



7th CINEC International Research Symposium 2026

*Bridging Academic Synergy for National Progress:
Integrating Knowledge for Economic Transformation*

**18th August 2026
The Hilton Colombo
Sri Lanka**

PROCEEDINGS

Organized By
Faculty of Health Sciences
CINEC Campus
Malabe





Proceedings of the 7th CINEC International Research Symposium 2026

*Bridging Academic Synergy for National Progress: Integrating Knowledge for
Economic Transformation*

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Preface





7th CINEC International Research Symposium 2026

Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation

The 7th CINEC International Research Symposium (CIRS 2026) is a premier multidisciplinary research forum organized by the Faculty of Health Sciences in collaboration with the Faculty of Science, CINEC Campus, under the theme "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation". The symposium provides a platform for academics, researchers, industry professionals and students to share innovative research, foster interdisciplinary collaboration and strengthen academic partnerships.

CIRS 2026 brings together participants from state and non-state higher education institutions, research organizations and industry across Sri Lanka, together with collaborators from renowned international universities, creating a vibrant forum for knowledge exchange and global engagement.

The symposium comprises eight research tracks, each coordinated by one of the eight faculties of CINEC Campus, representing a broad spectrum of academic disciplines. All submissions undergo a rigorous peer-review process to ensure the quality and integrity of the published research.

Through these initiatives, CIRS 2026 continues to promote research excellence, innovation and meaningful collaboration while advancing knowledge and national development.



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Symposium Tracks



Faculty of Health Sciences

“From Discovery to Development: Health Sciences for National Growth”

This track focuses on the critical bridge between fundamental medical research and its practical application, exploring how innovations in health sciences can be scaled to improve national healthcare systems and drive socioeconomic development.

Faculty of Computing

“Driving National Development & Sustainable Economic Transformation through Technology & Digital Innovation”

This track explores the role of ICT as a catalyst for national progress. It invites research into how data-driven solutions, artificial intelligence, and digital infrastructure can be leveraged to accelerate economic transformation and technological advancement.

Faculty of Engineering

“Collaborative Innovations: Sustainable Engineering for Economic Resilience”

Highlighting the need for interdisciplinary cooperation, this track explores how modern engineering practices can be harmonized with sustainability goals to create resilient systems capable of withstanding future economic challenges.

Faculty of Humanities and Education

“Humanities in National Development: Shaping a Sustainable Society through Education”

This track explores the foundational role of education and humanities in building a resilient society, focusing on how scholarly perspectives in these fields inform policy, social equity and sustainable development.



Faculty of Management and Social Sciences

“Unlocking Research Potential: Grant Achievement & Pathway to Commercialization”

This track is designed to guide researchers in translating academic success into real-world impact. It focuses on the strategic acquisition of research grants and the essential steps required to move an idea from a laboratory setting to a commercial market.

Faculty of Marine Engineering

“Advancing Marine Engineering for a Sustainable Maritime Industry”

Dedicated to the technical evolution of the shipping sector, this track focuses on engineering innovations that enhance vessel efficiency, safety, and environmental standards, contributing to a more sustainable maritime industry.

Faculty of Maritime Sciences

“Strengthening the National Blue Economy through Maritime Education & Innovations”

This track addresses the "Blue Economy," focusing on research into maritime logistics, governance, and innovative educational practices that protect marine resources while optimizing their economic value.

Faculty of Science

“Advancing Science for Sustainable Economic Futures”

Focusing on both pure and applied science, this track highlights how rigorous scientific investigation provides the foundational knowledge necessary for long-term economic stability and technological advancement.



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Key Messages

CIRS 2026





Message from the President of CINEC Campus

Capt. Ajith Peiris

It is with great pleasure that I extend my greetings to all participants of the 7th CINEC International Research Symposium (CIRS 2026). As CEO and President of CINEC Campus, it is immensely gratifying to witness the continued growth of this symposium, which signifies our enduring commitment to fostering a vibrant research culture and advancing academic excellence. CIRS has become a distinguished multidisciplinary platform where scholars, researchers, industry professionals, and students come together to share knowledge, inspire innovation and strengthen collaboration.

The theme of this year's symposium, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", highlights the importance of bringing together diverse expertise to address national priorities and create meaningful impact. By integrating academic knowledge with industry perspectives, we strengthen the role of research in driving innovation, supporting sustainable economic growth, and improving society.

CIRS 2026 continues to expand its scope through initiatives such as the Industry- Academia Synergy Zone (NEXORA), the Pre-Congress Workshop Series, and the Three Minute Thesis (3MT[®]) Competition, alongside multidisciplinary technical sessions representing all faculties. These programmes enrich the symposium experience while creating valuable opportunities for learning, collaboration, and professional engagement.

I extend my sincere appreciation to the Faculty of Health Sciences for organizing CIRS 2026 with dedication and professionalism. My gratitude also goes to the organizing committees, faculty members, reviewers, sponsors, industry partners, students and volunteers whose collective efforts have made CIRS 2026 possible.



On behalf of CINEC Campus, I commend all participants for their valuable contributions and encourage you to continue pursuing research that advances knowledge and benefits society. I am confident that the 7th CINEC International Research Symposium will strengthen partnerships, inspire new ideas, and reaffirm the commitment of CINEC to research excellence and national progress.

I wish the symposium every success.

Capt. Ajith Peiris

President/ CEO

CINEC Campus





Message from the Deputy President/Deputy CEO of CINEC Campus

Senior Professor & Chair Sampath Amaratunge

It is a privilege to convey my greetings and reflections on the 7th CINEC International Research Symposium (CIRS 2026), a significant academic gathering that reflects our collective pursuit of knowledge, innovation and excellence in research. The theme of the symposium, “Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation”, highlights the transformative role of research and innovation in addressing contemporary challenges and contributing towards national development.

Research is the foundation of progress, driving scientific discovery, technological advancement and evidence-based solutions. Higher education institutions have a vital responsibility to cultivate a culture of inquiry, encourage interdisciplinary collaboration, and empower researchers to generate knowledge with meaningful impact. CIRS continues to uphold this vision by providing a platform for academics, researchers, industry professionals, and emerging scholars to exchange ideas and foster scholarly collaboration.

With a vision to inspire transformative ideas and nurture innovation for a resilient and knowledge-driven society, CIRS promotes the integration of expertise across diverse disciplines. The symposium also strengthens the connection between academic research and practical applications through initiatives such as NEXORA, creating opportunities for productive collaborations.

I extend my sincere appreciation to the Faculty of Health Sciences, organizing committees, researchers, reviewers, academic staff, students, industry collaborators, sponsors and all contributors for their dedication towards the successful organization of CIRS 2026.



I hope this symposium will serve as a catalyst for meaningful intellectual exchange, inspiring researchers and scholars to pursue impactful ideas and collaborations that extend beyond disciplinary boundaries.

May the outcomes of CIRS 2026 contribute to advancing knowledge and strengthening the role of research in shaping a better future.

Senior Professor & Chair Sampath Amaratunge

Deputy President/ Deputy CEO

CINEC Campus





Message from the Keynote Speaker

Dr. Bandula Wijay

It is both an honor and a privilege to extend my greetings to the organizers, distinguished guests, researchers, academics, industry leaders, and students participating in CINEC International Research Symposium 2026. Gatherings such as these serve an important purpose: they bring together knowledge, creativity, and ambition, the very ingredients that drive innovation and progress.

We live in a world where scientific discovery and technological advancement are reshaping societies at an unprecedented pace. Yet the true value of research lies not merely in generating knowledge, but in applying that knowledge to solve meaningful problems. Research has its greatest impact when it improves lives, advances society, strengthens economies and addresses the challenges facing humanity.

Sri Lanka is uniquely positioned to make significant contributions to the global community. We are a nation of approximately twenty million people blessed with a literacy rate that ranks among the highest in the developing world. More importantly, we possess an abundance of bright, creative and capable minds. Throughout our history, Sri Lankans have demonstrated excellence in academia, medicine, engineering, business and public service. The talent exists. The opportunity exists. The question before us is how best to harness that talent for the benefit of both our nation and the world.

As researchers and innovators, we should continually ask ourselves an important question: What difference will this work make? Academic achievement is important, but the greatest breakthroughs often occur when research is directed toward solving real-world problems.



Whether in healthcare, agriculture, energy, environmental sustainability, artificial intelligence, advanced manufacturing, or education, there are opportunities to create solutions that improve millions of lives while generating economic value and international recognition.

I believe we should encourage our young researchers to think boldly and aspire to the highest levels of achievement. There is no reason why discoveries, technologies and innovations originating in Sri Lanka cannot compete successfully on the world stage. The same curiosity, intelligence, and determination that drive innovation in the world's leading research centers are present within our universities and institutions. What is required is the confidence to pursue ambitious goals and the commitment to transform ideas into practical solutions.

The future will increasingly belong to nations that convert knowledge into impact. Publications, presentations and academic accomplishments remain important milestones, but they should also serve as steppingstones toward innovation, entrepreneurship and societal benefit. Research that leads to new products, technologies, services, and industries can create employment, attract investment, generate valuable foreign exchange, and enhance a nation's standing in the global community.

I encourage all participants in this symposium to look beyond immediate boundaries and consider the larger challenges facing humanity. Within those challenges lie opportunities for leadership, innovation and lasting contribution. Let us aspire not only to participate in the advancement of knowledge, but also to help shape its direction. By doing so, we can create solutions that improve lives, generate economic value and elevate Sri Lanka's standing on the global stage.

The future will not be shaped by those who wait for change. It will be shaped by those who create it. Let us challenge ourselves to think boldly, pursue excellence, and direct our talents toward solving the problems that matter most. In doing so, we will not only advance science and innovation but also strengthen Sri Lanka's contribution to humanity and inspire future generations to aim even higher. I wish this symposium every success and hope that the ideas, collaborations, and discoveries that emerge from it will help shape a brighter future for our nation and for the world.

Dr. Bandula Wijay
Scientist-Inventor
CEO, CorSci LLC





Message from the Chief Guest

Prof. Rakesh Garg

It is a privilege and an honour to extend my warm greetings to the organizers, distinguished faculty, researchers, students and all participants of the CINEC International Research Symposium (CIRS) 2026. I congratulate the organizers for their continued commitment to fostering a vibrant culture of research, innovation and academic excellence through this flagship symposium.

Research is essential for progress in the medical sciences. Interdisciplinary research enables us to address complex global challenges by integrating different perspectives, methods and expertise. This approach encourages innovation, sparks creativity and transforms scientific knowledge into practical solutions that benefit society.

I am particularly encouraged to see undergraduate, graduate and postgraduate students actively participating in this conference by presenting their research. Such opportunities not only strengthen scientific inquiry but also cultivate critical thinking, ethical scholarship, effective communication and lifelong learning. Presenting research, engaging in scholarly discussions and receiving constructive feedback are invaluable experiences that shape the next generation of researchers and leaders.

The role of faculty members and mentors is equally significant. By guiding young investigators with scientific rigour, integrity and compassion, they create an environment where curiosity flourishes and excellence become a shared pursuit. Conferences such as CIRS provide an ideal platform for this exchange of ideas, promoting collaboration between students, academics, researchers and professionals across multiple disciplines.



As we embrace emerging technologies, including artificial intelligence, data science and digital innovation, it becomes increasingly important to ensure that research remains grounded in ethical principles, transparency, reproducibility and a commitment to societal welfare.

I encourage every participant to make the most of this symposium, share your ideas with confidence, learn from one another, challenge existing paradigms and build collaborations that extend beyond institutional and national boundaries. Every research question explored today has the potential to become tomorrow's breakthrough.

I extend my sincere appreciation to the organizing committee for their dedication in bringing together this outstanding academic event. I wish CIRS 2026 every success and hope that the symposium inspires meaningful discussions, innovative discoveries, and enduring partnerships that will advance research and benefit society for years to come.

With my best wishes for a successful and impactful symposium.

Prof. Rakesh Garg

MD, DNB, FICCM, FICA, FOAPM, PGCCHM, MNAMS, CCEPC, FIMSA
Fellowship in Palliative Medicine
Fellowship in Clinical Research Methodology & Evidence-Based Medicine
Professor, Department of Onco-Anaesthesia & Palliative Medicine
Dr B.R.A. Institute Rotary Cancer Hospital, AIIMS, New Delhi, India





Message from the Conference Chair

Senior Professor and Chair Menik Hettihewa

It is my great pleasure and privilege to welcome you to the CINEC International Research Symposium 2026 (CIRS 2026), a significant platform that brings together the diverse academic disciplines and research communities of CINEC Campus under one shared vision of knowledge, innovation and national development.

CINEC Campus is a unique multidisciplinary institution, bringing together a wide spectrum of academic and professional fields, including engineering, technology, computing, business, management, maritime studies, aviation, logistics, health sciences, social sciences and other emerging areas of knowledge. This diversity is one of our greatest strengths, creating an environment where disciplines can intersect, ideas can be exchanged and innovative solutions can emerge.

The theme of this symposium, “Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation” highlights the vital role of research and innovation in addressing the challenges faced by our nation and the wider global community. At the same time, the spirit of CIRS extends beyond any single discipline. National development requires the collective contribution of all fields of knowledge. Whether through technological advancement, engineering innovation, digital transformation, sustainable development, economic growth, improved healthcare, maritime and aviation excellence, or social progress, every discipline has a vital role to play in shaping a better future.

Research is the foundation upon which meaningful progress is built. However, the true value of research lies not only in the generation of knowledge, but in our ability to translate that knowledge into innovation, policy, practice, products, services, and solutions that create a positive impact on society.



In an increasingly interconnected world, complex national and global challenges can no longer be addressed in isolation. They demand interdisciplinary thinking, collaboration, creativity and a commitment to innovation.

CIRS 2026 provides an important forum for researchers, academics, professionals, industry experts, policymakers and students to share their discoveries, exchange perspectives, and establish meaningful collaborations. It is our hope that this symposium will foster connections across disciplines and institutions, creating new opportunities for collaborative research and knowledge exchange.

As an institution committed to academic excellence and innovation, CINEC recognizes the importance of nurturing a strong research culture and empowering the next generation of researchers, professionals and innovators. We believe that our students and academics must be equipped not only with knowledge and technical expertise, but also with the ability to think critically, innovate boldly, collaborate across disciplines and respond creatively to the evolving needs of society.

I firmly believe that the strength of a nation lies in its capacity to generate knowledge, embrace innovation and transform ideas into meaningful action. Through CIRS 2026, we seek to contribute to this journey by bringing together diverse disciplines and diverse minds with a shared commitment to creating knowledge and advancing society.

On behalf of CINEC Campus and the organizing committee, I warmly welcome all distinguished guests, keynote speakers, researchers, academics, industry partners, professionals and students to the CINEC International Research Symposium 2026. I sincerely hope that your participation will be intellectually enriching, professionally rewarding and inspiring.

May CIRS 2026 be a catalyst for new ideas, meaningful collaborations, transformative research, and innovative solutions that contribute to the advancement of CINEC, our nation and the global community.

Let us connect disciplines, inspire innovation, advance knowledge and transform research into impact for a better future.

Senior Professor & Chair Menik Hettihewa

Chairperson, CINEC International Research Symposium 2026
CINEC Campus





Message from the Conference Co-Chair

Senior Prof. K. R. Ranjith Mahanama

It is my great pleasure to welcome you to the 7th CINEC International Research Symposium (CIRS 2026). I extend my sincere greetings to all researchers, academics, industry professionals, students and invited guests who have joined us for this important scientific gathering. CIRS 2026 serves as a vibrant platform for the dissemination of high-quality research and the exchange of innovative ideas across diverse scientific disciplines. It reflects our shared commitment to advancing scientific knowledge, fostering interdisciplinary collaboration and addressing contemporary challenges through research and innovation.

This year's symposium brings together an impressive collection of research contributions that demonstrate the creativity, dedication and scholarly excellence of our authors. We are grateful to all researchers who submitted their work and shared their valuable findings. I hope that the presentations and discussions throughout the symposium will stimulate new perspectives, inspire future collaborations and create opportunities for impactful research.

The success of CIRS 2026 has been made possible through the collective efforts of many individuals. I sincerely thank the members of the Research Committee for their rigorous review of the submitted abstracts, the Organizing Committee for their tireless dedication, our keynote speakers for sharing their expertise, and our sponsors and partners for their generous support. My appreciation also goes to every participant whose enthusiasm and engagement make this symposium a truly rewarding experience.

I encourage you to actively participate in the scientific sessions, engage in meaningful discussions, and take advantage of the networking opportunities that the symposium provides. May CIRS 2026 inspire new ideas, strengthen research partnerships and contribute to scientific discoveries that benefit society.

I wish you a productive, enjoyable, and memorable symposium.

Senior Professor K. R. Ranjith Mahanama
Co-Chair, CIRS 2026 Research Symposium





Message from the Conference Co-Chair

Dr. Piyumi Wasana

It is my great pleasure to welcome you to the CINEC International Research Symposium (CIRS 2026). I am delighted to extend my warm greetings to all distinguished keynote speakers, researchers, academics, industry professionals, students and participants who have come together to share knowledge and foster collaboration.

The theme of CIRS 2026, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", highlights the importance of strengthening partnerships between academia, industry, healthcare and policymakers to transform research into meaningful societal impact. Through scientific discussions and interdisciplinary collaboration, this conference provides a valuable platform for addressing contemporary challenges and promoting innovation.

