD; Also they believe that VRT will permit early intervention and enable clinicians and researchers better track treatment progress for APD/ASD children

**Keywords.** Vocal Reaction Time (VRT), Children, Autism Spectrum Disorder (ASD), Central Processing, Speech Latency, Biomarker, Objective Assessment

**CMT 568**

# AUTOCTI: Automated Cyber Threat Detection Using AutoML

**Ravishankara Kulamarva, Preetham Bhandary, Sanjana A Padukone, Sakshi V Moger, Sreedevi P, Anantha Krishna Kamath**

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**Abstract.** The increasing complexity and frequency of cyberattacks have created a strong need for fast, intelligent, automated, and adaptive security systems. Traditional threat detection approaches rely heavily on static rules and manual configuration, which limits their ability to respond to evolving attack patterns. This paper presents the design and implementation of AutoCTI: Automated Cyber Threat Detection Using AutoML, a real-time framework that integrates modular threat detection and automated response mechanisms with automated machine learning. The proposed system's FastAPI-based backend and React.jspowered frontend dashboard enable real-time monitoring and analysis of incoming system logs. By automatically choosing and optimizing models using AutoML techniques (Autosklearn/ H2O), cyberthreats such as malware, phishing, and brute-force attacks can be identified. The categorization of identified threats based on severity and confidence scores initiates automated response actions, such as blocking, eliminating, or quarantining malicious entities. Real-time updates are delivered via WebSocket communication. Experimental evaluation shows that AutoCTI improves detection performance, reduces false positives, and boosts response efficiency when compared to traditional systems. The modular, database-free architecture ensures scalability, flexibility, and ease of deployment in a variety of environments. All things considered, this work offers a practical and automated cybersecurity framework that can provide prompt and reliable defense against modern cyberthreats.

**Keywords.** Cyber Threat Detection, AutoML, FastAPI, Real-Time Monitoring, Threat Intelligence, Automated Response, WebSockets, Phishing Detection, Malware Detection

**CMT 569**

# Integrating Supervised Learning Paradigms for Enhanced Marketing Campaign Outcome Prediction

**Sharath Kumar, Pratham Prabhakar, Pratham, P. Suyash, Pranav R**

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**Abstract.** Businesses are relying heavily on marketing to grow and hence need to evaluate their marketing strategies. Machine learning techniques have been adopted to perform data-driven predictions for the success rate of these marketing campaigns. This study uses the Extreme Gradient Boosting (XGBoost) model to predict the likelihood of the marketing campaign success based on various complex customer and product factors. To improve the prediction accuracy, the suggested framework combines feature engineering and ensemble learning methods. Important contributing aspects are methodically examined, including customer annual income, age, credit score, product type, product price range, advertisement intensity, and discount levels. And new metrics to further assess the hidden factors behind customers responses, like the affordability ratio amongst a few others are feature engineered. The model is trained and verified on a synthesized and balanced dataset to simulate real campaign conditions. The model has achieved an accuracy score of 0.8300. The proposed model helps business make reliable prediction across different and complex factors that affect customer response and boost their marketing performance and hence overall business.

**Keywords.** marketing campaign, customer response, consumer behaviour, XGBoost, success prediction

**CMT 571**

# Deep Learning-Based Prediction of Household Energy Consumption: An LSTM Approach with High Precision

**Dinesh Acharya, Chinmayee Bhat, Chaithra J Suvarna, Amoolya Shetty, Shabari Shedthi B**

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**Abstract.** VoltAI is an integrated AI-driven platform that combines accurate consumption forecasting, weather and imagerybased solar generation prediction, anomaly detection, and energy optimization for households and microgrids. The system uses a combination of LSTM, Prophet, and XGBoost models to forecast energy consumption over the short and medium term. It forecasts PV creation by using gradient-boosting regression on weather features and examining sky imagery. It recognizes odd utilizing autoencoders and isolation forests to generate or consume events. Through the use of a Deep Q-Network agent, the system optimizes battery usage and energy routing. The architecture, methodology, suggested experimental setup, and anticipated evaluation protocol of VoltAI are all covered in this paper

**Keywords.** Smart Grids, LSTM, CNN, Energy Forecasting, Solar Generation, Reinforcement Learning, and Anomaly Detection autoencoder.

**CMT 572**

# Model Predictive Controller Design Using Machine Learning Models and Implementation of Parameter Tuning

**Giri. P, Deepanna. S, Karishma. P, Deepika. G. P, Venkatesh. S, Rengarajan Amirtharajan**

**Abstract.** The development of an advanced Model Predictive Control (MPC) is crucial for ensuring precise thermal stability and optimising efficiency in the process development unit. To enhance the temperature regulation in the pilot model temperature station, this study analyses the implementation of predictive controller using machine learning models. The MPC framework employs a Feedforward Neural Network (FNN) and ridge regression to optimise predictive accuracy and performance. A comparative analysis is facilitated to evaluate the performance of both the machine learning-based methods with varying tuning parameter. The most reliable and effective controller design based on computational efficiency and performance metrics is selected. This proposed approach is analysed by introducing step reference trajectory. Experimental result depicts the potential of Machine Learning (ML) -enhanced MPC

**Keywords.** Temperature control, Model Predictive Controller, Machine learning techniques, system identification and handling

**CMT 573**

# Development of Machine Learning based Model Predictive Controller for Flow process

**Ramanathan. R, Alan Raj J, Kalaiarasan M, Selvaganapathy, S Venkatesh, Rengarajan Amirtharajan**

Amrita Vishwa vidyapeetham.

**Abstract.** Effective flow control is vital in industrial operations, where Model Predictive Control (MPC) is widely adopted for its ability to manage multivariable interactions and system constraints. Despite this, conventional MPC frameworks often face difficulties when dealing with high system complexity, resulting in reduced adaptability and predictive accuracy. This work explores the use of Machine Learning (ML) models, particularly linear regression, as a replacement for traditional process models within the MPC structure. The hybrid ML-MPC design enhances system adaptability, predictive capability, and robustness. Controller performance is evaluated based on error criteria, demonstrating that the ML-based controller achieves superior accuracy and efficiency compared to standard MPC approaches. These findings highlight the potential of ML-driven MPC as a more effective strategy for advanced industrial process control.

**Keywords.** Model Predictive Controller, Machine learning, linear regression, data-driven models, controller tuning and error metrics.

**CMT 575**

# LLM-Powered Text-to-SQL Generation and Data Visualization

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**Abstract.** The generation of SQL code from natural language for complex data warehouses places a heavy bottleneck, with existing automated NL2SQL approaches usually lacking the explainability to establish trust. This contribution presents an end-to-end approach to address these dual challenges of accuracy and explainability. The approach leverages a Graph-based Retrieval Augmented Generation (Graph RAG) architecture for semantically-driven SQL generation, a Generative AI module to offer code lineage visualization for trust, and Pandas AI for merged analysis of ad-hoc data. Experimental verification proves query correctness up to 91% and minimizes generation time from hours to seconds. By de-differentiating high-accuracy query generation and native transparency, this research makes data access democratic so that non-technical users can trustably interact with enterprise data.

**Keywords.** Gen-AI, Graph-RAG, SQL Generation, Big Data, Text-to-SQL.

**CMT 585**

# BEST: Blockchain And AI-Enabled EHR System for Ambulatory Care

**K. N. Rajanikanth [1], Dhanya Iyer [1], Abhiram Kasyap [1], Satish Doreswamy [2]**

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**Abstract.** The increasing demand for secure and efficient healthcare data management necessitates innovative solutions beyond traditional Electronic Health Record (EHR) systems. This work presents BEST, a blockchain-based HER management platform enhanced with AI-powered speech transcription to address challenges in data security, accessibility, interoperability, and compliance brought forth by modern clinic-based care. By integrating the InterPlanetary File System (IPFS) for decentralized data storage and smart contracts on a private Ethereum blockchain for secure metadata management, BEST ensures tamper-proof and transparent medical data handling. The system employs Angular framework for the frontend user interface and Django backend framework for FHIR-compliant interoperability to ensure seamless interaction and functionality. BEST offers a secure, patientcentered platform that simplifies clinical documentation, is compliant with such regulations as HIPAA, GDPR, DPDP and is architecturally designed for frictionless data exchange based on FHIR standards, breaking down data silos between ambulatory settings and the broader healthcare ecosystem. The system design followed by an implementation with a Raspberry Pi platform and a general computing platform is demonstrated.

**Keywords.**Electronic Health Record (EHR), Interplanetary file system (IPFS), Fast Healthcare Interoperability Resources (FHIR), DPDP, Ambulatory Care, Attribute-Based Encryption, Blockchain, Key-Aggregate Cryptosystem, Role Based Access Control, Raspberry Pi 4

**CMT 586**

# AI-Driven Sports Analytics: A Comprehensive Review of Player Performance and Injury Prediction Using Data Science

**Harish Kunder, Abhijit S. Patil, Hrishikesh Bhosle, Guruprasad, Pavan Kulkarni, Abdul Khadar Jilan A**

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**Abstract.** Data science and Artificial Intelligence (AI) are transforming sports analytics by improving player performance measurement, injury forecasting, and strategic planning across various sporting disciplines. Advances in machine learning, computer vision, and wearable sensor technology support the extraction of usable insights from large data sets, with game-changing applications in real-time tracking of players, biome- chanics analysis, and personalized training. Wearable technology and AI integration make it possible to closely monitor perfor- mance, enabling athletes and coaches to recognize strengths, weaknesses, and risk of injury by predictive modeling.Experiments in basketball, football, and other sports provide evidence of how data-driven solutions can be used to measure player performance, predict future matches, and improve team formation. Methods such as neural networks, decision trees, regression models, and support vector machines have been used to estimate player statistics, forecast league positions, and evaluate game strategies. Furthermore, advanced measurements such as expected goals (xG), player efficiency rating (PER), real plus minimum (RPM), and internal player ranking systems play a huge role in performance prediction and injury prevention.Despite promise, challenges such as the lack of data, the interpretability of models, and privacy still linger. However, by using interdisciplinary collaboration, ethical handling of data, and ongoing refinement of models, AI-based sports analytics is set to revolutionize contemporary sports into a smarter, more competitive, and fascinating field

**Keywords.** Sports Analytics, Artificial Intelligence, Ma- chine Learning, Injury Prediction, Player Performance, Wearable Technology, Predictive Modeling, Basketball Analytics, Football Forecasting, Data Mining.

**CMT 587**

# Machine Learning-Based Assessment of HTTP Security Header Deployment Across Top Web Domains

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**Abstract.** Web security headers play an essential role in defending websites against typical attacks in cyberspace but they are not uniformly applied across popular domains. The existing literature on the topic has seldom studied the security stance of popular websites using machine learning. This research covers these issues by constructing a dataset bottom on the basis of 2000 domains sampled out of the tranco list of popular domains. Seven security headers were tariffed out of each domain (COEP was ignored because of limited deployment) and a security score of scores (0-6) was derived. The regression and classification models of the random forest were used to predict the security score and classify the domains as being secure or insecure. Attributes in the form of a single header feature were analyzed in terms of their importance in the classification process. The models had an accuracy of 97 percent and clear distinction between secure and insecure domain and the confusion matrix demonstrated low misclassification levels. Analysis of features revealed that the headers that had the most impact on the security of a domain were Strict- Transport-Security and X-Frame-Options. The paper has come across the conclusion that machine learning is a potential effective method of measuring and forecasting the security stance of a site based on the data available in the HTTP header. The created dataset is a great source of additional research and could guide the web administrators on the best way to enhance security settings on their websites. The future work can expand the dataset and seek more security indicators that can enhance the predictive information that the models can deliver.

**Keywords**. HTTP Security Headers, Web Application Security, Cybersecurity Assessment, Educational Institutions, Regional Web Security, Secure Web Development, Header Analysis

**CMT 597**

# Establishing a lightweight CNN Baseline on the SalmonScan Dataset for Fish Disease Detection

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**Abstract.** The rapid spread of diseases in Atlantic salmon farming poses a major challenge, causing billions of dollars in economic losses annually. To address this, we developed a lightweight, high-performance, and fully reproducible convolutional neural network (CNN) trained from scratch on the SalmonScan benchmark dataset, which includes 456 healthy and 752 diseased fish images. Our approach employs controlled normalization and stratified cross-validation to counter dataset specific biases and class imbalances, distinguishing it from earlier methods based on classical machine learning or transfer learning. The model achieves a validation accuracy of 97.9% and a macro F1-score of 0.978, demonstrating that a compact, hand-designed architecture can match or outperform more complex transfer learning models. This study not only provides a validated framework for automated aquaculture disease diagnostics but also establishes an open and reproducible non– transfer learning baseline for the SalmonScan dataset, offering a sound benchmark for measuring future advances in disease detection.

**Keywords.** Fish Disesase Detection, SalmonScan, CNN Baseline

**CMT 598**

# A Comprehensive Survey on Continuous AI-Based Attendance Monitoring Systems

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**Abstract.** This paper examines how artificial intelligence (AI) is being applied in modern attendance monitoring systems with a particular focus on methods that use continuous face recognition to track and verify attendance. Traditional methods such as manual roll calls, RFID cards, and biometric scans often struggle with issues such as inaccuracy, time inefficiency, and vulnerability to proxy attendance. Recent developments in computer vision and deep learning have made it possible to develop contactless real time and highly scalable attendance tracking system. The study compares various AI models - including CNN, MTCNN, ResNet, and Vision Transformer - To see how they perform in terms of accuracy, speed and practical usability. The review shows that hybrid and deep learning methods like MTCNN with InsightFace embeddings provide excellent accuracy and reliability across different environments.

**CMT 600**

# Object Detection and Location Tracking on Water Surface using NVIDIA Jetson Orin Kit

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**Abstract.** Object detection and tracking on water surfaces is an essential part of improving safety and automation in small boats, autonomous vessels, and environmental surveillance. This paper reviews and analyzes the existing object detection and tracking approaches in aquatic settings, focusing on those that utilize CNNs and the NVIDIA Jetson Orin Nano Developer Kit. This therefore provides a critical review of the current technologies that are used for the detection and tracking of objects on the surfaces of water. It further looks at obstacle avoidance strategies and real-time adjustment mechanisms in navigation. The critical assessment of the current methods in the review has underlined some of the important challenges such as fluctuating light conditions, dynamic backgrounds, and reliable edge computing. The results of this study have shown that YOLOv5 and MiDaS integrated into the NVIDIA Jetson Orin Nano demonstrated high accuracy in detection, distance, and real-time inference under different conditions of water surfaces.. These findings reveal the potential of edge-based CNN models to facilitate efficient, low-latency object detection and tracking with no dependency on cloud connectivity, and hence the realization of smarter and safer maritime navigation systems.

**Keywords.** Object Detection, Water Surface Monitoring, Edge Computing,NVIDIA Jetson Orin Nano, Convolutional Neural Networks(CNNs), Real-Time Tracking, Maritime Safety, Floating Object Detection, Autonomous Navigation, Environmental, Monitoring, Deep Learning, Embedded Systems, Location Estimation, Obstacle Avoidance, Small Target Detection

**CMT 608**

# Electric Vehicle Growth Analysis and Forecasting Using Hybrid Machine Learning and Time-Series Models

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**Abstract.** Electric vehicle (EV) adoption has accelerated globally due to environmental concerns, policy incentives, and advances in battery technology. This study proposes a hybrid forecasting framework that integrates machine learning and time-series models to predict EV registrations. Baseline models including XGBoost, ARIMA, and ARIMAX are complemented by Prophet and Vector AutoRegression (VAR) to capture longterm trends and multivariate dependencies. Granger causality analysis is used to examine the influence of external factors such as fuel prices and charging infrastructure. The results indicate that VAR achieves the lowest prediction error, while Prophet effectively captures long-term adoption trends, supporting datadriven policy and infrastructure planning

**Keywords.** Electric Vehicles, Forecasting, Machine Learning, ARIMA, ARIMAX, XGBoost, Prophet, Vector AutoRegression (VAR), Granger Causality, Time-Series Analysis, Sustainable Mobility.

**CMT 609**

# A Review on AI-Powered Speech Translation Systems with Emphasis on Tulu-to-English Translation

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**Abstract.** The rapid evolution of artificial intelligence (AI) has transformed the planning and execution of human-computer interactions. The major research area developed as a result of this development is the use of speech translation. Speech-to- Speech Translation (S2ST) enables people to speak with each other in different languages using S2ST technologies. S2ST takes spoken words from one language, converts them into a different language, and maintains the original meaning and emotional content of the original words, as well as the rhythm of the speech. Even though significant advancements have been achieved with multilingual models containing a large number of languages, there are still a number of underrepresented regional languages in India. This paper is an extensive review of S2ST systems powered by artificial intelligence, highlighting both the challenges and opportunities offered by S2ST for Tulu, a low-resource Dravidian language spoken primarily in Coastal Karnataka. To achieve this goal, we review the current technologies (ASR, NMT, TTS, and synchronisation) used in developing ASR, NMT, TTS, and synchronisation systems across the years 2019-2025.We also review the literature on this topic and consider all implications related to the culture, society, technology, ethics, and other aspects of spoken word translation. Finally, this paper makes recommendations for creating inclusive AI technology that bridges the linguistic digital divide in India

**Keywords.** Speech-to-speech translation, low-resource languages, neural networks, multilingual AI, Tulu, ASR, NMT, TTS, dubbing, language technology

**CMT 610**

# Multimodal Emotion Detection Using Voice and Facial Expressions with Deep Learning

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**Abstract.** Emotions are a fundamental part of human communication, shaping the way individuals express themselves and interact with others. Creating intelligent systems that can automatically detect and interpret these emotions is essential for enhancing human–computer interaction. This paper proposes a real-time multimodal emotion recognition framework that analyzes both speech and facial expressions using deep learning techniques. A Convolutional Neural Network (CNN) is used to capture spatial features from facial images, while a Long Short-Term Memory (LSTM) network models temporal patterns in speech signals. Publicly available datasets, including TESS and FER-2013, were utilized for training and evaluation. Integrating audio and visual modalities improves recognition reliability compared to single-modality approaches, making the system practical for real-world interactive applications.

**Keywords.** Multimodal Emotion Recognition, Speech Analysis, Facial Expression Recognition, Deep Learning, CNN, LSTM, Human–Computer Interaction.

**CMT 614**

# Preprocessing real-world hazy images for improved results of DehazeFormer

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**Abstract.** Dehazing algorithms aim to restore image clarity, but their performance depends heavily on input quality and varies between synthetic and real-world images due to differences in haze characteristics. Synthetic datasets are generated using simplified physical models that fail to capture the complexity and non-homogeneous nature of real haze, leading to a domain gap and reduced effectiveness on real-world data. Most of the current models are trained on this synthetic data that fail to capture the complexities of haze in real-world images leading to poor results. Images that were preprocessed using the method proposed in the paper showed significant improvement in the standard haze metrics as compared to the raw image given as input to the model. This paper uses real-world hazy images from the benchmark dataset, Real-world Taskdriven Testing Set (RTTS). Experimental results demonstrate that applying a state-of-the-art pretrained dehazing model on preprocessed images yields improved visual clarity and perceptual quality.

**CMT 624**

# Context-Aware Semantic Classification of Digital News Headlines Using Transformer-Based Models

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**Abstract.** The rapid expansion of digital news content necessitates the development of effective classification systems. Traditional news classification relied on standard models such as Random Forest, Support Vector Machines (SVM), and Naïve Bayes. Advanced transformer models such as BERT, RoBERTa, and DistilBERT have improved Natural Language Processing (NLP) by utilizing advanced contextual understanding and selfsupervised learning. This study explores the application of BERT, RoBERTa, and DistilBERT for categorizing digital news titles based on the context. The transformer models were trained, tested, and validated using an open-source dataset that includes news headlines and their categories, such as business, entertainment, health, general headline, science, sports, technology, and global news. A comparative analysis reveals that the DistilBERT model outperforms the RoBERTa and BERT models in terms of classification accuracy while requiring less training time compared to the BERT and RoBERTa models

**Keywords.** Natural Language Processing Tasks, BERT Model, RoBERTa Model, DistiBERT Model, Transformers, Category Distribution, News Articles, Digital News, Pre-trained Models, Text Classification, Context Aware.
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**CMT 625**

# Hardware-Level Emulation of Wi-Fi Clone Attacks with On-Device Intelligence using ESP32

**Swathi Kulkarni, Dhruti Avadhani, Karrthik Adabettu, Sheela S, Sunil Kumar J**

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**Abstract.** This paper examines the feasibility and workflow of an Evil Twin Proof-of-Concept attack, implemented using two low-cost ESP32 microcontroller boards. The boards work together to actively de-authenticate all users connected to a legitimate Wi-Fi access point and create a clone of the legitimate access point. These two boards coordinate over a UART link. This project conducts a research exercise and does not intend to cause unauthorized disruption. This paper aims to demonstrate how inexpensive embedded hardware can be combined with lightweight machine learning algorithms to identify, disrupt, and impersonate nearby Wi-Fi access points. ESP32#1 continuously scans the radio environment, and the on-chip machine learning algorithm ingests the results to rank the discovered networks based on their cloning feasibility. Based on the results, the users can perform de-authentication using ESP32#2 and cloning using ESP32#1. While the legitimate access point gets de-authenticated, the clone acts as the legitimate network and encourages users to connect to it. Further in the paper, we discuss practical constraints encountered during development and modern protection mechanisms.

**Keywords.** Evil-Twin detection, Wi-Fi security, ESP32, ESPIDF, firmware vulnerability analysis, WLAN stack, TinyML, deauthentication emulation, embedded security

**CMT 628**

# WatermarkGAN: A comprehensive framework for Text-based Image Synthesis, Quality Analysis and Watermark Embedding

**Venugopala P. S., Sinchan A, Tejas Naik, Nandan Upadhyaya, Ankith Hebbar, Ankitha Nayak**

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**Abstract.** The paper presents a comprehensive AI-powered image generation and evaluation website that integrates a Gen- erative Adversarial Network (GAN) model for text-to-image synthesis, quality assessment, and efficient watermarking. The system comprises three standalone modules, DF-GAN Imple- mentation, a Deep Fusion Generative Adversarial Network for high-quality text-to-image generation trained on CUB-200 birds and MS-COCO datasets, Contrastive Language-Image Pre Training (CLIP) based Image-Prompt Evaluator, an intelligent evaluation system with dynamic semantic contradiction detection and WordNet integration for assessing generated image quality and an invisible Discrete Wavelet Transform (DWT) - Discrete Cosine Transform (DCT) based frequency-domain watermarks for comprehensive image protection, with support for text/image watermarks. All these standalone modules are then integrated into a full stack web application providing unified access to the above-mentioned standalone modules. The integrated web appli- cation provides researchers and practitioners with a complete pipeline from text prompt to evaluated, watermarked images, supporting both research and commercial applications in AI- generated content.

**Keywords.** Text-to-Image Generation, Generative Adver- sarial Networks, Contrastive Language-Image Pre Training, Im- age Quality Evaluation, Semantic Analysis, Web Applications, Discrete Wavelet Transform, Discrete Cosine Transform.

**CMT 642**

# A Composite Metric for Assessing Automated Testing Tool Effectiveness: Development and Validation of TCS

**Sushma**

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**Abstract.** Software testing is a very important stage of a Software Development Life Cycle. The increasing demand for a qualitative and affordable software testing tool has directed to the creation of variety of automated and AI-based testing approaches. A consistent technique to evaluate their overall performance has also become a mandate. This study proposes a composite metric called Tool Capability Score (TCS), to evaluates tool performance using seven essential characteristics: Automation Level, Integration Support, Execution Speed, Reporting and Analytics, Ease of Maintenance, Test Coverage and Scalability. Secondary data from previous research on software testing tools is used in this study. The data was analyzed through statistical and comparative methods to validate the proposed evaluation framework. Spearman's correlation was used for statistical validation of the calculated TCS values, which showed excellent agreement with expert ranks. The findings show that TCS minimizes subjective bias by offering a fair, data-driven method of comparing testing instruments. The Tool Effectiveness Index, Automation Capability Index, Testing Performance Efficiency, Testing Capability Maturity Score, Composite Evaluation Index, AI Testing Intelligence Quotient, and Efficiency-Adaptability Ratio are among the other metrics that are introduced in addition to TCS. With room for future development through additional dynamic performance indicators, the study provides a verified framework that aids researchers and organisations in choosing effective testing instruments.

**Keywords.** Software Testing, Automation Tools, Tool Capability Score (TCS), Performance Evaluation, Statistical Validation, AI-Based Testing.

**CMT 646**

# Optimizing Poultry Farming Through Environmental Data Analytics Using IoT, ERP Systems, and Machine Learning

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**Abstract.** Poultry farming faces significant challenges related to environmental fluctuations, inefficient resource management, and delayed health interventions, which can adversely affect bird welfare and farm productivity. To address these issues, this paper presents an integrated smart poultry farming system that combines Internet of Things (IoT)–based real-time environmental monitoring, machine learning–driven predictive analytics, and enterprise resource planning (ERP)–based farm management. IoT sensors continuously monitor critical parameters such as temperature, humidity, ammonia concentration, and light intensity, transmitting data to a centralized platform for analysis. Machine learning models analyze historical and real-time sensor data to identify abnormal conditions and predict potential health risks, enabling timely preventive actions. The ERP module utilizes these predictive insights to support automated resource planning, inventory tracking, and operational decision-making. The proposed modular architecture is scalable, cost-effective, and suitable for small- and medium-scale poultry farms. Experimental results demonstrate reliable monitoring performance and effective anomaly detection, highlighting the system's potential to improve productivity, reduce operational risks, and support sustainable poultry farming practices.

**Keywords.** Poultry farming, Internet of Things (IoT), machine learning, enterprise resource planning (ERP), environmental monitoring, predictive analytics, agricultural automation.

**CMT 674**

# Hybrid Deep Learning for Authenticating Video Integrity Using CNN–LSTM Architecture

**Vasudeva Pai, Nagendra Pai, Nishanth D Shetty, Raghavendra S Shettigar, Anoop A Dongre**

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**Abstract.** Video tampering detection has become a critical issue in multimedia forensics due to the widespread availability of advanced video editing tools and generative AI techniques. Manipulations such as deepfakes, frame insertion, deletion, and content alteration cause serious threats to the authenticity of digital media, particularly in misinformation and identity abuse scenarios. Conventional forgery detection methods based on handcrafted features including motion vector analysis and optical flow, often fail to generalize across diverse manipulation types and compression levels. This paper proposes a hybrid deep learning framework that integrates Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks to detect forged video content by jointly modelling spatial and temporal inconsistencies. The CNN component captures frame-level spatial artifacts such as blending boundaries and texture distortions while the LSTM models temporal dependencies and motion discontinuities across consecutive frames. The proposed approach is evaluated on wellknown benchmark datasets, including the Deepfake Detection Challenge (DFDC), FaceForensics++, and the Video Tampering Dataset (VTD). Experimental results demonstrate that the hybrid CNN–LSTM model achieves a detection accuracy of 98.9%, outperforming several traditional, singular CNN and recently proposed transformer-based approaches, highlighting its effectiveness for coherent video tampering detection.

**Keywords.** Deep Learning, Video Forgery Detection, CNN–LSTM, Multimedia Forensics, Deepfake Detection.

**CMT 676**

# Automobile Industry Growth Prediction Using Machine Learning

**Aishwarya M Bhat, Pruthvi Rai, Simran R Thakarkar, Sinchana B, Pavan Kalyan T**

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**Abstract.** The automobile plays a vital role in influencing economic growth and development during an era when datadriven insights are transforming various industries. This initiative provides a comprehensive framework for predicting the growth of the automobile industry across 16 states in India using machine learning. By using economic indicators such as GSDP, inflation, registered vehicles, vehicles produced, export value, and growth rate, the system forecasts key metrics —including vehicle production, export value, and growth rate — using a Random Forest regression model trained on a decade’s worth of historical data. The platform serves two primary functions: administrators manage state data and historical information, while users can submit current-year data to generate forecasts and access comparative visualisations. The system ensures high prediction accuracy and real-time performance by employing advanced feature engineering, model fine-tuning, and data preprocessing techniques.

**Keywords.** Machine Learning, Random Forest, Automobile Industry Growth Prediction, Data Visualisation, Forecasting System, State-wise Analysis.

**CMT 678**

# Spatial Dynamics of the Western Ghats Ecosystem in Kerala, India

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**Abstract.** The Western Ghats, a UNESCO World Heritage site and one of the world's eight hottest biodiversity hotspots, harbor exceptionally rich and ecologically significant flora. This study presents a spatial analysis of vegetation distribution across the Kerala segment of the Western Ghats using remote sensing, GIS techniques, and vegetation indices including NDVI, EVI, LAI, and FPAR. By integrating satellite-derived vegetation indices with key terrain factors, vegetation patterns were mapped and interpreted at the district scale. The results reveal strong associations between vegetation indices and terrain factors, delineating distinct ecological zones ranging from lowland evergreen forests to high-altitude shola–grassland mosaics. Notably, the Western Ghats cover 86.52% of Kerala's state boundary, emphasizing their dominant influence on the state's spatial and ecological framework. The findings provide an essential baseline for conservation planning, ecosystem management, and sustainable development in this biodiversity-rich and ecologically sensitive region.

**Keywords.** spatial vegetation analysis, vegetation distribution, Western Ghats, Kerala vegetation analysis, geographic information systems.

**CMT 686**

# Glow-Code: A Hybrid AI-Powered Platform for Personalized Skincare Analysis and Recommendation

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**Abstract.** Glow-Code is an AI platform for skin analysis and intelligent product recommendations. In a modular online structure, the platform combines quiz-based profiling, ingredient intelligence, and computer vision (area identification using YOLO and classification using MobileNet/CNN). To address the realistic input variation issue and enhance diagnosis performance, a dualstrategy region detection and ensemble of image and survey fusion are devised. According to experimental results, users are engaged by the provided straightforward confidence visualization and practical product assistance, and the categorization is performed well. Research on feedback and retention supports Glow-Code's suitability for a variety of users, as well as its instant ingredient transparency and privacy-preserving procedures. This cloud-friendly architecture allows the platform to be infinitely scalable as it evolves toward further clinical integrations and deployment around the world. These results present the potential of advanced AI methods to increase the accessibility, reliability, and trust of intelligent skincare applications.

**Keywords.** skin care, Deep learning, MERN, YOLO, Computer vision, smart system

**CMT 688**

# Evaluating Financial Impact of Misclassifications in Credit Scoring Through IRR Analysis

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**Abstract.** Peer-to-peer (P2P) lending platforms create direct connections between borrowers and lenders, providing an alternative to conventional banking systems. Accurately assessing credit risk and loan profitability is essential for the ongoing success of these platforms. This research explores models for credit scoring and profit scoring within P2P lending domain. Classifiers like Logistic Regression, neural networks, and ensemble methods, are employed to estimate the likelihood of borrower default. To quantify the financial impact of classification errors, the Internal Rate of Return (IRR) was computed for misclassified loans in each model. The effectiveness of the proposed approach is assessed using Bondora P2P lending dataset. The results demonstrated that the proposed approach gives better insight about model selection for credit risk assessment. The analysis highlights the importance of a data-driven approach to refining lending practices.

**Keywords.** Financial Technology, Peer-to-peer Lending, Credit Scoring, Profit Scoring, Portfolio Optimization

**CMT 691**

# Comparative Framework for Automatic Image Annotation Using CNN Architectures and CLIP-ViT

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**Abstract.** With the exponential growth of images and videos in recent years, manual annotation has become one of the most time-consuming and costly tasks in computer vision. Automatic annotation is designed to reduce human labour by proposing useful label suggested by deep learning and vision-language models. In this work, we provide a usecase for deep learning models such as classic convolutional neural networks (CNNs) models (ResNet50, Xception, and InceptionV3) to the multimodal CLIP-ViT-B/32 model for auto annotation task. Our work employs established feature extractors as pre-trained models, and several different classifiers such as Support Vector Machines (SVM), XGBoost, K-Nearest Neighbors (KNN), Logistic Regression, and Random Forest. All the models were studied for Fashion Product Images dataset. The findings reveal that the CLIP-based features along with a SVM classifier are the most accurate and consistent in predicting the power of vision-language alignment in the autolabeling of data. The study also leads to the further development of scalable, high-precision, and cost-effective labeling systems in the current computer vision tasks.

**Keywords.** Vision-Language Models, Image Labeling, Automatic Annotation, CLIP, Convolutional Neural Networks, Machine Learning.

**CMT 694**

# Guiding Light Beyond sight: AI-Powered Object Detection for Blind Navigation

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**Abstract.** This paper describes building a project which uses YOLOv5 and Faster-RCNN technologies for object detection to improve navigation for visually impaired users. The system is incorporated with a camera to detect the objects and the machine learning model processes the images to get the detected objects' identities and distances during both daytime and nighttime and the description is then made into audio cues and sent through the earphone to provide auditory cues in real-time and enabling the users to navigate confidently and independently in their day-to-day life. The project showcases technology's transformative potential in inclusivity and accessibility.