The proceedings of CIRS 2026 reflect the dedication, creativity, and scientific excellence of researchers from diverse disciplines. I congratulate all authors on their valuable contributions and thank our keynote speakers, reviewers, sponsors, and organizing committee for their unwavering support in making this conference a success.

I hope that CIRS 2026 inspires new collaborations, innovative ideas, and lasting professional relationships that contribute to scientific advancement and sustainable national development.

I wish you all a productive, rewarding, and memorable conference experience.

Dr. Piyumi Wasana

Co-Chair, CINEC International Research Symposium 2026





Message from the Conference Secretary

Dr. Harshani Perera

It is my great privilege and honour to welcome you to the 7th CINEC International Research Symposium (CIRS 2026). Serving as the Secretary of CIRS 2026, I am deeply honoured to be associated with this prestigious academic forum, which brings together researchers, academics, industry professionals, and students to exchange knowledge, showcase scholarly achievements and foster meaningful collaborations. The success of this symposium has been made possible through the collective dedication, commitment and unwavering support of numerous individuals and teams. I extend my sincere appreciation to the President and management of CINEC Campus, the Co-Chairpersons, members of the Research Committee, Scientific Committee, Organizing Committee, reviewers, keynote speakers, invited guests, sponsors, industry partners, faculty members and students for their invaluable contributions towards making this event a success.

I convey my heartfelt gratitude to all researchers and authors who have contributed their valuable work to CIRS 2026. Your dedication to advancing scientific knowledge, innovation and research excellence forms the foundation of this symposium. I also sincerely appreciate the active participation and enthusiasm of all delegates, whose engagement and intellectual contributions enhance the quality and impact of this academic gathering. I am confident that CIRS 2026 will serve as a catalyst for new ideas, collaborative partnerships and impactful research initiatives that contribute towards scientific advancement and national development. May this symposium provide an inspiring platform for knowledge exchange, professional growth and the establishment of enduring academic and industry connections.

I wish the 7th CINEC International Research Symposium every success and extend my warmest wishes to all participants for a productive, enriching and memorable research experience.

Dr. Harshani Perera

Secretary, CINEC International Research Symposium 2026





Message from the Dean - Faculty of Engineering, CINEC Campus

Professor Janaka Liyanagama

It is with great honor and privilege that I extend this message as the Dean of the Faculty of Engineering for the 7th CINEC International Research Symposium (CIRS-2026). CIRS-2026 serves as a premier platform for researchers, academics, industry professionals, and students to share breakthroughs, challenge existing paradigms and co-create innovative pathways. The research presented in these proceedings reflects our unwavering commitment to driving impactful innovation and addressing critical economic challenges through smart, sustainable engineering practices.

This year's overarching symposium theme, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", beautifully aligns with our own faculty theme, "Collaborative Innovations: Sustainable Engineering for Economic Resilience". Together, these themes underscore the vital role that higher education and advanced engineering research play in shaping a sustainable, resilient and prosperous future.

In today's rapidly evolving global landscape, engineering cannot exist in isolation. Economic transformation demands that we bridge the gap between theoretical knowledge and practical, real-world application. By fostering academic synergy, we break down institutional silos and create a collaborative ecosystem where ideas can flourish. Our focus on sustainable engineering ensures that the solutions we design today do not compromise the resources of tomorrow, thereby building a resilient foundation for long-term national progress.

I would like to express my heartiest congratulations and gratitude to the organizing committee, sponsors, reviewers, authors and participants whose dedication and intellectual contributions have made this symposium a reality. It is my sincere hope that the insights shared within these proceedings will inspire further collaboration, spark new research initiatives, and actively contribute to the economic transformation of our nation.

I wish all the participants a highly engaging, fruitful and inspiring symposium CIRS 2026.





**Message from the Dean - Faculty of Marine Engineering,
CINEC Campus**

Mr. Arjuna Ranasinghe

It is my pleasure to welcome all participants to the 7th CINEC International Research Symposium (CIRS 2026).

This year's theme, *"Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation"*, highlights the importance of research, innovation and collaboration between academia and industry in building a better future.

The Faculty of Marine Engineering is proud to contribute to this symposium through the theme *"Advancing Marine Engineering for a Sustainable Maritime Industry"*. Our faculty is committed to promoting research that supports sustainable maritime development and addresses the evolving needs of the marine industry.

I am especially pleased to see the active participation of our engineering cadets, with a significant number submitting research abstracts and engaging in this academic event. Their enthusiasm and commitment to research reflect the growing research culture within our faculty. I sincerely appreciate the efforts of our academic staff, supervisors and organizers whose guidance and commitment have made these achievements possible. Their continuous support in promoting research excellence and academic development is highly commendable.

I congratulate the organizing committee for their dedication in making CIRS 2026 a success. I wish all participants a productive symposium and hope this event encourages new ideas, meaningful collaborations and continued research excellence.





**Message from the Dean - Faculty of Management & Social Sciences,
CINEC Campus**

Professor Lalith Edirisinghe

It is with great pleasure that I extend my warm greetings to all researchers, academics, industry professionals, students, and distinguished guests participating in the 7th CINEC International Research Symposium (CIRS 2026). The theme of CIRS 2026, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", reflects the critical role of higher education in shaping a knowledge-driven economy. Today, universities are expected not only to generate new knowledge but also to transform research into innovative solutions that address societal challenges, support industry and contribute to sustainable national development.

The Faculty of Management & Social Sciences (FMSS) is committed to fostering a culture of research excellence, innovation, entrepreneurship and industry engagement. Guided by the principles of Education 5.0 and the aspirations of Industry 5.0, our faculty encourages research that is multidisciplinary, technology-enabled, human-centered and impact-driven. We believe that meaningful research should extend beyond academic publication to influence policy, improve organizational practices, create commercial opportunities and enhance the well-being of society.

Our faculty theme, "Unlocking Research Potential: Grant Achievement and Pathway to Commercialization", embodies this vision. We are committed to strengthening research capacity, securing competitive research funding and translating research outputs into practical innovations and entrepreneurial ventures that create value for Sri Lanka and beyond. Such partnerships are essential for developing innovative solutions to the complex economic and social challenges of our time.

I congratulate all authors whose scholarly work has been accepted for presentation and publication, and I sincerely thank the Organizing Committee, reviewers, keynote speakers, sponsors and partners for their dedication in making CIRS 2026 a success.

I wish every participant a productive, inspiring and rewarding symposium.





**Message from the Dean - Faculty of Maritime Sciences,
CINEC Campus**

Capt. Prasanna Sedrick

It is my great pleasure to extend my warmest greetings to the Organizing Committee, distinguished participants, researchers, industry stakeholders, sponsors, and guests attending the 7th CINEC International Research Symposium (CIRS 2026), held under the theme "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation".

The Faculty of Maritime Sciences proudly recognizes the dedication of our academic staff and Cadet Officers whose research contributions reflect our faculty theme, "Strengthening the National Blue Economy through Maritime Education and Innovations". I extend my sincere congratulations to the BSc in Maritime Operations, Batch 2 Cadets (2026) for their enthusiastic participation in both research and poster presentations, demonstrating the next generation's commitment to innovation and academic excellence.

For the past 36 years, CINEC has transformed maritime education in Sri Lanka, creating new pathways for Sri Lankan seafarers while remaining true to our motto, "Beyond a Graduate." I express my heartfelt gratitude to all our lecturers, students, marine officers, alumni and industry partners whose unwavering commitment has shaped this remarkable journey. I wish every participant a successful and inspiring symposium.





Message from the Dean - Faculty of Health Sciences, CINEC Campus

Senior Professor and Chair Menik Hettihewa

It is with immense pleasure that I extend my warmest greetings and best wishes to all participants from the health discipline to the CINEC International Research Symposium 2026 (CIRS 2026).

CIRS 2026 represents an important milestone in CINEC's journey towards strengthening a culture of health science-related research, health and medical innovation, collaboration, and knowledge exchange. As an international multidisciplinary research platform, the symposium brings together academics, researchers, professionals, industry experts, policymakers, and students from diverse fields, creating a vibrant space for the exchange of ideas and the advancement of knowledge.

The theme of this year's symposium, “Advancing Health Sciences for National Development”, draws attention to the critical role of health and wellbeing in the sustainable development of our nation. At the same time, the complex challenges faced by society today require contributions that extend across disciplines.

Advances in health sciences are strengthened by innovations in engineering and technology, digital transformation, data science, business and management, maritime and aviation sectors, social sciences, law and many other fields. It is through such interdisciplinary engagement that we can develop comprehensive and sustainable solutions to the challenges of our time.

The Faculty of Health Sciences is proud to be part of this important initiative and remains committed to promoting research that is innovative, evidence-based, impactful, and responsive to the needs of society. We believe that research should extend beyond the boundaries of academic publications and contribute meaningfully to healthcare, policy, industry, education and the wellbeing of communities.

CIRS 2026 provides an invaluable opportunity for researchers and innovators to share their discoveries, challenge conventional thinking, build new partnerships and inspire the next generation of scholars.



I am confident that the discussions and collaborations emerging from this symposium will contribute to new ideas and initiatives that have the potential to create lasting impact locally, nationally and internationally. I sincerely congratulate the organizing committee and all those who have contributed to making CIRS 2026 a reality. I also extend my appreciation to our distinguished keynote speakers, invited speakers, presenters, reviewers, industry partners, academic collaborators and participants for their valuable contributions.

I warmly welcome you all to CIRS 2026 and wish you a stimulating, enriching and memorable symposium. May this gathering inspire us to pursue research with purpose, embrace innovation with courage and work collaboratively towards a healthier, more prosperous, and sustainable future.

Let us advance knowledge, inspire innovation, and transform research into meaningful impact for national and global development.





Message from the Dean - Faculty of Science, CINEC Campus

Senior Professor Ranjith Mahanama

It is with great pleasure that I extend my warm greetings and best wishes, on behalf of the academic staff and students of the Faculty of Science, to all participants of the CIRS Research Symposium.

The Faculty of Science at CINEC is committed to fostering a culture of research, innovation, and academic excellence. Research lies at the heart of scientific discovery, technological advancement, and sustainable national development. Through initiatives such as CIRS 2026, CINEC provides a valuable platform for researchers, academics, professionals and students to present their findings, exchange knowledge and ideas, establish meaningful collaborations and inspire the next generation of scientists and innovators.

The continued growth of our research capacity, supported by enhanced laboratory facilities and a strong commitment to multidisciplinary research, reflects the vision of the Faculty of Science to become a center of excellence in scientific education and research. The CIRS 2026 Research Symposium is a testament to this vision, showcasing the dedication, creativity and scholarly achievements of the researchers while strengthening links between academia, industry, and the wider community.

I sincerely congratulate the organizing committee on their commitment and hard work in organizing this important event. I also commend all authors and presenters for their valuable contributions, which enrich the scientific community and contribute to addressing the challenges of today and tomorrow.

I wish the CIRS 2026 Research Symposium every success and trust that it will stimulate insightful discussions, foster lasting collaborations and inspire innovative research that creates a meaningful impact on society.





**Message from the Dean - Faculty of Humanities & Education,
CINEC Campus**

Professor Prasad Sethunga

It is a pleasure to extend my warm greetings to all participants of the CINEC International Research Symposium (CIRS) 2026.

I am particularly pleased that the faculty had the opportunity to contribute to this year's symposium by conducting a pre-congress workshop, further demonstrating our commitment to scholarly engagement and professional development.

The conference theme, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", highlights the importance of collaboration across disciplines in addressing national challenges and promoting sustainable development. As the Faculty of Humanities and Education, we are proud to contribute through our theme, "Humanities in National Development: Shaping a Sustainable Society through Education". Research in the humanities and education plays a crucial role in strengthening communities, informing policy, and promoting inclusive and sustainable development.

I am pleased to witness the active participation of our academics and students through the submission of research abstracts and posters. Their contributions reflect the faculty's commitment to research excellence and scholarly engagement.

I congratulate all contributors and sincerely thank Prof. Menik Hettihewa and the organizing committee for making CIRS 2026 a platform for innovation, collaboration, and knowledge sharing. I wish every participant a successful and enriching symposium.





**Message from the Acting Dean - Faculty of Computing, CINEC
Campus**

Ms. Suranji Nadeeshani

It is with great pleasure and honor that I send this message to the Annual International Research Symposium of CINEC Campus (CIRS-2026) hosted by the Faculty of Health Sciences. First, I congratulate all students and staff who have actively engaged throughout the process and showcased their prestigious research ideas today.

The theme, "Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation", reflects the strategic priority of CINEC Campus to cultivate interdisciplinary research that addresses the complex challenges we are facing today.

Diversity of the thoughts cultivated in CINEC Campus is one of our greatest assets. The symposium itself and the abstracts submitted demonstrate the capacity of our students for navigating different areas of studies such as Science, Technology, Management, Maritime, Education, Social Sciences and Economics. The research presented covers a wide range of topics including Artificial Intelligence, Digital Economy, Digital Security, Sustainable Development and many more.

As you have engaged with number of activities during the different sessions today, remember that your work matters and your ideas matter. The ideas you cultivate through this symposium today could be the born of next national or international level project or a great invention. You, our students, are the architects of new connections. You have the power to transform economy through innovations.

This proceedings book will serve as a valuable reference for future research and a source of inspiration for continued collaboration across disciplines. I extend my deepest appreciation to the student authors for their contributions to the faculty staff for their guidance and support. To the hosting faculty and the organizing committee for their exceptional work in bringing this symposium to this success.

Congratulations on the successful Symposium 2026!



05

Pre Conference Workshops



Reflecting on a Milestone: The CIRS 2026 Pre-Conference Workshop Series

The successful execution of all 10 pre-conference workshops for the CIRS 2026 conference represents a landmark achievement in fostering rigorous academic discourse, multidisciplinary research and professional innovation.

Spanning diverse technical, scientific, and educational fields with expert-led sessions addressing emerging paradigms in higher education, pharmaceutical safety, and advanced therapeutics the series engaged a massive community of scholars and practitioners across multiple onsite and online venues. Co-organized by respective university faculties in collaboration with the Pre-Conference Workshops and Editorial Committee, these sessions collectively built a robust, high-caliber intellectual foundation for the main conference proceedings.

Pre-Conference Workshop 1

Advanced Research Methodology in Social and Psychological Sciences: Addressing Contemporary Challenges and Advancing Best Practice Frameworks

The first pre-conference workshop aligned with CIRS 2026 was held on 22nd April (online) under the title "Advanced Research Methodology in Social and Psychological Sciences: Addressing Contemporary Challenges and Advancing Best Practice Frameworks", delivered by Dr. Idhamsyah Eka Puthra of University Prasada Indonesia YAI. The workshop was coordinated by Dr. Chandranie Adikaram in collaboration with the Pre-Conference Workshops and Editorial Committee of CIRS 2026. The session introduced participants to effective research methodologies, addressed common challenges in social and psychological research, and shared best practices for producing rigorous and credible research. The workshop was attended by 67 participants.



Pre-Conference Workshop 2

Authentic Learning: Real-world Experiences that Build 21st Century Skills

The second pre-conference workshop was held on 24th April at Klaus E Orlendorff Auditorium, CINEC Campus under the title "Authentic Learning: Real-world Experiences that Build 21st Century Skills", delivered by Prof. Prasad Sethunga of CINEC Campus. The workshop was organized by the Faculty of Humanities and Education in collaboration with the Pre-Conference Workshops and Editorial Committee of CIRS 2026. The session explored innovative teaching approaches that connect classroom learning with real-world experiences to develop critical thinking, collaboration, creativity, and other essential 21st century skills. The workshop attracted 172 participants.



Pre-Conference Workshop 3

Ensuring Quality, Safety and Efficacy of Medicines

The third pre-conference workshop was held on 21st May at Klaus E Orlendorff Auditorium, CINEC Campus under the title "Ensuring Quality, Safety and Efficacy of Medicines", delivered by Senior Prof. and Chair Chandanie Wanigatunga from the University of Sri Jayewardenepura. The workshop was organized by the Faculty of Health Sciences and the session highlighted the importance of ensuring the safety, effectiveness, and quality of medicines throughout their development, regulation, and use. A total of 267 participants attended.



Pre-Conference Workshop 4

Targeting Fibrosis: Discovery of Novel Anti-fibrotic Drugs

The fourth pre-conference workshop was held on 28th May (online) under the title "Targeting Fibrosis: Discovery of Novel Anti-fibrotic Drugs", delivered by Prof. Selim Celtek from ARU, UK. The workshop was organized by the Faculty of Health Sciences in collaboration with the Pre-Conference Workshops and Editorial Committee of CIRS 2026. The session provided an overview of current research on fibrosis and recent advances in the discovery and development of novel anti-fibrotic therapies. The workshop was attended by 159 participants.



Pre-Conference Workshop 5

Researching the Relationship between Culture, Law and Social Change

The fifth pre-conference workshop was held on 24th June at Klaus E Orlendorff Auditorium, CINEC Campus under the title "Researching the Relationship between Culture, Law and Social Change", delivered by Dr. Anna Weerakoon Karunatileke. The workshop was organized by the Faculty of Marine Engineering in collaboration with the Pre-Conference Workshops and Editorial Committee of CIRS 2026. The session encouraged participants to foster a culture of research integrity, ethical practice, and institutional responsibility beyond regulatory compliance. The workshop attracted 170 participants.



Pre-Conference Workshop 6

Teaching and Learning in the Age of Generative AI

The sixth pre-conference workshop was held on 26th June at Klaus E Orlendorff Auditorium, CINEC Campus under the title "Teaching and Learning in the Age of Generative AI", delivered by Prof. Sidath Liyanage from University of Kelaniya. The workshop was organized by the Faculty of Computing in collaboration with the Pre-Conference Workshops and Editorial Committee of CIRS 2026. The session explored the impact of generative AI on higher education and highlighted practical strategies for its responsible and effective integration into teaching and learning. The workshop was attended by 79 participants.



Pre-Conference Workshop 7

Mighty Mariner – Charting the Future: Empowering the Maritime Community

The seventh pre-conference workshop was held on 26th June 2026 at the Klaus E Orlendorff Auditorium, CINEC Campus. "Mighty Mariner – Charting the Future: Empowering the Maritime Community" was organized by the Aries Group of Companies in collaboration with the Faculty of Marine Engineering and the Faculty of Maritime Sciences. The event successfully brought together industry experts, academics, and maritime professionals. The workshop was attended by 270 participants.



Pre-Conference Workshop 8

Reinventing Yourself: Thriving Beyond Your Original Profession

The eighth pre-conference workshop was held onsite on 7th July 2026 at the Klaus E Orlendorff Auditorium, CINEC Campus, this high-impact workshop was expertly delivered by Eng. Thushara Asuramanna, General Manager/CEO, State Mortgage & Investment Bank and proudly organized by the Faculty of Engineering. Igniting ambition and purpose, the session provided 270 engaged participants with a transformative framework to align their personal passions, individual strengths, and professional expertise. It served as an invaluable guide for aspiring professionals ready to craft a deeply meaningful, resilient, and successful career trajectory.



Pre-Conference Workshop 9

Decode, Discover, Deliver: Unlock Insights, Drive Strategies, Create Impact

The ninth pre-conference workshop was held onsite on 10th July 2026 at the Klaus E Orlendorff Auditorium, CINEC Campus, this dynamic and empowering workshop was delivered by Prof. Pradeep Dharmasiri and Dr. C. P. Attapathu, with Ms. Dilhani de Silva serving as the moderator, and was proudly organized by the Faculty of Management and Social Sciences. Igniting scholarly excellence, the session provided 150 engaged participants with practical, hands-on guidance on critical thinking and rigorous research analysis. It served as an invaluable catalyst for researchers looking to elevate their research.



Pre-Conference Workshop 10

Tips, Tricks and Processes for Protecting and Commercializing Your Inventions

The tenth pre-conference workshop was held onsite on 21st July 2026 at the Klaus E Orlendorff Auditorium, CINEC Campus, this high-impact, forward-looking workshop was expertly delivered by Prof. M. N. Kaumal from University of Colombo and proudly organized by the Faculty of Science. Empowering scholars and innovators to bridge the gap between academic ingenuity and real-world market success, the session provided 150 engaged participants with vital, step-by-step guidance on intellectual property protection, robust patenting strategies, and the essential commercialization pathways required to translate groundbreaking ideas into practical, commercial applications.



06

NEXORA

Industry-Academia Synergy Zone



NEXORA – Industry–Academia Hub

NEXORA – Industry–Academia Hub is a signature initiative of the CINEC International Research Symposium (CIRS) 2026, designed to strengthen collaboration between academia and industry through innovation, entrepreneurship, research commercialization, and workforce development. Aligned with the CIRS 2026 theme, “Bridging Academic Synergy for National Progress: Integrating Knowledge for Economic Transformation”, NEXORA provides a platform for translating academic knowledge and research into practical solutions for real-world challenges.

Key highlights include the launch of a Personalized Cosmetics Platform, developed by the Faculty of Health Sciences in collaboration with Bioloom Islands, integrating skin diagnostics, microbiome analysis, DNA-informed insights, biosensing, and IoT technologies. The event will also formalize and showcase strategic industry partnerships with Frella International (Pvt) Ltd., Sunshine Holdings PLC, and LAUGFS Holdings, creating opportunities for industrial training, internships, and enhanced industry exposure for students.

NEXORA further celebrates student entrepreneurship through the presentation of *Cinnamon Ceylon Valora*, demonstrating the translation of academic knowledge and creativity into a value-added business venture. In addition, industry-driven technological innovations will be presented, including a Vision-Based Defect Detection and Production Monitoring System and an Automated Guided Vehicle (AGV) for Material Handling, developed by the Faculty of Engineering in collaboration with Prym Intimates Lanka (Pvt) Ltd. Another notable initiative is the AI-Based Aluminium Window Frame Profile Selection Tool, developed by the Department of Civil Engineering in collaboration with International Construction Consortium (ICC) Sri Lanka, providing an intelligent, data-driven approach to construction-related decision-making.

An important academic component of NEXORA will be the presentation of second-year research findings by students of the Master of Science in Pharmaceutical Science, Department of Postgraduate Studies, Faculty of Health Sciences. The students will submit their research findings in the form of concept papers to the Chairman of the National Medicines Regulatory Authority (NMRA), Sri Lanka, providing an opportunity to connect postgraduate research with regulatory perspectives and potential applications within the pharmaceutical and healthcare sectors.

Collectively, these initiatives position NEXORA as a dynamic platform for knowledge exchange, innovation, entrepreneurship, research dissemination, technology transfer, and sustainable industry academia partnerships. Through these collaborations, NEXORA contributes to developing industry-ready graduates, addressing real-world challenges, and advancing the broader vision of CIRS 2026 towards national progress and economic transformation.



07

The Orator-CIRS 2026



The Orator – CIRS 2026



Dr. Shanka M. Henkanatte Gedara
PhD (USA), MS (USA), BSc Eng (Hons),
AMIE (SL), GREENSL[®] AP, MIEPSL
Senior Lecturer – Grade 1
Department of Civil Engineering
Faculty of Engineering and Technology
CINEC Campus
Malabe

Algal Systems for Wastewater Treatment and Resource Recovery

Dr. Shanka M. Henkanatte Gedara

*Department of Civil Engineering, Faculty of Engineering, CINEC Campus, Malabe,
Sri Lanka*

The depletion of fossil fuel resources and escalating fuel prices have driven researchers to identify sustainable alternatives for transportation fuel needs. While terrestrial transport is successfully shifting toward electric vehicles, substantial decarbonization challenges remain for aerial and marine transit. Furthermore, a failure to develop a drop-in alternative fuel to supplement existing internal combustion engines will result in unmanageable waste streams, prematurely rendering refining infrastructures obsolete and causing massive vehicle disposal liabilities. In this context, biofuel derived from algal biomass stands out as a renewable, economically viable alternative that provides the exact infrastructure compatibility needed for current transportation needs.

Despite its potential, commercializing algal biofuels faces critical hurdles, notably freshwater scarcity, agricultural nutrient competition, and high energy demands for harvesting and conversion. Integrating algal cultivation with wastewater treatment provides a synergistic solution to these barriers. This dual-benefit approach supplies vital water and macronutrients directly to the algal system while substantially reducing the intensive aeration and energy demands of traditional activated sludge treatment processes. Grounded in these principles, the Photosynthetically Oxygenated Waste-to-Energy Recovery (POWER) system has demonstrated exceptional feasibility in wastewater remediation while generating substantial biomass for biofuel conversion, ultimately rendering the entire treatment process energy-positive. Utilizing the extremophilic red alga *Galdieria sulphuraria* within the POWER system ensured robust, seasonal treatment stability despite significant fluctuations in influent water quality. Furthermore, the extreme environmental conditions required by this specific algal strain naturally suppress competing organisms, drastically minimizing the need for chemical disinfectants in pathogen reduction.

08

The Orator – CIRS 2025



Introducing First Orator at the CINEC International Research Symposium

The Orator – CIRS 2025



Dr. W M Kalpani Madhushika Ratnayake
Ph.D., M.Sc. in Food & Nutrition,
PG Dip LAS, B.Sc. Human Biology
Head of the Department of Cosmetic Science
Senior Lecturer – Grade I
Faculty of Health Sciences
CINEC Campus
Malabe

Anti-Inflammatory Activity and Mechanisms of *Acronychia pedunculata* and *Psychotria sarmentosa* Leaves and their Activity Guided Fractionation and Active Compound Isolation

Dr. W M Kalpani Madhushika Ratnayake
Department of Cosmetic Science, Faculty of Health Science, CINEC Campus, Malabe, Sri Lanka

Inflammation is something we all experience, it is the body's natural defense mechanism against injury and infection. But what happens when this protective response goes out of control? Chronic inflammation becomes a silent driver behind many of today's most serious diseases, including arthritis, cardiovascular conditions, and even cancer. While modern medicine offers effective treatments, long-term use of drugs such as NSAIDs and corticosteroids often comes at a cost, including significant side effects. This raises an important question: can we find safer, more sustainable solutions?

My oration speech will bring you on a journey that bridges ancient wisdom and modern science. Sri Lanka, rich in biodiversity and traditional knowledge, has long used medicinal plants to treat inflammation. Among these, two plants: *Psychotria sarmentosa* and *Acronychia pedunculata* stand out for their historical use in managing pain, swelling, and inflammatory conditions. Yet, until recently, their scientific validation remained incomplete.

Our research set out to explore these plants in depth. Using well-established experimental models, we tested their effectiveness in acute, sub-chronic, and chronic inflammation. The results were remarkable. Both plant extracts significantly reduced inflammation, with inhibition levels reaching up to 78%.



More importantly, they lowered key inflammatory markers such as C-reactive protein and prostaglandin E₂, indicating not just local, but systemic effects. But the story does not end there.

These plants also demonstrated antioxidant properties, helping to combat oxidative stress, a major contributor to chronic inflammation. They reduced pain responses and even showed moderate antihistamine activity, suggesting broader therapeutic potential. Perhaps most encouraging of all, toxicity studies confirmed that these extracts are safe, even with prolonged use.

One of the most exciting discoveries from this study was the identification of a powerful bioactive compound called Evolitrine, isolated from *Acronychia pedunculata*. This compound showed exceptional anti-inflammatory and pain-relieving properties, outperforming many expectations and opening doors for future drug development.

So, what does this mean for us? It means that traditional knowledge, when examined through the lens of modern science, can lead to groundbreaking discoveries. It means that countries like Sri Lanka are not just custodians of biodiversity, but also potential contributors to global healthcare solutions.

In conclusion, this research not only validates the traditional use of these plants but also highlights their promise as safer, plant-based alternatives for managing inflammation. As we move forward, integrating ethnobotany, pharmacology, and innovation will be key to unlocking new therapies for some of the world's most pressing health challenges.



09

Three Minutes Thesis (3 MT[®]) Competition



Three Minute Thesis (3MT[®]) Competition of CIRS 2026

The Three Minute Thesis (3MT[®]) Competition of the 7th CINEC International Research Symposium (CIRS) 2026 organized by the Faculty of Health Sciences was successfully concluded on the 4th of June 2026 at CINEC Campus. This landmark event represented a significant achievement in CINEC's ongoing commitment to fostering research excellence, promoting scholarly communication, and strengthening the nation's postgraduate research culture.

The competition was conducted under the official permission granted by the University of Queensland, Australia, the originator of the internationally acclaimed Three Minute Thesis (3MT[®]) initiative. Furthermore, with the generous support of the National Science Foundation (NSF) of Sri Lanka, participation was extended to postgraduate researchers representing universities across the country, transforming the event into a truly national platform for academic excellence.

The Three Minute Thesis (3MT[®]) competition celebrates the ability of researchers to communicate complex scientific ideas with clarity, precision, and impact. Participants were challenged to present the significance of their research within three minutes, using only one static presentation slide, while engaging a non-specialist audience. This internationally recognized format not only showcases research achievements but also cultivates essential skills in public engagement, knowledge translation, and science communication.

The competition generated an enthusiastic response from the postgraduate research community, attracting a large number of applications from diverse academic disciplines. Following a rigorous evaluation process, fifteen outstanding postgraduate researchers were selected to compete. Their presentations reflected exceptional scientific merit, innovation, originality, and outstanding communication skills, demonstrating the breadth and quality of contemporary research conducted within Sri Lankan universities.

Presentations were evaluated by an esteemed panel of experts using the official 3MT[®] judging criteria, encompassing Comprehension and Content, Engagement and Communication, and Overall Presentation Effectiveness. Based on their performance, five finalists were selected from whom the top three presenters were recognized as winners. The winner was subsequently invited to showcase their research during the 7th CINEC International Research Symposium (CIRS 2026) held on 18th August 2026, providing them with an opportunity to present their work before a distinguished gathering of academics, researchers, industry professionals, and policymakers.



Top three winners of the 3MT competition are,

The Winner

Samamalee Upekshi Kankanamge
University of Sri Jayewardenepura

First Runner-up

Watutantrige Pulmini Milanika Alwis
University of Sri Jayewardenepura

Second Runner-up

K.M.G.Y. Sewwandi
Open University of Sri Lanka

The 3MT[®] organizing committee extends its sincere appreciation to the University of Queensland for granting permission to conduct the official 3MT[®] Competition, to the National Science Foundation of Sri Lanka for its invaluable support, and to the distinguished panel of judges for their expertise, dedication, and impartial evaluation. Appreciation is also extended to all participants whose enthusiasm, professionalism, and commitment contributed significantly to the success of the competition, as well as to the organizing committee, sponsors, staff members, and volunteers whose collective efforts ensured the smooth execution of this prestigious event.

The Panel of Evaluation

Senior Prof. and Chair Menik Hettihewa, Dean, Faculty of Health Sciences, CINEC Campus

Dr. Kalpani Ratnayake, HOD/ Department of Cosmetic Science, Faculty of Health Sciences, CINEC Campus

Dr. Piyumi Wasana, HOD/ Department of Postgraduate Studies, Faculty of Health Sciences, CINEC Campus

Dr. Shanka M. Henkanatte Gedara, Department of Civil Engineering, Faculty of Engineering and Technology, CINEC Campus

Dr. Pubudini Weerasooriya, Department of Postgraduate Studies, Faculty of Health Sciences, CINEC Campus

Dr. Piumika Yapa, Department of Pharmacy and Pharmaceutical Sciences, CINEC Campus



The Winner

Samamalee Upekshi Kankanamge
University of Sri Jayewardenepura



Replacing Imported Maize Starch: A Solution to Rising Medicine Costs

The rising cost of medicines is a major challenge in Sri Lanka. While the cost of active pharmaceutical ingredients is often considered the primary contributor to medicine prices, pharmaceutical excipients also account for a substantial proportion of manufacturing costs. Maize starch, one of the most widely used multifunctional excipients in tablets and capsules, is almost entirely imported, increasing production costs and dependence on foreign supplies. Developing locally available alternatives is therefore essential to strengthen pharmaceutical self-reliance and improve medicine affordability.

This research investigated the feasibility of replacing imported maize starch with starches extracted from indigenous Sri Lankan plant sources. Six starch-rich plants; *Oryza sativa* (rice), *Nymphaea pubescens* (water lily), *Nelumbo nucifera* (lotus), *Plectranthus rotundifolius* (Chinese potato) and *Dioscorea pentaphylla* (five-leaf yam) were selected based on their local availability and starch content. Native starches were extracted and subsequently modified through pre-gelatinization, acetylation and oxidation to improve their functional properties for pharmaceutical applications. Their suitability as binders, disintegrants, and fillers was evaluated by formulating paracetamol 500 mg tablets and capsules and assessing their quality according to pharmacopeial standards.

More than 50% starch yield was obtained from all selected plant sources. Several native and modified starches demonstrated superior flowability, compressibility, swelling, and solubility compared with imported maize starch. Tablets and capsules prepared using selected starches complied with pharmacopeial requirements, exhibiting acceptable hardness, friability, rapid disintegration and more than 90% drug release within 45 minutes.



These findings demonstrate that Sri Lankan native and modified starches can possibly replace imported maize starch as multifunctional pharmaceutical excipients. Such substitution could reduce dependence on imports, save over millions of dollars annually in foreign exchange, lower pharmaceutical manufacturing costs and ultimately improve the affordability and accessibility of medicines. The study highlights how locally available natural resources can provide sustainable solutions to national healthcare and economic challenges.



First Runner-up

Watutantrige Pulmini Milanika Alwis
University of Sri Jayewardenepura



Synthesis of Novel Metal-Based Therapeutics for Targeted Biological Applications

Metal-based therapeutics have revolutionized modern medicinal chemistry; notably the emergence of cisplatin has changed the landscape of cancer treatment. In spite of its effectiveness against a wide range of cancers, cisplatin shows some drawbacks such as; drug resistance, toxicity and limited selectivity toward cancerous tissues. Thus, the development of structurally modified platinum complexes with improved biological activity, target specificity and reduced toxicity have become a critical area in research.

This study focuses on designing and synthesizing novel sulfonamide-based picolylamine ligands and their platinum (II) complexes as potential compounds for targeted biological applications. Sulfonamide moieties possess diverse pharmacological properties, including antimicrobial, anti-inflammatory, and anticancer activities, while the picolylamine scaffold provides an effective bidentate chelation with the platinum(II) metal center, facilitating the formation of stable square planar complexes. Ligand Three new sulfonamide-based ligands were successfully synthesized: N(SO₂-1-naphthalene)-2 picolylamine (L1), N(SO₂-2-naphthalene)-2-picolylamine ligand (L2), and N(SO₂Me₂Nnap)-2-picolylamine ligand (L3). These ligands were subsequently utilized to synthesize four novel platinum(II) complexes: cis-[PtCl₂(N(SO₂-1-naphthalene)-2-picolylamine)] complex (C1), cis-[PtCl₂(N(SO₂-2-naphthalene)-2-picolylamine)] complex (C2), cis [PtCl₂(N(SO₂Me₂Nnap)-2-picolylamine)] complex (C3), and cis-[PtCl₂(N(SO₂-8-quinoline)-2-picolylamine)] complex (C4) of the previously reported N(SO₂-8-quinoline)-2-picolylamine ligand.