**Keywords.** YOLO-V5, Faster-RCNN, Object detection, visually disabled, Real-Time

**CMT 705**

# Detection of Multiclass Pediatric Congenital Heart Defects using Deep Learning based Stacking Ensemble Method

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**Abstract.** Congenital Heart Diseases (CHDs) are the most common pediatric cardiac abnormalities and Detection is crucial for successful management. But the challenge of distinguishing between several types of CHDs from chest X-rays (CXRs) is high because of inter-class similarity and low annotated datasets. The present work introduces a deep learning based stacking ensemble model for multiclass CHD classification of atrial septal defect (ASD), ventricular septal defect (VSD), patent ductus arteriosus (PDA) and normal cases. EfficientNetB1 and DenseNet121 are used as feature extractors in the proposed model, Vision Transformer (ViT) and ResNet50 are utilized as base classifiers. Their predictions are combined and given to XGBoost metalearner which serves as an effective decision layer. Experimental validation on the CHD-CXR dataset reported an overall accuracy of 94%, macro-averaged precision, recall and F1-score of 0.94, which is superior to state of the art methods in all metrics. Grad-CAM visualizes the regions of interest in CXR images, helping in understanding the model's decision making process. The proposed ensemble model offers a reliable, understandable and efficient solution for AI-based detection of pediatric CHD, ultimately improving detection and treatment outcomes

**Keywords.** Chest X-ray, Congenital Heart Disease, Deep Learning, Explainable AI, Pediatric Cardiology, Stacking Ensemble

**CMT 706**

# Machine Translation from Tulu to English using Transformer Architecture

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**Abstract.** The Machine Translation of Tulu to English is performed using the Transformer architecture. The Recurrent structures will be replaced by self attention, which aids in our comprehension of the relationship between the words and their context within the sentence. The limited parallelism, slow training, and difficulties in capturing long-range dependencies of current machine translation techniques based on Recurrent Neural Networks (RNNs), like GRU and LSTM architectures, lead to higher computational costs and reduced translation accuracy. Large datasets require longer training times because these models process input sequences sequentially, which restricts them from fully utilizing GPU-based parallel computation. Additionally, learning contextual relationships across long phrases is adversely affected by the vanishing and exploding gradient issues present in recurrent architectures. The Transformer cuts the time needed for the accuracy by using sinusoidal positional encoding and multiple heads of focus to observe the whole chain through computation in parallel as opposed to the conventional RNN-inspired models of Seq2Seq that rely upon on GRU or LSTM units for computation. 9,464 Tulu-English sentence pairs which have been tokenize and padded for successful acquisition were utilized as the dual language dataset on which the model was trained. Training employed a greedy decoding mechanism during prediction and developed a custom loss function alongside masking to deal with inputs and outputs of variable lengths. Standardized translation metrics like BLEU score, loss visualizations, and training and validation accuracy were employed to evaluate the system. The Transformer works efficiently for low resource languages like Tulu, as proven by experimental results indicating greater translation quality with a tenfold reduction in the computational power required to train the model.

**Keywords.** Artificial Neural Machine Transmission, Transformer, Self-attention mechanism, Encoder & Decoder, Sinusoidal positional encoding, Masked accuracy of model, BLEU Score

**CMT 714**

# Disaster Connect: A Unified Platform for Disaster Response and Relief using MobileNetV2 and BERT

**Babitha Ganesh, Ambika Hebbar, Apeksha Shetty, B M Samruddhi Rai, B Thrishali Gowda**

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**Abstract.** Natural calamities are still a destructive force within communities around the world and fast coordinated response systems are in great need. We propose Disaster Connect, a common mobile application that incorporates AI for SOS prioritization, provides alerts and updates about disasters, and provides safe evacuation routes. The system combines two models, a MobileNetV2 based image classifier and a BERT based text classifier, each trained independently for determining the priority of a distress signal. Using publicly available datasets, the text classifier achieved 93% accuracy while the image classifier reached 82.59%. The application makes use of the Google Maps Directions API for dynamic evacuation routes based on the user's location and uses official APIs to monitor various disasters such as floods, cyclones, earthquakes, and wildfires. Results indicate that Disaster Connect improves situational awareness, enhances prioritization of emergency requests, and facilitates faster and safer evacuation, hence rendering it practical in real world disaster response.

**Keywords.** Disaster response, Disaster management, BERT text classification, MobileNetV2 image analysis, Realtime evacuation routing.

**CMT 723**

# An Efficient Machine Learning Pipeline for Diabetes Readmission Prediction Using Multi-Phase Feature Optimization

**Yashwanth Reddy, Swetha, Mokshagna, Lakshmi Chetana**

Amrita Vishwa Vidyapeetham

**Abstract.** The prediction of diabetes readmission is of great interests for enhancing the quality of patients care and is essential for hospital resource management. In this work, we introduce a machine learning methodology for predict early readmission risk utilizing the The UCI Diabetes 130-US hospitals dataset that includes more than 100,000 patient records. The proposed method features the adoption of a powerful preprocessing mechanism of domain-consistent encoding, outlier treatment and median–mode filling, and a three-staged hybrid feature selection procedure consisting of filter, wrapper, and embedded methods. The feature selection algorithm extracted only 16 highly informative features and retained the predictive information of the original data set. To a put up class imbalance, Synthetic Minority Oversampling Technique was used prior model training. Several classifiers such as Decision Tree, Logistic Regression, Random Forest, K-Nearest Neighbors, Gradient Boosting, XGBoost and Neural Networks have been trained and tested based on various evaluation measures like Accuracy (Acc) , Precision (Prec) , Recall (Rec), F1-Score (F1) and Area under the curve (AUC). Experiment results show that ensemble models, with Random Forest and XGBoost having the best performances (F1-scores over 93% and ROC-AUC values over 95%) on the basis of only the 16 selected features.

**Keywords.** Diabetes, Readmission, Machine Learning

**CMT 724**

# Comparative Analysis of Traditional Machine Learning and Causal Inference Models for ICU Drug Treatment Outcomes

**Kamepalli S L Prasanna, Nithin Polimera, Meegada Nishanth Reddy, Divi Mahanth Sri Ram, Reddi Varun Rahul**

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**Abstract.** Accurate and interpretable treatment evaluation is essential in Intensive Care Units (ICUs), where clinical decisions must account for rapidly evolving physiological states. Traditional machine learning models achieve high predictive accuracy but remain limited by their reliance on correlations, making them unsuitable for estimating true treatment effects. This study investigates whether Causal Artificial Intelligence (Causal AI) can complement predictive models by providing robust and clinically meaningful treatment insights. Using the eICU Collaborative Research Database, we analyzed demographics, vital signs, laboratory values, and treatment timelines to evaluate the effect of early antibiotic administration on 30-day mortality. Logistic Regression, Random Forest, and XGBoost were trained for outcome prediction, with ensemble models achieving strong performance (AUC ≈ 0.99) compared to Logistic Regression (AUC = 0.68). Causal estimators—including Propensity Score Matching (PSM) and Inverse Probability Weighting (IPW)—indicated a mortality reduction of 5–17% among patients receiving early antibiotics. These results show that while predictive models excel in discrimination, causal inference provides actionable, interpretable, and clinically aligned treatment-effect estimates. The combined framework underscores the potential of Causal AI to support trustworthy and decision-centric care in critical settings. We also perform leakage-aware feature selection and explicitly state causal assumptions and limitations of observational ICU data.

**Keywords.** Causal AI, ICU, Machine Learning, Drug Treatment, Causal Inference, Decision Support.

**CMT 727**

# IoT and Machine Learning-Based Road Condition Monitoring and Pothole Detection System

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**Abstract.** Potholes and uneven road surfaces have been identified as the leading causes of accidents, vehicle damage, and traffic inefficiency, particularly in developing countries such as India. Currently, manual inspection methods are not only inefficient but also do not have the capability of real-time reporting. This article introduces an IoT-based Pothole and Road Condition Monitoring (RCM) System combined with Machine Learning (ML) for automatic localization and classification of road surface conditions. The system is based on an ESP32 microcontroller equipped with an ultrasonic sensor, accelerometer (MPU6050), and GPS module that enables live road data collection. A Random Forest Classifier trained on a 10,000-sample synthetic dataset modeled for Indian road conditions was able to classify the road as pothole, rough road, speed bump, or smooth road with an accuracy of 84.7%. Real-time data transmission and GPS mapping allow for the immediate visualization of the damaged areas. This system delivers an affordable, scalable, and intelligent solution to smart city road maintenance and safety.

**Keywords.** IoT, machine learning, ESP32, road condition monitoring, pothole detection, random forest, smart city, sensor fusion.

**CMT 731**

# EdgeStress: Real-Time Stress Detection Using IoT and Machine Learning

**Elwin Gonsalves, Farhan Bijapur, Sheela S**

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**Abstract.** Stress detection has been one of the sectors of research that has grown very rapidly due to the fact that it has a direct influence on human-being, productivity, and decisionmaking. This paper introduces EdgeStress which is a real-time IoT-based system that monitors stress levels continuously in a non-invasive way through physiological signals from cheap sensors. In the presented system, an ESP32 microcontroller is used for the collection of Galvanic Skin Response (GSR) and heart rate (BPM) data. These data are then sent to a pre trained Random Forest model which identifies stress as Low, Normal, or High. A dashboard built on Flask shows real-time parameters, previous trends, and interactive relaxation activities like guided breathing and humor-based interventions. The point of time here are the accurate classification of the real-time data and the responsive feedback which make the EdgeStress an efficient lightweight wellness monitoring and biofeedback tool

**Keywords.** IoT, Machine Learning, ESP32, Random Forest, GSR, Stress Detection

**CMT 736**

# AI Insights into Asia's Development Landscape: A Multi-Algorithm Classification Study

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**Abstract.** Rural and urban socio-economic development varies across Asia due to income, education, health, and employment. In this project, a machine learning-based multiclass classification system will be developed to classify Asian nations as developed, developing, or under-developing. An authentic global dataset from credible sources (the World Bank and UNDP) developed the relevant features to achieve the aims (GDP per capita, Human Development Index (HDI), literacy rate, life expectancy, and unemployment). Preprocessing will involve handling missing data and target variable encoding and feature scaling to improve model performance. Two supervised learning models, decision tree and logistic regression, are utilized to perform multi-class classification. Evaluation of model performance is by accuracy score and the confusion matrix after splitting the dataset into training and testing sets. Results will indicate that the decision tree operates slightly better due to its ability to make nonlinear decisions. An interface utilizing Gradio was developed to offer visualization and prediction in a user-friendly and interactive manner. This project demonstrates the value of data-driven approaches in developmental classification & analysis, which can be leveraged for educational research or as policy guidance in respect to regional development.

**Keywords.** Machine Learning, Multi-Class Classification, Socioeconomic Analysis, Asian Countries Development, Decision Tree, Logistic Regression. Introduction (Heading 1)

**CMT 749**

# Development of IoT Platform for Smart Kitchen Management

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**Abstract.** This project aims to reduce the cooking hazards and the accidents which are common in the kitchen environment using the concept of IoT by using the sensor readings. A ML model is also used to detect if the kitchen environment is safe or hazardous. If the model detects that the environment is hazardous, an alert message is immediately sent and the system is automatically turned off. So, the overall goal is to monitor the kitchen environment constantly to prevent accidents and hazardous situations such as boil overs and burning. Multi sensors are fused to get more accurate results. In this paper, a lightweight neural network is proposed which is trained on a synthetic dataset. Later the model is deployed on the ESP32 microcontroller using TFLite Micro to provide real time predictions if the environment is safe or hazardous. The communication is done using WiFi and the output is displayed on a webpage. The proposed model was able to achieve high accuracy on the unseen test data and was able to classify the two classes. This project provides a scalable, affordable and autonomous kitchen safety solution. Further, future work aims to include edge AI and expand the diversity of sensors for better detection.

**Keywords.** IoT, ESP32, TensorFlow Lite Micro, Multi-Sensor Fusion, AIoT

**CMT 776**

# Intelligent Crop Protection: AI Powered Detection and Diagnosis of Plant Diseases

**Venugopala P. S., Ashray K, Ashith C, Ankith Kumar, Adithya Maradithaya**

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**Abstract.** Agriculture is the main factor that supports India's economy, but, the continuation of crop diseases cause significant losses of yields every year which threatens food security and farmers' incomes. This research presents a smart, CNN-based system for the automatic identification and an explanation of plant leaf diseases. The model was trained on a large and diverse dataset of more than 27000 images of 4 crops and 22 disease classes. By using state-of- the-art preprocessing and feature extraction, the CNN attained a validation accuracy of 92.57%, which is in line with high precision and strong generalization power. The trained model is housed in a Flask-based web application that offers instant disease identification along with easy-to understand treatment suggestions, farm care instructions, soil management tips, and some care tips. By cutting the overuse of pesticides and promoting data-driven farming, the system is helping to sustain agriculture and increase crop yields. The next development will be an offline mobile version to provide more access and convenience in remote farming areas.

**Keywords.** Convolutional Neural Network (CNN), Plant Disease Detection, Deep Learning, Image Classification, Flask Web Application, Precision Agriculture, Sustainable Farming, Machine Learning, Crop Health Monitoring.

**CMT 777**

# Early Detection of Fetal Wellness and Distress using Biomedical Signal Processing

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Government College of Arts, Science and Commerce Sanquelim, Directorate of Higher Education, Goa

**Abstract.** Non-invasive fetal electrocardiography (NIFECG) is a promising technique to continuously monitor fetal's wellness and health status early in pregnancy. This intervention plays a critical role in reducing the likelihood of fetal injury and stillbirth. Robust extraction of the fetal signal from the maternal abdominal composite mixture of strong maternal and weak fetal electrocardiograms presents the greatest challenge to effective fetal ECG (FECG) monitoring. NIFECG can extract the fetal morphological parameters which can aid in diagnosing fetal distress ahead of delivery. In this research work, we highlight the use of biomedical signal processing method for noninvasive FECG extraction and evaluate their accuracy using the available open access databases from PhysioNet. Notably the advantages and limitations of these algorithms are highlighted include the key parameters that must be set to ensure their optimal performance. In this research study, by utilizing Independent Component Analysis (ICA) on the raw abdominal recordings, the maternal ECG (MECG) component can be substantially isolated and removed from the composite signal.The proposed straightforward method effectively and reliably performed fetal QRS (FQRS) detection on the five abdfecg records. The algorithm's efficacy was confirmed by a robust performance profile, including exceptional precision (98.43-100%) and sensitivity (88-100%), which culminated in a strong F1 score (96.7-100%). Our findings underscore the method's considerable proficiency in the accurate location of fetal R-peak indices. The goal is to develop sophisticated, noninvasive signal processing methods that provide the same morphological FECG data as invasive scalp electrodes, improving both safety and diagnostic depth in fetal monitoring.

**Keywords.** Abdominal ECG; fetal heart rate; Independent Component Analysis technique, PhysioNet database.

**CMT 781**

# Spike Sorting and Event Detection Using Selected Machine and Deep Learning Models

**Vaishnavi G Sai Shree Vakada, Biswajit Bhowmik**

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**Abstract.** Spike sorting and event detection are critical components of neuromorphic computing, enabling efficient processing and interpretation of neural signals. This paper comprehensively explores spike-sorting and event-detection techniques in neural data analysis. Beginning with an introduction that contextualizes the field's significance and challenges, the study delves into the intricacies of spike-sorting and event-detection methodologies. A thorough review of related work establishes the foundation for developing novel methods, as elucidated in subsequent sections. The paper meticulously outlines the implementation of these methodologies, accompanied by a rigorous analysis of the results obtained. The algorithms mentioned in this paper are the Decision Tree Classifier, Random Forest Classifier, K-Nearest Neighbors, Convolutional Neural Network, Binarized Neural Network, and Artificial Neural Network, achieving 86.04%, 96.57%, 96.96%, 95.98%, 96.7%, and 96.99%, respectively

**Keywords.** Spike sorting; Event detection; Neuromorphic Computing; Biological Plausibility; Neural Signal Analysis

**CMT 784**

# Context-Aware Recipe Recommendations using NLP with Multilingual Support

**Vandana B.S , Manjula Gururaj, Diyadarshini Amin, Disha Rani**

Information Science &Engineering Nitte (Deemed to be University) NMAM Institute of Technology, Karkala, Karnataka, India.

**Abstract.** Technology growth paved the way for automation in the field of cooking and the development of intelligent assistant that helps in processing natural language queries to impart accurate, responsive recipe recommendations to the users. The Hybrid NLP Framework, a full- stack dynamic application is focus is major focus of this paper. This application is designed to provide multi-language platform for easy understanding. Queries are analysed on a rule-based approach and a model based on TF-IDF with Cosine Similarity for clarity. The result obtained by using TF-IDF and Cosine Similarity produces an overall accuracy of 76.4% with balanced precision, recall. The F1-scores and the rule-based approach achieved an entity accuracy of 80.95%. For further conversational abilities, the new model called Large Language Models (LLMs) will be incorporated. This allows the assistant to understand all the inquiries and recommend ingredient alternatives thereby as a smart culinary partner. The combination of rule-based accuracy, TF-IDF and Cosine Similarity, and LLM flexibility illustrates a hybrid framework of precise, and user-friendly recipe suggestions.

**Keywords.** Recipe, Rule based, TF-IDF and Cosine Similarity, LLM

**CMT 790**

# Zero Trust Iot Security Platform

**Kanduri Aryaprasadh , Deepu M, B Devendra , Sheela S, Basavaraj Patil**

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**Abstract.** The proposed Zero Trust IoT Security Platform with a hardware–SaaS hybrid security framework is presented, utilizing Zero Trust architecture, encryption, and monitoring. Every sensor connected to the proposed platform, such as PIR and DHT22, will operate as an independent node carrying out TinyML-based anomaly detection and sending encrypted data via AES/ECC to the cloud. The proposed hardware component is made up of modular IoT nodes driven by ESP32 microcontrollers. The cloud management layer is a SaaS platform built on Firebase, functioning as the centralized management layer providing realtime dashboards, device management, compliance tracking, and role-based access control. Extensive testing achieved over 95% intrusion detection accuracy, rapid deployment under one hour, and scalability beyond 100 nodes.

**Keywords.** Zero Trust Architecture, Internet of Things (IoT), Edge Security, ESP32, TinyML, AES, ECC, Firebase, SaaS Platform, Device Authentication, Certificate Verification, Cloud Security, Anomaly Detection, Role-Based Access Control (RBAC), Micro-Segmentation, End-to-End Encryption.

**CMT 796**

# Smart Platform for Effortless Assignment Submission and Precision Grading

**Pratheek H, Mohammed Muzammil,Panishthi Shetty,Rida Khadeeja,Vaishnavi Shetty**

Sahyadri College of Engineering & Management

**Abstract.** GradeMate is a smart, web-based platform designed to simplify and enhance the assignment submission and grading workflow for both students and educators. The system addresses common academic challenges such as delayed submissions, inconsistent grading, limited feedback, and high faculty workload. By integrating Django-based backend services with Hugging Face transformer models, GradeMate automates the evaluation of student assignments and generates clear, meaningful feedback that supports continuous learning. The platform provides dedicated dashboards for students and instructors, enabling secure assignment uploads, deadline tracking, real-time notifications, and transparent grade management. The AI Evaluation Engine processes submissions, predicts grades, and generates feedback, while a rule-based validation layer ensures fairness, accuracy, and alignment with academic rubrics. All evaluation records are securely stored, supporting accountability and easy auditability. Designed with accessibility, user-friendliness, and scalability in mind, GradeMate offers a dependable digital solution suitable for modern classrooms and learning environments. By combining automation with human oversight, the system reduces manual effort, enhances transparency, and promotes a more effective and engaging learning experience.

**Keywords.** Automated Grading, Educational Technology, Machine Learning, Django Web Application, Hugging Face Models, Student Assessment, Feedback Generation, Academic Transparency.

**CMT 798**

# A System and Method for Vision-Based Stress Detection Using Facial Expressions and Convolutional Neural Networks

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[3]Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun, India

**Abstract.** Stress is among the most important psychological and physiological problems of the modern world, often resulting in severe physical disorders and diminishing productivity. Traditional ways of detecting stress rely almost exclusively on physiological sensors such as ECGs, EEGs, and GSRs. These sensors are expensive, intrusive, and impractical for real-time daily monitoring. The paper proposes a novel method for stress detection via facial expression, which employs Convolutional Neural Networks (CNNs) for model training. The method uses the MobileNetV2 architecture with transfer learning to classify facial images taken in real-time as “Stressed” or “Not Stressed.” A face detector in OpenCV is used for detecting a face and prepping the image before classified as either stressed or not stressed using TensorFlow/Keras. The model was trained with the dataset to achieve an overall accuracy of 91.4% on the test dataset, providing proof of robustness to changes in light and face angle. The method is a low-cost, non-intrusive, real-time method that can be applied to workplaces, educational institutions, and healthcare.

**Keywords.** component, formatting, style, styling, insert

**CMT 799**

# Bird Species Classification Using Convolutional Neural Network

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**Abstract.** This paper proposes the Bird Species Classification System, which automatically classifies images of birds into their respective species by adopting a deep learning approach with Convolutional Neural Networks. The proposed system is designed to help researchers, ornithologists, and nature lovers quickly identify species of birds with image-based recognition. In the work reported here, our model was trained on the publicly available Kaggle Bird Species Dataset, which includes 20 classes of birds and contains over 2,000 training images and 700 test images. For training the model, images with a wide array of environmental and lighting conditions are used to generalize the model performance. Image preprocessing, data augmentation, and CNNbased feature extraction are performed for training the proposed model. Test data revealed classification accuracy in the range of 93-95%. Later, the model was deployed using a Streamlit-based web interface that allows users to upload an image and get realtime predictions of bird species. This work further illustrates the practical applicability of CNN-based systems to ecological monitoring and wildlife documentation.

**Keywords.** Bird Species Classification, Convolutional Neural Networks (CNNs), Deep Learning, Image Classification, Data Augmentation.

**CMT 805**

# Baldness Progression Prediction Using XGBoost: Risk Forecasting Model

**Mark Maben [1], Arhath Kumar [1], Balachandra Rao HN [2]**

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**Abstract.** Hair-loss prediction is increasingly important as early thinning is influenced by genetic, hormonal, and lifestyle factors. This work develops a machine-learning framework using a structured dataset containing clinical and behavioral indicators such as age, stress, hormonal effects, and family history. After applying normalization, imputation, and encoding, an XGBoost classifier was trained to predict hair-loss risk and evaluated using accuracy, ROC–AUC, precision, recall, and Brier score. The model achieved strong performance, including 90.12% accuracy and a ROC–AUC of 96.63%. Feature-importance and SHAP analyses provided interpretability, and a five-year projection module was implemented to estimate future risk. The study demonstrates the usefulness of machine learning for scalable and preventive hair-loss assessment.

**Keywords**. Hair Loss Prediction, Baldness Detection, Clinical Features, Machine Learning, XGBoost, SHAP, Predictive Modeling, Digital Dermatology

**CMT 806**

# Tablet to Table: From Dosage to Dish-An AI Alchemy

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**Abstract.** Artificial intelligence (AI) plays an increasingly important role in the healthcare sector by assisting in predictive diagnoses and personalized nutrition. In this paper, the authors introduce an AI-based solution named Tablet to Table, aimed at transforming medical prescriptions into personalized dietary plans. This is achieved by incorporating the principles of Medicine and Food Homology (MFH). In the proposed solution, data is used to create appropriate food combinations to cater to disease types, age, diet, and activity level. Interpolation is performed to increase the precision level with regards to age aspects. In the proposed solution, the application has been built by integrating React.js. In the proposed solution, the potential contribution of AI in the healthcare sector has been explored.

**Keywords.** Artificial Intelligence (AI), Food Recommendation System, Medicine and Food Homology (MFH), Personalized Nutrition, Disease Management, Linear Interpolation Algorithm**.**

**CMT 808**

# Accelerating Forward-Forward Learning on Hybrid Transfer Architectures via Adaptive Negative Sampling

**Shiva Dhanush S, Sai Venkata Jaswant Kolupuri, Satyatma Chincholi, Shreyas Ghanathe, K C Narendra**

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**Abstract.** The Forward-Forward (FF) algorithm, a biologically-plausible learning rule, offers a potential solution to the backpropagation (BP) problem. However, the effect of the FF algorithm on the performance of hybrid transfer-learning architectures as compared to BP remains an open question. We experiment with both algorithms on a hybrid ResNet-18 feature extractor with a trainable MLP head for MNIST classification. Our surprising finding is that the performance of the head trained with a standard backpropagation is very poor as it only manages to achieve an accuracy of 85.55%, whereas a baseline Forward-Forward model (FF-Uniform) with random negative sampling performs much better and attains an accuracy of 94.21%. This implies that FF might be a better learning rule for that kind of architecture. Consequently, we come up with a novel idea, Adaptive Negative Sampling (ANS), to help the FF-Uniform model which is suffering from the weakest point. ANS detects and trains the model on the false positive errors made by it, thus following Hinton's original proposal to use "hard" negatives. This ANS model further raises the performance to 94.94%, contributing an additional 0.73% accuracy over the baseline FF and a staggering 9.39% increase over backpropagation. Error analysis, as performed by us, helps to explain how our ANS method almost entirely gets rid of the most frequent confusions, e.g., (7, 9), thus lowering the particular error rate for them by 98%.

**CMT 813**

# Towards Smart Manufacturing: AI-Driven Prediction and Analysis of Surface Roughness in Machined Components

**Shivananda Moolya [1], Suvarna Kulal [2], Pallavi Shetty [2], Faisal Abdullah Al-Kiyumi [1], Abdullah Saleh Al Farsi [1], Abdul Aziz Salim Al Nahdi [1]**

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**Abstract.** Surface finish is a critical quality attribute in machining processes, directly influencing the performance of the final product, its functionality, and its aesthetic appearance. Traditional approaches for determining surface roughness rely mainly on experimental measurements and previously derived empirical models, which are time-consuming, less accurate, and more costly. With the adoption of new technologies in industries adopting smart manufacturing, intelligent, data-driven methods are emerging as powerful tools for process optimization in machining. This study explores the application of artificial intelligence (AI) techniques to predict surface finish in machining operations. By controlling process parameters such as cutting speed, feed rate, depth of cut, and tool geometry, AI models are trained to learn complex, nonlinear relationships governing surface quality. The original XGBoost Regressor model was the best-performing model among those tested before tuning, as evidenced by its excellent R-squared score of roughly 0.937. Speed is the most crucial predictor of surface roughness, according to SHAP analysis.

**Keywords.** machining process, surface roughness, machine learning, SHAP analysis

**CMT 814**

# IoT-Vision System for Human Identification and Presence Counting Using Deep Learning

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**Abstract.** This paper presents an IoT-enabled vision system for real-time human identification and presence counting in smart environments using deep learning. The proposed framework integrates YOLOv8 for person detection, ByteTrack for multi-object tracking, and a MobileNet-based face recognition module within an edge–fog computing architecture. Experimental evaluation demonstrates a YOLOv8 detection performance of 0.9346 mAP@0.5, face recognition accuracy of 98.46%, and stable real-time operation at 18-22 FPS on edge devices, with an end-to-end latency of approximately 120 ms. The system reliably supports identity-aware occupancy analytics, entry-exit monitoring, and real-time alerts, making it suitable for deployment in smart campuses, offices, and public infrastructure.

**CMT 816**

# AI-Powered Multi-Class Adverse Drug Reaction Prediction from Real-World Clinical Data

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**Abstract.** Adverse drug reactions (ADRs) are a major challenge to healthcare, resulting in extended duration of hospitalisation, increased financial burden and potentially preventable deaths, thus requiring early detection for proper pharmacovigilance. Existing ADR prediction models typically rely on underreported spontaneous reporting systems and focus only on binary outcomes. To address this limitation, we develop a multiclass ADR prediction framework using the MIMIC-IV database. A clinically validated labeling pipeline was created by linking ICD diagnostic codes for gastrointestinal and allergic reactions with prescription events, and by applying KDIGO and DILIanalogue guidelines to time-series laboratory data for kidney and liver injury. This yielded five ADR categories: No ADR, Kidney ADR, Liver ADR, Allergic ADR, and GI ADR. We engineered predictive features from baseline labs, demographics, and ICDbased comorbidities, and applied SMOTE to manage class imbalance. Ten machine learning models and two hybrid ensemble methods were evaluated using stratified 10-fold cross-validation, with Accuracy and Macro F1-score as primary metrics. Results demonstrate the feasibility and clinical relevance of multi-class ADR prediction using real-world EHR data.

**Keywords.** Adverse Drug Reactions (ADR), Pharmacovigilance, MIMIC-IV, Multi-class Classification, Machine Learning, Ensemble Learning, Electronic Health Records (EHR), SMOTE.

**CMT 824**

# BEHANA: Enhancing Women's Safety through AI-Powered Solutions

**Ankitha Shetty, Navaneeth Shetty, Aditya Patil T, Ayush Chaudhary, Mahammad Shahil**

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**Abstract.** Women's safety is one of the raising concerns in the contemporary era. Several cases of harassment, exploitation, and even threat to human life. Rising concerns on such activities lead to multiple solutions have been proposed so far; this paper aims to propose a solution of a mobile application that is powered by modern Machine Learning techniques that empowers safety by providing several safety and precautionary features. The primary intention of the proposal is to equip women with the best solution to such quotidian complications. Using the Machine Learning feature of the proposed system, the application helps minimize the risks by predicting risk prone scenarios by leveraging the community knowledge and analyzing behavioral patterns. Such pro-active features enable women to navigate safely through places, suggest safer routes, and also initiate emergency protocols such as SOS and SMS. Adding on to these features with the integration of natural language processing (NLP) for analyzing the women community confidence of particular area or location based on their posts on the application indirectly helps rest of the female community from facing potential dangers. Combining the merits of these features, the proposed system provides a strong, robust, and reliable framework that not only detects potential risks but also prevents those risks. Furthermore, the proposed mobile application emphasizes usability for all spectrum of users, making it simple and in a user-centric design, making it accessible, intuitive, and reliable regardless of their technical expertise.

**Keywords.** NLP, RoBERTa, transformers, mobile application, Machine Learning, clustering algorithm, K-Means algorithm, Python.

**CMT 825**

# Dog Activity Detection from Accelerometer–Gyroscope Signals Using an Integrated CNN–BiLSTM Model

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**Abstract.** Making use of wearable sensors in identifying dog behavior helps in monitoring veterinary health and improves both training and understanding of the animals. This study presents an integrated CNN-BiLSTM to allow the multi classification of dog behavior using supervised activity recognition with extensive feature engineering, a semi supervised gap filling process, and extensive comparison of optimizers to optimize accuracy for each model and completeness for the dataset. The dataset used contains triaxial accelerometer and gyroscope data collected from several dogs with 100 Hz sampling rate using ActiGraph GT9X Link sensors. The data for input were organized into overlapping 2 second windows containing 200 samples. The hybrid CNN-BiLSTM model architecture combines convolutional layers to extract spatial feature with bidirectional LSTMs and a fully connected dense layer. Among the several optimizers used AdamW performed the most highly rated results, with a validation accuracy and weighted F1 score of 93.27respectively. The model associated with acceptable results in overall precision (over 91scores. The multistage gap filling process involved using model predictions with confidence (softmax probaility) $\geq 0.5$ to forward and backward filling missing labels and even neighbor mode selections with a global fallback effectively to fill in approximately 25gap filling method improves dog activity recognition accuracy by 28.36framework to handle imbalanced and semi labels time series data in animal behavior research.

**Keywords.** Dog activity recognition, CNN-BiLSTM, optimizer comparison, semi-supervised learning, wearable sensors, gap filling.

**CMT 829**

# An Empirical Evaluation of Synchronous vs Asynchronous Microservice Architectures for Enterprise Messaging Platforms

**Prajwal Hegde N [1], Nidhish Shettigar [1], Sanidhya Bhandary [1], Abhijna N [1], Krishna N Acharya [1], Krishnaraj Chadaga [2]**

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**Abstract.** Enterprise messaging platforms serve as critical infrastructure for modern organizations, enabling collaboration across distributed teams and time zones. Ensuring low-latency, scalable, and fault-tolerant communication is therefore essential. However, many such platforms still rely on tightly-coupled synchronous request-response communication patterns, which are prone to cascading failures under load. In contrast, asynchronous message-driven architectures decouple request acceptance from processing, enabling elasticity and improved resilience. This study presents an empirical comparison between a traditional synchronous microservice architecture (SBA) and an asynchronous message-driven architecture (AMDA) for an enterprise messaging platform. Both implementations were containerized and evaluated under identical load conditions using k6, while resource utilization was monitored via Docker. Results demonstrate that the synchronous design failed catastrophically under load, achieving only 17 successful responses out of 11,657 requests (99.85% failure rate), with average latencies exceeding 31 seconds. Meanwhile, the asynchronous architecture sustained 30,005 successful requests with zero failures, maintaining a mean API latency of 1.63 ms. Furthermore, AMDA remained fully operational during a faul injection experiment where the background worker was intentionally terminated, demonstrating high resilience through message buffering and graceful recovery. The findings provide concrete evidence that asynchronous, queue-based communication is not merely an optimization, but a fundamental requirement for scalable and reliable enterprise messaging systems.

**Keywords.** Microservices, Asynchronous Architecture, RabbitMQ, Enterprise Messaging, Scalability, Fault Tolerance

**CMT 830**

# An AI-Powered Solution for Sustainable Resource Management

**Prajwal Hegde N, Y Nidhi Shenoy, Abhijna N, R Ajay Prabhu, Vaishnavi N, Ankith Hebbar**

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**Abstract.** This paper aims to present an AI-powered energy optimization system designed to provide realtime insights, control, and predictions for residential or community-level energy usage. By integrating edge computing through a Local Backend, the system captures live data from energy monitoring hardware or simulation sources, processes it locally, and communicates with a cloud-based Main Backend using secure API key mechanisms. An LSTM-based AI model is employed to forecast upcoming energy trends, enabling users to make proactive decisions. Users interact with the system via a dynamic web interface that supports device control, dashboard analytics, and a personalized energy assistant chatbot. The IoT module, built using Arduino and PZEM-004T v3 energy meter, allows physical appliances to be monitored and toggled remotely. The system also features Server-Sent Events (SSE) for real-time feedback synchronization between cloud and edge layers. Designed with a human-in-the-loop approach, this solution balances automation with user oversight, making it scalable, efficient, and adaptable for modern smart home or gated community environments

**CMT 835**

# IoT-Enabled Omnidirectional Surveillance Robot with Cloud-Based Face Recognition

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**Abstract.** The rapid growth of connected devices within domains such as Internet of Things (IoT), embedded computing, and cloud-based AI has altered the terrain of autonomous surveillance technologies considerably. Present-day security systems require high degrees of movement and intelligence to be able to find their way through complicated indoor environments, process visual data on the spot, and react to changing situations without the need for human intervention. In order to fulfill these requirements, this article introduces a comprehensively integrated IoT-enabled omnidirectional surveillance robot featuring cloudbased face recognition through AWS Rekognition. The suggested robot utilizes a holonomic omnidirectional wheel configuration to effect smooth 360° movement, ultrasonic sensors for the robot to locate obstacles in its path without human intervention, and a Raspberry Pi 5 as the onboard microcontroller. The system continuously takes snapshots of the scene through a camera connected to the robot, uploads them to AWS S3, and calls face detection and recognition to be performed by Rekognition. Moving past traditional IoT robotics, this project delivers a physically mobile yet cloud-intelligent solution by seamlessly combining omnidirectional movement, autonomous navigation, scalable AI-based analytics, and real-time cloud connectivity into a unified surveillance platform. The results further establish the feasibility of employing compact cloud-assisted robots for indoor surveillance applications in academic, commercial, and industrial environments.

**Keywords.** IoT, Surveillance Robot, Omnidirectional Wheels, AWS Rekognition, Cloud Computing, Raspberry Pi, Autonomous Navigation.

**CMT 837**

# Real-Time Emotion classification Using TF - IDF with Logistic Regression, Naive Bayes, and SVM

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**Abstract.** Text-based emotion detection is a significant natural language processing task since text is regularly filled with subtle emotional indications, colloquial phrases, and vague meanings. The project is based on creating a single label emotion classification system that recognizes one of six emotions based on user generated text: Anger, Disgust, Fear, Joy, Sadness and Surprise. An enormous annotated dataset is processed with the help of such pre-processing as normalization, deleting of punctuations and numbers, expansion of slangs, emoji to text conversion, and the elimination of noises in general to enhance the quality of data. Text is then converted into numbers and its unigram and bigram features are used as TF IDF vectors.The three classical machine learning models have been trained and evaluated based on accuracy, precision, recall and F1 score which include Logistic Regression, Support Vector Machines and Multinomial Naive Bayes. TF IDF with Logistic Regression is the most successful of all these models. The Flask based backend is used to deploy the trained model and linked to a React based frontend to display emotion prediction in real time using a user friendly interface. This project shows a viable and effective method of detecting emotion based on traditional machine learning practice, and it can be used in sentiment analysis, content moderation, and analysis of user behavior.

**Keywords.** Multi-label Emotion Detection; Natural Language Processing; TF-IDF; Logistic Regression; Naive Bayes; Support Vector Machines; Class Imbalance; Emotion Recognition

**CMT 841**

# Vision Transformers for Accurate Inferior Alveolar Nerve Classification in Cone Beam Computed Tomography

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**Abstract.** The precise localization of the Inferior Alveolar Nerve (IAN) is crucial for safe dental and maxillofacial surgical procedures. This study compares and contrasts five Transformer architectures—Vision Transformer (ViT), Shifted Window Transformer (SwinT), Class-Attention in Image Transformers (CaiT), Gradient Focal Transformer (GFT), and the Data-Efficient Image Transformer (DeiT)—for automated classification of IAN position in Cone Beam Computed Tomography (CBCT) images. SwinT outperformed the other models and achieved the highest accuracy of 80.00% due to its hierarchical, multi-scale window attention mechanism, which effectively captures sensitive anatomical information and generalizes well on limited medical imaging data. In contrast, GFT performed lowest, mainly because of extreme overfitting caused by the gating operations, which enhanced training characteristics but were unable to generalize to new data. Overall, the results reveal that transformer-based designs have great potential for precise and reliable IAN position classification in CBCT for universal healthcare systems, especially those with hierarchical attention like SwinT.

**Keywords.** inferior alveolar nerve, vision transformer, dental radiography, universal healthcare, CBCT, healthcare

**CMT 844**

# Temperature Prediction Using Meteorological Parameters with Machine Learning

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**Abstract.** For all the sectors linked to climate monitoring, urban management, and public health, the accurate prediction of temperature is an absolute necessity. The present article represents an attempt to apply machine learning techniques to daily mean temperature prediction from supporting parameters such as humidity, wind speed, and atmospheric pressure. The analysis was carried out using the ”Daily Delhi Climate” dataset regarding average temperature, humidity, wind speed, and atmospheric pressure from the years 2013-17 in Delhi. After pre-processing, four learning models—Radial Basis Function Network (RBFN), Extreme Learning Machine (ELM), Multi-Layer Perceptron (MLP), and XGBoost—were trained. These were then used to build three ensemble models. The results show that a Stacked Ensemble model achieved the best overall performance, with a Test $R^2$ of 0.8867. Among the base models, XGBoost was the most accurate, while the ensembles proved superior to any single model, demonstrating the efficacy of machine learning for this task.

**Keywords.** temperature prediction, humidity, wind speed, atmospheric pressure, RBF Network, ELM, XGBoost, MLP, machine learning, regression

**CMT 845**

# Skin Cancer Detection and Classification Using Deep Learning Techniques

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**Abstract.** The number of occurrences of skin cancer is still increasing globally, and patient survival and treatment outcomes are greatly enhanced by early detection. Conventional diagnostic techniques depend on the visual examination and biopsy of dermatologists, which can be expensive, time-consuming, and occasionally subjective. This paper presents an automated deep learning-based multi-class skin lesion classification system that can recognize several lesion categories from dermoscopic pictures in order to get over these restrictions. To enhance efficiency, robustness, and generalization across various lesion kinds, the suggested approach uses transfer learning with sophisticated pretrained architectures like ConvNeXt, EfficientNetB3, and Vision Transformer (ViT), followed by an ensemble mechanism. To enable accurate evaluation, all images in the HAM10000 dermoscopic dataset are preprocessed, normalized, enhanced, and divided into training, validation, and testing sets. While pictures are reduced to 224×224 and adjusted using the three models, Grad-CAM viewing is designed to display the most discriminative lesion patches and ensure model transparency. Accuracy, AUC, and melanoma sensitivity are used to assess performance. Experimental results show that the ensemble model performs better than individual architectures in terms of diagnostic accuracy and clinical relevance, while heatmaps confirm strong feature focus over lesion locations. All things considered, our AI-enabled system shows significant promise for clinical support and future adoption in real-time screening scenarios by providing a reliable, understandable, and user-friendly solution for early skin lesion analysis.

**Keywords.** skin cancer, dermoscopic images, deep learning, ensemble model, transfer learning, Grad-CAM.

**CMT 847**

# Hybrid Deep Learning and Fuzzy Logic Model for Predicting Concrete Compressive Strength with Genetic Algorithm Optimization

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**Abstract.** The study constructs an in-depth hybrid intelligent system with full application of deep learning structures, fuzzy inference, and genetic algorithm optimization to precisely, dependably, and interpretively predict concrete compressive strength. The suggested framework is an application of Convolutional Neural Networks mixed with Long Short-Term Memory (CNNLSTM), Gated Recurrent Units (GRU) networks, and Multi- Layer Perceptron (MLP) networks. The more complex Genetic Algorithm (GA) optimization method is used in order to automate the process of hyperparameter tuning, with a Mamdani-type fuzzy logic system offering interpretable human-readable rules to the user. The models are trained and tested on the extensive UCI Concrete Compressive Strength dataset of 1,030 cases with eight important mixture parameters. The optimized CNN-LSTM model showed stromg performance in the form of $R^2 = 0.92$ 0.02 and Root Mean Square Error (RMSE) = $4.15 \pm 0.31$ MPa and was significantly better than all other comparative models. The genetic algorithm optimization has shown 15 percent higher performance than manual setup, and the fuzzy logic system has shown to give good interpretability in the $R^2$ of 0.72 + -0.06.The unified web interface obtained under 3 seconds prediction latency and 95 percentage of user task completion. The hybrid intelligent system is effective to tackle the important challenge of achieving a balance between prediction accuracy and interpretability in predicting concrete strength, and demonstrates the strong potential of hybrid computational intelligence systems for accurate and interpretable prediction in construction materials informatics.

**Keywords.** Concrete compressive strength prediction, Hybrid deep learning, Fuzzy logic systems, Genetic algorithm optimization, CNN-LSTM architecture, Construction materials informatics, Explainable AI in engineering.

**CMT 848**

# PrepInterview: A Multimodal Ai System to Enhance Student Interview Skills Through Behavioural and Speech Analysis

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**Abstract.** PrepInterview, a multimodal AI-based platform that provides real-time, personalized feedback to students to assess their performance during the interview to train the critical soft skills. The conventional mock interviews are not analyzed objectively in terms of non-verbal (eye contact, facial expression) and verbal (fluency, clarity) expression. PrepInterview combines both computer vision and NLP: a CNN with FER-2013 can detect seven emotions (65% accuracy), Haar cascade + random Forest can detect eye-contact (92% accuracy), Whisper, DistilHuBert, and BART are used to perform transcription, stutter detection, and summarization. Gemini API of Google creates customized suggestions. The system is created using Next.js, FastAPI, and MongoDB and analyzes the interviews recorded by the students and offers behavioral insights in real-time. The system provides automated behavioral feedback on emotion expression, eye contact, and speech fluency. Experimental evaluation demonstrates moderate performance in emotion recognition (65%) and high accuracy in eye-contact detection (92%) under controlled conditions. The platform is intended as a self-practice and feedback tool rather than a replacement for human-led interview training. The platform gives educators an expansive, impartial training device and supports unrestricted communication for professional preparation, particularly to students with limited resources. Work in the future: posture/gesture analysis, mobile deployment, and longitudinal employability studies. PrepInterview is a bridge between academic preparation and job preparation using data- driven, experiential learning.

**Keywords.** Student Interview Preparation, Educational Technology, Multimodal AI, Emotion Recognition, Eye Contents Detection, Whisper, Soft Skills Development, AI in Education.

**CMT 849**

# Cleansort: A Waste Image Classification System for Smart Cities

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**Abstract.** Waste separation is the premise of reducing environmental pollution, and yet manual sorting is slow, inaccurate, and not suitable for dealing with large quantities. To solve this problem, this work develops an automated image-based waste classifier using modern deep learning techniques. This study first explored a simple CNN architecture, but its performance was not good enough to reliably identify waste in real time. In order to improve both accuracy and efficiency, this work then chose the MobileNetV2 architecture and trained it on a dataset containing three principal categories of waste: organic, hazardous, and recyclable. Thanks to its lightweight architecture and powerful feature-learning capability, in comparison with the baseline model, MobileNetV2 yielded better accuracy and swiftness of processing. Being integrated into the trained network, a user-friendly web application allows users to upload images for instant classification. This demonstrates that the proposed system is practical, accessible, and suitable for everyday waste segregation needs.

**Keywords.** MobileNetV2, Deep Learning, Waste Classification, CNN, Image Recognition, Transfer Learning, Web Application, Waste Segregation.

**CMT 852**

# Wildlife Detection and Monitoring using Single Shot Detection

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**Abstract.** The problem of wildlife conservation, healthy and balanced ecosystem are intertwined. A balanced ecosystem provides an environment for the animals to thrive and flourish. The healthy population of wildlife assists the sustenance of a balanced ecosystem. Extinction of animals in a certain region is an indication of unhealthy and unbalanced ecosystem. This can be checked and avoided by constantly checking for the presence of animals in the given region. To check and monitor the wildlife is challenging. The natural habitats of animals are not easily accessible to humans and also poses serious threats to human life. The challenge of monitoring wildlife can be overcome to a great extent by adopting the computer vision technologies. There are various methods that are traditional and conventional in place to detect wildlife. However, modern computer vision techniques poses less threats and offers a near to accurate results. Computer vision employs methods based on neural network like R-CNN, Fast R-CNN, Faster R-CNN etc for detecting objects. These methods can also be extended for detecting the wildlife. This paper describes the work carried out to detect and monitor wild animals using single shot multi box detection with Tensor Flow API. On employing Tensorflow SSD detection of wildlife, the result was found to be satisfactory in terms of being accurate, precise and fast. For every image detection, log report is generated. The log report can be analyzed to detect the movement pattern of animals in a particular region.

**Keywords.** Wildlife Detection, Tensor Flow, SSDI

**CMT 867**

# Advanced Smart Accident Detection System with IoT and AI Integration

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**Abstract.** Road accidents are one of the leading causes of death worldwide, and delays in medical response often make the situation far more deadly. This project aims to develop a smart road accident and alert system that can automatically detect accidents by detecting impacts and vehicle tilts using the MPU 6050 sensor. The system will automatically send an alert to medical centers and registered users in real time to improve timeliness of help. Once the vehicle detects a sudden impact or tilt indicating an accident, an alarm will activate for 30 seconds and if not stopped manually will send location information to emergency services automatically, utilizing a GSM and GPS module. The mobile application will notify all registered users, speeding up a response yet again. Ultimately, the system aims to reduce response times during the critical incident of an accident, increase awareness of get the victim timely medical assistance, and ultimately save lives.

**CMT 869**

# Startup Success Predictor: A Machine Learning-Based Forecasting Framework for Early-Stage Venture Assessment

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**Abstract.** The venture capital landscape faces significant challenges in accurately predicting startup success, with failure rates exceeding 90% for early-stage companies. Traditional evaluation methods rely heavily on subjective assessments and domain expertise, often leading to inconsistent investment decisions. This paper presents a comprehensive machine learning-based forecasting framework designed to predict startup outcomes using quantitative metrics and historical performance data. We evaluated four distinct classification algorithms: Logistic Regression, Support Vector Machine (SVM), Random Forest, and Gradient Boosting (XGBoost) on a dataset comprising over 2,500 startup records. Our methodology incorporates extensive feature engineering, cross-validation techniques, and performance optimization strategies. The best-performing model, Gradient Boosting, achieved a test accuracy of 80% and ROC-AUC of 0.82, demonstrating significant potential for real-world deployment in venture capital decision-making processes. The framework addresses critical gaps in startup evaluation by providing datadriven insights that complement traditional due diligence methods.

**Keywords.** startup prediction, machine learning, venture capital, logistic regression, random forest, gradient boosting, classification, SVM, entrepreneurship analytics

**CMT 872**

# A Single-Layer Pseudo-Quantum Creep-In Mechanism for Time-Series Forecasting

**Subhash Nandan Chindukri , Sai Nithin Talasu , Amarnath Reddy Doduguru , Lakshmi Chetana Vemuri**

Amrita Vishwa Vidyapeetham.

**Abstract.** Time-series prediction is important to numerous applications, such as energy systems, climate analytics, and industrial maintenance. Classical sequential neural networks, e.g. RNN, GRU and LSTM, have shown good performance in modeling long-term temporal dependencies, but the expressiveness of these models are limited by their non-linear feature representation ability. We present a hybrid forecasting method that incorporates a pseudo-quantum layer with a classical LSTM architecture, thus allowing sin-based phased modulation to emulate interference-based transformations of features. We conduct the performance evaluation of the proposed Hybrid-L1 model on transformer temperature ETTh1 dataset and compare it with the baselines namely RNN, GRU and LSTM. MSE, MAE, Precision, Recall, F1-Score, Accuracy are used for reporting performance. The comparative study illustrates that adding the pseudo-quantum layer enhances predictive reliability and pattern learning speed for sequential data, suggesting that quantum-inspired algebraic computation can superior sequential learning even in the absence of physical quantum hardware.

**CMT 874**

# Predicting YouTube Video Popularity Through Machine Learning and Ensemble Learning Approaches

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**Abstract.** Lung sound analysis presents a promising, non-invasive, and potentially cost-effective approach for detecting respiratory diseases. This research aims to assess the feasibility of using lung sounds for pattern recognition and diagnosis of various respiratory disorders, specifically through the analysis of cough sounds. We review a range of recent studies that explore the use of deep learning models, machine learning algorithms, and feature extraction techniques in this context. These studies are categorized based on their methodologies, and their performance in accurately classifying lung sounds is discussed. Research findings highlight the significant diagnostic potential of lung sound analysis, demonstrating improved classification accuracies across various disease types. However, challenges such as data inconsistency, noise interference, and limited model generalizability remain. It captures the current state of lung sound analysis research in respiratory disease detection, offering insights that could drive future advancements in this critical field…

**Keywords.** YouTube popularity prediction, MLPRegressor, XGBoost, ELM, Gradient Boosting Regression, Radial Basis Function (RBF), Deep Learning

**CMT 875**

# Voice-Based Biometric System: One-Shot Learning for Unseen Speaker Generalization

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**Abstract.** Voice authentication is a very important component of biometric security and a very sensitive one in applications like financial transactions and secure communication. A key challenge lies in developing a scalable and reliable approach that operates with minimal enrolment data in just a few seconds and generalises to unseen speakers. This study addresses this gap by incorporating one-shot learning to voice authentication through a Siamese network framework. The results show robust accuracy compared to models that require a few minutes of voice data, while using only a single enrollment example of a few seconds, resulting in reduced data requirements while maintaining competitive accuracy. Evaluated on the LibriSpeech dataset, the model demonstrated strong generalisation to new speakers under variable conditions. This work highlights the potential of one-shot learning to authenticate speakers and deliver secure, efficient and scalable voice authentication solutions which are suitable for high-stakes applications.

**Keywords.** Voice Authentication, Speaker Verification, Siamese Network, One-Shot Learning, Biometric Security

**CMT 882**

# Retrieval-Augmented AI Platform for Accessible Legal Support in India

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**Abstract.** Nyay-Mitra is an AI-driven legal assistance system developed to simplify judicial information and support litigants in understanding court documents. The proposed framework integrates Large Language Models—LLaMA-8B and Gemma- 7B—with Retrieval-Augmented Generation (RAG) to produce factually grounded and precedent-aware legal responses. A curated instruction-based question–answer dataset, along with four years of Supreme Court judgments, is used to fine-tune the models through Low-Rank Adaptation (LoRA) and 4-bit quantization, enabling efficient deployment in resource-constrained settings. Performance is evaluated using Semantic Similarity, BLEU, and ROUGE metrics, where both models demonstrate strong accuracy and coherence, with Gemma showing marginally superior results. The findings indicate that lightweight, domainspecific legal LLMs can deliver reliable and explainable assistance, highlighting Nyay-Mitra’s potential for scalable judicial support systems.

**Keywords** .Legal AI, RAG, LLaMA, Gemma, Quantization, NLP

**CMT 885**

# EdgeBlockAI - An Offline, AI-Assisted Blockchain Framework for Supply Chain Anomaly Detection

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**Abstract.** All over the world, counterfeits are causing losses of billions annually. Standard blockchain infrastructures can create immutable audit trails; however, they are cloud-dependent, have high latency, do not pre-validate data, and require complex consensus mechanisms, which makes deployment on edge devices difficult. EdgeBlockAI is an offline, AI-assisted blockchain framework that uses edge-deployed anomaly detection and a lightweight DAG-based local ledger for supply chain authentication on resource constrained hardware. The data fusion is done using RFID identification, environmental DHT22 sensor and USB camera. The visual inspection is done using quantised AI models (Tiny CNN model for image data, LSTM model for sensor data) implemented on Raspberry Pi Zero 2W (512MB RAM). Unlike traditional blockchains that rely on network connectivity at all times, EdgeBlockAI features a local directed acyclic graph (DAG) ledger. Therefore, this ledger operates independently when the network crashes, especially in a localised network. Moreover, when the connection is restored, EdgeBlockAI leverages smart batching and conflict-free merging. Using smart filtering helps consume 60-80% less bandwidth through confidence thresholding and duplicate detection while ensuring that critical anomalies get uploaded right away. Our experimental results showed 2-3 times faster transaction execution than conventional blockchain (3-4 seconds end-to-end) and minimal data loss in successful offline operation. The model achieves 93% confidence in detecting anomalies while consuming 7.5–10W power, thus validating its practical feasibility for large-scale deployment in remote warehouses and resource-limited environments.

**Keywords.** Edge Computing, Blockchain, DAG ledger, Supply Chain Authentication, Anomaly Detection, Offline Architecture, Resource-Constrained Environment.

**CMT 889**

# DeepMarine: A Deep Learning Framework for detecting plastic debris in water and conserving Biodiversity

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**Abstract.** Plastic pollution in the ocean is a present day, significant environmental challenge worldwide, impacting aquatic ecosystems, species, and biodiversity. Manual identification of underwater trash is expensive, time consuming, and susceptible to human error. This work presents Deep Marine, a deep-learningbased framework to autonomously identify plastic pollution underwater. The framework uses an artificially created underwater data set, with both clean and plastic-contaminated images to increase the variability for training. The model, developed with a ResNet-18 and transfer learning architecture, classifies underwater images into either “Clean” or “Plastic”. Additionally, we incorporate Grad-CAM-based model explainability to increase our ability to interpret the model predictions by highlighting what parts of the image the model is using for detection. Our results provide a deep-learning-based approach that captures effective detection accuracy to demonstrate the framework’s possibilities for scaling and sustaining ocean monitoring for plastic debris in the marine environment. The platform will provide marine conservationists with the ability to move from manual to automated detection with the affordability and usability of either a photo or video capable camera system to monitor for plastic debris.

**Keywords.** Underwater Plastic Detection, Deep Learning, Convolutional Neural Networks (CNNs), Synthetic Dataset Generation, Grad-CAM Explainability.

**CMT 895**

# MED-XEL: Explainable AI on Ensemble Methods for Early Neurological Risk Forecasting

**Dr. P Steffy Sherly [1], Dr. P Velvizhy [2], Dr. P Matan [1], K Sandeep Kumar [1], Maanav S 1**

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**Abstract.** Early identification of individuals at elevated risk of stroke enables timely prevention during routine primary care encounters. This paper presents a deployment ready framework for early stroke prognosis that integrates four mature, well-understood classifiers Logistic Regression, Support Vector Machine, Random Forest, and XGBoost into a single ensemble model with post-hoc probability calibration. The system reports a calibrated risk estimate, a configurable clinical risk tier aligned to screening or confirmatory use, uncertainty intervals using conformal methods, and clinician facing explanations at global and local levels via SHAP and LIME together with partial dependence and individual conditional expectation views. The study describes robust data handling, patient level leakage control, metrics beyond discrimination (Brier score and Expected Calibration Error), and decision curve analysis for net clinical benefit. A FastAPI backend and a React frontend implement audit, consent capture, versioned model registry, and printable explanation cards. The design emphasizes traceability, interpretability, and safety, and is intended to serve as a reproducible baseline for external validation and prospective evaluation.

**Keywords.** Ensemble Learning, Explainable Artificial Intelligence, Clinical Decision Support System, Risk Analysis, Predictive Analytics, Model Interpretability.

**CMT 897**

# AI-Driven Sign Language Translation: Bridging Communication Gaps through Deep Learning and Computer Vision

**Manisha P Poojary, Arhath Kumar**

NMAMIT, Nitte

**Abstract.** Sign language serves as a primary mood of communication for individuals who are hearing or speech impaired. However, communication barriers arise when interacting with people unfamiliar with sign language. Recent advances in artificial intelligence(AI) and deep learning have enabled the development of the system that can automatically interpret hand gestures and convert them into meaningful text. Unlike earlier approaches that relied on handcrafted image processing techniques and classical machine-learning models such as Support Vector Machines(SVM) and K-Nearest Neighbors(k-NN),modern deep learning -based methods offer improved scalability and accuracy. in particular, Convolution Neural Networks(CNNs) have proven effective for static gesture classification using image data.This project builds on these advancements by developing a dual-model sign recognition system that can identify both ASL alphabets and commonly used sign words(such as ”hello”,”bye”,”thank you”,”yes” and”no”) directly from uploading images. The system uses a lightweight custom CNN for alphabet recognition and a ResNet18-based classifier for sign-word recognition, enabling accurate and efficient gesture interpretation without requiring specialized sensors, wearable devices, or real-time video processing. This work demonstrates the potential of deep learning-based static gesture recognition to support accessible communication solution for the hearing and speech-impaired community.

**Keywords.** Language Recognition,Deep Learning, Gesture Recognition,Human–Computer Interaction (HCI)

**CMT 904**

# Food Quality and Authenticity Detection Using Deep Learning and OCR-Based Techniques: A Survey

**Manjushree T, Arhath Kumar**

NMAMIT NITTE

**Abstract.** This survey comprehensively examines advance ments in food quality and authenticity detection through deep learning and optical character recognition (OCR) techniques. Convolutional neural networks (CNNs) have proven highly effective for visual quality assessment, demonstrating strong capabilities in identifying freshness, predicting spoilage trends, and detecting physical defects across diverse food types. The hierarchical architecture of CNNs enables automatic learning of discriminative visual features, offering more consistent perfor mance than manual inspection in controlled environments. Complementing visual analysis, OCR and natural language processing (NLP) form a crucial technological foundation for packaging authenticity verification. Modern OCR systems extend beyond basic text extraction to incorporate confidence estimation, domain adaptation, and multilingual processing. When integrated with transformer-based NLP models, these systems extract semantic meaning from ingredient lists, verify regulatory compliance, and detect counterfeit labeling patterns with increasing accuracy. Most promising are multimodal fusion approaches that synthesize visual and textual evidence. These integrated systems leverage complementary information sources—where visual analysis identifies produc quality issues while textual validation detects packaging authenticity concerns. The combined approach creates a comprehensive inspection framework that addresses the multidimensional nature of real-world food quality and authenticity assessment.

**Keywords.** Food Quality, Food Authenticity, Deep Learning, Convolutional Neural Networks, Optical Character Recognition, Natural Language Processing, Multi-modal Fusion, Food Safety.

**CMT 906**

# Career Verify - A Fake Job Posting Detection

**Bhagyashree M, Pallavi Shetty**

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**Abstract.** Its sudden boom has facilitated millions of job seekers to connect with employers. However, this openness has also made it a hotbed for phony job postings created with the intention of deceiving people for financial gains, identity theft, and more, or to collect information for illegal data gathering. These fake postings often look professional and legitimate.This paper proposes a machine learning-based fraud job posting identification system that uses TF-IDF text vectorization and Logistic Regression classification. It performs a deep analysis of the Employment Scam Aegean Dataset with preprocessing techniques, model training, evaluation, and deployment through a Flask-based web interface. Experimental results show high accuracy and reliability, proving that machine learning can efficiently detect fake job postings automatically

**Keywords.** Machine Learning, Fake Job Detection, Logistic Regression, TF-IDF, NLP, Classification, Fraud Prevention

**CMT 908**

# Anomatrix: Wifi Anomaly Detection

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**Abstract.** WiFi networks are increasingly vulnerable to anomalous traffic patterns caused by illegal access, denial-of-ser-vice attacks, and other emerging cyberthreats. Traditional Such behaviours cannot be detected by signature-based security systems because they rely on pre-established rules. This paper presents Anomatrix, a lightweight machine learning-based WiFi anomaly detection system that analyses flow-level traffic features using an XGBoost classifier. A well-organised preprocessing pipeline that incorporates feature scaling, label encoding, and standardised feature ordering ensures consistent prediction be-haviour throughout training and deployment phases. The model was evaluated on a synthetic WiFi flow dataset using a 70–30 train–test split. Experimental results demonstrate reliable detec-tion performance with an accuracy of 92.62% and balanced pre-cision and recall for both benign and anomalous traffic. The trained model is deployed through a Flask-based API to enable real-time anomaly classification. The system places a high prior-ity on practical usability, reproducibility, and efficient deploy-ment in real-world wireless security monitoring environments.

**Keywords.** WiFi Security, Anomaly Detection, Machine Learning, XGBoost, Network Traffic Analysis, Cybersecurity.

**CMT 910**

# Bridging Musicology and MIR: A Cross-Traditional Survey and Computational Analysis of Carnatic Music for Emotion Recognition

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**Abstract.** Carnatic music is one of the classical music traditions of South India, connected basically using rasa theory where melody is governed by ragas and each of these ragas will be associated with spiritual and emotional states in the raga-rasa aligned computational framework. Computational frameworks in Carnatic music refers to systematic, culturally informed modeling architecture that incorporates a kind of theoretical grammar, which includes characteristic melodic structures such as svaras, arohana-avarohana, prayoga, jiva svaras, nyasa svaras, and specific gamakas. Western music is often associated with discrete pitch, harmonic progressions, and steady rhythm wherein emotion labels are listener-centric and psychologically motivated. But in comparison with Carnatic music, they lack Carnatic-specific features like phrase grammar, microtonality, and culturally defined emotion frameworks. Each raga in Carnatic music is embedded in raga grammar where rasa emerges organically over time, shaped by prominent notes, gamaka types and register usage. Here in this form of art, we can say that the emotion is composer- and tradition-informed compared to the listener's perceptual aspect of Western music. There are contemporary studies and research efforts that dwell on studying rasa, which is relatively scarce compared to Western music research. This paper presents a ground survey that combines studies that focus on Carnatic MIR along with emotion modeling, along with works that relate to various other art forms and their models. Previous studies have focused on isolated aspects of raga analysis or emotion recognition, but lack in designing effective computational frameworks that integrate navarasa as a design principle in a raga-rasa framework that is well annotated. The survey highlights three main objectives: (i) to situate Carnatic music within the global classical music context and to bridge computational modelling with musicological theory ; (ii) to benchmark audio feature extraction frameworks and (iii) to examine deep learning strategies in the light of dataset limitations and emotion representation fidelity. Overall, by integrating these perspectives,the study uncovers critical research gaps and motivates the development of culturally grounded, data driven and evidence based frameworks along with robust feature extraction strategies combined with deep learning architectures that can standardize gamaka aware carnatic music datasets.

**Keywords.** Carnatic music, Motif and phrase analysis, Music Information Retrieval (MIR),Computational music, Gamakaaware feature extraction

**CMT 911**

# Spatio-Visual Helmet Violation Analytics Using YOLOv8

**Prathwini, S Sapthami**

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**Abstract.** Artificial intelligence is bringing a significant change in the area of traffic surveillance for automatic detection, realtime monitoring, and intelligent enforcement of traffic regulations. In this work, a motorcyclist detection system along with a no-helmet detection system is proposed using the YOLOv8 object detection technique, demonstrating the automatic detection of two-wheeler riders violating helmet laws while riding twowheelers on the road. Basically, the aim of the proposed system is to enhance the safety features on the roads concerning traffic accidents caused by violations of traffic laws. Moreover, the proposed system makes use of advanced deep learning models for the detection system along with accurate inspection for violation detection with real-time processing. A customized dataset with images for both helmet-wearing and no-helmet-wearing riders is prepared for testing purposes. Also, the system is capable of working in different environments with varying illumination conditions along with different densities on the road. Open CV is employed for accurate detection of violations within video frames. Moreover, a simplified Streamlit interface is available for easy uploading, live detection, and automatic violation detection on the video upload system Experimental results show that the proposed system achieves an mAP@0.5 score of 93% with high recall, demonstrating its effectiveness for real world traffic surveillance applications.

**Keywords.** Deep Learning, YOLOv8, Helmet Violation Detection, Computer Vision, Traffic surveillance, Object Detection, Real-Time Monitoring, Open CV, Streamlit.

**CMT 914**

# Traffic Routing & Prediction Using Optimized ACO-PSO

**Bhakthi S Shervegar, Pallavi Shetty**

NMAMIT

**Abstract.** Modern urban traffic systems demand intelligent routing solutions capable of responding to dynamic congestion. This project presents a hybrid optimization framework using Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO) to compute congestion-aware traffic routes. The model incorporates a Road Congestion Factor (RCF) that considers road length, inflow, outflow, and lane capacity. A PSO module fine-tunes ACO parameters to accelerate convergence and enhance route optimality. The system is deployed using Flask, enabling a real-time, user-interactive visual platform that predicts traffic flow and displays optimal routes through an SVG-based map. The proposed hybrid ACO-PSO model demonstrates improved path quality and reduced computation time compared to the baseline ACO approach.

**Keywords.** ACO, PSO, Traffic Routing, RCF, Swarm Intelligence, Flask, Prediction System.

**CMT 915**

# A Data Fusion–Driven Framework for Predicting Insurance Risk Using Explainable Ensemble and Deep Learning Approaches

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**Abstract.** Statistical model and historical data were used to measure the insurance risk. This is done by manual with the support of a statistician or other expert in risk analysis. However, the situation has now entirely transformed, appreciations to Artificial Intelligence (AI). AI will use historical data, statistics, and previous scenario decisions to either anticipate the future in a more realistic setting or provide better results overall. AI algorithms and their predictive power in risk management and assessment will be a good fit for evaluating risk in the insurance sector. The proposed model integrates health and vehicle insurance data into a unified system to predict claim likelihood. Both datasets are cleaned, standardized, aligned by common features, and labelled with an additional column indicating insurance type before being merged and split for training and testing. The proposed methodology incorporates supervised and unsupervised Machine Learning (ML) algorithms for classification and risk analysis. K-Means clustering is used for exploratory risk Segmentation. It uses the Stacked Ensemble model for the classification, with RF, XGBoost, LightGBM as the base learners and Logistic Regression as the Meta classifier. SHAP is used for identifying the most influential features. Deep Learning (DL) architectures such as RNN and LSTM are also evaluated as experimental baselines to compare their performance with tree-based models. The Proposed model is able to achieve the accuracy of 91.27% on hybrid dataset. The framework shows promise for deployment in practical insurance analytics.

**Keywords** ML, RISK ASSESMENT, DL, ENSEMBLE LEARNING, NAIVE BAYES, LR, SVM, LOGIC REGRESSION, LSTM, RNN, RF, DT, K-Means, SHAP

**CMT 918**

# AI Powered Sentiment Analysis using Image and Video

**Nireeksha [1], Harshitha G M [1], S Shyam Kumar [1], Panchajanyeswari H [2]**

[1]NMAMIT, Nitte.
[2]St. Agnes College

**Abstract.** To improve how modern systems interact with people, it is crucial to understand human emotions. In this work, a multimodal emotion-recognition system that can identify emotions in images and videos is developed. For image-based emotion detection, expressions such as happiness, sadness, anger, fear, disgust, surprise, and neutral can be identified using a pretrained Vision Transformer (ViT) model with an accuracy of 92 percent. Features from the ViT visual model and the Audio Spectrogram Transformer (AST), where only the fusion layer is trained using the RAVDESS dataset, are combined to improve emotional understanding of videos. This multimodal fusion analyzes vocal cues like pitch and tone. Also, a simple Flask web interface is put in place which allows users to upload a picture or video and view the recognized emotions right away. All things considered, the system shows that combining audio and visual signals greatly improves emotion-recognition performance and provides a useful framework for practical applications.

**Keywords.** Artificial intelligence, multimodal emotion recognition, sentiment analysis, Vision Transformer, Audio Spectrogram Transformer, deep learning, human–computer interaction.

**CMT 920**

# Mood Detection in Kannada Songs Using Audio Feature-Based Machine Learning and Hybrid Data Balancing Techniques

**Sowjanya Shetty, Anusha Prashanth Shetty, Raksha Puthran**

Nitte (Deemed to be University), NMAM Institute of Technology Department of MCA Nitte, Karkala, India.