The synthesized ligands and their corresponding platinum (II) complexes were comprehensively characterized using single crystal X-ray crystallographic techniques as well as spectroscopic techniques to confirm their molecular structures and coordination behavior. Structural characterization confirmed the successful formation of the desired ligands and complexes. Swiss target predictions show the target protein for L1, L2 and L3 is cyclooxygenase-2 (COX-2) which is involved in inflammatory processes and is overexpressed in cancer cells. Furthermore, *in-silico* studies show that these ligands and complexes have higher binding affinities with COX-2 enzyme.

Therefore, future studies will be carried out to investigate their biological properties such as anticancer, anti-inflammatory properties, and COX-2 inhibitory properties. This work is a contribution to the continuous development of next-generation platinum-derived drugs with enhanced efficacy, selectivity and reduced toxicity for clinical applications.



Second Runner-up

K.M.G.Y. Sewwandi
The Open University of Sri Lanka



An Enhanced Optimization Framework for Coordinated Solar PV and Battery Energy Storage Integration

The growth in electricity demand and the global transition towards renewable energy are placing increasing pressure on power systems. Solar photovoltaic-based distributed generation offers a practical means of meeting demand, reducing fossil-fuel dependence and improving energy security. This is particularly important for countries such as Sri Lanka, where abundant solar resources provide potential for electricity generation. However, uncoordinated integration can cause voltage fluctuations, reverse power flow, feeder overloading, increased losses and reliability concerns, thereby limiting further renewable penetration. Optimal placement and sizing of distributed generation are therefore essential to minimize losses, improve voltage profiles, maximize economic benefits and increase network hosting capacity. Battery Energy Storage Systems provide a viable complementary solution by storing excess solar energy and supplying it during peak demand. Coordinated planning of solar PV and BESS can regulate voltage, reduce reverse power flow, relieve feeder loading and improve reliability.

Although numerous studies worldwide have investigated the optimal integration of DG and BESS, many remain confined to simplified simulations, static operating conditions or small-scale test networks. Consequently, they often fail to represent practical variations in electricity demand and renewable generation, detailed network constraints and the computational challenges associated with larger distribution systems.



This research addresses these limitations by developing an enhanced hybrid optimization framework that integrates Particle Swarm Optimization with an exact-loss-formula-based analytical approach. The analytical component identifies technically promising candidate locations and provides guided initial solutions, reducing unnecessary search effort and improving the convergence and accuracy of the optimization process. The framework determines the optimal locations and capacities of solar PV-based DG and BESS while accounting for time-varying load and generation conditions, voltage limits, feeder thermal capacities, transformer ratings, reverse-power-flow restrictions, battery state-of-charge and energy-balance requirements, and economic performance.

The proposed framework was evaluated using standard IEEE distribution test networks and practical low-voltage network data under varying load and generation conditions with the methodology structured for further validation and application in practical medium-voltage networks. The results demonstrate improved convergence and solution accuracy, together with reductions in network losses and voltage deviations. By combining guided analytical screening with an efficient population-based search, the proposed method offers lower computational effort and greater suitability for larger and more complex networks. It therefore provides a scalable and practically implementable planning tool for improving system reliability, maximizing economic benefits, increasing renewable-energy hosting capacity and supporting coordinated DG and BESS deployment in developing power systems.



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Panel of Reviewers



FACULTY OF HEALTH SCIENCES

1. **Snr. Prof and Chair, Menik Hettihewa**, Dean/ Senior Professor & Chair, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
2. **Dr. Piyumi Wasana**, HoD/Senior Lecturer (Grade II), Department of Postgraduate Studies, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
3. **Dr. Kalpani Ratnayake**, HoD/ Senior Lecturer (Grade I), Department of Cosmetic Science, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
4. **Dr. Piumika Yapa**, Lecturer in Pharmaceutical Sciences, Department of Pharmacy and Pharmaceutical Sciences, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
5. **Dr. Harshani Perera**, Lecturer in Biomedical Science, Department of Biomedical Science, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
6. **Dr. Saumya Samarasinghe**, Senior Lecturer (Grade II), Department of Postgraduate Studies, Faculty of Health Sciences, CINEC Campus, Malabe, Sri Lanka
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Panelists of Technical Sessions



FACULTY OF HEALTH SCIENCES

From Discovery to Development: Health Sciences for National Growth

TECHNICAL SESSION



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FACULTY OF COMPUTING

*Driving National Development and Sustainable Economic Transformation
through Technology and Digital Innovation*

TECHNICAL SESSION



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FACULTY OF ENGINEERING

Collaborative Innovations: Sustainable Engineering for Economic Resilience

TECHNICAL SESSION



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FACULTY OF HUMANITIES AND EDUCATION

Humanities in National Development: Shaping a Sustainable Society through Education

TECHNICAL SESSION



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FACULTY OF MANAGEMENT AND SOCIAL SCIENCES

*Unlocking Research Potential: Grant Achievement and Pathway to
Commercialization*

TECHNICAL SESSION



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FACULTY OF MARINE ENGINEERING

Advancing Marine Engineering for a Sustainable Maritime Industry

TECHNICAL SESSION



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FACULTY OF MARITIME SCIENCES

Strengthening the National Blue Economy through Maritime Education and Innovations

TECHNICAL SESSION



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FACULTY OF SCIENCE

Advancing Science for Sustainable Economic Futures

TECHNICAL SESSION



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Panel Member

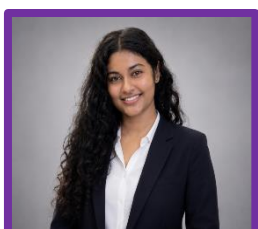
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Impact of Preimplantation Genetic Testing for Aneuploidy (PGT-A) on Embryo Implantation Success and Assessment of Pregnancy Outcomes in Patients with Recurrent Pregnancy Loss

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Introduction: Recurrent pregnancy loss (RPL) affects 1–2% of couples and carries substantial physical and psychological burden. Embryonic aneuploidy contributes to early pregnancy failure and increases with maternal age. Preimplantation genetic testing for aneuploidy (PGT-A) may improve embryo selection in IVF, although evidence of benefit in RPL remains inconsistent.

Objectives: To describe embryo chromosomal profiles and pregnancy outcomes following IVF with PGT-A in women with RPL, and to examine the influence of maternal age.

Methodology: A single-arm observational cohort study was conducted at Wish Fertility Hospital, Maharagama, Sri Lanka (January 2025–January 2026). Women with documented RPL (≥ 2 losses) undergoing IVF with PGT-A using autologous oocytes and next-generation sequencing were enrolled by consecutive sampling; donor-gamete cycles, non-comparable genetic indications and incomplete records were excluded. Data were analysed using descriptive statistics, chi-square tests and binary logistic regression (SPSS 27).

Results & Discussion: Among 118 women (mean age 40.88 ± 3.11 years; 90.7% aged ≥ 38 years), 78 (66.1%) obtained at least one euploid embryo while 40 (33.9%) had none. Among the 71 transfer-eligible women (91.0%) with complete follow-up, clinical pregnancy was 42.3%, miscarriage before 12 weeks 12.7% and ongoing pregnancy beyond 12 weeks 29.6%. Each one-year increase in maternal age lowered the odds of euploid embryo availability (OR 0.790; 95% CI 0.682–0.915; $p = 0.002$) and of clinical pregnancy (OR 0.271; 95% CI 0.128–0.571; $p < 0.001$), whereas each additional blastocyst biopsied raised the odds of a euploid embryo (OR 2.817; 95% CI 1.525–5.203; $p < 0.001$). PGT-A may therefore assist embryo selection when a euploid embryo is available, although the single-arm design without a comparator precludes causal inference.

Conclusion: One-third of women obtained no euploid embryo and miscarriage occurred in 30.0% of clinical pregnancies despite euploid transfer, indicating that non-chromosomal mechanisms warrant evaluation alongside optimisation of blastocyst yield and pre-procedure counselling.

Keywords: Aneuploidy, Maternal age, Miscarriage, Pre-implantation, Pregnancy loss



Comparative Analysis of Pharmaceutical Pricing Regulations in Sri Lanka and Selected International Models: Implications for Policy Reform and Medicine Affordability

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Introduction: Despite the implementation of pharmaceutical price controls under the National Medicines Regulatory Authority (NMRA) Act No. 5 of 2015 since 2016, medicine affordability remains a persistent public health challenge in Sri Lanka.

Objectives: This study aimed to compare Sri Lanka's pharmaceutical pricing regulations with selected international models to identify evidence-based policy reforms for improving affordability and regulatory efficiency.

Methodology: A mixed-methods comparative design was adopted across seven countries: Sri Lanka, India, Bangladesh, Pakistan, Egypt, South Africa, and the United Kingdom, selected to capture diverse pricing models India, Bangladesh, and Pakistan as regional comparators with similar economic and market conditions; Egypt and South Africa as out-of-region comparators reflecting different regulatory strategies; and the United Kingdom as a benchmark country with a highly developed, value-based pricing and health technology assessment system. The qualitative component analysed national regulatory frameworks focusing on pricing methodologies, revision mechanisms, and enforcement structures. The quantitative component evaluated 131 Maximum Ceiling Price (MCP) formulations benchmarked against India's National Pharmaceutical Pricing Authority (NPPA), Bangladesh's Maximum Retail Price (MRP) list, and South Africa's Single Exit Price database. Statistical analysis employed Wilcoxon signed rank tests with significance set at $p < 0.05$.

Results & Discussion: Qualitative findings revealed key structural deficiencies including the absence of External Reference Pricing, no separate frameworks for locally manufactured medicines, no generic-innovator price differentiation, and no regulatory provisions for public procurement pricing. The United Kingdom's value-based, confidentially negotiated pricing system precluded a direct quantitative comparison and was therefore examined qualitatively only. Quantitative analysis confirmed significant price disparities: Sri Lankan MCP prices averaged 2.3 times higher than India (+128%, $p < 0.001$) and 1.9 times higher than Bangladesh (+88%, $p < 0.001$).

Conclusion: Regulatory design limitations contribute substantially to higher medicine prices in Sri Lanka. Recommended reforms include integrating External Reference Pricing, establishing cost-plus frameworks for domestic manufacturing, introducing generic-innovator price differentiation, and developing Health Technology Assessment capacity.

Keywords: External reference pricing, Maximum retail price, MCP, NPPA, Pricing policy



Machine Learning Approaches for Drug Repurposing: A Case Study on Diabetic Drugs for Non-Alcoholic Fatty Liver

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Introduction: Non-alcoholic fatty liver disease (NAFLD) is the most prevalent chronic liver condition globally, driven by a complex interplay of insulin resistance and progressive hepatocyte apoptosis. Despite its massive clinical burden, pharmacological treatments remain severely limited, necessitating rapid and cost-effective drug discovery strategies.

Objectives: This study investigates the computational repurposing of established antidiabetic agents such as Glucagon-Like Peptide-1 Receptor Agonists (GLP-1 RAs), biguanides, and sodium-glucose cotransporter 2 inhibitors as potential NAFLD therapeutics. The research focuses on evaluating these compounds against two key molecular targets governing NAFLD pathogenesis: AKT1 (insulin signalling) and CASP3 (apoptosis).

Methodology: To achieve this, a multi-tiered in silico pipeline was engineered, bridging ligand-based machine learning with structure-based molecular docking. A dataset of candidate drugs was structurally converted into 2048-bit Morgan Fingerprints using the RDKit chemoinformatics library. To ensure independent validation and mitigate overfitting, the dataset was subjected to an 80:20 train-test split. A Random Forest Regressor algorithm was subsequently trained to establish Quantitative Structure-Activity Relationships (QSAR), predicting the dual-target efficacy of these compounds. To validate the machine learning predictions and reduce false-positive rates, the pipeline integrated spatial thermodynamic binding affinities for the AKT1 and CASP3 targets generated via targeted grid docking in AutoDock Vina, calculating a rigorous Consensus Score.

Results & Discussion: The Random Forest model demonstrated adequate predictive capacity as an initial enrichment filter, achieving an R^2 correlation coefficient of 0.4535. While statistically moderate, this metric successfully captured complex structural-activity patterns, allowing the pipeline to effectively eliminate biologically inert compounds prior to computationally expensive 3D docking. Subsequent targeted docking identified ChEMBL362588 as the premier lead candidate. It demonstrated exceptional dual-target binding affinity, achieving deep catalytic core insertion in AKT1 (-18.098 kcal/mol) and effectively jamming the executioner cleft of CASP3 (-12.902 kcal/mol).

Conclusion: In conclusion, this integrated machine learning and targeted docking framework successfully identifies highly potent, dual-target candidates. By effectively filtering compounds computationally prior to rigorous structural validation, this pipeline provides a robust, cost-effective foundation for developing targeted NAFLD therapeutics.

Keywords: Drug repurposing, Molecular docking, NAFLD, Polypharmacology, Structural bioinformatics



Needs Assessment and Development of a Validated Risk-Based Audit Toolkit to Strengthen Medical Device Regulatory Oversight in Sri Lanka

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Introduction: Medical device regulatory oversight in Sri Lanka remains largely compliance-oriented, with limited implementation of risk-based inspection approaches tailored to medical devices.

Objectives: This study aimed to assess existing regulatory practices and develop and validate a context-specific Risk-Based Audit Toolkit (RBAT) to strengthen medical device manufacturing oversight.

Methodology: A sequential mixed-methods study was conducted using semi-structured interviews with key stakeholders (n = 25), NMRA manufacturer database analysis, document review, and benchmarking against international regulatory frameworks, including WHO, ISO 13485:2016, and IMDRF guidelines. The RBAT was developed using a modified Delphi technique, adapting international regulatory guidance into a validated, context-specific inspection toolkit for Sri Lanka, and was validated through pilot implementation in four medical device manufacturing facilities. Qualitative data were analyzed using thematic analysis, while quantitative data were analyzed using descriptive statistics and Spearman correlation analysis.

Results & Discussion: The study identified significant gaps in risk-based inspection practices, limited availability of structured regulatory tools, and continued reliance on pharmaceutical GMP-based inspection approaches. More than 75% of manufacturers produced low-risk devices, while manufacturer capability demonstrated a strong positive association with device diversity ($\rho = 0.763$, $p < 0.001$). Pilot implementation demonstrated improved inspection prioritization and consistency, and the RBAT achieved high usability and excellent content validity (S-CVI = 1.00).

Conclusion: The study provides a validated, practical, and scalable framework to improve inspection prioritization, regulatory consistency, and evidence-based decision-making in resource-constrained regulatory settings.

Keywords: GMP, ISO 13485, Medical device regulation, Risk-based inspection



Development and Evaluation of a Freeze-Dried Polyherbal Extract Powder for the Management of Chronic Kidney Disease

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Introduction: Chronic kidney disease (CKD) is a progressive disorder characterized by gradual loss of renal function and is a major global health concern. In Sri Lanka, the increasing prevalence of CKD and CKD of unknown etiology has imposed a substantial healthcare and socioeconomic burden, particularly in rural communities. Due to the high cost and limited accessibility of conventional treatments, there is growing interest in affordable herbal therapies. This study aimed to develop and evaluate a freeze-dried polyherbal formulation for early-stage CKD management.

Objectives: To develop a standardized freeze-dried polyherbal extract powder and evaluate its phytochemical, physicochemical, microbiological, chromatographic, and pharmaceutical quality characteristics.

Methodology: Six medicinal plants traditionally used in Ayurvedic medicine *Tragia involucrata*, *Solanum xanthocarpum*, *Solanum indicum*, *Aerva lanata*, *Alysicarpus vaginalis*, and *Tribulus terrestris* were selected based on their reported nephroprotective and antioxidant properties. Aqueous extracts were prepared as a decoction and freeze-dried. The formulation was evaluated through phytochemical screening, physicochemical analysis, microbial limit testing, heavy metal analysis, thin-layer chromatography (TLC), and capsule quality assessment.

Results & Discussion: Phytochemical screening confirmed the presence of flavonoids, alkaloids, tannins, saponins, glycosides, phenolics, and terpenoids. The formulation exhibited acceptable physicochemical characteristics, including moisture content (2.4%), total ash (7.5%), acid-insoluble ash (0.6%), and water-soluble extractive value (28.6%). Microbial testing confirmed the absence of *Escherichia coli* and *Salmonella*, while heavy metal concentrations complied with World Health Organization permissible limits. TLC, using a mobile phase of methanol:dichloromethane (0.5:6.5:2.5, v/v), produced a characteristic chromatographic fingerprint demonstrating multiple phytochemical constituents. The freeze-dried powder also exhibited satisfactory flow properties and acceptable capsule weight uniformity (500.48 ± 5 mg), supporting its suitability for capsule formulation.

Conclusion: A standardized freeze-dried polyherbal formulation with acceptable pharmaceutical quality characteristics was successfully developed. These findings provide a basis for further preclinical efficacy, stability, and clinical studies to establish its nephroprotective potential, long-term safety, and suitability for the management of chronic kidney disease.