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**Abstract.** Music emotion recognition has become an important field in affective computing. It has applications in music recommendation, therapy, and personalized entertainment. However, most current research focuses on Western music, leaving regional languages like Kannada mostly unexplored. This paper introduces a machine learning framework for detecting moods in Kannada songs using audio features. We created a dataset of 3,559 songs and built an automatic mood mapping algorithm that uses percentile thresholds on audio features, which removes the need for manual labeling. To tackle class imbalance, we used a mixed method that combines undersampling and SMOTE. We evaluated several models including Random Forest, XGBoost, SVM, and Neural Networks using 5-fold cross-validation. Random Forest achieved 99.7

**Keywords.** Kannada Music, Emotion Detection, Audio Features, SMOTE, Random Forest, Machine Learning, Data Balancing, Regional Language Processing, Affective Computing

**CMT 922**

# Credit Score Simulator and Coaching Module for Intelligent Credit

**Bhavan Radhakrishna, Pallavi Shetty**

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**Abstract.** This study showcases a comprehensive system that merges credit score forecasting using machine learning with tailored financial coaching to enhance financial education for young adults. The system utilizes a fine-tuned RandomForest regression model developed on 100,000 financial records to estimate credit scores within the practical range of 300-850 (FICO scale) and produces clear, actionable suggestions via counterfactual simulation. The model attains an $R^2$ of 0.4627 and an RMSE of 49.53 points, accounting for 46.27% of the variability in credit scores by utilizing 10 financial features. An innovative learned linear calibration method guarantees accurate score forecasts, while a greedy simulation technique offers tailored routes to achieve desired credit scores. The system tackles significant deficiencies in financial literacy by converting unclear credit scoring into transparent, instructive experiences that allow users to model "what-if" situations and comprehend the measurable effects of financial choices. The results of the validation show strong performance across various metrics, offering practical benefits for interventions in financial education and behavior change. This study adds to the expanding overlap of explainable AI, fintech, and edtech by showcasing how machine learning can be utilized not only for prediction, but also for enabling empowerment through comprehension.

**Keywords.** prediction of credit scores, machine learning, financial knowledge, interpretable AI, RandomForest, financial literacy, counterfactual modeling, fintech

**CMT 923**

# Advanced Sleep Health Analyzer: A Machine Learning–Driven Approach for Personalized Sleep Quality Prediction and Health Intervention

**Bangera Jnanesh Ratnakar, Pallavi Shetty**

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**Abstract.** Digital health is changing thanks to artificial intelligence, which makes data-driven wellness insights, personalized monitoring, and early detection possible. The Advanced Sleep Health Analyzer (ASHA), a machine learning system that transforms unprocessed smartwatch data into insightful assessments of sleep quality and potential disorder risks, is presented in this study. ASHA uses ensemble learning, feature engineering, and linear interpolation to produce precise, age-aware predictions using a dataset of 20,000 sleep sessions. With 95% test accuracy, a Random Forest model outperformed XGBoost and LightGBM in terms of dependability and clarity. ASHA offers real-time forecasting, lifestyle analysis, and health impact metrics through its interactive Streamlit application. ASHA helps users better understand and enhance their sleep wellness by connecting wearable data with clinically relevant interpretation.

**Keywords.** Artificial intelligence (ai), sleep quality prediction, machine learning, wearable analytics, preventive medicine, feature engineering, linear interpolation.

**CMT 927**

# SignGemma Multilingual Expansion: Integrating Indian Sign Language (ISL) For Accessible Real Time Translation

**Omkar A, Kasu Maneesh, K. Deepak**

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**Abstract.** Very few datasets are annotated in detail and the patterns in the motions of sign languages due to the variation in individual styles of signing make the task of automatic sign translation rather difficult. This paper describes the sign-to-text translation system that uses only the pose skeletal system to perform the task. For the Conformer-CTC Encoder, we analyze the articulation of hand movements to establish long-term neural dependencies over continuous sign articulation. We describe a set of tools and techniques to enhance the stability of the system. To analyze the system for its accuracy, we train the model with custom sets and evaluate to verify that the timing does not differ. Multiple experiments demonstrate over the epochs that temporal structures are learned. This system is designed to operate reliably in real time for sign language translators and to provide lowlatency systems. This paper provides a computationally and hardware-friendly system for continuous sign translation to be used in real-time.

**Keywords.** Indian Sign Language (ISL), Conformer Encoder, CTC Loss, Pose Estimation, MediaPipe Holistic, Skeletonbased Recognition, Real-time Translation, Human–Computer Interaction (HCI), Deep Learning.

**CMT 929**

# A Lightweight, Client-Side Approach for Real-Time Detection of Text-Based Dark Patterns in E-commerce

**Anantha Murthy, Harshith P**

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**Abstract.** Dark patterns on e-commerce websites are an emerging peril to consumer autonomy: user interface designs 'nudge' users into unintended decisions or deceive them. The development of automated tools tackling this problem is challenging, as real-time analysis needs to be performed without compromising user privacy. This work presents a fast, privacypreserving, client-side browser extension that performs realtime detection of text-based dark patterns. The core technical challenge was overcoming the "performance-accuracy-privacy trilemma," wherein high-accuracy models clash with resource constraints and privacy requirements of a browser environment. Initial experiments utilizing expensive transformer models were impracticable due to their extreme latency. Thus, the research focused on a highly optimized Logistic Regression model with minimal footprint. This approach successfully balanced the trilemma; it delivered a robust F1-score of 0.960 and an almost instantaneous inference time of a fraction of a second, all within the client's browser. More importantly, this project contributes a novel, dependencyfree approach to serializing Python-trained classical ML models into universal JSON format for high-performance, client-side inference in standard JavaScript environments and demonstrates a practical pathway for effective AI tool deployment under resource-constrained, privacy-critical scenarios.

**Keywords.** Dark Patterns, Browser Extension Text-based Classification, Logistic Regression, Transformer Models, DOM Traversal/Manipulation

**CMT 935**

# AlertCrowd: Web-Based Framework for Video Crowd Alerting Using Enhanced CSRNet

**Aruna Kumari G K, Abheeshta P, Chinmayi, B Sahana Kini**

Department of Computer Science & Engineering Canara Engineering College, Sudhindranagara, Benjanapadavu Visvesvaraya Technological University, Belagavi, India.

**Abstract.** Crowd density estimation plays a crucial role in ensuring public safety, supporting urban planning, and managing large-scale events. Traditional methods relying on manual observation or classical computer vision techniques often lack robustness under occlusion, perspective distortion and varying environmental conditions. To address these challenges, we present AlertCrowd, a deep learning based framework for video crowd density estimation and motion analysis. The architecture integrates CSRNet for spatial density map generation with the Farneback optical flow algorithm to capture crowd dynamics. Critical to our approach, CSRNet is fine-tuned on public datasets (ShanghaiTech, MALL) augmented with custom annotated images to improve accuracy and robustness, evaluated on diverse video data reflecting real-world variations. Experimental results demonstrate accurate crowd density estimation with competitive mean absolute and squared errors while maintaining efficient CPU-based performance. The system supports accessible, costeffective crowd monitoring via a web platform offering real-time visualization, data interpretability, and applicability in public surveillance and event management. Designed primarily for post event analysis, AlertCrowd enables detailed crowd behavior insights valuable for after-action review and strategic planning.

**Keywords.** Crowd density estimation, Public safety, Deep learning, CSRNet, Optical Flow, Video analytics

**CMT 942**

# Handloom Saree Classification Using Transfer Learning with MobileNetV2

**Sandhya D Kotian, Raksha Puthran, Shabarish Chandu Bangera, Anusha Prashanth Shetty**

NMAMIT, NITTE

**Abstract.** Handloom sarees represents rich cultural diversity and tradition and are currently manually classified that is timeconsuming and susceptible to errors due to the presence of subtle visual differences and class-imbalances. In the present work, we propose a simple deep learning architecture based on MobileNetV2 for automatic classification of three dominant handloom sarees: Bandhani, Banarasi and Ikat. Transfer learning was employed using ImageNet pretrained weights, and we finetuned the model to 2,130 images that were curated timely. For addressing the class-imbalance problem, weighted cross-entropy loss was adopted and this led to strong generalization among all of the classes. The model obtained a test accuracy of 93.90% and precision and recall greater than 0.87. for each category. Evaluation metrics such as confusion matrix and classification report confirm the model's reliability and cultural awareness. This paper demonstrate a possibility to use effective CNN architectures to textile classification and provides a basis for implementing realtime application in e-commerce, heritage recording and fashion analytics. Index Terms— Handloom Classification, MobileNetV2, Transfer Learning, Deep Learning, Textile Recognition, CNN.

**Keywords.** Handloom Classification, MobileNetV2, Transfer Learning, Deep Learning, Textile Recognition, CNN

**CMT 944**

# Saree-Drape: A Deep Learning Framework for Automatic Karnataka Saree Draping Style Classification Using MobileNetV2 and MediaPipe-Based Multi-Person Detection

**Shetty Shamitha vasanth, Raksha Puthran, Sashwith S Poojari, Anusha Prashanth Shetty**

NMAMIT, Nitte

**Abstract.** Karnataka saree draping styles—Normal (Nivi), Uttar, and Coorg—reflect deep-rooted cultural identities and exhibit distinctive visual patterns. However, automatically identifying these draping styles from images is difficult due to variations in pose, illumination, background complexity, fabric patterns, and occlusions. This paper proposes Saree-Drap, a two-stage deep learning framework that incorporates MobileNetV2 for both saree detection and drape-style classification, combined with MediaPipe-based multi-person detection to ensure that only valid single-person images are processed. Because no public dataset exists for Karnataka drape styles, a custom dataset was constructed. The proposed system achieves 96.0% accuracy for binary saree detection and 96.0% accuracy for draping style classification with 96.2% accuracy in multi-person detection. The system is computationally efficient with 200ms inference time and is deployed using a Flask REST API for real-time inference. Saree-Drap contributes a practical and culturally relevant solution for fashion analytics, AI-based styling systems, and automated documentation of traditional attire.

**Keywords.** Saree Draping Styles, MobileNetV2, MediaPipe, Convolutional Neural Networks, Computer Vision, Deep Learning, Karnataka Traditional Dress, Flask API

**CMT 945**

# TraCI Based Rear-End Accident Detection Framework

**Akshara G Bhat, Bhuvan R Shetty, Tushar S Acharya, Yashas Amin**

Dept. of Information Science, NMAM Institute of Technology, Nitte, India.

**Abstract.** Rear-end crashes rank among the most common— and most dangerous — types of road accidents worldwide. In this paper, we introduce a fully reproducible simulation and detection framework that analyzes rear-end collision risk in urban traffic. We build the pipeline on the SUMO traffic simulator and its TraCI interface, then organize the experiments around a statistically grounded protocol. To detect hazardous situations, we propose a simple, inter- pretable, low-latency rule-based method. It flags risk based on three intuitive signals: vehicle headway, longitudinal deceleration, and the leader's speed. We then evaluate detection quality through a large-scale parameter sweep designed to span a broad range of traffic dynamics and driver behavior patterns.Finally, we inspect the results using detailed visualizations and statistical tests to measure robustness, sensitivity, and consistency across scenarios. To support repeatability and future work, we provide all simulation configurations and analysis components, making it easy to reproduce results, extend the framework, or run side-by-side comparisons with alternative methods.

**CMT 947**

# A Multi-Model Assessment of Deep Learning Techniques for Regional Cuisine Identification Using Food Imagery

**Sanjith K S, Shraddha, Raksha Puthran, Anusha Prashanth Shetty**

Nitte (Deemed to be University) NMAM Institute of Technology (NMAMIT), Department of Master of Computer Applications Nitte, Karnataka, India.

**Abstract.** This research makes an in-depth analysis of deep Learning models are created for the automated identification of North Indian and South Indian cuisines. With an increase in food recognition technologies, importance of nutrition tracking as well as the preservation of regional culinary heritage, different Convolutional Neural Network (CNN) architectures including DenseNet121, ResNet50, VGG16 and MobileNetV2 ,Simple CNN are considered on a customized dataset which includes 5,000 food images. Because of its dense connectivity and efficient feature learning, DenseNet121 achieves the greatest accuracy of 94.2 performance among the models that were examined. All models use transfer learning with extensive data augmentation strategies to accommodate the intrinsic diversity in food presentation styles. The top-performing model is then implemented on a web interface based on Streamlit that allows for real-time food type prediction. The results of this work contribute to the emerging domain of culinary informatics by comparing state-of-the-art CNN architectures and identifying an optimal framework for regional food classification tasks.

**Keywords.** Deep Learning, Food Recognition, Indian Cuisine, Transfer Learning, Computer Vision, DenseNet121

**CMT 948**

# Identification of Sarcasm, Emoji Utilization, and Aspect Recognition in Feedback Using Sentiment Analysis

**A Samved Rao, Aarthik K, Mamatha Balipa**

NMAM Institute of Technology

**Abstract.** Customer feedback often includes sarcasm, emojis, informal phrases, and fragmented text, making traditional sentiment analysis unreliable. To address these challenges, this study proposes a lightweight Feedback Analyzer that detects sarcasm, identifies relevant aspects, and computes aspect-wise sentiment using a hybrid machine learning and rule-based approach. Sarcasm—present in an estimated 10%–25% of social media reviews—can reverse literal sentiment, making accurate interpretation essential for understanding true user experience

**Keywords.** Sarcasm detection, aspect-based sentiment analysis, emoji sentiment, NLP, feedback analysis, machine learning.

**CMT 950**

# Survey on Machine Learning and Deep Learning Techniques for Stutter Detection

**Jyothi V Prasad, Sanjana Nayak, Khushi Malli, Charan R Karkera, Thrisha J Shetty**

NMAMIT, Nitte Deemed to be University

**Abstract.** Automatic stuttering detection has become a major focus in speech technology, integrating advancements in signal processing, machine learning (ML), and deep learning (DL) for reliable fluency assessment. Stuttering and disfluencies such as repetitions, prolongations, and blocks affect speech intelligibility, while manual identification by speech language pathologists remains subjective and labor intensive. This survey analyzes current ML and DL based stutter detection methods, highlighting feature extraction approaches, datasets, model architectures, evaluation metrics, and research challenges. The review traces the shift from traditional ML classifiers to modern deep neural and multimodal models, noting limitations including data scarcity and poor cross domain generalization. Traditional ML relies on handcrafted acoustic and prosodic features, pitch, energy, spectral envelopes, and temporal cues paired with SVMs, HMMs, or GMMs, but these methods struggle with feature engineering and nonlinear speech patterns. DL based architectures such as CNNs, RNNs, LSTMs, and transformer models overcome these constraints by capturing complex disfluency characteristics and long range temporal dependencies, leading to significant improvements in automatic stutter detection performance.

**Keywords.** Machine learning algorithms, Deep Learning algorithms, Stuttering, Multimodal approaches

**CMT 954**

# Text to Treatment - T2T: Memory Enhanced Retrieval Augmented Generation (RAG) Framework for Personalize Ayurvedic Medicine Recommendation using Large Language Models

**Pavan U.R, Anvith Alva, Prashulraj, Vaseem Dange, Yogeesha C.B**

Mangalore institute of Technology and Engineering

**Abstract.** Traditional systems like Ayurveda face serious integration into contemporary Those solutions in healthcare are not accessible, not standard, and far from intelligent. recommendation tools. Current approaches do not maintain conversational memory, personalization, and cultural awareness. This work presents a Memory-Enhanced Retrieval-RAG is an architecture that introduces persistent memory and cultural Integration for Ayurvedic medicine suggestions [1]. The model proposes multilingual RAG architecture that supports Prakriti–Vikriti analysis, combined with conversation buffer episodic, semantic, and procedural memory systems. A careful re-examination of eight earlier systems pointed out some serious lacunae: low personalization (3/8), weak conversation continuity of 1/8 and no persistent memory of 0/8.With such gaps, the proposed Approach realizes 90–95% retention of context, 40–60% increase in engagement, and 25–35%higher recommendation accuracy. This paradigm bridges Ayurvedic knowledge with contemporary clinical intelligence in the delivery of personalized medicine, marking a shift towards Toward Relationship-Based, Culturally Grounded AI Healthcare.

**Keywords.** Ayurveda, Retrieval Augmented Generation, Memory Component, Personalized Healthcare, Conversational AI and LLM

**CMT 955**

# Impacted Tooth Detection Using MobileNetV2

**Adarsh Gogate, Mamatha Balipa**

NMAM Institute of Technology

**Abstract.** Dental radiography plays a crucial role in diagnosing abnormalities that cannot be seen during a clinical examination. One such abnormality is an impacted tooth, which can lead to infection, misalignment, and cyst formation if not detected early. Manual interpretation of dental X-rays is time-consuming and prone to human error. This research proposes an automated impacted tooth detection system using MobileNetV2, a lightweight and efficient deep learning architecture.The model is trained using transfer learning, image augmentation, and class balancing techniques to address severe dataset imbalance (Normal: 17,144 images; Impacted: 428 images). Experimental evaluation shows a test accuracy of 88.8%, demonstrating MobileNetV2's effectiveness in medical image classification. A Gradio-based interface enables real-time prediction with confidence scoring. This system has strong potential for clinical decision support and rapid dental screening.

**Keywords.** MobileNetV2, dental X-ray, impacted tooth, deep learning, transfer learning, medical imaging.

**CMT 957**

# Automated Oral Technical Evaluation Using Speech Recognition and Semantic Scoring

**Adithi Shetty, Mamatha Balipa, Aishwarya A Poojary**

NMAM Institute of Technology

**Abstract.** Manual oral examination evaluation is often sub- jective and inconsistent, with a very high time demand from examiners. This paper addresses the challenge of automatically evaluating spoken technical answers through an automated as- sessment framework by combining ASR with semantic similarity techniques.In this proposed system, the speech of a learner first undergoes speech-to-text conversion by ASR. Then, NLP models, such as BERT and Sentence-BERT (SBERT), compute cosine similarity between the meaning of a transcribed answer and a reference response. In the final score, both content relevance and fluency contribute to a more objective and bal- anced evaluation. Experiments show that this design decreases evaluator bias, improves scoring consistency, and presents a scalable method applicable both within educational institutions and during technical interviews..

**Keywords.** Automatic Speech Recognition (ASR), Semantic Scoring, BERT, Sentence-BERT (SBERT), NLP, Technical Eval- uation, Oral Assessment

**SME 961**

# Artificial Intelligence Based Prediction of Menopausal Transition Phases from Symptomatology

**Manjula Gururaj Rao [1] , Priyanka H [2], Sthuthi R [1], Pragathi S Rao [1], Tarani S Kulkarni [1], Prnavi Shetty[1]**

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**Abstract.** Menopause is a critical changeover in a woman's life, often accompanied by physical and psychological changes that affect overall health. Early identification of menopausal stages can support timely medical guidance and preventive care. This study explores the use of machine learning (ML) and deep learning (DL) techniques to predict menopausal stages based on symptom-related survey data. The model is able to predict 3 stages as peri-menopause, menopause and postmenopause. The collected responses and data set is created based on same. The dataset is preprocessed and analyzed using various classification models to determine the stage of menopause. The ensemble-based learning has shown the result of 86.55% of accuracy. The explainable AI is used to get the better result on the prediction of different stages of the menopause.

**Keywords.** Pre-processing, DL, ResNet, GoogleNet, EfficientNet, VGG, DenseNet, MobileNet

**CMT 963**

# Identification of Hate Speech in Kannada Through the Use of Deep Learning Technique

**Abishay M, Mamata Baplipa**

NMAM institute of technology

**Abstract.** The growth of regional-language content on digital platforms has amplified the demand for automated systems able to detect hate speech beyond just text. This project introduces a comprehensive Kannada hate speech detection system that examines audio characteristics and written text to categorize speech as hateful or benign. Unprocessed audio undergoes automatic speech transcription and translation as necessary, allowing for linguistic analysis in conjunction with acoustic feature extraction. Mel- Frequency Cepstral Coefficients (MFCCs) are extracted from each audio sample and input into a Convolutional Neural Network (CNN), with the translated text providing an extra semantic dimension to assist in classification choices. The model shows impressive results on the training data but lower precision on new samples, suggesting overfitting due to a small dataset and variability in the quality of speech transcriptions. In spite of these challenges, the project effectively creates a working baseline that merges audio and text indicators, showcasing the viability of automated detection of hate speech in Kannada and laying the groundwork for future enhancements with larger datasets and more sophisticated speech models.

**Keywords.** Kannada Speech Processing; Hate Speech Detection; MFCC Features; Convolutional Neural Network (CNN); Audio Classification; Speech-to-Text; Translation-based Analysis; Deep Learning.

**CMT 972**

# Mental Health Prediction System Using Artificial Intelligence

**Manjula Shenoy K [1], Sachin Singh [2]**

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**Abstract.** Mental health is a notably critical element of human well-being, particularly since stress grows via academic, professional, and personal pressures. This is a project which presents such a prediction system integrating Machine Learning (ML) and Deep Learning (DL) models. It gauges then forecasts mental health plus stress. Two distinct components are developed, with one handling structured numerical and categorical features. Inputs that are demographic and that are lifestyle-related get used in the XGBoost-based component while input that is freetext gets processed by the LSTM neural network so as to identify psychological conditions. To classify mental health conditions, the DL model interprets user-submitted textual descriptions of emotional states, along with the ML model using features like gender, occupation, country, treatment history, with behavior patterns to predict a stress mood index. A Flask-based web application deploys both models so users can input data plus they obtain quick helpful feedback. The combined system shows that using multi-modal AI techniques effectively improves mental health diagnostics as well as allowing early intervention.

# CONTENT

**CMT 19**

# Low-Cost Multimodal Fusion of 2D LiDAR and RGB Camera for Accurate Object-Level Perception

**Anil M. Kabbur [1], Vinod Kumar V. Meti [2], Prakash Pawar [2], Sumanth B [2], Karan G [2], and Mohammed Yunus M. G. Khatib [2]**

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**Abstract.** Sensor fusion between LiDAR and camera modalities has emerged as an effective approach for improving perception in autonomous robotic systems. However, most existing solutions rely on high-cost sensors and computationally intensive algorithms. This paper presents a low-cost LiDAR–camera fusion framework using a YDLiDAR TG30 2D LiDAR and a Logitech C270 RGB camera to achieve real-time object-level perception. The system is developed using ROS 2 Humble and integrates intrinsic and extrinsic calibration to accurately project LiDAR point clouds onto camera images. A custom fusion node performs coordinate transformation and depth-based visualization in real time. Experimental validation conducted in indoor environments demonstrates reliable projection accuracy within near-range distances, even under low-light conditions. The proposed framework offers an affordable, modular, and computationally efficient solution suitable for educational robotics, indoor navigation, and resource-constrained mobile platforms.

**Keywords** .YDLiDAR, Sensor Fusion, Multimodal, ROS, Object-level Perception.

**CMT 26**

# A study on propagation delay and power dissipation of a 2-bit CMOS magnitude comparator with critical path evaluation

**Tirunagari Manudeep [1],Tirunagari Manusree [1], Padilam Adithya Taran Yadav [1], Samana Nagendran [1],Arjun Sunil Rao [1], Jennifer Charlotte Saldanha [2]**

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**Abstract.** This work presents the design of 2-bit magnitude comparator in Cadence Virtuoso tool using gpdk090 technology. The detailed analysis of propagation delay and power dissipation (both dynamic and static power) for its outputs—L (A < B), E (A = B), and G (A > B) are analyzed. The comparator was simulated and evaluated to quantify delay and power behavior under varying conditions. Results show that the L (A<B) output achieves the shortest propagation delay of 7.55 ns, while the E (A=B) and G (A>B) outputs incur higher delays of 74.99 ns and 49.20 ns due to longer critical paths. Further, Results reveal that the L (A<B) output achieves the lowest power dissipation, with dynamic and static values of 5.07 mW and 1.49 µW, respectively, owing to its simple hierarchical decision path. The E (A=B) output exhibits the highest dynamic power consumption of 50.51 mW while maintaining a low static dissipation of 1.55 µW. This large dynamic overhead is attributed to the cascaded XNOR and AND logic used in equality detection, which introduces high switching activity and glitching effects. The G (A>B) output demonstrates moderate dynamic power of 8.11 mW but records the highest static leakage of 3.92 µW, arising from device sizing and threshold voltage trade-offs to enhance timing performance. These findings establish that equality detection is the most energy-intensive operation, while greater-than logic suffers from elevated leakage currents. The study provides critical insights into the relationship between logic structure and power characteristics, offering guidance for targeted low-power design strategies in comparator circuits and similar digital building blocks.

**CMT 34**

# Health Monitoring Systems for EV Battery

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**Abstract.** Electric vehicle (EV) battery health monitoring is crucial to guaranteeing dependability, performance, and safety. A data-driven State of Charge (SOC) prediction framework utilising machine learning models assessed across three distinct battery chemistries—Lithium-ion, Lithium Polymer, and Lead-acid in this paper. Different operating conditions were captured using publicly accessible datasets from Mendeley Data, the CALCE Battery Research Group, and open-source GitHub repositories. Due to its robustness and low computational complexity, a Random Forest Regressor (RFR) was employed as the main SOC estimation model. Its performance was compared with that of a Recurrent Conditional Variational Autoencoder (RC-VAE) to analyse modelling limitations and cross-chemistry generalisation. The Random Forest model is evaluated experimentally using Mean Absolute Error, Root Mean Squared Error, and the coefficient of determination ($R^2$). The results show that the Random Forest model offers more consistent and dependable SOC predictions, whereas the RC-VAE performs worse under specific datasets and scaling conditions. Additionally, as a proof-of-concept, a voice-activated, lightweight chatbot interface was incorporated to enable users to ask questions about SOC information and get basic charging-related advice through natural language interaction. The suggested method demonstrates how well cross-chemistry SOC estimation can be combined with user-friendly interfaces for useful EV battery monitoring applications.

**Keywords.** Electric vehicle batteries, State of Charge, Machine learning, Random Forest regressor, Battery monitoring

**CMT 35**

# Renewable Energy: A Path Towards Sustainable Development

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**Abstract.** The transition to renewable energy is integral for addressing the multifaceted challenges posed by climate change, while enhancing energy security and facilitating sustainable development. This review critically examines the contributions of solar, wind, hydro, biomass, and geothermal technologies to environmental, economic, and social sustainability. It presents analyses of both global and Indian contexts, with particular attention to policy frameworks, technological innovation, and persistent obstacles. The evidence suggests that advancements in energy storage, smart grid infrastructure, and green hydrogen are poised to significantly accelerate the ongoing renewable energy transformation.

**CMT 42**

# Extended Kalman Filter based SOC estimation of Lithium - Ion Battery

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**Abstract.** Battery Management System (BMS) is an electronic unit used for safety, durability and maintaining the performance of a rechargeable battery. It has become an integral part of modern batteries. Key functions of the BMS are Battery monitoring, Battery control and communication. Battery monitoring unit monitors the cell temperature, voltage and current. Battery control takes care of cell balancing, calculation of state of charge (SOC) and state of health (SOH) and control unit communicates the gathered information. In this work the focus is on estimation of state of charge using extended Kalman filter. SOC is estimated for a given drive cycle at different temperatures and compared it with the SOC estimated using the coulomb counting method. To calculate the actual SOC, SOC-OCV relationship for the given battery is made use.

**Keywords.** EV, C rate, SOC, SOH, BMS, HPPC

**CMT 43**

# Study of Gasochromic Pt-decorated WO3 thin films synthesized via the Sol-Gel Route

**Dr. Nisha[1], Megha Narayan[1], Dr. Palash Kumar Basu [2]**

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**Abstract.** Metal Oxide-based Chemi-resistive sensors for hydrogen gas detection utilize microheaters, posing a risk of explosion due to electric sparks, as hydrogen concentrations above 4% are highly flammable. Gasochromic sensors, on the other hand, are safe as they can detect target gases based on changes in optical transmittance at room temperature. The transmittance of synthesized films changes reversibly when the target gas is alternatively purged and stopped. In the proposed work, noble metal-doped WO3 thin films are synthesized via the sol-gel route followed by spin coating. UV-VIS-NIR transmittance spectra for the samples were measured at room temperature by alternatively exposing the samples to 4% Hydrogen and synthetic air. The results show that gasochromic sensing can be enhanced by increasing the doping concentration to 2wt%. The better sensing could be linked to the fine dispersal of the Pt nanoparticles on WO3 thin films, facilitating the adsorption and hydrogenation of molecular hydrogen.

**CMT 45**

# Microinverter Using Li-Ion Battery

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**Abstract.** The micro-inverter is small, compact source of energy and can provide a single-phase output voltage of 230v and support a load power of 150W. This microinverter can be used to power up devices such as Wi-Fi routers, mobile chargers, Closed-Circuit Television (CCTV) cameras, emergency medical equipment, emergency lights, etc. The DC power required for the inverter is obtained from the stack of Li-ion batteries connected in a series-parallel combination. The charge controller ensures the charging of the individual battery of the stack has a balance of charging and provides the protection required for the battery. Existing microinverters use lead acid battery. The proposed converter uses Lithium-ion batteries as they are more efficient compared to lead acid batteries and require less space, have low self-discharge, and have higher energy density. Charge controller is designed, simulated and the Printed Circuit Board (PCB) of the same is fabricated. This PCB ensures uniform charge distribution optimizing the size and heat dissipation. The inverter uses a modified sinusoidal pulse width modulation signal generated by a PIC microcontroller. The H-bridge configuration uses MOSFET as a switch and is driven by opto-isolators. The 12V AC output of the H-bridge is converted into 230V ac using the step-up transformer. Testing of the project is carried out at individual stages, and the results are verified with theoretical values.

**CMT 49**

# Multimodal Sensor Fusion for Real-Time Object Detection

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Department of Electronics and Communication Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, India.

**Abstract.** This paper describes a multimodal sensor fusion developed on the Raspberry Pi platform for real-time object detection and distance estimation. This architecture has a camera and a 24 GHz mmWave radar sensor for achieving the vision and a range sensing. A pretrained YOLO model is used for identifying classes such as persons from live video frames to carry out real-time object detection. The radar provides the distance measurement for which a 1-D linear Kalman filter is applied to get a smooth and accurate estimate, and then fused with the camera data. The result of this experiment showed that the fused system offers significantly higher stability in object detection and distance estimation as compared to single sensor readings. A final configuration where radar measurement is activated only when the detected object is at the centre of the frame, which achieved near-accurate results with less noise. The proposed system is lightweight and also cost-effective for real-time perception for low-cost embedded applications in autonomous vehicles and intelligent surveillance

**CMT 52**

# Lifecycle Assessment of Bioenergy Production from Waste Cooking Oil: A Review and Case Study

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**Abstract.** This paper presents a comprehensive review of the life cycle assessment (LCA) of biofuel production from waste cooking oil (WCO). It consolidates previous findings on greenhouse gas (GHG) emissions, revealing that WCO-based biofuels can achieve a minimum of 30% reduction compared to conventional diesel. The study also examines the policy landscape influencing WCO biofuel production, highlighting key regulatory drivers and barriers. Recommendations are proposed to stimulate industry growth and support sustainable biofuel adoption. The findings underscore the potential of WCO biofuels as a viable low-carbon alternative in the transition to cleaner energy systems. Finally, the paper concludes with preliminary findings of an inter-university project involving the use of biodiesel derived from WCO in fishing boats in Malaysia.

# CONTENT

**INTERNATIONAL CONFERENCE ON NURTURING INNOVATIVE TECHNOLOGICAL TRENDS IN ENGINEERING – BIOSCIENCE (NITTE-BIO 2026)**

# CONTENT

**INTERNATIONAL CONFERENCE ON NURTURING INNOVATIVE TECHNOLOGICAL TRENDS IN ENGINEERING – BIOSCIENCE (NITTE-BIO 2026)**

**BIO 2606**

# Production and Characterization of Biofuel from Macroalgae: A Sustainable Biofuel Alternative

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Department of Biotechnology, K. S. Rangasamy College of Technology, Tiruchengode, Tamil Nadu, India.

**Abstract.** The fossil fuel depletion and the rising energy demand have driven interest in renewable biofuels. This study demonstrates the production of biodiesel from macroalgae through lipid extraction and direct trances terification using sulphuric acid and methanol. This process yielded biodiesel and glycerol. On further purification, the biodiesel was separated and the key physical properties were studied. The properties like density (0.8292kg/m$^3$), viscosity (2.071 cP), flash point (43°C) and fire point (47°C) were favourable. Combustion analysis of B5 biodiesel showed heat released rate 44J/deg at 36°C. These findings show that biodiesel produced from macroalgae is a potential fuel alternative.

**Keywords.** Biodiesel, Lipid extraction, Direct Transesterification, Combustion analysis, B5 Biodiesel, Macroalgae.

**BIO 2612**

# Optimization of process parameters for the extraction of natural pigment from Cassis auriculata using Response Surface Methodology

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**Abstract.** Cassia auriculata is one among the potential source of carotenoid which serves as the natural food colorant and antioxidant. The present study highlights the comparison of various extraction methods including cold extraction, Soxhlet extraction, microwave assisted and ultra sound assisted extraction of carotenoid from Cassia auriculata. Phytochemical screening of Cassia auriculata using aqueous and organic solvents of different polarity was done. Spectroscopic analysis was performed using UV-Visible Spectrophotometer and quantitative estimation of total carotenoid was also done. Among the tested methods, based on extraction efficiency and the quantity of carotenoid extracted, microwave and ultrasonic assisted extraction methods were found favorable. Ultrasonication resulted with the 99.4 % efficiency and 90.7 µg/g of carotenoid for DMSO extract whereas microwave assisted extraction yielded 97.1 % efficiency and 93.6 µg/g of carotenoid for hexane extract. Further, a two-level full factorial central composite design of Response surface methodology performed for ultrasound assisted extraction method revealed that the solvent-material ratio of 5 % and extraction duration of 8 min was found as the optimal process parameters for the maximal extraction of carotenoid content of 97.266 µg/g. The validation also confirmed that the experimental values were in good agreement with the predicted optimal solutions. Hence, the study proposed an efficient way of extracting carotenoid from Cassia auriculata by the method of ultrasound assisted extraction.

**Keywords.** Cassia auriculata; Carotenoid; Optimization; Microwave assisted extraction, ultrasound assisted extraction.

**BIO 2614**

# Growth Optimization of Antioxidant and Antimicrobial activity of Lentinus SP

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**Abstract.** The growth conditions of Lentinus edodes, a edible mushroom was optimized by employing various medium both in liquid and solid medium. The antioxidant activity of Lentinus sp mushroom, and to determine the total phenolic and flavonoid compound of mushrooms extract. The antioxidant property was conducted by two method i.e., ABTS (2-2'-azino – bis(3ethylbenzothiazoline-6-sulphonic acid)) and DPPH(1, 1- dipHenyl-2-picryl hydrazyl). By ABTS method, they exhibited highest antioxidant activity in ethyl acetate extract of around 58.85%, while, in DPPH they exhibited 50.12%. The total phenolic compound content was found higher in the ethyl acetate extract of 1.370mg/g gallic acid equivalent, while in Flavanoid compound is exhibited 1.350mg/g of catechins equivalent. The antimicrobial properties of Lentinus sp culture filterate extracted with four different different solvent (Hexane, Ethylacetate, Chloroform and Dichloromethane) were discussed. Agar well diffusion test method was used for the evaluation of activity using bacteria (Pseudomonas aeruginosa, Staphylococcus aureus, Micrococcus leuteus, Escherichia coli, Vibrio cholera, Salmonella flexineri) and yeast (Candida albicans).The crude extracts of Lentinus sp possesses relatively high antimicrobial activity. Out of the four different organic extracts ethyl acetate extract was more effective and inhibited the growth of human pathogenic bacteria and yeasts.

**Keywords.** Lentinus sp Mushroom, Antioxidant, ABTS, DPPH, Antimicrobialactivity.

**BIO 2615**

# Green synthesis of nanoparticles from holy basil leaves for enhanced antimicrobial activity

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**Abstract.** The storage of short-shelf-life vegetables, like ladies' finger (okra), is frequently hampered by microbial spoilage and nutrient breakdown. In this paper, a green synthesis method of silver nanoparticles (AgNPs) with Holy Basil (Ocimum sanctum) leaf extract as an environmentally friendly reducing and stabilizing agent has been developed. Phytochemical characterization established the bio active compounds, tannins, flavonoids, phenols, and proteins, required for the formation of nanoparticles. Synthesized AgNPs were identified with UV-Vis spectroscopy, SEM, EDX, and XRD to analyze their morphology, crystalline nature, and stability. Antimicrobial and antioxidant bio assays exhibited remarkable activity against Escherichia coli and Aspergillus niger, with potential in inhibiting microbial contamination and oxidative spoilage. Biodegradable film coatings loaded with AgNPs were applied to ladies' finger to analyze their efficacy in shelf-life extension. Coated vegetables showed less microbial growth, lower dehydration levels, and retained nutritional and sensory values over a longer period. This study identifies the capability of Holy Basil-mediated AgNPs as a green and sustainable vegetable preservation solution, which meets environmental and food safety objectives.

**Keywords:** Green synthesis, silver nanoparticles, Holy Basil (Ocimum sanctum), Antimicrobial film, Food preservation.

**BIO 2618**

# Development and agronomic evaluation of liquid organic fertilizer derived from black soldier fly (BSF) frass

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**Abstract.** In recent years, the Black Soldier Fly (Hermetia illucens) has attracted quite a bit of public interest in both social media and print media for its ability to process organic waste material into valuable products under the guise of sustainable and circular agriculture. One of these mixed organic waste materials is often referred to as frass, which is the combination of the larvaes feces, the consumed feed, and molted larvae skin. Frass is an effective soil amendment for soil fertility and plant health since it is a readily available tough plant material that nature provides the three macronutrients (N-P-K) and carbon from organic matter, macronutrients, probiotic microbes, and chitin. Additionally, other scientists have studied various aspects of frass such as nutrient biodegradability and more simply, the formulations and uses of liquid organic fertilizers (LOFs), both from frass and the leachate from frass. The appeal of LOFs to increase convenience in application as in application for example, fertigation or foliar sprays, is encouraging for commercial application. There is already considerable reporting on the impacts of plant and soil microbe activity for the plant germination, growth and development, yield etc., aspects of frass derived LOFs. The method of formulation and stabilization may employ microbial fermentations, thus mitigating an anticipated challenge such as Response Surface Methodology (RSM), to show that the fermentation of microbial will provide nutrient density and good shelf-life. Hence, strong evidence shows that LOFs from BSF frass, are both a reasonable nutrient source and renewable, as we minimize wasting chemical fertilizer and organics waste pollutants. As such, BSF frass LOFs in agriculture is an additive sustainable nutrient recycling practice. In order for practice to scale-up, future research should concentrate on standardization, quality control forms and demonstration.

**BIO 2626**

# Studies on Method of Mitigating Fuel Losses from Fuel Tank of Two-Wheeler

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**Abstract.** In India, two-wheelers are the most widely used form of transportation because of their low cost, good fuel economy and versatility on crowded roads. They serve a variety of users, from urban commuters to rural residents and include motorbikes, scooters and mopeds. India is now home to one of the world's largest two-wheeler markets due to the country phenomenal development in the two-wheeler population over time. Due to its large geographic area and diverse range of climatic zones, India sees a wide variety of weather conditions. In general, India's summers are quite hot, though local differences are significant. In order to minimize gasoline loss from a two-wheeler fuel tank, which is mostly caused by evaporation, a number of measures are employed in an effort to reduce exposure to environmental conditions and minimize vapor emission. The higher solar radiation and higher air temperature accelerate the fuel losses from the fuel tanks of two wheelers. In this work, we have used rexin cover and rexin cover with aluminium foil and it was mounted on the outer surface of the fuel tank of the two-wheeler to reduce the fuel losses as petrol is highly volatile. The experiments were conducted during hot summer and the fuel losses were measured from tanks with and without rexin and rexin with aluminium foil. From the experiments it was observed that the fuel losses increase with increase in time and reduces in the evening. The fuel losses were minimum with rexin cover with aluminium foil and this is due to reduction in solar radiation which enters the fuel tank.

**Keywords.** Petrol, fuel tank, evaporative loss, mitigation, tank cover.

**BIO 2631**

# Altered Fatty Acid Composition and Its Relationship with Inflammatory Markers in Type 2 Diabetes Mellitus

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**Abstract.** Type 2 Diabetes Mellitus (T2DM), a metabolic disorder affecting the status of the glucose in the human body. Fatty acid composition has a central role in modulating inflammation, an important driver of diabetes initiation and progression. Imbalances in saturated, monounsaturated, and polyunsaturated fatty acids can trigger pro inflammatory pathways, contributing to insulin resistance. The study sims to investigate the correlation between fatty acid profile and inflammatory markers (hs-CRP and Interleukin-6) in type 2 diabetic individuals. The biochemical analysis was done with the use of kits available in the market. The gas chromatography technique was applied for the fatty acid profiling. The data was analyzed using SPSS software. Total saturated Fatty acid (SFA) and total Ω 3 poly unsaturated fatty acid (PUFA) were significantly increased in diabetics compared to non-diabetics ($P<0.001$), whereas total mono unsaturated fatty acid (MUFA) and total omega-3 PUFA were significantly decreased in diabetics. Interleukin-5 and hs-CRP is significantly positively correlated with total omega-6 PUFA and negatively correlated with total omega-3 polyunsaturated fatty acids. Results suggests an imbalance in fatty acid composition - particularly elevated saturated and omega-6 fatty acids and reduced Ω-3 and MUFA – may contribute to systemic inflammation and insulin resistance in T2DM.

**Keywords.** Type 2 Diabetes mellitus; hs-CRP, Interleukin-6; Fatty acids; PUFA.

**BIO 2632**

# A Comparative study on Calophyllum inophyllum and Hevea brasiliensis seed oil-based Biodiesel Production Process

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**Abstract.** Biodiesel is regarded as the most promising renewable substitute for fossil diesel fuel, with the potential for production in rural regions of economically underdeveloped areas in developing countries. Biodiesel can be produced from non-edible seed oils by single stage transesterification or two stage esterification-transesterification reaction. In the present study, biodiesel was produced from non-edible Calophyllum inophyllum and Hevea brasiliensis seed oil using the lab scale reactor with optimum process parameters. Since both oils had higher amount of Free Fatty Acid (FFA) content the initial esterification pre-treatment was carried out to reduce acidic content of oil. Then the critical reaction parameters catalyst (NaOH) concentration, alcohol (Methanol) volume and reaction time were varied to maximise the biodiesel yield for both sources. The final biodiesel yield of 89% from Calophyllum inophyllum oil and 90% from Hevea brasiliensis seed oil was obtained. Comparatively both sources had optimum process parameters of catalyst concentration of 1% (wt/v), alcohol concentration of 35% (v/v) an 90 min reaction time for the highest biodiesel yield.

**Keywords.** Biodiesel, Transesterification, Non-edible seed oil, Calophyllum inophyllum, Hevea brasiliensis.

**BIO 2634**

# Phytogenic Fabrication of Tithonia diversifolia Zinc Nanoparticles as a Therapeutic Modulator in Redox Equilibrium, Inflammatory Modulation, and Oral Tissue Repair

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**Abstract.** This study aimed to synthesize flower-mediated zinc oxide nanoparticles (ZnO-NPs) via green synthesis using Tithonia diversifolia. The synthesized nanoparticles were characterized through UV-Visible Spectroscopy, with an absorbance peak at 370 nm, Fourier Transformed Infrared Spectroscopy (FT-IR), which gave peaks for O–H stretching, C–H stretching, C=O stretching, C–N stretching, Scanning Electron Microscope (SEM), revealed uniform spherical nanoparticles of sizes ranging from 125.3nm to 169.7nm, X-Ray Diffraction (XRD) confirmed the crystalline nature of the Zinc Oxide nanoparticles. Energy Dispersive X-Ray (EDAX) spectrometer analysis confirmed the elemental signal of ZnO NPs. The ZnO nanoparticles showed strong antioxidant, antiarthritic, and antiperiodontal activities. Their highest antioxidant inhibition of 80.53% in the DPPH assay (IC 50 values) indicated their unique capacity to scavenge free radicals. Their maximum antiarthritic inhibition of 80.36% in the protein denaturation assay reflected their strong potential. The antiperiodontal study revealed the highest antibacterial effect against Enterococcus faecalis with a maximum inhibition zone at a 100 µg/ml concentration.

**Keywords**: Tithonia diversifolia, Zinc nanoparticles, Green synthesis, Antioxidant activity, Anti-arthritic activity, Anti-periodontal activity.

**BIO 2635**

# Fasting effects of paracetamol-induced hepatotoxicity in Rats by analysing lipid profile and Histopathological Studies

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**Abstract.** Paracetamol (acetaminophen), a drug that is mainly used for its antipyretic and analgesic features. An overdose can lead to hepatotoxicity which will cause a significant change in the biochemical and physiological properties. This study mainly focuses on the effects of fasting on paracetamol-induced hepatotoxicity in rats by analysing and comparing the alterations on lipid profile and histopathological parameters. For the experiment wistar albino rats were taken and divided into groups such as control, only fasting, fasting with drug, only drug induced.
Time duration for fasting is 16 hours. Hepatotoxicity was induced by administering a dose of paracetamol through oral administration, an 2g/kg in rats at the end of 7 th day and fasting was implemented for a pre- determined period of 16 hours before induction. Lipid profile testing, including the cholesterol, triglycerides, and lipoprotein fractions were measured, with Liver tissues were harvested for histopathological examination to assess structural damage, inflammation, and cellular integrity. In Conclusion, Clinical lab results show that analysing an significant lipid dysregulation and extensive hepatic damages in the hepatotoxic group by comparing to other fasting and controls groups. Fasting method provides a protective effect by mitigating lipid profile disturbances and reducing histopathological alterations such as hepatocyte degeneration, necrosis, and inflammation. With these findings, a potential protective role of fasting method can be implemented against paracetamol-induced hepatotoxicity.

**Keywords.** Paracetamol, Histopathological, Fasting, lipid profile, Hepatotoxicity.

**BIO 2637**

# In vitro rejuvenation of the therapeutic plant Andrographis paniculata: A sustainable step toward pharmacological resource management

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**Abstract.** An efficient and readily dependable in vitro protocol for total plant regeneration from apical bud through multiple shoot proliferation has been established for Andrographis paniculata, a threatened medicinal plant since it has varied pharmacological properties and thus its conservation and cultivation are of prime importance. Explants are grown on Murashige and Skoog medium containing B5 vitamins, sucrose (3%), and growth hormones (BAP, KN, IAA, NAA) for the initiation of shoots, multiplication, and induction of roots at different combinations and concentrations of BAP, KN (0.05–2.00 mg/L) individually as well as in different concentrations of BAP+KN, BAP+IAA, BAP+NAA. IBA, NAA, and IAA in the range 0.2–2.0 mg/L are applied for root induction. Shoot induction frequency was highest in BAP (1.0 mg/L) with a response percentage of 73.2%. Adventitious bud induction from nodal explants was highest in BAP+NAA (84.8%). Shoot length of BAP+KN averaged at 3.71 cm (74%) at 1.0+0.5 mg/L, and BAP+NAA at 1.0+0.6 mg/L reached a value of 5.70 cm (84.8%). The highest response was observed at BAP (89.2%), KN (29.3%), BAP+KN (37.4%), and BAP+IAA (33.1%). Out of auxins tested, IBA 1.0 mg/L showed maximum root induction (89.2%). Hence, in vitro grown A. paniculata propagation is a more suitable option for sample collection for drug production.

**Keywords.** Andrographis paniculata, In vitro regeneration, Multiple shoot proliferation, Plant tissue culture, Growth hormones.

**BIO 2638**

# Phytogenic Silver Nanoparticles from Andrographis paniculata: Green Nanotherapeutics Targeting Diabetes, Oxidative Stress, and Fungal Infections

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**Abstract.** The burgeoning focus on eco-friendly nanotechnology has propelled investigations into plant-mediated synthesis of functional nanoparticles. Leveraging Andrographis paniculata, an herb with extensive pharmacological relevance, this work elaborates the green synthesis of stable silver nanoparticles (AgNPs) using ethyl acetate leaf extract. Characterization via UV-Vis spectroscopy, FTIR, SEM, and TEM confirmed the formation of monodispersed, biomolecule-capped spherical AgNPs measuring 180–200 nm. These nanoparticles demonstrated pronounced antidiabetic activity through significant α-amylase and α- glucosidase inhibition, exhibiting IC50 values of 0.75 μg and 0.80 μg respectively, closely paralleling the standard drug acarbose. Furthermore, robust antioxidant potential was established via DPPH and hydrogen peroxide scavenging assays. Antifungal efficacy against Malassezia furfur was evident with low minimal inhibitory concentration, highlighting antidandruff potential. Cytotoxic evaluation on INS-1 pancreatic β-cell lines showed a dose-dependent controlled decrease in cell viability, underscoring therapeutic safety. Collectively, these findings reveal that Andrographis paniculata - mediated AgNPs are promising multifunctional nanotherapeutics combining antidiabetic, antioxidant, and antifungal properties. This green synthesized nanoplatform offers a sustainable, cost- effective alternative for developing novel pharmacological agents targeting diabetes and associated oxidative and microbial disorders with significant translational potential in biomedicine.

**Keywords**. Andrographispaniculata, Silvernanoparticles (AgNPs), Antidiabetic activity, Antioxidant Potential, Cytotoxicity and antidandruff Assay.

**BIO 2653**

# The Efficacy of Lemon Oil (Citrus Limon) as a Natural Antimicrobial Agent Against Clinically Relevant Pathogens: A Triplicate Suspension Test Study

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**Abstract.** The global rise in antimicrobial resistance has necessitated the exploration of alternative and complementary antimicrobial agents. Essential oils, with their complex phytochemical profiles, present a promising avenue. This study rigorously evaluates the in vitro antimicrobial efficacy of cold-pressed lemon oil (Citrus limon) against three clinically significant pathogens: Escherichia coli (a Gram-negative bacterium), Staphylococcus aureus (a Gram-positive bacterium), and Candida albicans (a fungal yeast). A standardized suspension test method, based on the European Standard EN 13697, was employed. Three independent trials were conducted for each organism, testing lemon oil concentrations of 3%, 4%, 5%, 6%, and 7% (v/v) over contact times of 10, 20, 30, and 40 minutes. Microbial viability was determined using the pour plate method, and results were expressed as $Log_{10}$ reductions relative to untreated controls. The results demonstrated a clear dose dependent and time dependent biocidal activity. E. coli proved to be the most susceptible, achieving a >1 $Log_{10}$ reduction at 5% in 30 minutes. S. aureus and C. albicans required slightly higher concentrations or longer contact times to achieve similar reductions, with consistent >1 $Log_{10}$ reduction observed at 5-7% within 30-40 minutes. The highest reductions (1.5-1.6 $Log_{10}$) were observed at 7% for 40 minutes across all pathogens.
These findings substantiate the significant antimicrobial potential of lemon oil and support its further investigation as a natural disinfectant or antiseptic agent for clinical and community settings to help mitigate the burden of healthcare associated infections and antimicrobial resistance.

**Keywords.** Lemon Oil, Citrus limon, Essential Oil, Antimicrobial, Escherichia coli, Staphylococcus aureus, Candida albicans, Pour Plate Method, Suspension Test, Log Reduction, Clinical Pathogens.

**BIO 2654**

# Extraction of Hesperidin from Sweet orange peels

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**Abstract.** Flavonoids constitute widespread phenolic compounds present in all the plant spices and are the main cause for the colouring of flowers, fruits, and leaves. The natural biosynthesis, isolation, and structural explanation have wide applications in the food, drug and processing industries. Hesperidin is the major flavanone glycoside is the one of the constituent of locally available (Nagpur) oranges. Dried orange peels are extracted from methanol at room temperature; the solvent is evaporated and loaded on a column with different resins to recover Hesperidin. The solute affinity was verified with the Tulsion 40, 42, and 343 resins for pH and concentration. The desorption of Hesperidin gave the best results using 0.5N NaOH as eluent. The average extracted Hesperidin is in the range from 1.25% to 1.35%. The extraction was efficient when large quantities of the peels were used with the water and orange peel ratio of 6.

**Keywords.** Orange peel, Extraction, resin, adsorption, and Hesperidin.

**BIO 2660**

# Crop Yield Prediction Using Random Forest Regressor

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**Abstract.** Crop yield prediction is an essential component of modern agricultural planning, having direct policy implications on food security and resource allocation. The research effort underlying this study applies machine learning techniques to forecast agricultural yield based on a wide, multi-dimensional dataset of Indian crop production for the period 1997-2020. This dataset knits together such dimensions as agronomic properties, geographic regions, seasonality, rainfall, and, importantly, key input parameters like fertilizer and pesticide use. Out of multiple advanced predictive tools, the most appropriate was Random Forest Regressor, considering its robustness, interpretability, and capability to capture nonlinear interactions within heterogeneous agricultural ecosystems. The model proved to be highly reliable and achieved a very high generalizing performance with a R2 score of 0.9696, thus explaining 96.96% of the variance in yield outcomes. Error metrics further validated the stability of the model, where RMSE stood at 156.11 tonnes per hectare and MAE at 14.15 tonnes per hectare, whereas overfitting was minimal, indicated by a difference of only 0.56% between the training and testing R2. Feature importance analysis showed that the type of crop emerged as the most decisive variable, contributing 82% to predictive power, with geographic location following at 15%, hence providing useful insights for data driven decision-making in agriculture and regional planning. In general, results establish the appropriateness of Random Forest for large-scale, practical yield prediction scenarios and point out perspectives for its integration into precision agriculture systems, sustainable farming initiatives, and long-term strategic policy development.

**Keywords.** Crop Yield Forecasting, Random Forest Regressor, Agricultural Data Modeling, Precision Agriculture, Non-linear Regression Models.

**BIO 2668**

# Development Of Herbal Hand Sanitizer Through Teak (Tectona Grandis) Leaf Extract and Formulation of Natural Ph Indicator and Ph Strips Through Bougainvillea Glabra (Betacyanin) – Review

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**Abstract.** Hand washing is one of the foundations of community health and it is important in the prevention of infectious diseases transmission both at the community and clinical setting. The growing concern about the harmfulness of synthetic antimicrobial agents and chemical additives has prompted the strong interest in herbal and environmentally friendly alternatives. Plant-based hand sanitizers supplemented with bioactive phytochemicals are in this case a safer, sustainable and effective method of controlling microbes. Tectona grandis (teak) leaves are well known due to their antibacterial, antioxidant and anti-inflammatory effects which are ascribed to the presence of flavonoids, phenolics, and tannins hence it has a potential in the formulation of herbal hand sanitizer. At the same time, the skin compatibility and stability of the product also require monitoring and maintenance of appropriate pH. Plant-based natural pigments have been considered as better alternatives to synthetic pH indicators. Bougainvillea glabra bracts have high concentrations of betalain pigments, particularly betacyanins, which experience dramatic changes in a wide pH range with exceptionally high antioxidant stability. A combination of all these properties makes betacyanin an effective natural pH indicator. The innovation of pH indicator solutions and strips based on Bougainvillea glabra serves not only to increase the product safety level but also to facilitate the green chemistry concept. Thus, the present research will combine the design of a herbal hand sanitizer made of teak leaf with the design of natural pH indicators and strips of Bougainvillea glabra, and encourage the use of sustainable, plant-based approaches to personal hygiene products.

**Keywords.** Herbal hand sanitizer, Tectona grandis, Bougainvillea glabra, Betacyanin, Natural pH indicator, pH strips, Phytochemicals.

**BIO 2671**

# Genomic Signal Processing Approach for Mutation-Specific Lung Cancer Detection Using Multi-Domain Feature Fusion

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**Abstract.** Accurate identification of mutation-driven lung cancer remains a critical challenge in genomic diagnostics, particularly for genes such as TP53 and EGFR that play a central role in tumor progression. This work presents a comprehensive signal- processing-based framework for mutation-specific lung cancer detection using DNA sequence analysis. The proposed approach integrates numerical mapping of genomic sequences with hybrid spectral feature extraction and machine learning–based classification. Three numerical representations—EIIP, binary mapping, and complex mapping—are investigated to evaluate their influence on classification performance. Genomic sequences are transformed using signal processing techniques, and discriminative features are extracted through frequency-domain analysis before classification using a support vector machine with k-fold cross-validation. Quantitative evaluation demonstrates that complex mapping provides superior performance, achieving an accuracy of 95.4%, sensitivity of 94.7%, specificity of 96.1%, and an AUC of 0.982. Binary mapping achieves moderate performance with 92.1% accuracy, while EIIP mapping shows comparatively lower discrimination capability with an accuracy of 89.3%. The results clearly indicate that incorporating both magnitude and phase information through complex-valued representation enhances the separability of mutation-specific genomic patterns. Overall, the proposed framework offers a reliable and computationally efficient approach for mutation-level lung cancer detection. Its modular design allows easy integration with advanced learning models, making it suitable for future genomic diagnostic and precision medicine applications

**BIO 2672**

# Lung Cancer Detection Using Yolov8s: A Deep Learning Approach For Medical Image Analysis

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**Abstract.** Lung cancer remains one of the leading causes of cancer-related mortality world- wide, with early detection being crucial for improved patient outcomes. This paper presents a comprehensive approach to lung cancer detection using YOLOv8s, a state-of-the-art object detection algorithm, applied to medical imaging datasets. Our methodology involves training a custom YOLOv8s model on a dataset of 1,400 lung CT images annotated with three distinct classes: adenocarcinoma, general cancer lesions, and lung nodules. The model was trained for 70 epochs with optimized hyperparameters, achieving remarkable performance metrics including 98.66% mean Average Precision (mAP@50), 94.82% precision, and 96.64% recall. The experimental results demonstrate the effectiveness of YOLOv8s in accurately detecting and classifying lung cancer abnormalities, with inference times of 23.8ms per image at 640×640 resolution, making it suitable for real-time clinical applications. This research contributes to the growing field of computer-aided diagnosis systems and provides a robust foundation for automated lung cancer screening tools that can assist radiologists in early detection and diagnosis.

**Keywords.** Lung cancer detection, YOLOv8s, Deep Learning, Medical Image Analysis, computer-aided diagnosis, object detection, CT imaging.

**BIO 2673**

# Rapid Composting of Solid Waste: An Eco-Friendly Solution for Affordable Organic Manure

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**Abstract.** Rapid composting technology has received considerable attention during recent years because of its scientific credibility and financial viability in organic waste treatment and soil fertility amendment. Rapid composting technology not only relieves the pressure on municipal landfill sites but it is also an effective tool for farmers to obtain inexpensive and nutrient-rich organic manure for prosperous crop cultivation. In this light, this research work endeavored to transform different kinds of organic wastes such as flower waste, corn husk, plantain waste, tea powder waste, and vegetable waste into high-quality organic manure using an optimized aerobic rapid composting technique. To achieve various treatment combinations such as T1 through T9 with changing proportions of different kinds of organic waste and cow dung using bulking, all samples were placed in grow bags of 18 × 18 cm with periodic turning to facilitate sufficient aeration and microbial action. Compost samples were obtained at 15-day intervals up to a total of 75 days with analysis of samples to evaluate the maturity status of various samples, different physicochemical parameters were analyzed, including moisture content, pH, electrical conductivity, total organic carbon, nitrogen, phosphorus, potassium, and organic matter. The experimental results showed that T4, T5, T6, and T7 have an ideal composition level with substantially increased content of NPK and an ideal C/N ratio varying from 3.84:1 to 17.32:1, ensuring effective decomposition of organic matter. Based on this experimental work, rapid composting can become a cost-effective and efficient tool in preparing high-quality organic manure with parallel reduction in solid organic waste.

**Keywords.** Organic fertilizers, Municipal solid wastes, Degradable, Flower waste, Plantain waste Compost.

**BIO 2674**

# A CNN–BiLSTM Framework for Splice Site Prediction: Performance and Complexity Trade-Offs of DNA Numerical Mappings

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**Abstract.** Accurate identification of splice sites is a fundamental task in genomic sequence analysis, directly influencing gene structure annotation and downstream biological interpretation. This work presents a convolutional neural network–bidirectional long short-term memory (CNN-BiLSTM) framework for splice site prediction and systematically investigates the impact of different DNA numerical mapping schemes on both classification performance and computational complexity. Four widely used representations—binary, integer, EIIP, and complex mapping—are evaluated using the same network architecture and training protocol to ensure a fair comparison. Experimental results obtained from biologically realistic synthetic DNA sequences demonstrate that the proposed framework achieves consistently high performance across all mappings. Binary mapping attains an overall accuracy of 98.33% with a macro F1-score of 0.983, while EIIP mapping improves biological expressiveness, yielding an accuracy of 97.56%. Complex mapping delivers the best predictive performance, achieving 98.91% accuracy and a macro F1-score of 0.985, at the cost of increased computational overhead. In contrast, integer mapping offers the lowest memory and computational requirements but shows comparatively reduced accuracy of 96.84%. Receiver operating characteristic analysis confirms strong class separability, with area under the curve values exceeding 0.95 for all mapping schemes. The results highlight a clear trade-off between predictive accuracy and computational efficiency, providing practical guidance for selecting suitable DNA representations in splice site prediction tasks.

# CONTENT

**INTERNATIONAL CONFERENCE ON CIVIL ENGINEERING TRENDS AND CHALLENGES FOR SUSTAINABILITY (CTCS-2026)**

**CTCS 2604**

# Sustainable Development and Evaluation of a Geothermal Cooling System under Varying Water Temperatures

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**Abstract.** There is a need to develop a sustainable cooling system to reduce global warming and ozone layer depletion. There are several sustainable cooling systems and, in this work, we carried out experimental investigation on a geothermal-based low-cost cooling system to evaluate its performance and it is driven by solar PV system. In this work, a 100-liter water tank was used to simulate well water conditions, and a compact heat exchanger served as the cooling coil. The water from the water tank was circulated through the cooling coil using a pump. An axial fan was used to direct the room air across the cooling coil's surface to facilitate sensible heat transfer between the room air and cooling coil. The system performance was evaluated by conducting the experiments by varying the tank water temperatures such as 28, 26 and 24 °C. At steady state condition, important performance parameters such as dry bulb and wet bulb temperatures of air, air velocity, and pressure drop across the heat exchanger were measured. From the results analysis, it was observed a significant reduction in dry bulb temperature with decreasing water temperature. However, the wet bulb temperature of the air remained nearly constant. Due to consistent airflow characteristics, the air velocity and pressure drop across the heat exchanger were observed to remain stable. The coefficient of performance of this cooling system is improved with lower water temperatures due to increased cooling effect and nearly constant power consumption. From this work, we suggest that the renewable energy driven geothermal cooling system will be suitable for rural areas to mitigate the demand of conventional air conditioning system using well water as the cooling medium.

**Keywords.** Alternative cooling, geothermal, water temperature, laboratory study, performance

**CTCS 2615**

# Comparative Assessment of Lighthouse Project Construction Technologies for Urban Housing: A GHTC-India Framework

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**Abstract.** Rapid urbanization demands alternatives to conventional cast-in-situ construction methods. This study evaluates six prefabricated technologies under the Global Housing Technology Challenge (GHTC) framework through literature review, government document analysis, and semi-structured surveys with industry professionals. Using purposive sampling and analytical comparison, prefabricated 2D panel systems and 3D volumetric modular technologies emerged as optimal solutions for Lighthouse Projects (LHP). Case study confirms 40-50% time savings, 20% cost reduction, and enhanced performance. However, adoption barriers include logistical challenges, skilled workforce shortages, and high initial investment requirements. Results demonstrate that modular prefabrication provides viable pathways for sustainable urban housing with appropriate policy and industry support.

**Keywords.** Prefabrication; Modular construction; Lighthouse Project; Urban Construction; Mass Housing

**CTCS 2619**

# Identification and Quantification of Pavement Surface Distresses Using Convolutional Neural Network and Image Processing Techniques

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**Abstract.** Automated pavement distress detection is a key element in the assessment of road surface conditions and is crucial in the establishment of intelligent maintenance systems. Convolutional Neural Networks (CNNs) have been very successful for image classification purposes, providing a strong alternative to traditional image processing techniques. In this work, an automated system for quantifying road surface distress dimensions, namely cracks and potholes, is described. First, a CNN model was trained on an open-source dataset to segment distress types. Then the segmented images were processed using OpenCV-based image processing methods like gray scaling, blurring, reducing noise, and edge detection to extract distressing features. These features were further utilized to calculate the width of cracks and potholes detected. The approximated measurements were cross-validated against the manually calculated values using performance criteria like Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). In the case of both potholes and cracks, the calculated error was below 3 mm, showing an excellent level of accuracy. The findings indicate that this method is applicable for field implementation, which can provide a reliable calculation of distress dimensions and subsequent Pavement Condition Index (PCI) estimation following IRC:82 guidelines.

**Keywords:** Pavement Distress; Convolutional Neural Network; Image Processing; Feature Extraction; Pavement Condition Index (PCI).

**CTCS 2621**

# Data Driven Forecasting of River Water Quality Index to Support Sustainable Water Management

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**Abstract.** An accurate estimation of the Water Quality Index (WQI) is a must for the proper management of water resources, the protection of the environment, and the health of the public. The research examines the comparative efficacy of four machine learning models: Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest (RF), and Long Short-Term Memory (LSTM) in predicting WQI from nine essential physicochemical parameters: BOD, DO, pH, temperature, nitrate, COD, conductivity, and TOC. To enable sequential learning in the LSTM model, a thorough pre-treatment pipeline was developed, which included feature standardization and dataset conversion. For the training, testing, and total datasets, the model is evaluated using R2, RMSE, and MAE. The results indicate significant variations in the models' predictive power. RF surpassed other models by a large margin, thus proving its excellent predictive stability and robustness. It achieved an overall R2 of 0.9985, an RMSE of 1.67, and an MAE of 0.73. ANN and LSTM models also demonstrated good performances (R2 ≈ 0.994), thus being strong evidence of their capability to model complex nonlinear interactions in water quality datasets. On the contrary, SVM's performance was considerably less strong (R2 ≈ 0.62), indicating that it cannot capture nonlinear and multivariate patterns well. Residual analysis is in line with the argument that RF, ANN, and LSTM have a robust generalization ability. The paper points out Random Forest as the most trustworthy and accurate model for real-time WQI prediction. At the same time, ANN and LSTM may be viable alternatives, particularly in monitoring dynamic or temporally varying situations.

**Keywords:** Water Quality Index (WQI); Support Vector Machine (SVM); Artificial Neural Network (ANN); Random Forest (RF); and Long Short-Term Memory (LSTM) and prediction

**CTCS 2623**

# Experimental Study on Sustainable Concrete using blended cement binders

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**Abstract.** The escalating utilization of Portland cement has intensified global environmental concerns, thereby motivating the systematic investigation of alternative supplementary cementitious materials (SCMs) to reduce the ecological footprint of cement-based construction. The incorporation of SCMs into blended cement concrete (BCC) has consistently been reported to enhance mechanical performance. Despite these advantages, robust prediction of the compressive strength (CS) of BCC remains non-trivial, primarily due to the heterogeneous, multi-phase nature of the composite and its inherently nonlinear mechanical response under load. The present study undertakes a comprehensive sustainability assessment of concrete mixtures with and without SCM incorporation, employing compressive strength and as principal performance metrics in line with contemporary sustainable materials research frameworks. The results demonstrate that mixtures exhibiting higher compressive strength generally correspond to superior sustainability potential, when evaluated in terms of material efficiency. Furthermore, the findings underscore the critical importance of prioritizing locally sourced SCMs, as the environmental gains associated with partial Portland cement replacement can be significantly undermined by emissions and energy consumption linked to long-distance transportation within life-cycle assessment boundaries.