Keywords: CKD, Freeze-drying, Herbal medicine, Lyophilization, Polyherbal formulation



Prevalence of Work-Related Stress and Its Association with Hypertension, Hyperlipidemia and Type 2 Diabetes Mellitus Among Sales and Marketing Employees in Sri Lanka

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Introduction: Occupational stress is an important public health concern associated with adverse physical and psychological health outcomes. Sales and marketing employees may experience high job demands, performance pressure, competition, customer interactions, irregular working hours, and job insecurity. Sri Lanka is also experiencing a substantial burden of non-communicable diseases, including hypertension, dyslipidemia, and type 2 diabetes mellitus.

Objective: This study aimed to determine the prevalence of occupational stress and its association with hypertension, hyperlipidemia, and T2DM among sales and marketing employees in Sri Lanka.

Methodology: A descriptive cross-sectional analytical study was conducted among 298 sales and marketing employees aged 25–50 years from public and private sector organizations. Participants were recruited using convenience sampling. Data were collected using a structured questionnaire covering socio-demographic, occupational, lifestyle, and medical characteristics. Occupational stress was assessed using a modified 8-item Perceived Stress Scale (PSS), with scores categorized as low (0–10), moderate (11–21), and high (22–32). For this study, clinically significant stress was operationally defined as moderate or high stress (PSS score ≥ 11). Hypertension, hyperlipidemia, and T2DM were assessed using self-reported medical history and available clinical records. Descriptive statistics, chi-square tests, and correlation analyses were performed. Statistical significance was set at $p < 0.05$. Potential confounding factors, including age, sex, lifestyle behaviors, and occupational characteristics, were considered when interpreting.

Results & Discussion: Moderate stress was observed in 81.2% and high stress in 7.4% of participants, giving a clinically significant stress prevalence of 88.6% (264/298). Occupational stress showed statistically significant associations with hypertension, hyperlipidemia, and T2DM ($p < 0.05$). Unhealthy lifestyle characteristics, including inadequate physical activity, unhealthy dietary practices, alcohol consumption, smoking, and disturbed sleep were observed.

Conclusion: Occupational stress was highly prevalent and significantly associated with selected metabolic disorders among the study participants. The findings support the need for workplace stress-management, health screening, and preventive health-promotion strategies.

Keywords: Hypertension, Hyperlipidemia, Occupational Stress, Sales and Marketing, T2DM



Screening and Molecular Identification of Star Fruit (*Averrhoa carambola*)- Epiphytic Yeasts with Ethanol Fermentation Ability

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Introduction: Although *Averrhoa carambola* (star fruit) possesses recognized nutritional and medicinal properties, limited information is available on its indigenous epiphytic yeasts and their contribution to fermentation and bioactivity.

Objectives: To isolate and molecularly identify indigenous epiphytic yeasts from star fruit and evaluate their fermentation performance, volatile profile, antimicrobial activity, and anti-inflammatory potential.

Methodology: Epiphytic yeasts were isolated by serial dilution and spread plating on potato dextrose agar supplemented with gentamicin. Fermentative ability was assessed using glucose, fructose and sucrose fermentation assays with Durham tubes. Selected isolates were identified by PCR amplification of the ITS region using ITS1/ITS4 primers, followed by Sanger sequencing and BLAST analysis. Star fruit juice was fermented for 21 days using a consortium of selected indigenous yeast isolates. The fermented beverage was analyzed using an electronic nose (E-nose), agar disc diffusion assay for antimicrobial activity, egg albumin protein denaturation assay for anti-inflammatory activity, and one-way ANOVA ($p < 0.05$).

Results & Discussion: Nine morphologically distinct yeast isolates were recovered, of which five exhibited strong fermentative ability. SH4 and SH6 were identified as *Aureobasidium* sp. (PZ138264), while SH9 was identified as *Aureobasidium melanogenum* (PZ139606). E-nose analysis demonstrated alcohol-associated sensor responses of 41.464, 36.529 and 28.824, indicating differences in volatile compound production. The fermented beverage exhibited antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. Compared with commercially available red wine under identical agar disc diffusion conditions, no statistically significant differences were observed (ANOVA, $p > 0.05$). The highest anti-inflammatory activity was 54.95% inhibition in the protein denaturation assay.

Conclusion: Native *Aureobasidium* spp. isolated from *A. carambola* demonstrated promising fermentation potential and produced a fermented beverage with detectable antimicrobial activity and moderate anti-inflammatory effects. These findings support their potential for functional beverage development, although further optimization and biological validation are recommended.

Keywords: Antimicrobial activity, *Aureobasidium*, Fermentation, Functional beverage, Star fruit



A Comparative Analysis of Regulatory Policies Influencing Local Pharmaceutical Manufacturing Development in Sri Lanka

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Introduction: The pharmaceutical sector in Sri Lanka remains heavily dependent on imported finished pharmaceutical products despite increasing domestic demand and existing local manufacturing capacity. Local manufacturers currently supply approximately 18–20% of the national pharmaceutical requirement by volume, exposing the country to medicine shortages, foreign exchange pressures, and supply chain vulnerabilities.

Objectives: This study evaluated the impact of regulatory, fiscal, and procurement policies on local pharmaceutical manufacturing in Sri Lanka through comparative policy benchmarking with India, Pakistan, and Bangladesh.

Methodology: A sequential exploratory mixed-methods approach was employed involving 40 purposively selected stakeholders with expertise in pharmaceutical regulation and manufacturing, comprising manufacturing executives (37.5%), National Medicines Regulatory Authority (NMRA) officials (25%), health policy experts and academics (25%), and industry association representatives (12.5%). Data were collected using structured questionnaires and semi-structured interviews and analyzed using descriptive statistics, Chi-square goodness-of-fit tests, Wilcoxon signed-rank tests, and exact binomial probability tests.

Results & Discussion: Stakeholders perceived prolonged regulatory approval timelines (95%, $p < 0.001$), complex documentation procedures (87.5%, $p < 0.001$), and inadequate institutional capacity within the NMRA (80%) as major barriers to manufacturing expansion. Licensing and registration procedures were also perceived as significantly difficult (Wilcoxon signed-rank test, $p < 0.001$). Participants further identified an inverted VAT structure, whereby local manufacturers are subject to 18% VAT on raw materials and machinery while imported finished pharmaceutical products remain tax-exempt, as a major constraint to industrial growth. Comparative benchmarking indicated that Sri Lanka's regulatory framework was perceived to be less supportive than those of India, Pakistan, and Bangladesh.

Conclusion: The findings suggest that strengthening pharmaceutical self-sufficiency requires regulatory digitization, fiscal reforms, institutional strengthening, and long-term procurement mechanisms to support sustainable industrial growth.

Keywords: NMRA, Pharmaceutical manufacturing, Regulatory policy, VAT structure



Establishment of Allele-specific PCR Assay for Detection of *CYP3A5* (A6986G) and *MDR1* gene (C3435T) Polymorphisms

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Introduction: The cytochrome P450 3A5 (*CYP3A5*) and multidrug resistance 1 (*MDR1*, also known as ATP-binding cassette subfamily B member 1 or *ABCB1*) genes exhibit A6986G and C3435T polymorphisms, respectively, influencing tacrolimus pharmacokinetics. Tacrolimus, a widely used post-kidney transplant immunosuppressant, requires genotype-guided dose adjustments to optimize therapeutic efficacy. Despite this clinical importance, genotyping data and assay methodologies remain limited in Sri Lanka.

Objectives: To establish and evaluate a conventional multiplex allele-specific PCR assay within a Sri Lankan private hospital laboratory to simultaneously detect *CYP3A5* (A6986G) and *MDR1* (C3435T) polymorphisms in kidney transplant patients, supporting genotype-guided tacrolimus dosing.

Methodology: DNA amplifications were performed using an adapted published methodology with a known heterozygous reference sample. Analytical specificity of the established assay was evaluated using DNA extracts from five non-target organisms, with a known patient DNA sample as the positive control. Analytical sensitivity was assessed using 10-fold serial dilutions of the heterozygous reference DNA sample. Repeatability was evaluated over three consecutive days using reference DNA. Preliminary clinical evaluation was conducted using five patient samples.

Results & Discussion: The assay produced specific amplification of wild-type and mutant *CYP3A5* (210 bp) and *MDR1* (134 bp) alleles under optimised touchdown PCR conditions (68–60°C). No amplification was observed in non-target samples, confirming specificity. Repeatability was consistent across three runs, with detectable amplification ranging from 10⁴–10⁶ genome equivalents/mL. Preliminary clinical evaluation demonstrated all five patients were *CYP3A5* heterozygous, while four were *MDR1* heterozygous and one homozygous wild type; distributions were descriptively similar to regional reports and consistent with known pharmacogenomic associations when interpreted alongside blood tacrolimus levels.

Conclusion: While the assay demonstrated preliminary feasibility and reliability, limitations including single-sample optimisation, small clinical and specificity cohorts, and conventional PCR constraints highlight the need for advancement. Future real-time PCR integration, improved primer design, and expanded clinical validation may enable a faster, quantitative, and broadly applicable assay.

Keywords: Allele-specific PCR, *CYP3A5*, *MDR1*, Polymorphisms, Tacrolimus



Molecular Detection of *Toxoplasma gondii* in Brain Tumour Patients in Sri Lanka: A Preliminary Study

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Introduction: *Toxoplasma gondii* is a neurotropic intracellular parasite capable of establishing latent infections in the central nervous system, particularly in immuno-compromised individuals. Its potential role in brain tumour pathogenesis remains unclear, especially in the Sri Lankan context.

Objectives: This study was aimed at detecting *Toxoplasma gondii* DNA in brain tumour patients using polymerase chain reaction (PCR).

Methodology: A descriptive cross-sectional study was conducted among 317 organ cancer patients at Apeksha Hospital, Maharagama, from which brain tumour patients were identified as the study population. The limited sample size and selective inclusion of clinically suspected patients precluded inferential statistical analysis. Results are presented descriptively. Thirteen (13) patients were identified with brain tumours, of whom five (5) clinically suspected of toxoplasmosis were selected for molecular analysis. Genomic DNA was extracted from blood samples and subjected to PCR targeting the multicopy B1 gene of *T. gondii*. Amplified products were analyzed using agarose gel electrophoresis. Positive samples were identified by the expected 200 bp *T. gondii* B1 gene amplicon and confirmed using a positive control (*Toxoplasma gondii* RH 50174D, ATCC, USA).

Results & Discussion: Out of five suspected cases, two (2/5, 40.0%) showed positive amplification for the B1 gene of *T. gondii*, confirming the presence of parasite DNA among the studied brain tumour patients. The remaining three samples (3/5, 60.0%) were negative by PCR. This study provides preliminary molecular evidence of *T. gondii* infection among brain tumour patients in Sri Lanka.

Conclusion: PCR demonstrated high analytical sensitivity for the detection of *Toxoplasma gondii* DNA in clinically suspected cases. Although limited by a small sample size, the findings highlight the importance of molecular screening in immuno-compromised patients and support further large-scale studies to investigate the potential association between toxoplasmosis and brain tumours.

Keywords: Brain tumour, B1 gene, PCR, Sri Lanka, *Toxoplasma gondii*



Development and Validation of Amplification - Refractory Mutation System Polymerase Chain Reaction (ARMS-PCR) for Detection of Factor II (G20210A) Gene Mutation

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Introduction: Venous thromboembolism is a major clinical manifestation of hereditary thrombophilia, with the Factor II (Prothrombin) G20210A mutation representing a significant inherited risk factor that increases plasma prothrombin levels and predisposes individuals to thrombosis. Although conventional molecular methods, such as PCR-RFLP and Sanger sequencing, provide reliable detection, they are limited by high costs, longer turnaround times, and risks of contamination. Consequently, there is a need for rapid, cost-effective, and highly specific diagnostic approaches. This study developed and analytically validated a SYBR Green I-based Amplification Refractory Mutation System (ARMS) real-time PCR assay for the rapid and accurate detection of the Factor II G20210A mutation.

Objectives: To develop and validate a SYBR Green I-based ARMS Real-Time PCR assay for accurate detection and genotyping of the Factor II (G20210A) mutation.

Methodology: Allele-specific primers targeting Factor II G20210A mutation were designed using the GRCh38 genomic reference sequence, and a SYBR Green-based ARMS RT-PCR assay was optimised using heterozygous mutant control DNA. Analytical specificity, sensitivity, and inter-assay repeatability were evaluated. Clinical performance was assessed using 20 anonymised samples with previously confirmed genotypes, excluding unsuitable specimens. Diagnostic sensitivity and specificity were determined from the CFX96 Manager software following real-time PCR data.

Results & Discussion: The optimised assay successfully amplified wild-type and mutant alleles with distinct melting temperatures of 86°C and 82°C, respectively. The assay demonstrated high repeatability with coefficient of variation values below 3%. Analytical sensitivity was established at 9.83×10^3 copies/μL. Clinical validation demonstrated complete agreement with gold standard diagnostic methods except for one degraded sample.

Conclusion: The study successfully developed and validated a rapid and reliable SYBR Green-based ARMS RT-PCR assay for detecting the Factor II G20210A mutation, demonstrating high specificity, sensitivity, and repeatability, offering a cost-effective molecular diagnostic approach tool for hereditary thrombophilia screening in resource-limited laboratories.

Keywords: ARMS RT-PCR, Hereditary thrombophilia, Molecular diagnostic, Venous thromboembolism



Investigation of Indigo Carmine Degradation via Singlet Oxygen [$O_2(1\Delta g)$] Generated from Natural Photosensitizer using FTIR Spectroscopy

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Introduction: Water pollution is a major global environmental concern resulting from rapid expansion of industries and urbanization. Among various contaminants released into aquatic systems, Indigo Carmine is a significant challenge due to their chemical stability, persistence, and potential toxicity. Singlet oxygen can be generated via photosensitization and the reactive oxygen species selectively oxidize electron-rich double bonds in chromophoric systems.

Objectives: This study focuses on the FT-IR determination of structural changes of Indigo Carmine via singlet oxygen using curcumin as the natural photosensitizer.

Methodology: The rhizomes of fresh turmeric (30 g) were extracted using Soxhlet extraction technique using absolute methanol as the solvent and the photochemical degradation of Indigo Carmine using curcumin was carried nearly 4 hours using gas wash bottle containing indigo carmine dye (500 ppm), crude extracted curcumin (0.025 g), and dissolved molecular oxygen in water: methanol (48 : 2, V/V %) as the solvent to ensure complete solubility of Indigo Carmine and curcumin and the presence of halogen lamp (100 W). Liquid -liquid extraction was conducted for the resultant mixture using dichloromethane: water (1:1, V/V %) as the solvent to separate degradation products of dye molecules from curcumin. Finally, the aqueous layer underwent lyophilization. FT-IR was conducted for curcumin, indigo carmine and lyophilized powder to determine the degradation.

Results & Discussion: The characteristic alkene conjugated double bond of Indigo Carmine showed changes in the degraded sample, indicating cleavage of the conjugated chromophoric system. Major spectral changes were observed in the region around $1600-1500\text{ cm}^{-1}$, corresponding to the $C=C$ conjugated stretching vibrations, confirming oxidative degradation of the dye molecule. Additionally, changes in the $1000-1200\text{ cm}^{-1}$ region suggested modification of sulfonate and aromatic functional groups after oxidation. The degradation spectrum also showed broadening in the $3200-3500\text{ cm}^{-1}$ region, indicating formation of hydroxyl containing oxidation products.

Conclusion: These observations support the singlet oxygen-mediated structural changes of Indigo Carmine sensitized by natural curcumin photosensitizer. The observed degradation of Indigo Carmine demonstrates the potential application of natural photosensitizer-assisted singlet oxygen oxidation for textile and dye effluent treatment methods.

Keywords: Curcumin, Indigo Carmine, Singlet oxygen, Water pollution



Impact of Part-Time Employment on Mental Health and Academic Performance among Undergraduate Students in Selected Non-State Higher Education Institutes in the Colombo District, Sri Lanka

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Introduction: Part-time employment has become increasingly common among undergraduate students due to financial needs, work experience opportunities, and increasing living costs. However, balancing employment with academic responsibilities may influence students' academic performance and mental health.

Objectives: This study aimed to examine the association between part-time employment, academic performance, and mental health among undergraduate students in selected non-state higher education institutes in the Colombo District, Sri Lanka. A quantitative cross-sectional study was conducted between March and May 2026 among undergraduate students from six selected non-state higher education institutes.

Methodology: Data were collected from 197 undergraduate students using a structured online questionnaire. Academic performance was assessed using cumulative Grade Point Average (GPA), and mental health was evaluated using the Depression, Anxiety, and Stress Scale (DASS-21). Descriptive statistics and inferential analyses, including independent-sample t-tests and one-way ANOVA, were performed using SPSS Statistics version 30.

Results & Discussion: Among participants, 131/197 (66.5%) were engaged in part-time employment. The overall mean GPA was 3.50 ± 0.44 . The mean GPA among employed students was 3.53 ± 0.38 , while non-employed students had a mean GPA of 3.44 ± 0.53 . Independent sample t-tests revealed no significant differences between employed and non-employed students in GPA ($p=0.197$), depression ($p=0.198$), stress ($p=0.133$), or anxiety ($p=0.578$). The mean DASS-21 scores among employed students were stress = 12.47, anxiety = 10.73, and depression = 10.00, indicating normal stress, moderate anxiety, and mild depression according to DASS-21 severity classification.