**Keywords.** Supplementary cementitious materials, Blended cement concrete, Compressive strength.

**CTCS 2635**

# Optimizing High-Strength Self-Compacting Concrete Using Silica Fume and GGBS: A Strength and Durability Study

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**Abstract.** Development of high-strength self-compacting concrete (HSSCC) is a significant innovation in modern construction, providing greater mechanical qualities, workability, and durability. One key drawback of self-compacting concrete is the increased expense resulting from the extensive use of cement and admixtures, this can be minimized by using additional supplementary cementitious materials (SCM). It is obvious that as cement consumption declines, the lease of $CO_2$ from the cement sector decreases, which has a beneficial impact on sustainability. The present study herein address the effect of Silica fume and GGBS on Mechanical and durability properties of high-strength self-compacting concrete. The partial replacement of ordinary Portland cement (OPC) with GGBS and silica fume minimizes cement production's environmental effect while simultaneously improving fresh and mechanical qualities. These include fresh concrete properties, as well as compressive and flexural strengths. The experimental investigations in this work also examine water absorption, permeability, and resistance to chemical attacks, providing insights on HSSCC performance under harsh conditions. The synergistic effect of these SCMs refines the microstructure, reduces permeability, and improves material resilience to environmental deterioration. In the current investigation, the GGBS content was set at 40This study finds that the incorporation of GGBS and silica fume into HSSCC constitutes a substantial development in concrete technology. This novel material paves the path for more robust, efficient, and sustainable infrastructure solutions by increasing durability, lowering environmental impact, and improving mechanical qualities.

**Keywords.** HSSCC, GGBS, Silica fume

**CTCS 2639**

# Artificial Intelligence and Deep Learning Framework for Concrete Compressive Strength Prediction Through Regression and Classification Analysis

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**Abstract.** This study develops a deep learning framework to predict concrete compressive strength using both regression and classification approaches. The model is trained on the Yeh (1998) dataset, which contains 1,030 samples and eight input variables: cement, water, coarse aggregate, fine aggregate, superplasticizer, fly ash, blast furnace slag, and curing age. A fully connected deep neural network with batch normalization and dropout is used to improve training stability and limit overfitting. The regression model achieves strong test performance, with a coefficient of determination (R2) of 0.847, a Root Mean Squared Error (RMSE) of 4.98 MPa, and a Mean Absolute Error (MAE) of 3.84 MPa, indicating effective learning of the nonlinear relationship between mix composition and strength. In parallel, the classification model groups concrete into three strength ranges, Low (<25 MPa), Medium (25–45 MPa), and High (>45 MPa), and reaches 83% test accuracy, with precision, recall, and F1-score all equal to 0.83. Training curves show stable convergence with minimal overfitting, while the error distribution remains centered near zero with a standard deviation of 4.98 MPa, suggesting unbiased predictions. Overall, the framework shows promise for real-time quality control and mix optimization in construction, although its applicability beyond the Yeh (1998) dataset would require further validation.

**CTCS 2650**

# Numerical Evaluation of Hexagonally Perforated Cold-Formed Steel Channel Sections Under Compression

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**Abstract.** In recent years, the use of cold-formed steel (CFS) section members has grown significantly in both residential and industrial construction. This is because they are very structurally efficient and have other good qualities. So, it's very important to optimise CFS parts with holes to keep their structural integrity. Adding an edge stiffener has been found to bring back the sections' lost capacity. ABAQUS software was used to do finite element (FE) modelling of CFS sections with no holes, holes that weren't stiffened, and holes that were stiffened. The FEA results were compared to experimental data that was already available. The ratio was roughly 0.93, which proved that the model was correct. This validated model was subsequently utilised for a parametric analysis to evaluate the influence of characteristics including shape, size, quantity, spacing, and edge distance of apertures on axial capacities. Optimised sections were made for perforated CFS sections under compression for both stiffened and unstiffened cases, based on how many conduits were needed. To evaluate the effects of parameters such as member length, opening shape, size, number, spacing, and edge distance on the axial capacity of perforated cold- formed steel (CFS) members under both stiffened and unstiffened conditions, 156 compression models were developed using ABAQUS. It was found that regular and elongated hexagons were the best shapes.

**Keywords**. Cold-formed steel; Optimization; Finite Element Analysis; Hexagonal web holes; Axial compression.

## CONTENT

**INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND MATHEMATICS FOR ADVANCED TECHNOLOGY (MSMAT-2026)**

## CONTENT

**INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND MATHEMATICS FOR ADVANCED TECHNOLOGY (MSMAT-2026)**

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**INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND MATHEMATICS FOR ADVANCED TECHNOLOGY (MSMAT-2026)**

**MAT 2620**

# Innovation in Low-Cost Air–Oxygen Ventilation with Integrated $SpO_2$ Monitoring

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**Abstract.** Respiration is the basic human process and respiratory diseases are among the leading causes of death globally, COVID-19 pandemic being as a prominent example. This paper presents overall review of the design and development of a $SPO_2$-responsive smart ventilator system. Here, the proposed idea of ventilator integrates embedded electronics with closed-loop control strategies to deliver adaptive respiratory support. Arduino Uno microcontroller which serves as the central unit, it coordinates data from a MAX30100 pulse oximeter sensor to regulate airflow delivered by a DC pump through MOSFET control. A Proportional- Integral-Derivative (PID) control algorithm actively adjusts airflow to maintain optimal blood oxygen saturation ($SPO_2$) levels. Also, the system function is to collect real-time monitoring of cardiac activity, which provides alerts for abnormal conditions such as Bradycardia and Tachycardia. Unlike conventional ventilators, this design promotes affordability, accessibility, and automated responsiveness, making it highly relevant for emergency scenarios and low-resource healthcare settings.

**Keywords.** $SPO_2$, Smart Ventilator, Arduino Uno, MAX301000 pulse oximeter, PID Control, Patient Monitoring, Closed-Loop System

**MAT 2624**

# Impact of Heater Geometry on Thermal and Electro-Mechanical Behavior of MEMS Micro hotplate

**Celine Sony, Hannah Maju, Krishnananda S, Abner Sebastian Lopez, Akul Prasanth, Lekshmi M S, Deepthi Jayan K, Priya S, and Aparna George**

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**Abstract.** Metal oxide gas sensors have been widely adopted owing to their high selectivity, sensitivity, ease of fabrication, and low cost. Sensor sensitivity can be further enhanced by operating at high temperatures, typically achieved with a microhotplate. In this study, a novel microhot-plate geometry, termed' Celimespire,' is proposed and simulated using COMSOL Multiphysics. In this study, the temperature distribution, electric potential, and thermal stress within the structure were analyzed. The performance impact of different heating mate-rials, such as platinum, titanium, and tungsten, was investigated, with platinum demonstrating superior thermal and electrical properties for heater applications. Additionally, the influence of heater thickness on the power consumption and thermal efficiency was examined. The correlation between the electric potential and thermal stress was explored, and high- stress regions were identified within the celimespire configuration. These findings provide valuable insights into the design of an efficient microhotplate for gas sensing applications.

**Keywords.** Microhotplate; COMSOL Multiphysics; Platinum; Geometry; Thermal stress.

**MAT 2625**

# Physicochemical Characterization and Comparative Evaluation of Biodiesel from Niger and Cotton Oils

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**Abstract.** Fossil fuels are posing a growing threat to the world through rising fuel prices, depleting natural resources, and climate change. By producing and analyzing biodiesel from cotton and Niger oil, this study explores an alternative. Prior to being trans esterified with methanol and NaOH to produce methyl esters, both oils were first characterized to ascertain their potential as raw materials The method produced 78.5% cotton oil and 88% Niger oil biodiesel when 60°C, a 6:1 molar ratio of methanol to oil, and 1% catalyst were used as the ideal reaction conditions. For the produced methyl esters (NOME and COME) and their blends, the main fuel characteristics—density, viscosity, saponification value, iodine value, cetane number, calorific value, and flash point—were investigated. The viscosity, which was quite high in raw oils, significantly decreased after trances terification, according to the results, reaching 4.79 cSt for COME and 5.72 cSt for NOME, which are both suitable for diesel engines. Every property that was measured complied with worldwide biodiesel standards (ASTM D6751 and EN 14214). The total fuel quality was further improved by combining Niger and cotton biodiesel, striking a balance between safety and performance. The produced biodiesel provides advantages for the environment over conventional diesel, including higher oxygen levels and reduced emissions of smoke, hydrocarbons, sulphur, $CO_2$, and particles. Effective mixing ratios can improve engine performance, even if petroleum diesel is slightly thicker. Overall, the findings suggest that biodiesel made from cotton and Niger oils, either alone or in combination, might be a viable, sustainable, and cleaner alternative to fossil diesel.

**MAT 2641**

# Isolation and Extraction of Polyhydroxyalkanoates from Microorganisms Using Deep Eutectic Solvents

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**Abstract.** This study investigates an eco-friendly method for isolating and extracting polyhydroxyalkanoates (PHA) from Halomonas boliviensis using deep eutectic solvents (DES). PHAs are promising biodegradable alternatives to petroleum-based plastics but face cost and sustainability challenges in production and extraction [1], [6]– [8]. Fruit peel waste was used as the primary carbon source for bacterial cultivation, aligning with circular bioeconomy approaches that valorize agri-food residues [2], [7]. Sequential experimental runs demonstrated significant improvements in yield, increasing from 0.88% to 10% of dry cell weight after optimizing culture and extraction conditions, consistent with previous reports that highlight the importance of cultivation parameters in maximizing PHA recovery [3], [4]. The optical density (OD) values measured at 235 nm supported polymer quantification, confirming successful extraction. These results validate the potential of DES-based extraction as a sustainable alternative to conventional solvent methods [5] and establish proof-of-concept for further development towards biodegradable plastic synthesis.

**MAT 2643**

# Sustainable Hydrogen Production from Sericulture Waste: Current Technologies, Challenges, and Future Prospects

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**Abstract.** In order to fulfill the growing need for energy, the use of fossil fuels has increased dramatically, leading to significant waste production and climate degradation. Modern civilization is therefore compelled to search for sustainable energy sources that may meet rising demand while simultaneously lowering carbon footprints and greenhouse gas emissions. Hydrogen (H2) has gained a lot of interest lately as one of the most promising clean and sustainable fuels. This article summarizes the notable advancements in the study on manufacturing biohydrogen from renewable bioresources, including organic waste, lignocellulosic biomass, algal biomass, and industrial wastewaters. The process of turning organic materials into hydrogen-rich gas is known as biomass gasification. The fact that green hydrogen does release greenhouse gases during synthesis gives it its moniker. Hydrogen energy is considered an essential part of the economy since it optimizes the use of resources and enables regeneration systems.

**Keywords.** Biomass, lignocellulosic, Hydrogen, Sericulture

**MAT 2652**

# Gamma Irradiation and Thermal Cycling Effects on Transformation Behavior of Heat-Treated NiTi Shape Memory Alloys

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**Abstract.** NiTi-based shape memory alloys (SMAs) are extensively used in aerospace, biomedical, and nuclear applications due to their distinctive phase transformation behaviour, including the shape memory effect and superelasticity. However, their functional stability under gamma irradiation and thermal fatigue remains a key concern for deployment in extreme environments. This study investigates the influence of gamma irradiation (0, 20,40,60 and 80 kGy) and thermal cycling on the transformation behaviour of NiTi SMAs heat-treated at 660 °C. Samples were subjected to gamma irradiation and repeated thermal cycling, and their transformation temperatures—martensite start (Ms), martensite finish (Mf), austenite start (As), and austenite finish (Af) were measured using Differential Scanning Calorimetry (DSC). Results indicate minimal change in transformation temperatures across irradiation doses, with only a slight variation in As and Af. This suggests that the 660 °C heat treatment effectively stabilizes the microstructure against radiation-induced defects. Thermal cycling revealed a gradual decrease in transformation temperatures during the initial cycles, attributed to dislocation accumulation and internal stresses. After approximately N=7 cycles, transformation temperatures stabilized, and the appearance of the R-phase was observed in all irradiated samples. These findings confirm that NiTi SMAs, when properly heat-treated, maintain phase transformation characteristics even after moderate gamma exposure and repeated thermal cycling. This highlights their potential for reliable performance in applications requiring structural adaptability and radiation tolerance, such as actuators in nuclear facilities, aerospace components, and implantable medical devices.

**MAT 2659**

# Experimental Study of the Effect of Load on the Emissions and Engine Performance of a Dual-Fuel Diesel Engine Powered by Sericulture Waste

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**Abstract.** Fossil resources are running out because of the growing population's increased demand for energy. A sustainable energy source, biogas provides a workable substitute for fossil fuels in dual fuel mode for compression ignition (CI) engines. To generate biogas, cashew nut fruit, cow urine, and silkworm larval litter were mixed in a 45:10:45 weight ratio as influent feedstock. Anaerobic digestion produced biogas at an average temperature of 32°C, which was then collected in a biogas bag under 2 bar pressure. A 5.2 kW, four-stroke, single-cylinder diesel engine running at 1500 rpm with a constant compression ratio of 16 was utilized to test the biogas under a variety of load conditions. At 80% load, the dual fuel mode and the pilot fuel mode had brake thermal efficiencies of 15.43% and 22.14%, respectively. Carbon monoxide (CO) and hydrocarbon (HC) emissions in dual fuel mode were measured and compared to those in pilot fuel mode due to decreased volumetric efficiency. The results revealed declines of 71.8% and 41.67%, respectively. According to the findings, biogas produced can be used in dual fuel mode to increase mechanical efficiency and reduce emissions.

**Keywords**. Biogas, anaerobic digestion, dual-fuel mode, diesel engine, sericulture waste.

**MAT 2661**

# Aluminium-Gallium Co-doped ZnO: rGO Nanocomposite Electrode for Supercapacitor Applications

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**Abstract.** In this work, Al-Ga co-doped ZnO (AGZO) and reduced graphene oxide (rGO) nano composite thin films with varying rGO concentration were synthesized via a sol–gel spin coating method. The films were characterized to investigate the combined effect of co-doping and carbon incorporation on their structural and electrochemical performance. XRD analysis confirmed the retention of the hexagonal wurtzite ZnO phase with a strong c-axis orientation. The incorporation of rGO led to noticeable peak broadening and reduced crystallite dimensions, indicating the modified nucleation and increased lattice distortion. AFM analysis revealed a systematic decrease in surface roughness, indicating smoother and more compact film morphology due to Al–Ga co-doping and rGO incorporation. FTIR analysis confirmed the successful incorporation of rGO into the AGZO matrix. Electrical studies showed a significant reduction in resistivity, reaching a minimum of 3 Ω cm at 3 mg rGO due to the formation of efficient conductive pathways. The formation of the AGZO: rGO composite yielded a hybrid structure combining the pseudo capacitive nature of metal oxides with the electric double-layer capacitance of rGO. The optimized AGZO: rGO film exhibited enhanced capacitance on stainless steel substrates, highlighting its potential as an efficient and durable super capacitor electrode material.

**MAT 2666**

# Encryption and Decryption Process Using Number Theory Techniques and Simple graph

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**Abstract.** In modern era, security of data/information plays an important role. To secure the data/information different mathematical functionalities are used to build the cryptographic algorithms. Hardness of any algorithm is completely relied on the mathematical approaches used in the algorithm. Numerous mathematical approaches of number theory and graph theory are collectively contributed by many researchers to secure the information/data in the field of cryptography. In this paper, original information/data is initially substituted using Caesar cipher method and then encrypted information is represented in graph using simple graph.

**MAT 2667**

# Exploring Distance Magic Labeling in Double star Graphs

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**Abstract.** In this paper, I investigate D-distance magic labeling (D-DML) of simple undirected graphs for a distance set $D \subseteq \{0,1,2, \ldots d\}$, where d is a diameter of graph G. A D-DML of graph G(V,E) is a bijection $g : V(G) \rightarrow \{1, 2, \ldots, |V|\}$ such that for every vertex $v \in V(G)$, $\sum u \in N$ g(u) D(v) is constant, say k which is called as magic constant (where $ND(v) = \{u \in V/d(u, v) \in D\}$). This work explores D-DML of double star graphs, shadow graphs and splitting graphs of double star graphs.

**Keywords.** magic labeling; double star; shadow graph; splitting graph.

**MAT 2670**

# Incorporation of Marine Sand as a Sustainable alternative in Alkali-Activated Concrete

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**Abstract.** The rapid expansion of the construction sector has significantly increased the demand for natural materials, particularly aggregates, which constitute nearly 75% of the volume of concrete. Of this, fine aggregates account for approximately 30% and, being sourced entirely from natural deposits, their sustainable utilization is crucial. Marine sand (MS) is naturally abundant along coastal regions and presents a potential alternative to conventional Natural River Sand (NRS). This study experimentally evaluates the influence of partially replacing NRS with MS on the mechanical and durability performance of alkali-activated concrete (AAC). NRS was substituted with MS in incremental levels ranging from 0% to 30% at 5% intervals. Compared to NRS, MS exhibits a lower specific gravity and a 62.5% higher water absorption capacity, reflecting its more porous nature. Particle size analysis further shows that NRS possesses a higher fineness modulus than MS due to its coarser particle characteristics. Several trails were carried out in which the molarity of NaOH was checked at 10M and 12M and the sodium silicate ($Na_2SiO_3$) to sodium hydroxide (NaOH) ratio was varied at 1.5, 2 and 2.5. Based on the results, a 20% replacement of NRS with MS along with NaOH concentration of 12M and $Na_2SiO_3$ to NaOH ratio of 2.5 was identified as the optimal mix. This investigation demonstrated that replacing NRS with MS in AAC not only improved engineering properties but also enhanced sustainability, yielding higher compressive strength and outstanding durability performance under coupled sulphate and chloride attack over a one-year exposure period.

**MAT 2671**

# Influence of Lubrication Methods on Cylindrical Grinding Efficiency: Dry, Flooded and MQL Conditions

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**Abstract.** This experimental investigation presents a comprehensive analysis of the impact of different lubrication conditions—dry, flooded, and Minimum Quantity Lubrication (MQL)—on cylindrical grinding operations of gun metal. The study evaluates critical performance parameters including surface roughness, workpiece temperature, machining time, roundness, and grinding wheel degradation at varying spindle speeds (240, 370, and 610 RPM). Results demonstrate that flooded conditions consistently produced superior surface quality with Ra values ranging from 0.49- 0.71 μm across all speeds, while maintaining the lowest temperature profiles (31.8-34.5°C), significantly outperforming dry machining where temperatures reached 84.2°C at high speeds. Interestingly, MQL represented an effective compromise, achieving acceptable surface roughness values that improved with increased speeds (Ra decreasing from 0.82 to 0.50 μm as speed increased) while maintaining moderate temperatures (36.1-47.2°C). Microstructural analysis revealed that dry conditions caused noticeable thermal damage to both the workpiece and grinding wheel at higher speeds, while flooded conditions preserved the integrity of both. Roundness measurements further confirmed the superiority of flooded machining, exhibiting minimal deviations compared to the significant variations observed in dry conditions. These findings were corroborated through L9 orthogonal array analysis, establishing robust correlations between lubrication methods and machining outcomes. The research demonstrates that while flooded machining offers optimal performance for precision grinding applications, MQL represents a viable alternative that balances satisfactory surface finish with reduced environmental impact and resource consumption, particularly at higher grinding speeds where its performance approaches that of conventional flooding techniques.

**Keywords**. Cylindrical grinding, Lubrication conditions, Surface roughness, Workpiece temperature, Gun metal, Grinding wheel degradation.

**MAT 2672**

# Process Optimization for Energy-Efficient Centreless Grinding: Critical Analysis and Industrial Implementation

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**Abstract.** Centreless grinding is a highly efficient machining process widely used in industrial applications due to its ability to produce precise cylindrical components. However, conventional grinding techniques often lead to excessive energy consumption and increased coolant usage, raising concerns about sustainability and cost-effectiveness. This study critically assesses and implements an energy-conscious centreless grinding process with a focus on Minimum Quantity Lubrication (MQL) and Nano-MQL techniques as alternatives to traditional cooling methods. The research evaluates the effects of dry, MQL, and Nano-MQL grinding on surface finish, material removal rate (MRR), energy consumption, and thermal effects using EN24 (AISI 4340) alloy steel as the workpiece material. Experimental trials were conducted under varying feed types (through-feed, in-feed, and end-feed), depth of cut, and lubrication conditions. The results indicate that Nano-MQL exhibits superior surface finish (Ra = 0.57 μm) compared to MQL (Ra = 1.48 μm) and dry grinding (Ra = 1.03 μm), while also achieving a higher MRR of 2.24 mm3/min in certain conditions. Moreover, Nano-MQL significantly reduces machining temperatures, reaching an average of 51°C compared to 210°C in dry grinding. Despite slightly higher energy consumption (1.313 kW for Nano-MQL vs. 0.839 kW for dry machining), the environmental benefits, coolant reduction, and enhanced machining performance make Nano-MQL an ideal sustainable solution for centreless grinding. The study concludes that Nano-MQL can effectively replace conventional flood cooling systems while maintaining productivity, reducing heat generation, and improving energy efficiency. These findings contribute to the development of a more sustainable, cost-efficient, and high-performance grinding process for modern manufacturing industries.

**Keywords.** Centreless grinding, Minimum Quantity Lubrication (MQL), Nano-MQL, Energy efficiency, Surface finish, EN24 (AISI 4340) alloy steel.

**MAT 2674**

# Characterization of the Microstructure and Tribological Properties of SS316l Fabricated by the Fused Deposition Modelling Technique

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**Abstract.** Post-processing is essential for FDM-printed metal parts due to issues like intrinsic porosity and poor bonding. High-Pressure Torsion (HPT) is a severe plastic deformation technique that enhances wear resistance and mechanical properties. However, its effects on the microstructure and tribological behavior of these parts remain unclear. This study employs methods like X-ray diffraction, optical microscopy, transmission electron microscopy, and scanning electron microscopy to investigate the deformation mechanisms in HPT-processed stainless-steel grade 316L parts. Based on microstructural and strain data (εeq), the deformation of SS316L components that have undergone HPT processing is separated into three levels, ranging from (εeq = □0-10) as level 1, (εeq = □10-20) as level 2, and (εeq = □20-30) as level 3. Level 1 witnessed twinning, development of dislocations, multiplication, and twin matrix lamellae. Level 2 is characterized by shear banding and secondary nanotwin production, whereas level 3 reaches an equilibrium stage with equiaxed nano-sized grains. A linear additive theoretical model has been developed to analyze the influence for grain boundary, solid solution, dislocation, and twinning collectively contribute to hardness enhancement and overall strength of SS316L components.

**Keywords.** Fused deposition modelling, SS316L, High-pressure torsion, Mechanical deformation, Microstructural evolution, Strengthening.

**MAT 2678**

# SF-Au/CMC Bionanocomposite Films Electrical and UV-Shielding Properties

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**Abstract.** In the present study, the simple casting technique is used to create multifunctional recyclable material. To overcome the brittleness of the bionanocomposite (BNCs) film, regenerated silk fibroin (rSF) is combined with carboxymethyl cellulose (CMC) and AuNPs to remove the insulating characteristic. The rSF demonstrated a dual role as a capping and reducing agent during the formation of AuNPs. The properties of both native and BNCs films have been examined using analytical characterization techniques. The successful in-situ production of gold nanoparticles in the SF matrix was validated by the presence of a surface Plasmon resonance peak in the wavelength range $\lambda$ = 534–565 nm. The structural changes and the functional groups present in the SF-Au/CMC BNCs are verified using FT-IR spectroscopy. Distinct X-ray diffraction measurement displayed prominent AuNPs peaks at 38.26°, 44.51°, 64.76°, and 77.7° respectively, which revealed crystalline nature of AuNPs with FCC structure. The scanning electron microscopy (SEM) images verified the uniform distribution of SF-AuNPs and CMC in the host matrix. The I-V characteristic confirms that the DC conductivity of SF-Au/CMC BNCs films rises with increasing AuNP concentration. Although the dielectric constant value increases with concentration at low frequencies, the material can be utilized in storage devices. Impedance analyzer characteristics showed that SF-Au/CMC BNCs had enhanced conductivity as the concentration of AuNPs rose, ranging from 10-9 to 10-4 S/cm. The UV rays were successfully blocked by the constructed BNCs. These findings demonstrate the potential applications of SF-Au/CMC BNCs in UV-protective materials, energy storage devices, and flexible electronics.

**Keywords.** Silk fibroin, Bionano composites, Optical, Electrical properties, UV-Shielding.

**MAT 2680**

# A density functional study of $H_2$ storage on lithium decorated novel nitrogen-doped nanographene

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**Abstract.** In this study, a promising material for hydrogen storage is explored within the framework of density functional theory (DFT) by using the M06 functional and the 6-311++G(d,p) basis set. After ensuring the stability of the host material, lithium-decorated dibenzodiazapyracylene (CHN-Li) was used, and molecular hydrogen was adsorbed sequentially. The kinetic stability of all clusters has been verified with the energy band gap and the global reactivity parameters. The charge transfer analysis during successive hydrogen adsorption was illustrated through electrostatic potential (ESP) maps and Hirshfeld charge (HFC) analysis, whereas partial density of states (PDOS) revealed the type of interaction between the alkali metal Li and H 2 . A single Li atom can adsorb up to 4 H 2 molecules with an average adsorption energy of 0.16 eV, clearly indicating a quasi-molecular interaction via the Niu-Rao-Jena type of interaction, and Li has been decorated on the 4 identical sites with proper stability. Thus, a total of four Li atoms will lead to the prediction of a H 2 storage capacity of 9.47 wt% by adsorbing 4H 2 molecules at each site, which was far above the US-DOE target.

**MAT 2686**

# Effective reduction of p-nitroaniline using highly dispersed carboxymethyl cellulose stabilized gold nanoparticles

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**Abstract.** We synthesize highly dispersed gold nanoparticles using carboxymethyl cellulose (CMC) as a stabilizing agent and ascorbic acid as a reducing agent. At an amount of 0.01% w/v CMC, highly dispersed, spherical-shaped gold nanoparticles are formed. When the CMC amount is increased to 0.5% w/v, chain-like aggregated structures are observed, resulting from the assembly of spherical gold nanoparticles. X-ray diffraction analysis indicates that the synthesized CMC stabilized gold nanoparticles have a highly crystalline face-centered cubic (fcc) structure. The stabilization of gold nanoparticles by CMC occurs via interactions involving the hydroxyl (–OH) and carboxylate (–COO−) functional groups present in CMC. The resulting highly dispersed gold nanoparticles exhibited effective catalytic activity in the reduction of p-nitroaniline.

**Keywords.** Gold nanoparticles, Catalysis, Eco-friendly Synthesis, Carboxymethyl cellulose, p-Nitroaniline.

**MAT 2688**

# Synthesis and Bioassay study of Tetrahydro-6H- [1,3,4] thiadiazolo [2,3-b] quinazolin-6-one Derivatives Promoted by CuI 2 as a catalyst

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**Abstract.** The simple and an efficient right path of the synthesis of fused Thiadiazole with quinazalones derivatives was obtained promoted by active catalyst which is from 5-(4-(methylsulfonyl)benzyl)-1,3,4-thiadiazol-2-amine (3) , cyclohexane-1, 3-dione(4) and substituted aromatic aldehyde (5) activated by transition metal halide as a such as $CuI_2$ .The compound (3) can be obtained by 2-(4-(methylsulfonyl) phenyl)acetic acid with Thiosemicarbazide, in the presence of $H_3PO_4$ (protic acid) at 65 0 C . All the prepared analogous was confirmed by use advanced spectroscopic data like 1 HNMR, 13 CNMR and LCMS. All newly synthesized compounds have been screened for their in vitro antibacterial and antifungal activities against Escherichia coli, Pseudomonas aeruginosa, Bacillus megaterium, Bacillus subtilis, and Aspergillus.

**Keywords**: 2-(4-(methylsulfonyl)phenyl)acetic acid, Thiosemicarbazide, cyclohexane-1,3-diketone , Aromatic aldehyde, , 2-(4-(methylsulfonyl) benzyl)-5-phenyl-5,7,8,9 -tetrahydro-6H-[1,3,4] thiadiazolo [2,3-b] quinazolin-6-one, CuI 2 , Antimicrobial activity.

**MAT 2689**

# SEM-driven characterization of 3D-printed UHV hole

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**Abstract.** In this work, we introduce a scanning electron microscopy (SEM)–based method for characterizing holes embedded in material surfaces, enabling analysis of both the geometric attributes and morphological irregularities of formed voids. In contrast to the contact-based measurement techniques, our SEM-based approach provides nanometer-scale resolution for precise, non-contact analysis, enabling the assessment of fine geometric features and complex surface structures. The proposed method is applied in our electron–ion trapping experiment (EiTEx), where ultra-high-vacuum (UHV)–compatible additively manufactured components, such as the trap aperture and the oven-assembly heat-shield opening, require detailed surface assessment. In this paper, the method is demonstrated using the heat-shield hole of the oven assembly as a representative example, while the approach remains broadly applicable to similar analyses across diverse areas of materials science.

**MAT 2690**

# Transition metal catalyst promoted to Synthesis and In- Vitro Studies of thiadiazolo [3, 2-a] pyrimidine-6- carbonitrile analogues

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**Abstract.** An efficient one-pot synthetic method for the highly using a conventional method of MCRs of different substituted aromatic aldehydes, 5-(pyrazin-2-yl)-1,3,4-thiadiazol-2-amine, and 3-(1H-indol-3-yl)-3-oxopropanenitrile effected by Pd (OAc) 2 catalyst in a strong base scaffold an effective highly substituted 5H-[1,3,4]thiadiazolo[3,2-a] pyrimidine-6-carboxylate derivatives. This method offers a practical one-pot synthesis of 5H-[1, 3, 4] thiadiazolo [3,2-a]pyrimidine-6-carboxylate derivatives. The titled derivatives can be confirmed by spectroscopic evidences including 1 HNMR, 13 CNMR and LCMS analyzed. A representative panel of two gram positive bacterial strains, such as S. aureus and B. subtilis, and two gram negative bacterial strains, such as P. aeruginosa and E. coli, were used to evaluate the moieties in vitro antibacterial qualities.

**Keywords.** Aromatic aldehydes, 3-(1H-indol-3-yl)-3-oxopropanenitrile, 5-(pyrazin-2-yl)-1, 3, 4-thiadiazol-2-amine, Pd (OAc) 2, Thiadiazolo derivatives, Antibacterial Activity

**MAT 2692**

# Investigation on Barrier Thickness Variation Effect on AlInN/GaN based MOSHEMT Performance

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**Abstract.** We developed a straight forward hydrothermal method that eliminates the need for a template in the growth of cerium oxide ($CeO_2$) nanorods (NRs) on same substrates that were used such as fluorine doped tin oxide (FTO). The cerium oxide nanorod films were covered with optimised tungsten oxide ($WO_3$) coatings using sputter deposition For the fabrication of the electro chromic device (ECD), $WO_3$ thin films were formed at oxygen partial pressures ($ppO_2$) of 8×10-4 mbar. $CeO_2$ NRs were grown using a hydrothermal method on a glass substrate covered with FTO. The structural, morphological, optical, and EC characteristics of $WO_3$ films on the $CeO_2$ NRs/$WO_3$ were characterised by means of XRD, SEM, Raman spectroscopy, FTIR, Vis-UV Spectroscopy, and CV measurements, respectively. In calculation, the $CeO_2$ NRs/$WO_3$ composite film had exposed a better electrochemical property than pure WO3, with a diffusion coefficient of 7.45×10-11cm2 /s. And $CeO_2$/$WO_3$ thin film is demonstrated the best colouring efficiency of 14.83 cm2 /C, which can be essential in the electrochromic application. In order to select the appropriate doping constituents for energy-efficient smart windows, we seek to gain a deeper understanding of how CeO2 NRs affect WO3 electrochemical behaviour.

**Keywords.** WO3 film, CeO2/WO3 hybrid film, Electrochromic analyser, SEM, Vis-UV Spectroscopy, $H_2SO_4$ electrolyte.

**MAT 2697**

# Jacobian-Based Velocity Control Framework for a Five-Link Inchworm-Inspired Climbing Robot

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**Abstract.** This work investigates a Jacobian-based method for controlling the kinematics and velocity of a five-link robotic manipulator inspired by inchworm movement. This manipulator is designed for vertical climbing tasks. The control system uses Denavit-Hartenberg forward kinematics, geometric inverse kinematics, and a calculated Jacobian, along with joint velocity control based on the Moore-Penrose pseudo-inverse. Instead of controlling motion at the position level, this method directly manages the end-effector's instantaneous velocity. This approach reflects the nature of inchworm movement, where upward motion comes from the coordinated movements of revolute joints that alternate between anchoring and releasing. To improve computational efficiency, the full Jacobian is simplified to its main Cartesian component in the upward direction, maintaining analytical consistency. By integrating the resulting joint velocities over time, we can see how sequential joint movements create a net upward motion through phase-dependent anchoring. Simulation tests show stable transitions between forward and reverse gaits, symmetric responses of joints, slip-free climbing, and consistent vertical movement with each cycle. This strategy has a clear physical explanation and is confirmed through time-based simulations, showing steady joint velocities, joint movements, and linear motion under a set vertical velocity profile.

**Keywords.** 5-link Inchworm Robot, Forward Kinematics, Jacobian, Inverse Jacobian, Joint velocity control.

**MAT 2698**

# Bayesian Small-Area Estimation of District-Level Diabetes Prevalence in India Using Environmental and Demographic - Geo Covariates

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**Abstract.** India's diabetes epidemic is accelerating World Health Organization (WHO) calls India a "diabetes hotspot," and age-standardized prevalence has risen sharply (from ~31.4 per 1000 in 1990 to 58.0 per 1000 by 2021). Yet national- and state-level averages obscure stark local disparities. Such coarse measures can misdirect resources and mask districts in urgent need of intervention. We develop a novel hierarchical Bayesian small-area estimation framework – an "Eco- Demographic-Geo Fusion" model – that integrates direct NFHS-4 survey estimates with a rich set of district covariates (demographic, socioeconomic, environmental and geographic) and imposes spatial smoothing via a DAGAR spatial prior. This approach admits multiplicative interactions among covariate domains (e.g., demographic×environmental) and blends local and global spatial effects, capturing complex non-additive risk patterns beyond conventional models. Compared to standard area-level, SAE methods and also provide information regarding spatial effect of area by neighboring areas. Applied to NFHS-4 (2015–16) data, our model produces district-level adult-diabetes prevalence estimates for all 701 districts. We find a mean prevalence of ~83.7% (±6.1%) nationwide, with pronounced heterogeneity: spatial clustering is strong and the highest burdens concentrate in southern and western states (Tamil Nadu, Kerala, Goa) as well as in Punjab and Haryana. The model dramatically reduces uncertainty. For example, a raw survey estimate of 82.8% (SE 1.99%) in Anantnag (J&K) was shrunk to 76.5% (95% CI 66.4–76.1%) by the model (MSE≈0.0045). In aggregate, district-level mean- squared errors are roughly 60–70% smaller than for direct estimates, converting erratic local rates into stable, reliable prevalence maps and plots to identify spatial patterns and spatial dispersity.

**Keywords**. Small Area Estimation, Direct Acyclic Graph Auto-regressive Model, Hierarical Bayesian Spatial Model, National Family and Health Survey.

**MAT 2704**

# Casting-Oriented Synthesis of CMC/$In_2O_3$ Nanocomposites with Engineered Microstructure for Optically Enabled Antibacterial Applications

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**Abstract.** The casting process is a simple and cost-effective production procedure that ensures homogenous dispersion of nanofillers throughout the polymer matrix while preserving the structural integrity and functional performance of the final nanocomposite. This work employed the casting procedure to create CMC/ $In_2O_3$ nanocomposites and then investigated their optical properties. Fourier transform infrared spectroscopy (FTIR) and field emission scanning electron microscopy (FESEM) were used to examine the structural properties. The FTIR spectra verified the physical connection between the $In_2O_3$ NPs and the CMC polymer matrix. The FESEM study demonstrated a homogeneous dispersion of $In_2O_3$ nanoparticles throughout the CMC polymer matrix. The CMC/ $In_2O_3$ nanocomposites have excellent optical characteristics and increased UV light absorption capacities. This result suggests that the nanocomposites may be useful in optoelectronics applications. Nanocomposites'; optical constant improved as the concentration of $In_2O_3$ nanoparticles improved. The transmission of these nanocomposites reductions as the content of $In_2O_3$ NPs rises. The optical energy gap for allowable indirect transitions decreases from 3.783 eV to 2.946 eV as the concentration increases to 3.9 wt.%. In the case of forbidden indirect transitions, the value drops from 3.419 eV to 2.235 eV. Beyond their promising optoelectronic behavior, the nanocomposite films exhibited remarkable antibacterial activity when tested against Staphylococcus aureus and Escherichia coli using the disk diffusion method. The inhibition zones were significantly larger for the Gram- negative E. coli, reaching 25 mm at the highest $In_2O_3$ loading. These results highlight the multifunctional potential of CMC/ $In_2O_3$ nanocomposites as bioactive materials, suitable for applications such as antibacterial coatings, infection- resistant biomedical surfaces, and optoelectronic biosensors in next-generation medical technologies.

**Keywords.** CMC, $In_2O_3$ NPs, FESEM, FTIR, Energy Gap, Antibacterial Applications.

**MAT 2705**

# Investigation on the Influence of 3d Printing Parameters on Density of Invar-36 by Selective Laser Melting

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**Abstract.** This study focuses on the 3D printing of invar (Fe-64, Ni-36) using the selective laser melting (SLM) method. As printing parameters are very important, there is a need to identify the influence of the parameters on the printed samples. In this study, the Taguchi based L18 orthogonal array optimization technique and ANOVA method was used to identify the optimal printing parameters combinations to achieve minimal density. Linear regression analysis was also used to determine the influence between the printing parameters(factors) and density (response). A confirmation test was conducted to validate the Taguchi method. It was found that among the considered 3D printing process parameters, scan speed has the most contribution at 46.55% followed by laser power with 31.77%, laser energy density 0.04%, hatch distance 0.35% and layer thickness 1.49% towards achieving maximum density. From the experimental results, the dominant factor was identified to be scan peed followed by laser power.

**Keywords.** Selective laser melting, additive manufacturing, Taguchi method, L18 Orthogonal array, density.

**MAT 2707**

# Structural and Optical Properties of Al-doped NiO Nanoparticles Synthesized by Chemical Co-Precipitation Method

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**Abstract.** This work examines the structure and optical characteristics of Al doped nickel oxide (NiO) nanoparticles made by chemical co-precipitation using sodium hydroxide and nickel acetate hexahydrated, Aluminium nitrate nanohydrated at 550 °C for four hours. The average crystallite size was determined by TEM and agrees with the XRD results. Fourier Transform Infrared Spectroscopy (FTIR), DRS Spectroscopy, and Photoluminescence Spectroscopy (PL) were used as characterization techniques. NiO formation-related functional groups were found via FTIR analysis. For pure NiO nanoparticles, the produced NiO showed an optical band gap of 3.59 eV, and luminescence tests show emissions in the UV and visible regions. As the amount of Al increases, there is a noticeable drop in the optical bandgap and a rise in luminescence intensity, which is explained by the smaller particles. Moreover, these chemical co-precipitation produced NiO nanoparticles are attractive candidates for possible optoelectronic applications due to their combined optical characteristics.

**Keywords.** NiO Nanoparticles, TEM, FTIR, PL, Reflectance, Band Gap. Complexity, Fractals, Time series, Brownian Motion, Fractional Brownian Motion, Share market.

**MAT 2708**

# Experimental Analysis on Condensation of Steam with Nitrogen gas on Steel, Aluminium and Copper Surfaces

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**Abstract.** This study presents results of steam condensation on a vertical tube with nitrogen gas present. The convective heat transfer coefficient and quantity of condensate collected when steam passes along with nitrogen over the three materials is measured and analysed. The effect of coating on these materials viz. stainless steel, aluminium and copper at different flow rates of nitrogen gas is presented in detail. In the experimentation, steam pressure is kept constant and nitrogen's pressure is varied. The steam which is generated in the steam generator is passed at particular pressure of 0.75 kg/cm$^2$ with nitrogen pressure of 10.0 kg/cm$^2$, 15.0 kg/cm$^2$, 20.0 kg/cm$^2$. The result shows that higher pressures of nitrogen, less condensate will be collected. This trend is same for both coated and non-coated surfaces. The presences of Nitrogen gas in steam-$N_2$ gas mixture is not allowing steam molecules to condense on the surface. Hence increasing the presence of $N_2$ is suggested for reducing the steam condensation phenomenon. The least condensate collected is 4.5 ml for stainless steel without coating for nitrogen at 20.0 kg/cm$^2$. This may cause because of a smoother surface of the stainless steel rather than the coated unpolished surface. However, the coated aluminium had least heat transfer coefficient with the value of 99.78W/m$^2$ K for 20.0 kg/cm$^2$ of nitrogen pressure. This investigation may be useful in the field of nuclear power plants, cryogenic cooling systems, cryogenic propellant tanks, and durability of coatings but not limited to.

**Keywords**: Heat transfer coefficient, Condensation, Nitrogen Gas ($N_2$), Volatile Organic Compounds (VOCs).

**MAT 2709**

# A Low-Cost Real-Time Digital Power Converter Design Using LAUNCHXL-F28027 for Photovoltaic Applications

**Russul H. Mohammed[1], Rasha Akar Abbood[2], Najlaa Hassoon Salman[2], Mohannad Jabbar Mnati[2, a)], Saad Mutashar[3], and Alex Van Den Bossche[4]**

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[2] Department of Electronics Engineering and Artificial Intelligence Technologies, Polytechnic College for Engineering Specialties – Baghdad, Middle Technical University, Baghdad, Iraq
[3] Medical Instrumentation Engineering Techniques Department, College of Engineering and Techniques, Al-Mustaqbal University, Al Hilla, Iraq
[4] Department of Energy and Systems, Ghent University, Ghent, Belgium

**Abstract.** This paper describes the real-time implementation of digital power converter hardware in the loop using the LAUNCHXL-F28027 microcontroller development board and MATLAB Simulink. The low-cost LAUNCHXL-F28027 eval platform is used for real-time control applications, and MATLAB Simulink is used for designing and implementing control algorithms. To realize accurate control relevant power electronic converters, which are required so far in renewable energy systems, electric vehicles, and industrial automation. Introduction In this work, a Simulink model of the digital power converter control logic is developed and deployed onto the LAUNCHXL-F28027 board using MATLAB Simulink code generation and hardware implementation. The LAUNCHXL-F28027 is used well for real-time control of power converters and can develop easily because it can be linked with MATLAB Simulink. Helps in simplifying the implementation of digital power conversion systems. That is the power of low-cost hardware platforms making it possible. Significant results have been shown during the course of implementing and testing a digital power converter with the help of LAUNCHXL-F28027 and the Digital Power Booster Pack. These results are split into performance metrics, stability analysis, and efficiency evaluation.t.

**Keywords.** Digital Power Converter, LAUNCHXL-F2802, Real-Time

**MAT 2711**

# Performance Analysis of FinFET Based Digital Circuits

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**Abstract.** The scaling of the bulk MOSFETs has led to faster and denser integration of circuits. However, the downsizing is facing many challenges due to higher frequencies, lower supply voltages etc. in the nanometer regime due to the adverse short-channel effects. Those effects cause an increase in the leakage current, thus making circuits more sensitive to variations in process parameters. Thus, new options with much lesser short channel effects have been increasingly finding demand. Here in this paper, we discuss FinFET with 18 nm technology node, with the elevated conducting channel enabling the gate to surround it on three sides. Simulation studies of the 18 nm FinFET is done to analyse its static and transient performance parameters. The comparative performance analysis of the noise margins, delay and power of FinFET based inverter with that of a CMOS inverter using Cadence Virtuoso tool is discussed.

**MAT 2714**

# Screening Food-Safe Compounds as Molecular Binders for Detection of the Date-Rape Drug Rohypnol

**Advaith V Rambhatla, Bhargavi S, Dharshini K, Hari Sudarshan Chinta, AH Manjunatha Reddy and Sumathra Manokaran**

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**Abstract.** The rising incidence of Drug-Facilitated Sexual As-sault (DFSA) has increased the misuse of sedatives such as Flu- nitrazepam (Rohypnol), a colorless, odorless, and flavorless benzodiazepine that can be easily dissolved into beverages. Current detection methods are largely forensic such as HPLC-MS and available only after an incident is reported, offering no real-time protection for potential victims. Existing field tests rely on toxic dyes or corrosive reagents that alter the taste, color, or chemical integrity of a drink, making them unsuitable for consumer use in social settings. To address this gap, we propose an in-silico approach to identify an edible, inherently non-toxic "recognition element" capable of selectively binding Flunitrazepam without affecting beverage quality. A curated library of approximately one hundred consumable, low-hazard compounds including amino acids, vitamins, polyphenols, amines, and common food additives was compiled based on PubChem safety filters. Each molecule was converted to PDB format and docked against an energy-minimized Flunitrazepam structure using AutoDock Vina. Binding affinities, pose stability, and interaction patterns were analyzed to rank potential sensor candidates. Several food-grade compounds showed promising binding behavior, demonstrating the feasibility of computational pre- screening for developing safe, subtle, and user-friendly drink-tampering detection tools aimed at preventing sexual assault.

**Keywords**. Flunitrazepam, Rohypnol detection, molecular docking, consumable compounds, AutoDock Vina, Python Molecular Viewer, drink safety.

**MAT 2717**

# Ionic Gelation-Based Encapsulation of Nisin in Chitosan Nanoparticles

**Kaavyashree Vinayagamurthy, Srijeeta Ghosh, Tanya Prashanth, Harshitha Shravya, Manjunatha Reddy A H, Sumathra Manokaran**

Department of Biotechnology, RV College of Engineering, Bengaluru - 560059, (Autonomous Institution Affiliated to VTU, Belagavi), India.

**Abstract.** Growing concern over antibiotic resistance, and declining efficacy of conventional antimicrobial agents against resistant strains, has shifted research toward non-conventional antimicrobial compounds1. Nisin exhibits antimicrobial activity through a dual-targeting mechanism that simultaneously disrupts bacterial membrane integrity via pore formation and blocks peptidoglycan synthesis through specific isolation of lipid II1. This triggers rapid bacterial death via cellular constituent leakage and metabolic collapse1. In this study, nisin was extracted from Lactococcus lactis (MTCC strain 440) using thermal acid extraction method1. Chitosan, a biodegradable and biocompatible polysaccharide derived from chitin, serves as a promising carrier for antimicrobial agents2. The positive charge of chitosan allows strong electrostatic interaction with nisin and the bacterial membrane for stable encapsulation2,3. The ionic gelation method used here is preferred for chitosan nanoparticle synthesis and nisin encapsulation because it is simple, cost-effective, and mild aqueous process that forms stable nanoparticles preserving the bioactivity of sensitive compounds like nisin4,8. Nisin loading into chitosan nanoparticles was achieved by mixing nisin solution with pre-formed chitosan nanoparticles. SEM analysis showed dense, irregular aggregated morphology indicating successful encapsulation of nisin into chitosan nanoparticle3,6 In addition, UV spectrophotometry was used to determine the efficiency of encapsulation1 of nisin into chitosan.

**MAT 2718**

# A Comparative Analysis of Classical and Kernel-Enhanced GARCH Models for Bitcoin Volatility with Oil Price Effects

**Kaavyashree Vinayagamurthy, Srijeeta Ghosh, Tanya Prashanth, Harshitha Shravya, Manjunatha Reddy A H, Sumathra Manokaran**

Department of Biotechnology, RV College of Engineering, Bengaluru - 560059, (Autonomous Institution Affiliated to VTU, Belagavi), India.

**Abstract.** Growing concern over antibiotic resistance, and declining efficacy of conventional antimicrobial agents against resistant strains, has shifted research toward non-conventional antimicrobial compounds1. Nisin exhibits antimicrobial activity through a dual-targeting mechanism that simultaneously disrupts bacterial membrane integrity via pore formation and blocks peptidoglycan synthesis through specific isolation of lipid II1. This triggers rapid bacterial death via cellular constituent leakage and metabolic collapse1. In this study, nisin was extracted from Lactococcus lactis (MTCC strain 440) using thermal acid extraction method1. Chitosan, a biodegradable and biocompatible polysaccharide derived from chitin, serves as a promising carrier for antimicrobial agents2. The positive charge of chitosan allows strong electrostatic interaction with nisin and the bacterial membrane for stable encapsulation2,3. The ionic gelation method used here is preferred for chitosan nanoparticle synthesis and nisin encapsulation because it is simple, cost-effective, and mild aqueous process that forms stable nanoparticles preserving the bioactivity of sensitive compounds like nisin4,8. Nisin loading into chitosan nanoparticles was achieved by mixing nisin solution with pre-formed chitosan nanoparticles. SEM analysis showed dense, irregular aggregated morphology indicating successful encapsulation of nisin into chitosan nanoparticle3,6 In addition, UV spectrophotometry was used to determine the efficiency of encapsulation1 of nisin into chitosan.

**MAT 2719**

# A Comprehensive Review of Alumina Nanofluids for Heat Transfer Applications

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**Abstract.** In this paper, the traditional GARCH models for conditional variance, such as GARCH, EGARCH, TGARCH, and GJR-GARCH, are compared with the partial GARCH model. The partial GARCH model incorporates oil prices as an exogenous factor to capture external influences on Bitcoin volatility. The estimation was carried out using the nonparametric Kernel regression method. The daily log returns of Bitcoin and oil prices for the period January 2018 to December 2024 were analysed for modeling volatility. Model performance for in-sample and out-of-sample was evaluated using standard accuracy measures, such as mean squared error, QLIKE, and the Diebold-Mariano test. The empirical results reveal that the Kernel-enhanced Partial GARCH model performs better for in-sample (training dataset), particularly for capturing nonlinear spillover effects from oil prices to Bitcoin volatility, and the EGARCH (1,1) model performs better than other models for out-of-sample (test dataset) volatility forecasting. Although parametric GARCH models remain effective for forecasting, this research highlights that the semiparametric extension of the GARCH model is also plays a vital role in understanding market volatility. Using EGARCH for prediction and Partial GARCH for structural analysis together is useful for risk managers and policymakers dealing with risk management in digital asset and energy-related financial markets. It also highlights the importance of incorporating exogenous factors in modelling cryptocurrency volatility.

**Keywords:** Bitcoin Volatility; Volatility forecasting; GARCH Models; Exogenous Factors; Kernel regression

**MAT 2720**

# On a New Class of Finite Integrals Involving Generalized Hypergeometric Function

**N Ambika [1] and Kurumujji Shantha Kumari [2]**

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**Abstract.** Motivated by the results earlier obtained by Rakha et al. [1], we were able to derive fifty novel category of integrals which involve hypergeometric function expressed in terms of gamma functions. In order to put these fifty integrals, two master formulas have been constructed by generalizing the results obtained by Rakha et al. [1]. The derivation method is based on the most interesting integral introduced by Lavoie and Trottier as well as the Watson's summation theorem generalized by Lavoie et al. [2].

2020 MATHEMATICS SUBJECT CLASSIFICATION. 33C05, 33C20,26A33.

**Keywords**. Single integral, Watson's summation theorem, Lavoie-Trottier Integral formula.

## CONTENT

**INTERNATIONAL CONFERENCE ON SMART AND SUSTAINABLE DEVELOPMENTS IN MATERIALS, MANUFACTURING AND ENERGY ENGINEERING (SME-2026)**

# CONTENT

**INTERNATIONAL CONFERENCE ON SMART AND SUSTAINABLE DEVELOPMENTS IN MATERIALS, MANUFACTURING AND ENERGY ENGINEERING (SME-2026)**

**SME 2601**

# Modified Flower Pollination Enhanced Model Predictive Temperature Controller for Polymer Extrusion Process

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**Abstract.** Polymer extrusion process is a process, which is broadly customed in many industries. This extrusion process works on with the temperature control system for controlling the temperature in various stages of the extrusion process. Different forms of controllers for temperature control in extrusion process was presented; such controllers like PID, Fuzzy, ANFIS, optimized and predicted PID controllers. In this research work, an optimized and enhanced model predictive controller is proposed. For optimizing and enhancing the variables in the controller, the modified flower pollination algorithm was presented. The performance of the planned work is looked over by scheming the controller in MATLAB Simulink software. The various analytical metrics are obtained and related as well as checked with the conventional controllers. By compare and contrast method it is proved that the error in the proposed controller is less.

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**SME 2602**

# Comparative Analysis of Fault Detection and Identification in Shell and Tube Heat Exchanger Using Multivariate Statistical Tools

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[2] Visvesvaraya Post-Doctoral Fellow, Department of Instrumentation and Control Engineering, National Institute of Technology, Tiruchirappalli, India – 620015.

**Abstract.** In a number of industries, including manufacturing and healthcare, Fault detection is essential as early discovery of abnormalities can avert serious risks or interruptions. Various pieces of equipment are being used in the manufacturing sectors. There is a chance that a fault may eventually develop in the process equipment under some unavoidable circumstances. The faults can be found using various fault detection and identification method based on the process-data, followed by fault diagnosis. This study aims at investigating the potential of classifying the fault in a Shell and Tube heat exchanger using two Multivariate Statistical tools called Correspondence Analysis (CA) and Support Vector Machine (SVM). CA is a powerful multivariate statistical method that is primarily used for identifying and evaluating relationships in categorical data, whereas Support Vector Machine is an efficient supervised learning algorithm that is widely used for classification tasks. To begin, we compiled four sizable set of samples representing various possible failure scenarios. On the dataset, the CA and SVM models were trained and assessed using metrics including F1-score, accuracy, precision, and recall. Although SVM and CA have shown effectiveness in binary classification tasks, CA performs better in multiclass fault detection than SVM. It has been observed that this metric was more effective in decomposing the data by capturing dynamic information and preserving variance. It showed a superior performance from the perspectives of data compression, discrimination, and classification.

**SME 2609**

# Mechanical and Tribological Performance of Hybrid AZ91 Magnesium Composites Reinforced with Titanium Diboride and Multi-Walled Carbon Nanotubes via Stir and Ultrasonic-Assisted Casting

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KLE Technological University, Hubli-580031, Karnataka, India.

**Abstract.** The demand for lightweight, high-strength materials in automotive and aerospace industries has spurred research into hybrid magnesium metal matrix composites (HMMCs). This study explores the reinforcement of AZ91 magnesium alloy with 5 wt.% $TiB_2$ and 1–2 wt.% Multi-Walled Carbon Nanotubes (MWCNTs) using stir casting and ultrasonic vibration-assisted casting. Four composite variants were fabricated: AZ91 + 5 wt.% $TiB_2$ + 1 wt.% MWCNTs (stir casting), AZ91 + 5 wt.% $TiB_2$ + 2 wt.% MWCNTs (stir casting), AZ91 + 5 wt.% $TiB_2$ + 1 wt.% MWCNTs (ultrasonic-assisted casting), and AZ91 + 5 wt.% $TiB_2$ + 2 wt.% MWCNTs (ultrasonic-assisted casting). These composites were evaluated for hardness, tensile strength, wear resistance, and microstructural properties using scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS). Ultrasonic-assisted casting yielded superior mechanical properties due to enhanced reinforcement dispersion and reduced porosity. The AZ91 + 5 wt.% $TiB_2$ + 2 wt.% MWCNTs composite fabricated via ultrasonic-assisted casting exhibited a 25% increase in tensile strength, an 18% improvement in hardness, and enhanced wear resistance compared to its stir-cast counterpart. SEM analysis confirmed uniform reinforcement distribution along grain boundaries, contributing to these improvements. These findings highlight the potential of AZ91-$TiB_2$- MWCNT composites for high-performance structural applications that require exceptional strength- to-weight ratios and wear resistance.

**Keywords.** Magnesium AZ91 composite; Titanium Diboride; multi-walled carbon nanotubes; stir casting;ultrasonic-assisted casting; hardness; tensile strength; wear rate.

**SME 2619**

# Parameter Optimization for Additive Manufacturing of Lightweight Components in Aerospace/Automotive Applications

**Vinod Kumar V Meti [1] , Vaibhav Vinod Dhulla [1] , Krish Ketan Patel [1] , Kamalaksh Dessai [1] , and Vijaykumar S. Jatti [2]**

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**Abstract.** Additive Manufacturing (AM), commonly referred to as 3D printing, is revolutionizing the aerospace and automotive industries by enabling the production of intricate and lightweight components from digital files, and further decreasing waste and production time compared To conventional_methods.Although Fused Deposition Modelling (FDM) is a popular AM technique due to its accessibility and inexpensive cost, its output quality is highly dependent on variables su ch as layer height, print speed, bed temperature, and nozzle temperature. This study combines the industrial-grade Aion 500 printer with real-time fault detection and parameter adjustment. After printing under various conditions, a representative aerospace part was designed and printed in solid and topology optimized to assess accuracy, strength, material efficiency, and overall geometrical refinement. A YOLOv8 deep learning model was trained for defect recognition using a bespoke dataset, high-definition webcams, and edge computing modules to record still images. The findings demonstrated a 34% decrease in geometric deviation, a 27% improvement in surface quality, and a 40% improvement in dimensional consistency. In addition, YOLOv8 real-time monitoring achieved 91.3% accuracy at 20 frames per second. This study shows that combining AI- based monitoring with parameter optimization improves the reliability of FDM and pushes the process closer to intelligent, defect-aware manufacturing. At this stage, the system focuses on real-time monitoring with simulated corrective feedback rather than fully autonomous control. However, the framework sets a clear foundation for future closed-loop implementations where the printer can adjust parameters automatically during the build.

**SME 2628**

# Electric Vehicle Fast Charging Optimization with V2G Integration using Adaptive Frilled Lizard Optimization

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**Abstract.** The increasing popularity of electric vehicles (EVs) has led to a sharp increase in the need for more intelligent and economical charging infrastructure. A suggested Adaptive Frilled Lizard Optimization (AFLO) method is presented in this study to handle the operational difficulties associated with EV charging and V2G (Vehicle-to-Grid) interface. This algorithm can be used to optimize a daily charging schedule according to cost, peak demand, and user equity. A fleet of 30 EVs with 40 kWh batteries and V2G capability were evaluated using a simulation to determine the effectiveness of the suggested method. The vehicles' battery charging and discharging capacities ranged from 3.3 kW to 7.2 kW over a 24- hour period. Photovoltaic (PV) generation characteristics, price volatility in the real-time energy market, and time-of-use electricity tariffs were all taken into account in the simulation. Based on the results, the AFLO algorithm lowers the daily electricity cost to $104.2, which is 31% less than the baseline and 12% less than CHHO. Additionally, by reducing peak demand by 26.8%, the method improves V2G energy throughput to 128.7 kWh/day. The Time-Aware Fairness Index (TAFI) also rises to 0.73 and the maximum waiting time for an individual drops to 33.5 minutes, both of which show increased grid efficiency and user satisfaction. The sensitivity tests, which show the AFLO algorithm's resilience and applicability to actual smart charging and grid-support scenarios, lastly verify that the algorithm performs steadily even in the face of fluctuations in PV availability, price volatility, or scenario size.

**Keywords.** Electric Vehicle, V2G, Photovoltaic, Adaptive Frilled Lizard Optimization, and Time-Aware Fairness Index.

**SME 2632**

# Artificial Neural Network Modelling for Production of Biodiesel from Waste Cooking Oil

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**Abstract.** Artificial neural network (ANN) are bioinspired algorithms used in various engineering applications. The objective of this present study is to create a model algorithm for biodiesel synthesis from the collected waste cooking oil utilizing artificial neural networks (ANN). The factors consider to be influencing the biodiesel production are concentrations of solutions, time and temperature, pH of the solution, and agitation speed. In previous trials, methanol to oil ratio, sodium hydroxide to oil ratio, in addition to reaction temperature were taken as in terms of independent type of variables and % biodiesel yield inulin as a dependent variable. The results reveal that the 3-10-1 architecture of ANN provides goodness of fit to predict the percentage yield of biodiesel. The prediction ability of ANN is assessed by the coefficient of determination ($R^2$). The resultant $R^2$ value shows that the ANN predicted values fitted well to the percentage yield of biodiesel.

**Keywords.** Inulin, Artificial neural network, biodiesel, Extraction, Percentage yield.

**SME 2633**

# Aerodynamic shape optimization of a Fixed-Wing UAV Fuselage:A FV Study

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**Abstract.** With the advancements in Unmanned Aerial Vehicles (UAVs), its application can be seen in various industries, from defense to medical services. All these applications call for increased efficiency regarding endurance and performance. One of the most effective ways of realizing this is by minimizing the total drag imposed on the aircraft. The fuselage is a critical subsystem of the UAV where avionics and payload are accommodated, and significantly contribute towards the total aerodynamic drag. Here, the current research aims for aerodynamic fuselage shape optimization to reduce drag and improve the overall performance of the UAV. An airfoil-based approach to designing the fuselage is carried out, and several iterations of computational analysis were conducted to compare and assess drag forces. Drag values from each configuration were compared, and design adjustments were made as required to obtain an optimized fuselage configuration. This research shows that an optimized fuselage can effectively minimize aerodynamic drag by 34 % as compared to the preliminary design, improving the endurance and overall performance of the UAV. The research adds to more efficient UAV design development by resolving fuselage-induced drag, which remains neglected in current studies.

**SME 2641**

# Performance study of a solar cooker working on evacuated tubes as solar energy collector

**Gautama Hebbar, Krishna Prasad S, Nihar Ramraj Sanil, Parikshith, Prajwal R Reddy, Praneeth P Kotian, Manu Kashyap, Samith J Acharya, Vishwanath, Tharunraj**

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**Abstract.** A solar cooker utilizes the heat energy from the thermal radiation received from the sun. There are many types of solar cookers which work on different solar energy collectors. An evacuated tube based solar cooker is being constructed and studied in this present work. Initially three types of fluids namely water, engine oil and palm oil were used inside a single collector and temperature readings were recorded using a normal mercury in-glass thermometer throughout the day. The temperature readings were also recorded throughout the day with an Aluminum foil kept below the evacuated tube with palm oil inside the collector. It was found that palm oil temperature reached to a maximum temperature of 216°C at 01:30 PM. This study was carried to understand the suitability of heat transfer fluid inside the collector. A solar cooker was fabricated and palm oil was filled inside the tubes and the drum. The temperature rise of the oil inside the cooker drum was not achieved since the number of collectors were less for the fabricated cooker drum. Hence the solar cooker didn’t work as the rise in temperature was not sufficient for cooking purpose.

**SME 2643**

# Rolling Element Bearing Fault Diagnosis using Bhattacharya Distance

**H. S Kumar , Gururaj Upadhyaya**

**Abstract.** Rolling Element Bearing (REB) fault diagnosis is one of the widely researched themes as REBs are critical components of rotating machines. Several modern methods including Reinforcement Learning and Deep Learning approaches have been used to explore the extent to which an individual or a group of approaches can help in distinguishing between a healthy and unhealthy bearing. In most of the cases the data for such analyses have been the data extracted from time -frequency domain. This paper explores the possibility of distinguishing between healthy and unhealthy REB using statistical features obtained from discrete wavelet transforms (DWT) of Interval-Dependent denoised vibration signals. To analyse these statistical features Bhattacharya Distance with Bayes error estimate at error/ significance levels consistent with six-sigma approach was used. It was observed that among 17 statistical features tested, Weibull negative log-log (WNLL) was able to distinguish between a healthy and unhealthy bearing at the above significance levels.

**Keywords**. Bhattacharya Distance, REB fault diagnosis, wavelet-based denoising, Statistical features.

**SME 2650**

# Review on welding and Stress relieving of Ti-6Al-4V: Challenges and Recent Advancements

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**Abstract.** Ti-6Al-4V is known for its high strength, corrosion resistance and lightweight properties. Welding of Ti-6Al-4V poses specific challenges because of its susceptibility to form brittle phases, such as martensite (α;), which may degrade its ductility, toughness and also welding is known to deteriorate the fatigue properties due to the residual tensile stresses introduced after welding. Several modern welding techniques, like tungsten inert gas welding, laser welding and electron beam welding have been reviewed in this paper for their effect on thermal distortion and phase transformation. Post-weld heat treatment (PWHT) is essential for regaining ductility and minimising residual stresses. These treatments initiate the transformation of the martensitic structure into a more beneficial alpha-beta (α + β) structure, enhancing its mechanical properties. Surface treatments, namely shot peening (SP), laser shock peening (LSP), and ultrasonic peening, are emphasized for their potential to improve fatigue resistance and resistance to corrosion. These peening techniques induce compressive residual stresses that boost fatigue strength by mitigating fracture initiation and reduces surface roughness which improves corrosion resistance in severe conditions. This review outlines the present state of research and industrial practices, highlighting the necessity of integrating welding, post-weld treatments, and surface treatments to enhance the performance of Ti-6Al-4V components in highly demanding applications, including aerospace, automotive and marine sectors.

**Keywords.** Ti-6Al-4V, Welding, Residual stress, Post weld treatment, Surface treatment.

**SME 2656**

# Mechanical and Thermal Properties of PLA Reinforced with Natural and Synthetic Materials - A Review

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**Abstract.** Polylactic acid (PLA) is a biodegradable plastic made from renewable resources such as corn starch, sugarcane, and cassava. It has gained significant attention as a sustainable alternative to petroleum-based plastics because of its eco-friendly nature and potential to reduce dependence on fossil fuels. Despite these advantages, PLA suffers from brittleness, low impact strength, and limited heat resistance, which restrict its use in demanding applications. To overcome these limitations, researchers have developed reinforced PLA composites by incorporating fibers, nanofillers, and polymer blends. These modifications have greatly improved the material's strength, thermal stability, and overall durability. Among natural reinforcements, flax fibers have emerged as a highly promising option due to their low cost, lightweight nature, and mechanical properties comparable to glass fibers. Flax fiber–reinforced PLA composites provide an environmentally friendly alternative with excellent performance. Although PLA naturally decomposes in compost and soil environments, additives such as nano clays can alter its biodegradation behavior without necessarily speeding up the process. Furthermore, PLA's crystallization behavior plays a critical role in determining its mechanical and thermal properties. Factors like cooling rate, annealing temperature, and the use of nucleating agents significantly influence crystal growth and structure. By improving its crystallinity, PLA's strength, heat resistance, and barrier properties can be enhanced. Recent research has focused on optimizing reinforcement techniques, processing methods, and 3D printing parameters to further improve its performance. These advancements have expanded PLA's potential for industrial and commercial applications, solidifying its role as a leading sustainable material for the future

**SME 2658**

# FPGA Implementation of Personalized Voice Extraction System

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**Abstract.** A real-time target speaker voice isolation system is presented, designed for low-latency FPGA implementation and verified through software simulation. The system is intended to extract a desired speaker's voice from noisy audio mixtures using a short reference speech sample. A Python-based simulation environment was developed to model and validate the complete signal-processing pipeline, including preprocessing, time–frequency analysis, feature extraction, mask generation, and signal reconstruction. The algorithm utilizes Short-Time Fourier Transform (STFT) for spectral conversion, a Mel filterbank and Mel-Frequency Cepstral Coefficients (MFCC) for speaker-specific feature extraction, and a Wiener-like gain filter for adaptive noise suppression. Quantitative evaluation was performed in terms of Signal-to-Noise Ratio (SNR), Noise Reduction Ratio (NRR), and latency, with results indicating the feasibility of real-time operation on FPGA hardware. The simulation establishes a verified digital signal-processing model that forms the foundation for subsequent FPGA hardware implementation and optimization

**SME 2673**

# Matrix-equations to Forecast Working of Parallel-Cross-flow Heat-Exchanger

**Arvind Kumar Senthil Kumar [1] and Karthik Silaipillayarputhur [2]**

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**Abstract.** The primary goal of this research project is to create matrix equations to predict how a parallel-cross-flow-heat-exchanger (PCFHX) would operate using fundamental concepts like heat-balance and heat-exchanger (HX) efficacy. A matrix is used to express the simultaneous linear equations that result from applying heat-balance and HX-efficacy principles to all heat-exchanger passes. Matrix equations are helpful in predicting the intermediary and final temperatures during the construction, design, and operation of a PCFHX. The entire process is carried out on a dimensionless basis and is appropriate for any unit system. The number of transfer units (N), efficacy (E), and capacity-rate ratio (C) are steady- state dimensionless variables used in heat exchanger design & performance analysis and are used in this work. By altering the dimensionless variables, a parametric study using matrix-equations was conducted. To predict the heat- exchanger's performance at every given pass, graphs were made. It is clear from every graph that there is a cut-off value for N and that raising it above that value doesn't really help.