Conclusion: The findings indicated that part-time employment was not significantly associated with differences in academic performance or mental health. However, workload-related factors such as working hours may influence student outcomes. Balanced work schedules and appropriate support strategies are important for promoting students' academic success and mental health.

Keywords: Academic performance, DASS-21, Mental health, Part-time employment, Undergraduates



Dietary Behaviours and Body Image Satisfaction among Undergraduates in Selected Non-State Higher Educational Institutions in Colombo District, Sri Lanka: A Preliminary Study

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Introduction: Body image satisfaction may influence dietary behaviours and physical activity among undergraduates, yet evidence from non-state higher educational institutions remains limited.

Objective: This study aimed to assess dietary behaviours, physical activity and body image satisfaction, and to examine their association among undergraduates in selected non-state higher educational institutions in Colombo District, Sri Lanka.

Methodology: A cross-sectional study was conducted among 154 undergraduates from selected non-state higher educational institutions in the Colombo District, Sri Lanka, using a stratified random sampling method. Data were collected using a self-administered questionnaire. Dietary patterns were assessed using a 24-hour dietary recall, and body image satisfaction was measured using a validated Figure Rating Scale. Height and weight data were self-reported by participants and were used to calculate Body Mass Index (BMI). Data were analysed using descriptive statistics and multivariable linear regression.

Results & Discussion: Most participants were aged 21–23 years (62.9%), with a male-to-female ratio of 1:3. Most undergraduates had low physical activity levels (60.2%), skipped breakfast (25.9%), and reported unhealthy dinner choices (45.7%). Nutritional problems were reported among 48.3% of the participants. Most participants agreed that academic pressure influenced their dietary behaviours (45.7%). Although only 28.5% were dissatisfied with their current weight, 44.4% desired to be thin, while feelings of shame, self-blame, and guilt were common. In multivariable linear regression, higher physical activity ($\beta=0.163$, $p=0.046$) and higher BMI ($\beta=0.447$, $p<0.001$) were significantly associated with greater body image satisfaction, whereas dietary behaviours showed no significant associations ($p>0.05$).

Conclusion: Unhealthy dietary behaviours, low physical activity levels, nutrition problems and body image concerns were common. Regular physical activity and BMI were significant predictors of body image satisfaction. These findings suggest targeted health promotion programmes for healthy dietary practices, active lifestyles, and positive body image perceptions.

Keywords: Body image satisfaction, Dietary behaviours, Non-state universities, Sri Lanka, Undergraduates



Determination of Prevalence of Maturity Onset Diabetes of the Young 3 (MODY 3) in Sri Lanka and Genetic Screening for *HNF1A* Mutation in Suspected MODY 3 Patients

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Introduction: Maturity Onset Diabetes of the Young (MODY) is a monogenic type of diabetes that occurs in adolescents and young adults. This form makes up 1-5% of cases of diabetes worldwide. The reported subtypes of MODY are 14 where *HNF1A*-MODY (MODY 3) is the most reported form in Asia.

Objective: This study aims to determine the prevalence of MODY 3 in Sri Lanka as well as genetic screening for the *HNF1A* mutation in suspected MODY 3 patients.

Methodology: The research consisted of two phases. Phase I was a cross-sectional, questionnaire-based screening survey conducted among individuals aged 15 to 30 years across all nine provinces of Sri Lanka with the aim of identifying suspected MODY patients based on demographic, clinical and family history criteria. During Phase II, a molecular analysis of blood samples was conducted based on suspected MODY cases from Phase I, for the exon 4 of the *HNF1A* gene. The analyses were done using IBM SPSS, version 27 and BioEdit version 7.7.1. A total of 388 valid responses were collected.

Results & Discussion: Our study population were majorly females (62.4%), with a mean age of 23.23 ± 2.48 years. The mean BMI was 22.1 ± 4.4 kg/m², falling within the healthy weight range. 4.1% (16 of 388) were identified as suspected MODY cases, and 0.8% (3 of 388) were classified as suspected MODY 3. In Phase II, Sanger sequencing yielded 2 heterozygous variants that were conserved in both the control and one suspect across multiple 1 NCBI reference alignments (NG_011731.2 and NM_000545.8), while an additional upstream intronic variant was detected in another.

Conclusion: *HNF1A* exon 4 sequencing revealed heterozygous variants of uncertain significance, thus requiring functional validation. The results provide initial insight into the possible incidence of MODY 3 in Sri Lanka, with implications for genetic screening as an initial step in diagnosis. The findings highlight the importance of raising awareness, expand multigene panels, as well as utilize population-specific diagnostic tools for the enhancement of precision diabetes care in Sri Lanka.

Keywords: *HNF1A*, Genetic testing, MODY 3, Monogenic diabetes



Comparative Evaluation of Phytochemical Profile and Biological Activities of *Zingiber zerumbet* (L.) Roscoe ex Sm. Rhizome Extracts

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Introduction: The demand for natural bioactive compounds in the cosmetic industry has stimulated research into medicinal plants. *Z. zerumbet* rhizome is rich in phytochemicals with promising pharmaceutical and cosmetic potential.

Objectives: This study investigated the phytochemical profile and *in vitro* antioxidant, antibacterial and toxicity of aqueous, ethanol, and hexane extracts of *Z. zerumbet* rhizome.

Methodology: Dried rhizome powder was obtained by maceration in aqueous, ethanol, and hexane solvents (1:10, V/V%) at 25 °C. Qualitative phytochemical screening was performed. Antioxidant potential was evaluated by using 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay across a concentration series from 0.125 to 2.0 mg/mL. The antibacterial efficacy was assessed at a concentration of 1 mg/mL against *Escherichia coli* (Gram-negative) and *Staphylococcus aureus* (Gram-positive) using the disc diffusion method. Ciprofloxacin was used as the positive control. Toxicity was assessed by brine shrimp lethality assay (BSLA). Data were analyzed using SPSS Statistics (version 25).

Results & Discussion: The polar extracts exhibited greater phytochemical responses for alkaloids, flavonoids, and tannins compared with the hexane extract. The ethanol extract demonstrated a 2.7 ± 0.1 mm zone of inhibition against *S. aureus*, indicating significant antibacterial activity, while aqueous and hexane extracts ($p < 0.05$) did not inhibit this bacterium. No significant differences were observed among the extracts against *E. coli* ($p > 0.05$). DPPH assay, IC_{50} values of 1.61, 1.67, and 5.26 mg/mL in ethanol, hexane and aqueous extracts, respectively, compared to ascorbic acid, all extracts showed weak antioxidant activity. The BSLA test results indicated that the LC_{50} values of hexane, ethanol and aqueous extracts are 0.05, 0.25, and >1 mg/mL, respectively.

Conclusion: The hexane extract exhibited the highest toxicity relative to other extracts. The findings indicate that the ethanol extract of *Z. zerumbet* rhizome exhibited higher phytochemical responses and selective antibacterial activities against *S. aureus*. However, antioxidant activity is weaker than ascorbic acid. The hexane extract showed notable cytotoxicity potential.

Keywords: Antibacterial activity, Antioxidant, Brine shrimp lethality assay, Phytochemical, *Zingiber zerumbet* rhizome



***In Vitro* Evaluation of the Antioxidant and Anti-Inflammatory Activities of a Phenolic-Rich Methanolic Leaf Extract**

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Introduction: Oxidative stress and inflammation are closely associated with the pathogenesis of numerous chronic diseases, highlighting the need to identify plant-derived bioactive compounds with potential health benefits. *Syzygium zeylanicum* (L.) (Maran) which remains understudied.

Objectives: To evaluate antioxidant and anti-inflammatory activities of the methanolic leaf extract of this plant.

Methodology: This study evaluated the total phenolic content (TPC), antioxidant, and anti-inflammatory activities of the methanolic leaf extract of *S. zeylanicum*. A 0.03 mg/mL to 1 mg/mL concentration series was prepared. TPC was determined using the Folin-Ciocalteu assay, antioxidant activity by 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) assays, and anti-inflammatory activity by protein denaturation and human red blood cell (HRBC) membrane stabilization assays. All experiments were performed in triplicate and analyzed using an unpaired t-test ($p < 0.05$).

Results & Discussion: The extract exhibited a high TPC of 73.03 ± 0.16 mg gallic acid equivalents (GAE)/g extract. At 1 mg/mL, DPPH and ABTS radical scavenging activities reached $80.67 \pm 0.23\%$ and $82.26 \pm 0.37\%$, respectively, compared with $88.52 \pm 0.19\%$ and $89.35 \pm 0.26\%$ for the positive control, Butylated Hydroxytoluene (BHT) ($p < 0.05$). The extract demonstrated remarkable antioxidant activity with IC_{50} values of 0.08 mg/mL (DPPH) and 0.08 mg/mL (ABTS), while BHT exhibited IC_{50} values of <0.03 mg/mL in both assays. Protein denaturation inhibition and HRBC membrane stabilization activities reached $79.37 \pm 0.19\%$ and $78.68 \pm 0.67\%$, respectively, at 1 mg/mL, compared with $86.15 \pm 0.45\%$ and $88.06 \pm 0.18\%$ for the positive control, ibuprofen ($p < 0.05$). The extract also demonstrated remarkable anti-inflammatory activity with IC_{50} values of 0.05 mg/mL and 0.06 mg/mL for the protein denaturation and HRBC membrane stabilization assays, respectively, while ibuprofen exhibited IC_{50} values of <0.03 mg/mL in both assays.

Conclusion: These findings support methanolic leaf extract as a promising source of antioxidant and anti-inflammatory compounds. Further *in vivo* and toxicity studies are warranted.

Keywords: Antioxidant activity, Anti-inflammatory, Medicinal plant, *Syzygium zeylanicum*, Total phenolic content



Preliminary Characterization of the Jaw Skin Microbiome of Healthy Adults in Colombo District, Sri Lanka

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Introduction: The skin microbiome plays an important role in maintaining skin health and protecting the body against potentially harmful microorganisms. Understanding the composition of the skin microbiota and the presence of antibiotic-resistant bacteria is essential for assessing potential public health risks and guiding appropriate antimicrobial use.

Objectives: The aim of this study was to characterize the skin microbiome and to identify the bacterial population resistant to erythromycin and vancomycin antibiotics from the jaw skin of healthy adults in Colombo district, Sri Lanka.

Method: A convenience sample of five healthy individuals were chosen based on pre-defined inclusion and exclusion criteria. Ethical clearance, and informed consent were obtained and skin swabs were collected under sterile conditions. Bacterial enrichment, serial dilutions, spread and quadrant streaking techniques were used to isolate morphologically distinct colonies. The sensitivity against erythromycin and vancomycin was tested by Kirby–Bauer disc diffusion method. Selected isolates were cultured to isolate genomic DNA and then the 16s ribosomal RNA (16s rRNA) gene was amplified by Polymerase chain reaction (PCR). Agarose gel electrophoresis was used to visualize PCR products which were subsequently Sanger sequenced for the identification of the bacteria.

Results and Discussion: A total of 43 bacterial colonies were identified by spread plating. Sequence analysis showed the presence of four species namely, *Acinetobacter nosocomialis*, *Acinetobacter baumannii*, *Mammaliicoccus sciuri*, and *Bacillus cereus*. Of the 10 isolates selected, 2 were resistant to erythromycin which were *Acinetobacter baumannii* and *Mammaliicoccus sciuri*, and all isolates were susceptible to vancomycin.

Conclusion: This preliminary study provides only baseline information on the jaw skin microbiome of healthy adults in Sri Lanka. Further research with larger sample size and culture independent, molecular-based methods is recommended to validate the findings and gain a better understanding of the Sri Lankan skin microbiome.

Keywords: Antibiotic resistance, Erythromycin, Jaw skin, Skin microbiome, Vancomycin



Comparison Study of Beneficial Effects of Stem and Leaves of *Costus speciosus* L. on Pathophysiology of Liver Fibrosis

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Introduction: Liver fibrosis is a progressive liver disorder characterized by excessive accumulation of extracellular matrix proteins due to chronic liver injury. The Angiotensin Converting Enzyme (ACE) plays a significant role in the renin–angiotensin system (RAS) in the progression of liver fibrosis. Therefore, ACE inhibition has emerged as a promising therapeutic strategy for the management of hepatic fibrosis. *Costus speciosus* L. is a medicinal plant rich in phytochemicals and widely used in traditional medicine.

Objective: This study aimed to compare the phytochemical composition and *in vitro* ACE inhibitory activity of different stem and leaf parts of red and green stem varieties of *Costus speciosus* with captopril as the positive control.

Methodology: Plant materials including green whole plant, green leaves, green stem, red whole plant, mature leaves, baby leaves, and red stem were collected and dried. The dried samples were powdered and extracted using Soxhlet extraction with absolute methanol. Qualitative phytochemical screening was carried out to identify tannins, flavonoids, alkaloids, saponins, terpenoids, phenolics, and steroids. ACE inhibitory activity was evaluated using a commercially available ACE assay kit at 340 nm. Statistical analysis was performed using one-way ANOVA with significance considered at $p < 0.05$.

Results & Discussion: The results demonstrated that baby leaves from the red stem variety exhibited the highest ACE inhibitory activity, while the green stem showed the lowest activity compared to positive control. Phytochemical analysis at a concentration of 1000 ppm revealed the presence of tannins, flavonoids, alkaloids, phenolics, terpenoids, saponins, and steroids were particularly concentrated in baby leaves and whole plant samples. The red stem showed minimal detectable phytochemicals. The observed ACE inhibitory activity may be associated with the rich phytochemical content, especially phenolics and flavonoids.

Conclusion: *Costus speciosus* particularly the baby leaves of the red stem variety, possesses promising ACE inhibitory and phytochemical properties, suggesting its potential as a natural hepatoprotective agent for managing liver fibrosis with additional studies as hepatic stellate cells, fibrosis biomarkers or animal models.

Keywords: ACE inhibition, *Costus speciosus*, Hepatoprotective, Phytochemicals



Development and Evaluation of Orally Disintegrating Tablets Formulated with *Erythrina variegata* Leaf Extract, a Plant-Based Anthelmintic Agent

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Introduction: Helminthiasis is a major public health issue in tropical regions due to drug resistance and poor compliance with conventional anthelmintics. Although *Erythrina variegata* leaves contain bioactive compounds with known anthelmintic properties, no standardized orally disintegrating tablet (ODT) formulation has yet been developed from this plant.

Objectives: This study aims to evaluate the development, formulation, and performance of an ODT incorporating *Erythrina variegata* leaf extract (EVLE) as a plant-based anthelmintic agent.

Methodology: Ethanolic leaf extract of *Erythrina variegata* was quantitatively evaluated for flavonoids by AlCl₃ test. In-vitro anthelmintic tests against *Strongyloides stercoralis* were compared with standard albendazole (40 mg/mL). ODTs containing EVLE prepared by wet granulation method were subjected to quality control tests, especially rapid disintegration (≤ 30 s), hardness, friability, flavonoid quantification, anthelmintic activity, and palatability test (n = 20).

Results & Discussion: The concentration of total flavonoids in the EVLE was found to be 2.2 % w/w. At the concentrations employed in the anthelmintic assay, this corresponds to approximately 0.55 - 4.40 mg QE/mL. Since flavonoids such as quercetin have demonstrated direct nematocidal activity in previous studies, it is found that the flavonoid content of EVLE has contributed substantially to the observed anthelmintic activity.

Conclusion: This study produced a herbal ODT with validated properties and demonstrated in-vitro anthelmintic efficacy. The formulation thereby bridges ethnomedicine and modern formulation.

Keywords: Anthelmintic activity, *Erythrina variegata*, Herbal formulation, Orally disintegrating tablets



Preliminary Formulation Optimization of an In-Situ Gel Prototype for Rectal Delivery: A Natural Mucoadhesive Approach with *Borassus flabellifer* Fruit Resin

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Introduction: Conventional rectal dosage forms such as creams, ointments, and suppositories are associated with limitations including poor mucosal retention, rapid clearance, and patient discomfort. Thermosensitive in-situ gelling systems offer promising alternatives by transitioning from liquid state at room temperature to gel upon rectal administration at body temperature, thereby enhancing drug residence time and therapeutic efficacy.

Objectives: This study aimed to develop and evaluate mucoadhesive thermosensitive rectal in-situ gel containing 1% w/v Pramoxine Hydrochloride, utilizing *Borassus flabellifer* (Palmyra palm) fruit resin (BFR) as novel natural mucoadhesive agent. Pramoxine Hydrochloride is an anti-pruritic and local anaesthetic active pharmaceutical ingredient. BFR, an underutilized natural resource, rich in polysaccharides, offering superior biocompatibility and mucoadhesive strength compared to traditional synthetic polymers. Primary objective was to verify whether substituting traditional synthetic mucoadhesive polymers with natural source would maintain or compromise the gelling integrity of the vehicle.

Methodology: Initial phase focuses strictly on design, optimization, and physical characterization of drug-free polymeric prototype. BFR was extracted from ripened fruits through controlled aqueous extraction and evaporation. Twelve formulations (F1–F12) were prepared using cold method, combining varying concentrations of Poloxamer 407, Poloxamer 188, and BFR.