**SME 2675**

# Approximation Error Model for the Solution of Inverse Conjugate Heat Transfer Problem

**Shreya Shubhanga Aithal[1], and N. Gnanasekaran[2]**

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**Abstract.** This study presents a solution to an inverse conjugate heat transfer problem using the Approximation Error Model (AEM). A vertical mild steel fin attached to an aluminium plate is modelled in ANSYS Fluent, with symmetry utilized to reduce the computational domain. The forward problem determines the temperature distribution for known parameters, while the inverse problem estimates unknown parameters, namely convective heat transfer coefficient and heat flux, from measured temperature data. To reduce the computational cost associated with solving the Navier–Stokes equations, a reduced conduction-based model is employed. Artificial Neural Network (ANN) models are developed to replace both the complete and reduced models, significantly improving computational efficiency and enabling integration between ANSYS and MATLAB. To compensate for discrepancies between the complete and reduced models, the Approximation Error Model (AEM) approach is adopted. For the purpose of assessing the effectiveness of the inverse estimation framework, temperature data obtained from numerical simulations are treated as measured data, to which noise is added to represent experimental uncertainty. The unknown parameters are then estimated within a Bayesian framework using the Metropolis–Hastings Markov Chain Monte Carlo (MHMCMC) algorithm.

**Keywords.** Inverse estimation; Heat flux; Heat transfer coefficient; Complete model; Reduced model; Artificial Neural Network; Approximate Error Model; Bayesian framework; Markov Chain Monte Carlo

**SME 2680**

# Experimental Study on the Effect of Steel Mesh Diameter as Textile Reinforcement on the Flexural Behavior of Precast Concrete Sandwich Panels

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College of Engineering, Wasit University

**Abstract.** Lightweight precast concrete sandwich panels (PCSPs) are increasingly used in short-span roofing systems where low self-weight, thermal efficiency, and economical construction are required. In such panels, steel wire mesh is commonly employed as textile tensile reinforcement; however, the influence of mesh wire diameter on flexural behavior has not been clearly established. This study experimentally investigates the effect of steel mesh diameter on the flexural performance of lightweight PCSPs. Three sandwich panel specimens (D1, D2, and D3) with overall dimensions of 1000 × 450 mm were fabricated using self-compacting concrete wythes with a constant thickness of 10 mm and an expanded polystyrene (EPS) insulation core of 50 mm thickness. The specimens were reinforced with steel wire meshes of three different diameters: 2.0 mm, 2.5 mm, and 3.0 mm, while the mesh spacing and all other parameters were kept constant. The panels were tested under four-point bending to evaluate cracking load, peak load, load–deflection response, and cracking and failure patterns. The experimental results showed that increasing the steel mesh diameter from 2.0 mm to 2.5 mm significantly improved cracking resistance, peak load, and ductility, accompanied by more uniform crack distribution and stable post- cracking behavior. In contrast, further increasing the mesh diameter to 3.0 mm did not enhance flexural performance and led to reduced deformation capacity due to crack localization. The findings indicate the existence of an optimal steel textile diameter for lightweight PCSPs with thin concrete wythes and provide practical guidance for the design of low-cost sandwich roofing panels.

**Keywords**. precast concrete sandwich panels; lightweight roofing systems; steel wire mesh; textile reinforcement; mesh diameter; cracking load; thin concrete wythes; EPS insulation

**SME 2685**

# Calculation the Reliability-Adjusted Distance to Optimize TSP Solutions

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**Abstract.** The Traveling salesman problem (TSP) is a classic optimization problem used in logistics, transportation planning and their related areas. However, most literature formulations for the TSP assume static distances, and fail to capture real-world variations such as traffic jams and temporal weather changes. In this work, a new reliability- adjusted distance framework is contributed which incorporates the success probability of travel into the TSP's cost function. By incorporating a probabilistic reliability term, the model penalizes high-uncertainty routes and encourages to establish reliable connections. The designed regulation introduces a generalization of the distance metric based on whole- path stability, which helps improving decision making in dynamic environments. Optimization of the solutions is performed using the 2-OPT local search heuristic to find high- quality answers quickly. We get the experimental results of the new approach by using python language, the results show significant enhancement in route robustness and overall travel efficiency as compared to typical TSP methods. The results verify the suitability of the model in intelligent transportation systems, autonomous vehicle navigation, and emergency logistics with high reliability and decision adaptability.

**Keywords.** Traveling Salesman Problem (TSP), 2-OPT Algorithm, Reliability, Optimization, Distance Adjustment.

**SME 2687**

# Structural Analysis of the Wastes of the "Almalyk MMC" JSC Copper Concentrate Factory

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**Abstract.** This study presents a comprehensive structural analysis of the waste materials generated by the Almalyk Mining and Metallurgical Combine ("Almalyk MMC" JSC) copper concentrate factory (CCF). The primary objective of this study is to characterise the mineralogical and chemical composition of the factory's tailings and solid waste, in order to assess their environmental impact and potential for resource recovery. A variety of tailings and slags samples were collected and analysed using a combination of advanced analytical techniques. These techniques included scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) The results indicate that the waste material is predominantly composed of sulfide minerals, including chalcopyrite and pyrite, along with gangue minerals such as quartz and feldspar. Secondary mineral phases, including iron oxides and hydroxides formed through oxidation processes, were also identified. The morphological analysis indicates the presence of fine-grained particles, with complex associations between metal-bearing sulfides and inert gangue components. These findings are of crucial importance for the understanding of the potential environmental risks, particularly acid mine drainage, and for the development of effective waste management strategies. In addition, the structural characterisation provides a foundation for exploring opportunities to recover valuable metals from the wastes, thus contributing to sustainable mining practices at "Almalyk MMC" JSC.

**SME 2690**

# Experimental role of Surface Preparation in Enhancing the Bond Strength of BFRP–Al-T6 Hybrid Joints

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**Abstract.** Adhesively bonded composite metal joints are gaining importance in lightweight aerospace structures as they provide more uniform distribution of stress, reduce structural weight, and increase damage tolerance compared to conventional mechanical fastening. In these hybrid systems, the mechanical performance of the joint is strongly influenced by the surface condition of the metallic adherend. This study focuses on the experimental investigation of aluminium surface treatments on the mechanical response of adhesively bonded Basalt Fibre Reinforced Polymer (BFRP) to Al 6061-T6 single-lap joints. The substrates were subjected to various surface preparation methods, including untreated condition, sandpaper, alkaline etching using NaOH solution, and resin pre-coating (RPC) were studied to see their effect on interfacial bonding and joint strength. BFRP laminates were prepared using the hand layup technique and adhesively bonded with aluminium adherends using a two-part epoxy adhesive. Mechanical performance was evaluated through tensile shear and three-point flexural tests conducted in accordance with relevant ASTM standards. The results demonstrate a strong dependence of joint performance on surface preparation and among all treatments, RPC treated joints exhibited the highest tensile shear strength (12.11 MPa) and flexural strength (79.45 MPa), indicating superior interfacial compatibility and effective stress transfer. To analyse the failure mechanisms of the substrates under various surface treatment processes, optical microscopic analysis was performed systematically. Based on the analysis, the damages and interfacial properties for the respective surface treatments can be identified easily. These findings highlight the effectiveness of resin pre coating for developing mechanically robust BFRP–Al6061 adhesive joints suitable for lightweight aerospace structural applications.

**Keywords.** Adhesive bonding; Basalt fibre reinforced polymer (BFRP); Aluminum 6061-T6; Surface preparation; Resin pre-coating; Mechanical performance

**SME 2691**

# Surface Treatment Dependent Strength and Failure Behavior of Aluminum 5052-Basalt Fiber Composite Adhesive Joints

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**Abstract.** Adhesive bonding is a widely adopted technique for fibre-reinforced composite structures to join in aerospace and lightweight load-bearing applications, owing to its capability to reduce structural weight, promote uniform load transfer, and minimize stress concentrations. The mechanical performance of adhesively bonded joints is highly dependent on the surface condition of the adherends. This study evaluates the bonding performance of single-lap joints fabricated using dissimilar adherends, namely aluminium-basalt fibre reinforced polymer (Al- BFRP) joints. Aluminium 5052 substrates were subjected to various surface preparation methods, including untreated condition, sandpaper, alkaline etching using NaOH solution, and resin pre-coating (RPC). The joints were bonded using araldite@2011 and mechanically characterized through tensile lap shear and flexural tests performed on a polymer universal testing machine. The experimental results revealed that all surface treatment methods significantly improved the bonding performance compared to untreated joints. Among the investigated techniques, RPC treatment demonstrated the highest enhancement, achieving an improvement of approximately 155% in lap shear strength. A similar improvement trend was observed in flexural strength, indicating enhanced stiffness and superior load-bearing capability. The outstanding performance of RPC-treated joints is attributed to improved surface wettability, enhanced mechanical interlocking, and stronger interfacial adhesion between the aluminium and BFRP adherends. Optical micrographs showed that bond performance strongly depended on surface treatment. Resin pre-coated Al-5052 joints exhibited homogeneous morphology with negligible porosity, no interfacial cracks, and cohesive failure. The resin interlayer ensured efficient stress transfer and superior tensile and flexural performance.

**Keywords.** Adhesive bonding; Aluminium 5052; Basalt fibre-reinforced polymer; Surface treatment; Resin pre-coating; Lap shear strength; Flexural behaviour; Dissimilar joints

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**SME 2692**

# An experimental evaluation of the FSW of an aluminum matrix composite reinforced with minerals

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**Abstract.** The present work deals with friction stir welding (FSW) of mineral reinforced Aluminium Matrix Composites (AMCs) and exploring the influence of several process variables on the joint characteristics. Measurements were made for the mechanical behavior and microstructural analysis, including tensile strength and weld zone hardness. Studies on grain microstructures revealed that process factors are crucial to the refinement of grains. Smaller grains observed at the bottom region of weld zone than the top due to variations in the thermal effect. Joint strength in terms of ultimate tensile strength and joint efficiency and weld zone hardness measurements showed that process factors are crucial in determining the joint qualities. Outside the ideal range of process variables, lack of stirring and insufficient plasticization cause the strength of welded parts to decrease and fault formation. Better mechanical qualities could be seen in joints that were joined with tool traverse speeds of 100 mm/min and tool rotational speed of 1200 rpm.

**Keywords.** FSW, PAMC, Grain Structure, Characterization.

**SME 2693**

# Design of a Self-Optimizing PLC Architecture for Dynamic Memory and Scan-Time Management in Industrial Automation Systems

**Aishwarya Hubballi, Shrihari Katti, Mantesh C. Choukimath, Satish GJ and Anand Lakkundi**

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**Abstract.** PLCs are used for cyclic scan-based control, which is important for safety and throughput due to their ability to provide accurate deterministic scan time and bounded memory behavior. Industrial applications in the present day are facing more variable workloads, such as communication bursts and analytics while requiring fixed scan configuration changes, making them inefficient for CPU headroom and potentially violating deadlines with jitter. A PLC architecture that is self-optimized and dynamically manages scan-time and runtime memory while maintaining real- time guarantees is presented in this paper. This architecture uses runtime to estimate demand for task execution, tracks memory pressure/fragmentation and solves a limited optimization problem every cycle (or at regular intervals) to adjust task rates, budget as well as safe memory actions. Fixed-size pools are utilized for challenging real-time tasks, while non-critical allocations are subject to bounded compaction and admission control through the use of a real time-safe memory manager. A budget guard is utilized by an adaptive scheduler to limit optional workload and minimize scan-time variance while concentrating on safety-critical tasks. Constrained calculations, analysis, mathematical models, and analytical methods are available to ensure that constraints are enforced with confidence. According to a synthetic evaluation, the average scan time is reduced by 50% compared to an initial fix baseline. This suggests that closed-loop runtime optimization can enhance determinism and efficiency in dynamic automation workloads while still being compatible with IEC 61131 programming practices. Additionally, this proposed framework improves scalability and robustness by allowing for autonomous workload response (self-service) instead of manual retuning. This architecture optimizes the use of computational and memory resources while maintaining deterministic behavior by combining runtime monitoring with predictive decision-making. This approach is particularly well-suited to next-generation smart manufacturing systems, edge-enabled PLCs, and Industry 4.0 environments where adaptive/reliable/high-performance control is important.

**SME 2694**

# PLC-Based Implementation of PID Control for Flow and Level Regulation in a Tank System

**Aishwarya S H, Surajkumar, Shrihari Katti, Mantesh C Choukimath, Satish G J, Anand Lakkundi**

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**Abstract.** Flow and level control of liquid storage tanks is a fundamental requirement in industrial process systems. This paper presents a PLC-based implementation of a PID control strategy for regulating both flow rate and liquid level in a single tank system.[3] The dynamic behaviour of the tank is modeled using mass balance principles to describe the relationship between inflow, outflow, and liquid level. The control algorithm is implemented using a programmable logic controller configured in Siemens TIA Portal V17, while the process behaviour and plant dynamics are simulated using Factory I/O version 2.5.8. PID controller parameters are tuned to achieve stable operation with minimal overshoot and reduced steady-state error. The performance of the proposed control scheme is evaluated under setpoint variations and disturbance conditions. Simulation results demonstrate that the PLC-based PID control approach provides effective and reliable regulation of flow and level, confirming its suitability for industrial tank control applications.

**Keywords.** Flow control, level control, PID controller, programmable logic controller, TIA Portal V17, Factory I/O 2.5.8.

**SME 2695**

# High-Speed PLC-Based Motion Synchronization Using Feedforward + Feedback Modelling

**Vivek Padi, Vishal Chavannavar, Shrihari Katti, Mantesh Choukimath, Anand Lakkundi, and Satish GJ**

Department Of Mechanical Engineering KLE Technological University Hubballi, India

**Abstract.** High-speed pick-and-place systems are extensively used in modern manufacturing industries such as electronics assembly, packaging, and precision automation, where accurate multi-axis motion synchronization is essential for achieving high throughput and operational reliability. In PLC-based motion control systems, achieving sub-millisecond synchronization remains a major challenge due to inherent limitations such as PLC scan-cycle delays, communication latency, nonlinear actuator dynamics, and external disturbances. Conventional feedback-only control strategies are often inadequate at high operating speeds, as they react to errors only after they occur, leading to phase lag and synchronization inaccuracies. To address these limitations, this paper proposes a hybrid feed forward and feedback motion synchronization approach specifically designed for real-time PLC implementation. The feed forward component predicts the behavior of the system using predefined motion profiles and known dynamic parameters to compensate for predictable delays and inertial effects, while the feedback controller corrects residual errors caused by disturbances and modeling uncertainties. Both control actions are integrated within the PLC scan cycle, ensuring deterministic execution and computational efficiency. The proposed method is evaluated through PLC-based simulation of a high-speed pick- and-place motion system, where key performance indicators such as synchronization error, response time, and robustness under load variations are analyzed. Simulation results demonstrate a significant reduction in synchronization error and phase delay when compared with conventional feedback-only control, particularly during high-speed motion and rapid acceleration phases. The proposed hybrid control strategy offers a practical, lightweight, and industry-ready solution for improving motion synchronization accuracy in PLC-controlled high-speed automation systems.

**SME 2696**

# Shape Memory Alloy a Comprehensive Review

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**Abstract.** Shape Memory Alloys (SMAs) have been characterized into thermo mechanical evolution, focusing on the Shape Memory Effect (SME) and super elasticity driven by reversible martensitic transformations. It critically evaluates material hierarchies: NiTi is established as the benchmark for high-cycle biomedical and aerospace applications due to superior fatigue resistance, while Cu-based and Fe-based systems offer cost-effective alternatives for industrial damping and civil infrastructure respectively. The study identifies Additive Manufacturing, specifically Selective Laser Melting, as the critical solution to traditional casting limitations, enabling precise porosity control and precipitate homogenization. Furthermore, it highlights the necessity for advanced multi-physics Finite Element Method (FEM) models to resolve non-linear convergence issues in emerging electro caloric and morphing structure applications.

## CONTENT

**INTERNATIONAL CONFERENCE ON VLSI, SIGNAL PROCESSING, POWER ELECTRONICS, IOT, COMMUNICATION AND EMBEDDED SYSTEMS (VSPICE-2026)**

**INTERNATIONAL CONFERENCE ON VLSI, SIGNAL PROCESSING, POWER ELECTRONICS, IOT, COMMUNICATION AND EMBEDDED SYSTEMS (VSPICE-2026)**

**ICE 1003**

# Comparative Analysis of Latch-Based and Current-Mirror Sense Amplifiers for 18 nm 6T SRAM Cells Designed in Cadence Virtuoso

**Megha N, Dhanush G, Sanjitha, Mohammed Shahan Hassan Niyaz and eManvith S Shetty**

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**Abstract.** This paper shows the design and analysis of low power, 6T Static Random Access Memory (SRAM) cell using a 18nanometer Fin field-effect transistor (FINFET) technology in the Cadence Virtuoso environment. The goal is to achieve functional stability, low power, and an efficient cell design for embedded applications. Reliable read and write operations are completed with the proper sizing of transistors and optimized design. In this work, we have integrated both latch-based and current mirror-type sense amplifiers to evaluate their performance. focusing on key parameters like delay time and power consumption. The outputs of each configuration were analyzed under identical simulation conditions, Graphical analysis high- lights the trade-off between speed and power efficiency, helping identify the optimal sense amplifier for low-power, high-speed SRAM applications in 18nm FINFET technology.

**Keywords**. 6T SRAM, 18 nm FINFET Technology, Latch- Based Sense Amplifier, Current Mirror Sense Amplifier, Low- Power SRAM Design, Read Delay, Cadence Virtuoso

**ICE 1006**

# Optimized 8-Bit Radix-8 Booth Multiplier Architecture Using Modified Boot Encoding

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**Abstract.** This project uses Verilog HDL to design and implement an 8-bit Radix-8 Booth Multiplier. The Booth algorithm is used to speed up multiplication and reduce the number of partial products. By encoding three multiplier bits at a time, the Radix-8 method reduces the number of addition and subtraction operations needed. Compared to traditional multipliers, this design lowers hardware complexity and increases computational efficiency. Xilinx Vivado 2018.3 is used to simulate the multiplier, and the results verify accurate, fast signed multiplication, which makes it ideal for high- performance arithmetic applications such as digital signal processing.

**ICE 1016**

# Implementation of a High-Performance 64-bit Signed ALU Using 90 nm CMOS Process

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**Abstract.** Modern high-performance computing demands efficient arithmetic units with low delay and area overhead. This paper presents an ASIC implementation of a 64-bit signed Arithmetic Logic Unit (ALU) supporting essential arithmetic and logic operations, including addition, subtraction, multiplication, division, logical, and shift functions. Signed addition and subtraction are implemented using an optimized architectural approach to ensure accurate sign handling and reduce computation latency. A signed barrel shifter is integrated to perform efficient arithmetic and logical shifts for both positive and negative values. To optimize multiplication, a Vedic multiplier based on the Urdhva-Tiryagbhyam Sutra is employed, offering faster computation through parallel partial product generation. For division, a signed restoring algorithm ensures correct handling of all signed input combinations. The design is developed in Verilog HDL and verified through extensive simulation. The complete ASIC flow—from RTL to GDSII—is realized using Cadence tools with UMC 90nm CMOS technology. Post-synthesis reports show an area of 368,410.08 µm2, a critical path delay of 4.86 ns, and a total power consumption of 34.94 mW. Final layout passes DRC and LVS checks, confirming the design's manufacturability. This work demonstrates the effectiveness of integrating Vedic arithmetic and architectural-level enhancements into ASIC flows to achieve high-speed and area- efficient arithmetic units.

**Keywords.** Application Specific Integrated Circuit (ASIC), Arithmetic Logic Unit (ALU), Design Rule Checks (DRC), Layout vs Schematic (LVS), Static Timing Analysis (STA), Urdhva-Tiryagbhyam (UT).

**ICE 1030**

# Implementation and Verification of AMBA AHB Protocol Using UVM

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**Abstract.** The Advanced High-performance Bus (AHB) protocol, integral to the ARM AMBA, is crucial for high-speed communication in system-on-chip (SoC) designs. This paper details the design and verification of an AHB protocol implementation, emphasizing a systematic approach using the Universal Verification Methodology (UVM). Key design features include pipelined operation, burst transfers and Configurable data bus widths. A detailed architecture of AHB master, slave, and interconnect components is presented. The verification employs a comprehensive UVM-based testbench with drivers, monitors, sequencers, and scoreboards tailored for the AHB protocol. The UVM interface enhances modularity and reusability, covering various scenarios to ensure thorough validation. This methodology effectively ensures protocol compliance and early identification of potential design issues.

**ICE 1038**

# PWM-Based FPGA Realization of Field-Oriented Control with GPPI Regulators and Q1.13 Precision

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**Abstract.** This paper presents the design and implementation of a Field-Oriented Control (FOC) system for three-phase AC motor control, using the Xilinx Artix-7 FPGA. The architecture is entirely modelled in Xilinx ISE for functionality verification, using fixed-point Q1.13 format. The choice of this format justifies for the real-time performance of the proposed system without floating- point overhead. The complete FOC system which includes four major stages, Clarke and Park transformations, PI controllers, inverse Park transformation, and space vector PWM (SVPWM) generation, are integrated into a unified hardware architectural design. The functionality validation of the developed architecture system is performed with Nexys A7-100T FPGA board, demonstrating accurate PWM signal generation and stable current control under varying input conditions.

**ICE 1040**

# Contrastive analysis of Bypass and Vedic Multiplier for FPGA-Based system design

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**Abstract.** Low-power and highspeed multiplier architectures are widely used in signal processing, communication, and embedded applications. This research work presents a comparison between two commonly used multiplication architectures in terms of their power consumption. The Vedic multiplier, is based on the Urdhva Tiryakbhayam sutra, while the Bypass multiplier, uses the operand-dependent bypassing technique. Both multipliers are implemented using Verilog HDL, and power analysis is performed using the Xilinx Vivado Power Analyzer tool. The analysis of the total on-chip power, dynamic power, device static power, RTL schematics and technology-mapped netlists, is performed to understand the architectural differences. The bypass multiplier reduces dynamic power due to fewer transitions. In contrast, the Vedic multiplier provides lower latency with higher power compared to Bypass multiplier. This comparative study concludes that the bypass multiplier can be used for low power and minimal resource applications, whereas the Vedic multiplier is used for high-speed applications where performance is critical.

**ICE 1043**

# Improving Fraud Detection in Imbalanced Data Using Model-Agnostic Threshold Optimization

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**Abstract.** As digital payments continue to accelerate in scale and speed, detecting fraudulent transactions has become increasingly crucial and challenging. A major difficulty arises from the extreme imbalance between legitimate and fraudulent credit card transactions, which causes conventional classifiers to misidentify a large share of minority-class instances despite high overall accuracy. Existing imbalance-handling methods—such as oversampling, under sampling, and cost-sensitive learning—often introduce computational overhead, distort data distribution, or depend heavily on specific model architectures. To address these limitations, this paper proposes a lightweight, model-agnostic threshold-optimization framework that enhances fraud detection without modifying the classifier or the training data. The method identifies an optimal decision threshold by maximizing Cohen's Kappa across stratified subsets of the training set, yielding a stable and robust operating point for imbalanced classification. Experiments on the widely used credit card fraud dataset demonstrate that the optimized threshold significantly improves True Positive Rate while maintaining strong AUC performance across Random Forest, Logistic Regression, and XGBoost. These results highlight threshold optimization as an effective and computationally efficient strategy for improving fraud detection performance in severely imbalanced environments.

**Keywords**. Credit Card Fraud Detection; Class Imbalance; Threshold Optimization; Cohen's Kappa; Imbalanced Classification; Machine Learning.

**ICE 1048**

# Adaptive Weighted Federated Deep Learning for Privacy-Preserving ICU Mortality Prediction

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**Abstract.** The healthcare systems create a significant volume of Electronic Health Records (EHRs) that is ripe for predictive modeling to aid clinical decision-making, especially regarding emergency care situations. Traditional machine learning techniques require centralized data collection and communication which can be restrictive due to heavy privacy regulations (e.g., HIPAA, GDPR, and India's PDP Bill). With federated learning (FL), multiple hospitals can collaborate and train models collectively but not share raw patient data. While FL is an advantage, the current methods and in particular Federated Averaging (FedAvg) have significant challenges (i.e., non-IID data distribution, unequal client participation, and vulnerability to many attacks, including data poisoning and gradient leakage). Moreover, ICU mortality prediction requires trustable, trustworthy, secure, and fair models that can address the challenges of highly heterogeneous clinical data. Our survey responds to this need with a thorough review of current FL techniques, privacy preserving procedures, and deep learning methods for ICU prediction, and addresses the strengths, weaknesses, and current gaps that motivate the need for other approaches.

**Keywords.** Federated Learning, Adaptive Weighting, Deep Neural Networks, Privacy Preservation, Differential Privacy, Homomorphic Encryption, Data Poisoning, ICU Mortality Prediction.

**ICE 1051**

# Design and Implementation of a Single-Cycle RISC-V Processor on FPGA

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**Abstract.** The Reduced Instruction Set Computer V (RISC-V) architecture has become a highly popular open-standard Instruction Set Architecture (ISA) because of its simplicity, modularity and the level of extensibility. Its open source ecosystem allows wide scale customization, which makes it a useful platform of academic learning, architectural exploration, and research-oriented innovation. In this paper, the design and implementation of a fully functional RISC-V processor is done, and the main aim is to create a full datapath and control logic architecture. The processor is implemented in a Hardware description language (Verilog HDL) and incorporates key functions, such as the programme counter, arithmetic logic unit (ALU), control unit, register file, and memory modules, to run a few RISC-V instructions arithmetic and memory instructions in one clock cycle. Its design is tested with the Xilinx Vivado environment and is also deployed on the PYNQ-Z2 FPGA board to verify the hardware level, and it operates correctly and in real time. The work also investigates the principles of pipelined processor architecture with the simulation of a simple pipelined RISC-V core, and gives comparative analysis on performance and structural trade-offs. In general, this research paper fills the gap between the theoretical concepts of processor architecture and the practical hardware implementation, emphasising the reasons why the RISC-V platform can be used in education and research.

**Keywords.** RISC-V, Single-Cycle Processor, Verilog HDL, FPGA Implementation, Pipelined Architecture, Vivado, Computer Architecture, Datapath Design.

**ICE 1055**

# Blockchain-Based Digital Evidence Management and Retrieval System with AI-Assisted Case Analysis

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**Abstract.** The increased integration of digital instrumentation in criminal investigations has presented challenges with the management, authentication, and storage of digital evidence. In particular, centralized systems often suffer from problems with manipulation, data distortion, transparency, and these issues can decrease confidence in the results of the court process. In this paper, blockchain models are discussed to create secure, immutable, and transparent digital evidence chain-of-custody protocols. The paper also discusses decentralized storage, such as the Inter Planetary File System (IPFS), to provide safer and more reliable distributed storage of sensitive data. Another innovative element of this work will be the use of Retrieval-Augmented Generation (RAG) models to provide intelligent case retrieval and automatic analysis of files and criminal records, and alleviate law enforcement agencies' endeavor by identifying cases with similarities, emerging investigative trends, and gained spatial reasoning accuracy in criminal investigations. This paper reviews, categorizes, and assesses currently available blockchain based forensic systems, including their data frameworks, encryption methods, and legal acceptability, and outlines how AI enabled retrieval can enhance and strengthen operational processes for workflows. By reviewing literature, publicly available datasets, and some real implementations, this research recognizes in the existing landscape, there are gaps and introduces a modular and scalable hybrid, transparent and privacy preserving records framework for use in policing and justice environments for improved accountability and trustworthiness in the management of digital evidence.

**Keywords.** Blockchain, Digital Evidence, Retrieval Augmented Generation (RAG), Chain of Custody, IPFS, AI, Decentralized Storage, Case Retrieval, Immutability, and Digital Forensics.

**ICE 1059**

# FinFET-Based SRAM Cell Topologies for Low-Power VLSI at 18-nm Technology

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**Abstract.** Static Random-Access Memory continues to play a critical role in modern System-on-Chip architectures, IoT platforms, and biomedical devices, where low-power operation, stability, and performance are essential. However, CMOS scaling below 20 nm severely affects SRAM reliability due to short-channel effects, increased leakage power, and significant device variability. FinFET technology offers superior electrostatic control, reduced leakage, and improved current drivability, enabling robust SRAM operation in nanoscale regimes. This paper presents the design implementation and detailed comparative analysis of 6T, 8T, 10T, and 12T FinFET-based Static Random-Access Memory cells in 18 nm technology using Cadence Virtuoso and Spectre. Key performance parameters include Static Noise Margin, read and write delay, and leakage power. Among the analyzed topologies, the 8T SRAM cell consistently offers the best overall performance. While 10T and 12T cells exhibit enhanced robustness under specific conditions, the 8T topology delivers the optimal trade-off between power, performance, and stability, making it the most efficient and practical choice for modern nanoscale memory applications. The FinFET-based 8T SRAM cell demonstrates up to 52.5% reduction in write delay compared to the conventional 6T cell and achieves 21% lower write leakage power compared to 10T and 38% lower write leakage power compared to 12T SRAM cells.

**Keywords:** FinFET, SRAM, Static noise margin, Leakage power, 18 nm technology

**ICE 1060**

# A Comparative Study of Oxide Semiconductor Channels for Thin-Film Transistors

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**Abstract.** Oxide thin-film transistors (TFTs) are currently attracting considerable interest as a future device technology because of their high electron mobility, optical clarity, and ability to be processed at low temperature. The objective of this study is to compare by simulation the performance of TFTs with ZnO, IGZO, CdO, and CdZnO semiconductor materials as to how their characteristics can affect device performance. The simulations were all conducted under the same device structure and trap distribution. Variations are solely dictated by their intrinsic materials. The transfer and output curves are analyzed to extract the key parameters, which include the threshold voltage and the field effect mobility. From the results, the electrical differences between the various oxide can be observed, where the intrinsic transport properties of the material play an essential part in determining the performance of the TFT device. These results are an invaluable part of understanding material choice for oxide TFTs and also confirm the potential of oxide semiconductors for use in large area, transparent, and low-power electronics.

**Keywords.** Oxide thin-film transistors, ZnO, IGZO, CdO, CdZnO, Trap density modeling, Field-effect mobility.

**ICE 1061**

# Design of GPS/Telemetry Microstrip Patch Array Antenna Using a Series-Parallel Feed Configuration

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**Abstract.** In this paper, the microstrip patch array antenna (MPAA) on a single substrate material at frequencies of 1.585 GHz and 2.29 GHz is demonstrated for GPS and telemetry applications. Patch elements in the MPAA structure are fed using the serial-parallel feed configuration. The micro strip patch array antenna-1 (MPAA-1) is right-hand circularly polarised (RHCP), and the micro strip patch array antenna-2 (MPAA-2) is linearly polarized. In MPAA-1, the circular polarisation (CP) is achieved by truncating the opposite corners of the square patches. The measured axial ratio (AR) bandwidth of MPAA-1 is $\sim$ 7 MHz with a minimum magnitude of AR of 0.9 dB at 1.585 GHz in the zenith position of the array. The isolation between the MPAAs has a magnitude of $< -40$ dB at resonating frequencies. The half power beam width in the xoz plane is 25o for MPAA-1 and 16o for MPAA-2, whereas it is $\sim$ 79.8 o for MPAA-1 and $\sim$ 86o for MPAA-2 in the yoz plane. The gain of MPAA-1 and MPAA-2 is 10.3 dBic and 11.6dBi, respectively.

**ICE 1063**

# FPGA Implementation of Image Filtering and Enhancement using Braun Multiplier Architecture

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**Abstract.** This paper presents a real-time FPGA-based image denoising and brightness enhancement architecture using a streaming data processing approach. The proposed system employs FIFO-based buffering and sliding window generation to perform mean filtering for effective noise suppression while preserving image structure. Both 8-bit and 16-bit image configurations are supported to evaluate precision, scalability, and hardware efficiency. Quantitative performance is assessed using brightness-based metrics, Mean Squared Error (MSE), and Peak Signal-to-Noise Ratio (PSNR), while qualitative evaluation is carried out through visual analysis of standard test images. Hardware implementation is performed on a Xilinx Spartan-6 FPGA using Verilog HDL, and real-time internal signal observation is enabled through Integrated Logic Analyzer (ILA) cores. Experimental results demonstrate consistent noise reduction with PSNR improvements of approximately 3–5 dB in the denoising stage, along with controlled brightness enhancement. Synthesis results indicate that the proposed architecture achieves a balanced trade-off between image quality, resource utilization, timing performance, and power consumption, making it suitable for real-time embedded and FPGA-based image processing applications.

**Keywords.** FPGA, Image Denoising, Mean Filtering, Brightness Enhancement, Braun Multiplier, FIFO Buffering, MSE, PSNR.

**ICE 1064**

# High-Level Hardware Synthesis of a Prefetching Mechanism from Python to FPGA via MyHDL

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**Abstract.** Effective hardware support for memory prefetching is possible with the use of high-level synthesis methodologies that are capable of implementing optimal architectures based on the high-level algorithmic description provided by the algorithm. In this study, a hardware prefetcher based on the concept of stride is implemented using Python and integrated into the gem5 simulation tool to assess the performance of the stride address generation. A synthesizable RTL representation for the validated model has been derived using Python-based hardware design environments and Vivado High-Level Synthesis. The synthesized hardware has been implemented and tested on the PYNQ-Z2 platform via the AXI-Lite interface. The simulation and hardware experiments have verified the correctness of the strides prefetch and the cache performance improvements due to regular access strides. The work here is to develop a memory prefetching design using a high-level synthesis approach is highlighted by the practicality of a Python-to- FPGA design flow.

**ICE 1099**

# Hardware Realization of March C driven MBIST under Fault Injection

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**Abstract.** With the continuous scaling of VLSI technology, embedded memory modules occupy a significant portion of chip area, making their reliability critical for overall system performance. Increased memory density and reduced feature sizes have made testing more challenging and time-consuming. Built-In Self-Test (BIST) architectures provide an efficient solution by integrating self-testing capabilities directly into the circuit, reducing reliance on external test equipment. The paper discusses the design and implementation of a Memory Built-In Self-Test (MBIST) architecture using the March C algorithm for memory fault detection. The proposed approach systematically detects common memory faults, including Stuck-at Faults (SAF), Transition Faults (TF), and Coupling Faults (CF), through structured read and write sequences in ascending as well as descending address order to ensure complete memory coverage. Simulation results validate the correct operation of the MBIST and demonstrate the effectiveness of the March C algorithm in achieving reliable and low-overhead memory testing for real-time embedded systems.