Results & Discussion: Among prototypes evaluated, formulation F2 containing 400mg BFR, 1g Poloxamer 188, and 2g Poloxamer 407 was identified as optimal vehicle. Crucially, evaluation of F2 demonstrated that removing carbomer which is usual synthetic gel-forming polymer did not negatively affect vehicle. Rather, incorporating BFR positively improved gelation time, achieving rapid sol-gel transition at physiological target of 37 °C in under 2 minutes. Furthermore, F2 demonstrated uniform spreadability (51.46 g·cm/s), indicating ideal mucosal coverage. It also successfully passed the syringeability test using a 3mL syringe with a 23G x 1¼" needle, ensuring excellent applicability for rectal administration.

Conclusion: Preliminary findings indicate that BFR is promising natural mucoadhesive polymer for thermosensitive rectal in-situ gel formulations.

Keywords: *Borassus flabellifer*, In-situ gel, Mucoadhesion, Poloxamer, Rectal drug delivery, Thermosensitive gel



Formulation of Herbal Candy: Organoleptic, Physicochemical and Nutritional Analysis

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Introduction: The traditional medicine practiced in Sri Lanka is largely based on Siddha Medicine, which utilizes medicinal plants, minerals, and metals in various therapeutic formulations. Among the medicinal plants, *Piper longum* L. (*P. longum*; *Tippali*) and *Glycyrrhiza glabra* L. (*G. glabra*; Adimaduram) possess expectorant and other pharmacological properties that make them valuable for the management of respiratory tract disorders.

Objectives: This study aimed to develop and characterize a standardized herbal candy containing *P. longum* and *G. glabra* incorporated with palm sugar candy, a novel formulation that has been rarely explored for respiratory health, and to evaluate its organoleptic, physicochemical and nutritional properties.

Method: Six different formulations were prepared and evaluated by 30 semi-trained panelists using a 5-point hedonic scale to identify significant differences among the formulations and to determine the most acceptable product. Preliminary phytochemical screening of the cold ethanolic extracts revealed the presence of flavonoids, saponins, tannins, and terpenoids in *G. glabra*, whereas only tannins were detected in *P. longum*.

Results & Discussion: Among the formulations developed, the herbal candy containing *G. glabra* and *P. longum* aqueous extracts at a ratio of 1:3 exhibited the highest sensory acceptability. Physicochemical analysis of the selected formulation showed a pH of 6.10 and moisture, ash, crude fat, salt, total sugar, and protein contents of 3.06, 7.98, 0.09, 0.009, 65.55, and 0.74 g/100 g, respectively. Mineral analysis revealed the presence of potassium (178.88 mg/100 g), sodium (132.25 mg/100 g), magnesium (165.00 mg/100 g), and calcium (75.00 mg/100 g).

Conclusion: The findings indicate that the developed herbal candy possesses acceptable sensory, physicochemical, and nutritional characteristics with potential functional and therapeutic benefits for respiratory health. Further studies are recommended to optimize the formulation for improved preservation of bioactive compounds and to evaluate its antioxidant, antimicrobial, and shelf-life stability properties.

Keywords: *Glycyrrhiza glabra*, Herbal candy, Palm sugar candy, Physicochemical, *Piper longum*



Regulatory Framework of Assistive Devices in Sri Lanka: A Comprehensive Analysis of Policy, Practice and Challenges

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Introduction: Assistive devices improve independence, mobility and quality of life for persons with disabilities, older adults and individuals with functional impairments. In Sri Lanka, demand is increasing due to population ageing, non-communicable diseases, road traffic injuries and other causes of disability. However, access to safe, affordable and appropriate technologies remains constrained by weaknesses in regulation, coordination, monitoring and financing.

Objective(s): To evaluate Sri Lanka's regulatory framework for assistive devices and identify regulatory, institutional and implementation challenges affecting their safety, quality, affordability and accessibility.

Methodology: A mixed-method exploratory design was used. Questionnaires and semi-structured interviews were conducted with 5–12 purposively selected stakeholders representing regulators, healthcare providers, importers, suppliers and distributors. Policy and regulatory documents were reviewed. Quantitative data were analyzed using IBM SPSS Statistics Version 29 and qualitative data using Braun and Clarke's thematic analysis. Five-point Likert-scale responses, Cronbach's alpha and an exploratory Chi-square test were used.

Results & Discussion: Regulatory requirements were rated as only "somewhat clear" by 83.3% of respondents. Policy and regulation (Mean = 3.0, SD = 0.63) and product availability (Mean = 3.0, SD = 1.09) showed moderate effectiveness, while financing performed weakest (Mean = 2.5, SD = 1.05). Cronbach's alpha was 0.546, indicating moderate internal consistency. No significant association was observed between stakeholder category and perceived regulatory clarity ($\chi^2 = 0.00$, $p = 1.00$); these exploratory statistics require cautious interpretation due to the small sample. Qualitative findings identified fragmented responsibilities, overlapping mandates, weak enforcement, inadequate monitoring and post-market surveillance, limited technical expertise, insufficient stakeholder participation, and affordability barriers.

Conclusion: Sri Lanka requires a more unified regulatory framework for assistive devices, supported by stronger institutional and technical capacity, stakeholder coordination, post-market surveillance and alignment with international standards. These measures could strengthen governance and promote equitable access to safe, effective and high-quality assistive technologies.

Keywords: Assistive devices, Disability inclusion, Regulatory framework, Sri Lanka, Stakeholders



Synthesis and Structural Elucidation of a Schiff Base

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Introduction: Schiff bases are an important class of imine compounds known for their structural versatility and biological activities, particularly characterized by the azomethine ($-C=N-$) functional group and exhibits diverse of biological activities.

Objectives: This study focuses on the synthesis and characterization of a Schiff base (E)-N-(3-phenylprop-2-en-1-ylidene) aniline.

Methodology: The compound was synthesized with aniline and cinnamaldehyde under reflux for 2 hours in absolute ethanol via acid-catalyzed condensation. After purification through recrystallisation process and the structure was confirmed using different spectroscopic methods such as UV-Visible, FT-IR, ¹H-NMR, and ¹³C-NMR spectroscopy. Thermal stability was assessed using thermogravimetric analysis (TGA), while electronic properties were calculated using the Hartree-Fock method.

Results & Discussion: The UV-Vis spectrum exhibited a strong absorption band at 290 nm corresponding to $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, while FT-IR confirmed the formation of the azomethine ($C=N$) group. The ¹H-NMR and ¹³C-NMR spectra validated the expected chemical environment of protons and carbons in the imine structure while thermogravimetric analysis (TGA) revealed that the compound remained intact up to approximately 100–120 °C before undergoing multi step decomposition at higher temperatures. Computational studies performed using the Hartree-Fock (HF) method with a 3-21G basis set supported the experimental findings, confirming structural stability (no imaginary frequencies) and revealing an electron rich nitrogen center (Mulliken charge $-0.7017 e$), moderate dipole moment (2.13–2.53 D), and significant polarizability.

Conclusion: The research successfully demonstrated the synthesis of a Schiff base, and these results suggest the compound is a promising candidate for future studies on pharmaceutical and material science development.

Keywords: Aniline, Cinnamaldehyde, Imine, Schiff base



Formulation of an Effervescent Herbal Tablet Dosage Containing *Glycyrrhiza glabra* L. and *Centella asiatica* L. Urban Extract with *In-vitro* Anti-microbial Activity against *Helicobacter pylori*

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Introduction: *Helicobacter pylori* infection is a major global health concern associated with chronic gastritis, peptic ulcer disease, and an increased risk of gastric cancer. The emergence of antimicrobial resistance has increasingly challenged conventional eradication regimens, creating a need to investigate alternative and complementary therapeutic approaches. Herbal medicines containing bioactive phytochemicals have attracted considerable interest as potential sources of antimicrobial agents, highlighting the importance of developing standardized, patient-friendly formulations supported by scientific evidence.

Objective: This study aimed to formulate an herbal effervescent tablet containing methanolic root extract of *Glycyrrhiza glabra* L. (Fabaceae) and ethanolic leaf extract of *Centella asiatica* L. Urban (Umbelliferae) and to preliminarily evaluate its anti-*H. pylori* activity. Both extracts have previously been reported to possess anti-*H. pylori* activity; therefore, their combined use in an effervescent tablet was explored as a potential synergistic herbal formulation.

Methods: Dried plant materials were extracted by maceration at 40 °C. The extracts were concentrated using a rotary evaporator and freeze-dried to obtain solid extracts. The dried extracts were geometrically mixed at a 1:1 ratio with citric acid, sodium bicarbonate, and selected excipients, followed by direct compression using a manual tablet press to obtain tablets weighing 500 mg $\pm$ 7.5%. The prepared tablets were evaluated for physical characteristics, effervescence, and preliminary antimicrobial activity using the disc diffusion method on blood agar.

Results: The formulated tablets demonstrated a mean hardness of 7.36 kP and friability of 0.057%. Rapid effervescence and disintegration were observed within 80 seconds. Clarithromycin (15 μ g) produced an inhibition zone of 24.67 $\pm$ 0.58 mm, whereas the herbal formulation demonstrated a modest inhibition zone of 13.00 $\pm$ 1.73 mm (CV = 13.3%) only at 30 mg/mL. Lower concentrations showed no detectable inhibition.

Conclusion: The formulation demonstrated acceptable physical properties and detectable but modest preliminary anti-*H. pylori* activity. Further studies using broth micro-dilution assays, quantitative phytochemical characterization, and appropriate statistical analysis are recommended to establish reproducibility, determine minimum inhibitory concentrations, and evaluate potential synergistic effects.

Keywords: *Centella asiatica*, Effervescent tablets, *Glycyrrhiza glabra*, *H. pylori*



Dispensing of Diazepam tablets from bulk packages in Community Pharmacies, Karapitiya, Sri Lanka: *An In Vitro* Evaluation

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Introduction: Maintaining medicine quality throughout the distribution and dispensing chain is essential to ensure safety, efficacy, and therapeutic performance. Repackaging medicines from bulk containers into alternative packaging materials may expose tablets to environmental factors such as light and temperature, potentially affecting their stability and quality. Therefore, appropriate packaging and storage conditions are important in community pharmacy practice.

Objectives: This study aimed to evaluate the effects of different packaging materials and storage conditions on the physicochemical quality and stability of repackaged 5 mg diazepam tablets over 30 days.

Methodology: Nine samples, each containing 200 tablets from the same bulk batch, were repackaged using transparent polythene covers, cellulose paper envelopes, and white plastic bottles. Samples were stored under controlled temperature conditions (<25 °C), ambient conditions (27–30 °C), and photostability conditions involving direct sunlight exposure for six hours daily. Seven physicochemical parameters, including appearance, weight variation, hardness, friability, disintegration, dissolution, and assay, were evaluated on days 0, 15, and 30 according to British Pharmacopoeia specifications. Data were analyzed using paired t-tests and one-way ANOVA with Tukey's post-hoc test.

Results and Discussion: All samples complied with specifications for weight variation ($\pm 10\%$), friability (<1%), and disintegration (<15 minutes), although none met the specified hardness requirement (<4 kg). Noticeable colour changes were observed in polythene- and cellulose-packaged tablets exposed to direct sunlight. On day 15, all samples maintained acceptable assay values (92.5–107.5%). However, by day 30, only seven samples met assay specifications, while sunlight-exposed tablets packaged in polythene and cellulose failed to comply, suggesting potential photodegradation. All samples met dissolution requirements (>80%); in dissolution profiles, significant reductions were observed between the original bulk package and samples stored under sunlight and ambient conditions for all packaging materials on days 15 and 30.

Conclusion: Packaging materials and storage conditions influenced the quality and stability of repackaged diazepam tablets. The findings highlight the importance of light-resistant packaging and appropriate storage conditions especially during bulk dispensing in community pharmacies to maintain medicine quality and therapeutic efficacy.

Keywords: Bulk dispensing, Diazepam, Pharmacopeia, Physicochemical properties, Quality control test



Association of Pre-Pregnancy Body Mass Index and Gestational Weight Gain with Maternal and Neonatal Outcomes among Postnatal Mothers in a Selected Urban Hospital in Sri Lanka

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Introduction: Pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) are important determinants of maternal and neonatal health. This study aimed to assess the association between pre-pregnancy BMI, gestational weight gain, and maternal and neonatal outcomes among postnatal mothers in a selected urban hospital in the Western Province of Sri Lanka. Ethical approval was obtained from the CINEC Research and Ethics Review Committee and the Colombo South Teaching Hospital–Kalubowila Ethics Review Committee.

Objective: To determine the association of pre-pregnancy BMI and gestational weight gain with maternal and neonatal outcomes among postnatal mothers.

Methodology: A prospective hospital-based study was conducted among 390 postnatal mothers aged 18–44 years with singleton pregnancies using a structured questionnaire. The mean gestational weight gain was 10.47 ± 5.64 kg (range: –7.00 to 43.00 kg). Information on maternal characteristics, gestational weight gain, maternal outcomes, and neonatal outcomes was collected and analyzed.

Results and Discussion: Pearson correlation analysis demonstrated that pre-pregnancy BMI was significantly associated with maternal outcomes, including gestational weight gain ($r = 0.414$, $p < 0.001$), pregnancy-related diseases ($r = 0.213$, $p < 0.001$), and caesarean delivery ($r = 0.145$, $p = 0.004$). However, a weak-to-moderate positive correlation was identified between maternal and neonatal complications ($r = 0.273$, $p < 0.01$), indicating that mothers who experienced complications were more likely to have neonates with complications. Gestational weight gain showed weak but statistically significant positive correlations with low/high birth weight ($r \approx 0.17$, $p < 0.05$), while no significant association was observed with neonatal intensive care unit (NICU) admission ($p > 0.05$).

Conclusion: Pre-pregnancy BMI and gestational weight gain were significantly associated with several maternal and neonatal outcomes. Optimizing maternal nutritional status before conception and promoting appropriate gestational weight gain during pregnancy may contribute to improved pregnancy outcomes and neonatal health.

Keywords: Body mass index, Maternal outcomes, Neonatal outcomes, Postnatal mothers, Sri Lanka



Capacity Utilization in Pharmaceutical Manufacturing Industry in Sri Lanka: A Mixed-Methods Analysis of Systemic Constraints

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Introduction: The pharmaceutical manufacturing industry plays a vital role in ensuring medicine security, reducing import dependency, and supporting Sri Lanka's economy. Despite government initiatives to promote domestic pharmaceutical production, manufacturing capacity remains considerably underutilized. Understanding the factors contributing to this underutilization is essential to strengthen the local pharmaceutical industry and improve national healthcare resilience.

Objectives: To evaluate the level of manufacturing capacity utilization among National Medicines Regulatory Authority (NMRA) approved Category A pharmaceutical manufacturers in Sri Lanka and identify the systemic, financial, regulatory, and operational factors influencing production efficiency.

Methodology: A convergent mixed-methods study design was employed. All 31 NMRA-approved Category A pharmaceutical manufacturers were invited to participate, and 21 manufacturers completed the structured questionnaire (response rate: 67.7%). Manufacturing capacity utilization was calculated as the ratio of actual production output to installed manufacturing capacity using manufacturer-reported production data. Semi-structured interviews were conducted with representatives of pharmaceutical manufacturers and key regulatory stakeholders. Interviews were audio-recorded with participant consent, transcribed verbatim, and analyzed using thematic analysis through iterative coding and reviewer consensus. Quantitative data were analyzed using descriptive statistics.

Results & Discussion: The mean manufacturing capacity utilization was approximately 42%, demonstrating substantial underutilization across the sector. None of the participating manufacturers operated above 75% of installed capacity. Major barriers identified included dependence on imported raw materials, supply chain disruptions, regulatory approval delays, limited financial resources, medicine price controls, shortages of skilled personnel, equipment maintenance challenges, and fluctuating market demand. Government initiatives, including Buy-Back Agreements and investment incentives, were perceived to support domestic manufacturing; however, their effectiveness was constrained by implementation challenges.

Conclusion: Pharmaceutical manufacturing capacity in Sri Lanka remains substantially underutilized due to multiple interconnected systemic constraints. Strengthening regulatory efficiency, improving supply chain resilience, and fostering greater collaboration between government and industry may enhance production efficiency, reduce import dependency, and improve national medicine security.

Keywords: Capacity utilization, Mixed method, Pharmaceutical manufacturing, Production efficiency, Sri Lanka



Determinants of Consumer Satisfaction and Financial Burden in Community Pharmacy Services: A Cross-Sectional Study in Sri Lanka

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Introduction: Community pharmacies play a crucial role in primary healthcare delivery, particularly in improving access to medicines and healthcare advice.

Objectives: This study aimed to evaluate consumer perceptions of medication management services, financial burden, and overall satisfaction with community pharmacy services

Methodology: A descriptive cross-sectional study was conducted over three months among 200 community pharmacy consumers. Adults who had visited the selected outlets during the past six months were recruited by convenience sampling. Validated, structured questionnaire covering socio-demographic characteristics, pharmacy utilization, consumer perceptions, satisfaction, and financial aspects. Data analysis was performed using SPSS, applying descriptive statistics, chi-square tests, one-way ANOVA, Pearson correlation, and multiple linear regression, with statistical significance set at $p < 0.05$.

Results & Discussion: Among the 200 respondents, 68.5% were female, with the majority belonging to young and middle-aged age groups. Prescription medicines constituted the most frequently purchased products (35.5%), while pharmacy visits were predominantly occasional (47.0%) or monthly (37.0%). Incomplete dispensing of prescribed medicines was reported by 39.3% of participants. Most respondents (90.5%) relied on out-of-pocket payments, with 62.0% reporting monthly pharmacy-related expenditures of Rs. 1,000–5,000. Satisfaction was relatively high with respect to interpersonal aspects of service, including dignity, respect, and equitable treatment; however, comparatively lower perceptions were observed regarding medication counselling and information provision, with more than half of respondents reporting neutral perceptions of advice on drug interactions, adverse effects, and medication storage. Overall satisfaction with community pharmacy services was moderate. Payment modality, frequency of pharmacy visits, and waiting time were significantly associated with satisfaction ($p < 0.05$), while payment modality and waiting time emerged as significant predictors of overall satisfaction

Conclusion: Although community pharmacy services were generally perceived positively, notable gaps were identified in medication counselling, medicine availability, and affordability, highlighting the need for targeted interventions.

Keywords: Consumer Perception, Financial Burden, Medication Management, Patient Satisfaction



Comparative Viral Protein–Host Interaction Analysis of Chikungunya Virus Isolated from *Aedes* Mosquitoes: Insights into Arthritis-Associated Pathways

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Introduction: CHIKV is a mosquito-borne RNA virus that frequently causes chronic arthritis. Although clinical manifestations are well described, strain-specific genomic determinants underlying persistent joint inflammation remain poorly understood.

Objectives: To identify genomic variations among mosquito-derived CHIKV strains and determine host interaction pathways associated with chronic inflammatory arthritis.

Methodology: Complete genomes were retrieved from NCBI GenBank and ViPR. Sequence alignment was performed using MAFFT, followed by mutation analysis using Geneious. Functional impacts were predicted using SIFT and PROVEAN. Host–pathogen interaction networks were generated using STRING–Viruses, VirHostNet and HPIDB and analysed in Cytoscape. KEGG and Reactome databases were used for pathway enrichment.

Results & Discussion: Comparative analysis detected 131 amino acid substitutions, predominantly in non-structural proteins. Brazilian and Madagascan strains exhibited the highest mutation burden. Deleterious mutations in nsP2 and nsP3 may influence immune evasion and viral replication. Host interactome analysis identified TNF, IL6, IL1B, STAT1, STAT3, NFKB1 and MAPK14 as central inflammatory hubs. Significant enrichment of the MAPK, NF-κB, and JAK–STAT pathways support their roles in chronic chikungunya arthritis and distinguishes CHIKV pathogenesis from that of dengue virus.

Conclusion: Mosquito-derived CHIKV strains exhibit strain-specific genomic variations associated with inflammatory signalling. The identified mutations and host pathways provide promising targets for future therapeutic intervention and experimental validation.

Key Words: CHIKV, Chronic arthritis, Comparative genomics, Dengue Virus, Host–pathogen interactions



Evaluation of the Nationwide Adverse Drug Reaction Reporting Database and Knowledge, Attitudes, and Practices of State Pharmacists Regarding ADR Reporting in Sri Lanka

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Introduction: Adverse drug reactions (ADRs) are a major cause of patient morbidity and increased healthcare costs worldwide. Pharmacovigilance systems are essential for detecting and preventing medicine-related harm. In Sri Lanka, the National Medicines Regulatory Authority (NMRA) maintains the national ADR reporting system; however, underreporting and incomplete reports remain significant challenges. State pharmacists play a key role in ADR reporting, yet their contribution has not been comprehensively evaluated.

Objectives: To evaluate ADR reports submitted to the NMRA between 2020 and 2025, assess the knowledge, attitudes, and practices (KAP) of government pharmacists regarding ADR reporting, and identify barriers affecting reporting practices.

Methodology: A mixed-method study included retrospective analysis of Individual Case Safety Reports (ICSRs) in the NMRA VigiFlow database and a nationwide online cross-sectional survey among state pharmacists. ADRs were assessed using WHO–UMC causality criteria, Brighton Collaboration criteria for anaphylaxis, and the Anatomical Therapeutic Chemical classification system. Data were analysed using descriptive statistics, chi-square tests, and Pearson correlation.

Results & Discussion: A total of 1,232 ICSRs were analysed. Anaphylaxis accounted for 64.2% of reports, while 73.6% were classified as probable/likely according to WHO–UMC criteria. However, only 40.1% of anaphylaxis reports achieved Brighton Level 1 diagnostic certainty, indicating incomplete documentation. Systemic anti-infectives, particularly β -lactam antibiotics and cephalosporins, were the most frequently implicated medicines. Among 308 pharmacists, 69.5% demonstrated moderate knowledge. Knowledge was significantly associated with ADR reporting practice ($\chi^2 = 17.238, p = 0.001$), while knowledge and attitude showed a weak positive correlation ($r = 0.112, p = 0.049$). Major barriers included lack of time, limited feedback, inadequate clinical information, and perception that ADR reporting was not an assigned responsibility.

Conclusion: State pharmacists demonstrated moderate knowledge and positive attitudes towards ADR reporting; however, institutional barriers and incomplete documentation limit effective pharmacovigilance. Strengthening training, simplifying reporting systems, and improving feedback mechanisms could enhance ADR reporting quality and medicine safety surveillance in Sri Lanka.

Keywords: Adverse drug reaction, Anaphylaxis, Knowledge, Pharmacovigilance, Sri Lanka



A Smart, Unique Device Identification Platform to Enhance Traceability of Medical Devices for Recall and Field Safety Actions in Sri Lanka's Surgical Device Sector

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Introduction: Sri Lanka imports approximately LKR 8–12 billion worth of medical equipment annually. However, there is no national digital system in place to identify, trace, or recall those imported products, especially high-risk medical devices.

Objective: To enhance the traceability of imported surgical devices, facilitate prompt Field Safety Actions (FSAs), and bolster post-market surveillance in Sri Lanka's surgical device industry, this project suggests developing a Smart Unique Device Identification (UDI) Platform.

Methodology: A mixed-methods exploratory strategy was used, with primary data from 235 stakeholders, including NMRA semi-structured interviews and structured surveys with authorities, hospital procurement staff, importers, customs officers, and healthcare professionals. Additionally, secondary data from device import databases from different countries and five years of NMRA FSA records (2019–2024) were examined. The U.S. FDA GUDID, the EU EUDAMED, Singapore's HSA, India's CDSCO, and Japan's PMDA were the five international UDI systems against which the results were compared.

Results & Discussion: The results highlight a clear disconnect between regulatory intent and operational reality in Sri Lanka's surgical device sector. The findings showed clear gaps in current practice. Seventy-six percent of clinical staff could not access lot or serial number details for devices already implanted in patients, and 87% of biomedical engineers had never received a direct FSA notification from the NMRA. Among 47 FSAs reviewed, 81% were sent only by letter or email, with no standard identifier connecting the alert to the actual device in use. The proposed platform includes four modules: device registration, mobile label scanning, real-time inventory tracking, and automated FSA alerts, supported by a blockchain audit layer for high-risk implants.

Conclusion: A Smart UDI Platform, built around international UDI principles and adapted to local regulatory and clinical realities, offers a practical pathway towards stronger post-market surveillance and faster Field Safety Actions.

Keywords: Block-chain, Field safety, Post-Market Surveillance, Traceability, Unique Device Identification



Data-Driven Insights into Cosmetic Product Registrations: Trends and Risk Profiling from Sri Lanka

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Introduction: The global cosmetic industry has rapidly expanded, highlighting the need for effective regulatory oversight. In Sri Lanka, cosmetic products are regulated by the National Medicines Regulatory Authority (NMRA). Understanding cosmetic product registration trends and identifying risk-based insights is important for strengthening regulatory decision-making.

Objectives: To evaluate temporal trends and identify risk-based insights in cosmetic product registrations at the NMRA from 2022 to 2025.

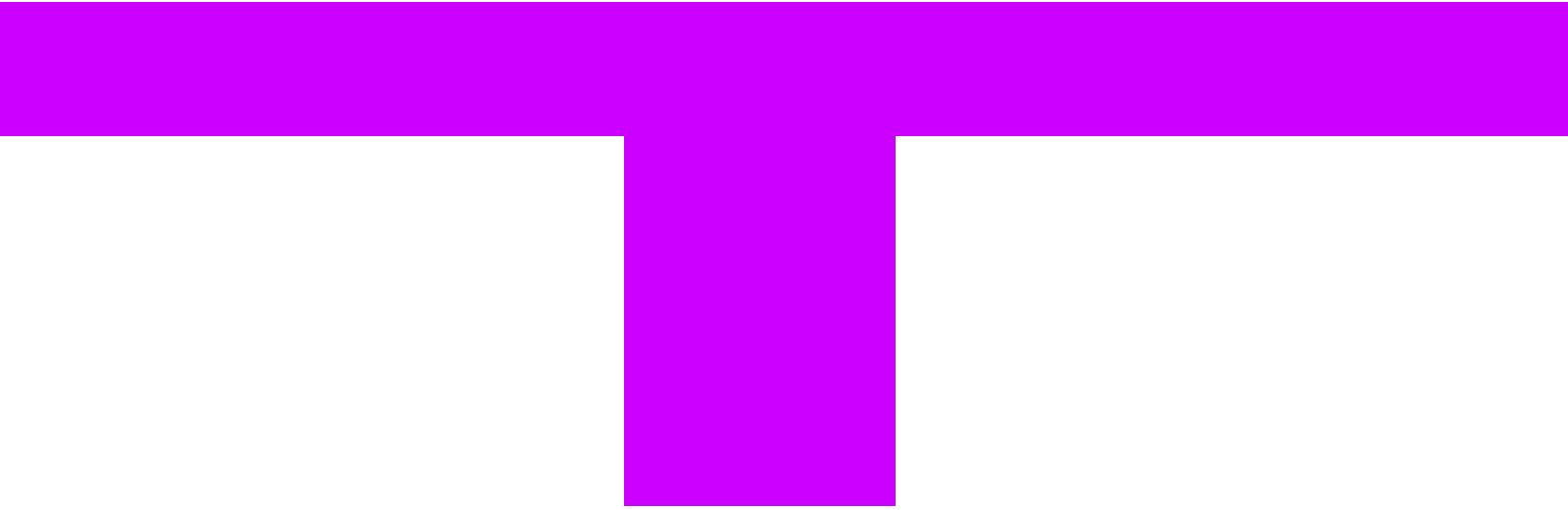
Methodology: A retrospective descriptive study was conducted using secondary data on cosmetic product registrations at the NMRA (2022-2025). Key variables included product category, brand, importer, country of origin, registration type, rejected product categories and reasons for rejection. Inclusion criteria included cosmetic products registered and rejected during the study period. Exclusion criteria included duplicate entries, records with missing variables, and products not classified under cosmetics.

Results & Discussion: The dataset comprised 13,600 registered cosmetic products representing more than 500 brands, indicating substantial market diversity. Fragrance products formed a significant share of registrations (23.9%), followed by skincare (20.2%) and makeup (16.3%) products. By country of origin, India accounted for the largest proportion of registrations (18.9%), followed by Sri Lanka (17.4%) and France (11.2%). More than 200 importers sourced from over 70 countries, reflecting a globalized supply chain in Sri Lanka. Most registered products originated from international manufacturers, indicating a strong dependence on imported cosmetic goods. Among the 175 rejected products, skincare (41.95%) and haircare (14.37%) products accounted for the largest proportions. The most frequently reported reason for rejection was the presence of prohibited ingredients (35.8%), followed by non-compliance with Good Manufacturing Practices (15.9%). Approximately 77% of registered cosmetic products were granted provisional approval by NMRA.

Conclusion: The findings provide evidence to support the NMRA to optimize regulatory prioritization across different product categories.

Keywords: Cosmetics registration, Cosmetics regulation, NMRA, Risk-based, Sri Lanka





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AI-Based Multilingual Call Volume Prediction and Agent Allocation System

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Introduction: In multilingual markets such as Sri Lanka, a shift with the correct headcount but the wrong language mix still misroutes calls. Classical forecasting methods (Holt-Winters, ARIMA/SARIMA) struggle to absorb drivers such as language or campaign type, while published work has largely focused on aggregate volume. This paper addresses that gap.

Objectives: The objectives were to: (i) generate language-disaggregated call volume forecasts for Sinhala, Tamil, and English using Random Forest regression with prediction intervals; (ii) build an agent allocation engine converting these forecasts into per-language headcount recommendations; and (iii) benchmark the models against historical-mean and SARIMA baselines.

Methodology: The system comprises a Flask backend, a React frontend, and a PostgreSQL database supporting cross-company deployment. In the absence of a labelled Sri Lankan dataset, evaluation used a synthetic dataset matching properties reported in the call-centre literature. Three Random Forest regressors were trained independently per language on an eight-feature vector, tuned via five-fold GridSearchCV. Tree-level spread produced 90% prediction intervals. A temporal 80/20 split benchmarked Random Forest against a historical-mean baseline and a fitted SARIMA model, and a cost module estimated staffing impacts.

Results & Discussion: Random Forest achieved MAE = 13.37, RMSE = 22.60, and $R^2 = 0.919$, exceeding the historical-mean baseline ($R^2 = 0.124$) and SARIMA ($R^2 = 0.710$). Per-language R^2 ranged from 0.901 to 0.934, with 90% prediction intervals achieving 88.4% empirical coverage. The cost module projected staffing savings of 18–25%, though as a simulation-based estimate from synthetic data, this should be read as indicative pending validation.

Conclusion: This paper presents a language-disaggregated call volume forecasting system paired with a skill-based agent allocation engine for multilingual call centres. The approach substantially outperformed both baselines, with a caveated 18–25% cost saving. The main limitation is reliance on synthetic data; validation on real operational data is the priority.

Keywords: Call volume forecasting, Language-skill-based agent allocation, Random Forest



Preservation of Human Information Using AI Technology

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Introduction: Artificial Intelligence (AI) offers many benefits but also raises privacy concerns. This research proposes a personal AI agent that protects sensitive data, detects unauthorized changes, and enhances privacy, security, and user trust.

Objectives: The main objectives of this topic are to develop an AI system that prioritizes privacy. This can be used as a personalized data wallet using centralized agents across the system.

Methodology: The system uses a user-centered approach to develop a personal AI agent that protects sensitive data by preventing unauthorized access, data leaks, and misuse while ensuring secure AI interactions.

Results & Discussion: The discussion emphasizes the need for a secure and intelligent framework that protects users' personal data while enabling safe interaction between humans and Artificial Intelligence systems. The proposed approach introduces a personal AI agent that acts as a trusted digital guardian, continuously monitoring sensitive information, detecting unauthorized changes, and preventing misuse of data across multiple AI platforms. It prioritizes user privacy, data integrity, and stronger individual control over personal information. It also extends protection to organizations by safeguarding confidential data against unauthorized access, identity theft, data breaches, and other cyber threats, reducing financial and reputational risks. Additionally, it highlights standardized security protocols that verify authenticity of personal data before processing, improving transparency, accountability, and trust in AI systems, and supporting a secure, privacy-focused, human-centered AI ecosystem for individuals and organizations. Overall, the framework strengthens responsible AI adoption and enhances long-term digital safety for all users across global digital environments worldwide.

Conclusion: Artificial Intelligence is a powerful technology designed to benefit humanity by reducing privacy risks, protecting personal data and human life, and ensuring a safe, secure environment for trustworthy interaction with AI.

Keywords: Artificial Intelligence (AI), Human Information, Preservation



Fishing Boat Operations Management and AI-Based Maintenance Prediction System

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Introduction: Small-scale fishing companies often use manual records for boat details, trips, crew, expenses, payments, catch records, and maintenance history. This can cause delays, incomplete records, and weak decisions. This study presents a web-based Fishing Boat Operations Management and AI-Based Maintenance Prediction System that combines operations management and maintenance support in one platform.

Objectives: This study aimed to develop a role-based web system managing fishing boat operations and integrating an AI component to predict vessel maintenance needs from historical engines and condition data.

Methodology: Development followed an iterative process comprising requirements analysis, system design, implementation, testing, and integration. The web platform was built using Laravel, Livewire, MySQL, and Tailwind CSS, while TensorFlow and Keras were used for the maintenance prediction component. A dataset of 2,300 historical boat and engine records was cleaned and feature-engineered into 42 input variables. The resulting MaintenanceNet model is a Deep Neural Network with four dense hidden layers (256, 128, 64, and 32 neurons), incorporating batch normalization, dropout regularization, and a sigmoid output layer for binary maintenance prediction.

Results & Discussion: The model achieved an accuracy of 83.19% and a ROC-AUC score of 0.5939, demonstrating practical feasibility for the target use case. The completed system provides a centralized digital platform for small-scale fishing operations, with AI-driven maintenance support integrated directly into the Boat Account interface.

Conclusion: The platform supports small fishing companies in improving records and maintenance decisions, with Future work can focus on improving the dataset, enhancing model performance, increasing usability, expanding mobile accessibility, and integrating real-time sensor data.

Keywords: Deep Neural Network, Fishing boat operations, Machine learning, Predictive maintenance, Web-based system



Automatic Emotion Recognition and Colour Preference Analysis from Children's Drawings Using Deep Learning

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Introduction: Children's drawings provide non-verbal clues to their emotional and psychological states, yet conventional interpretation depends on subjective, expert-driven analysis that is hard to scale, motivating objective automated tools for psychologists, educators, and art therapists.

Objectives: This study develops an automatic framework to recognize children's emotions and analyze colour preferences from their drawings using image processing and deep learning, deployed as a real-time application for educational and art-therapy use.

Methodology: Over 600 drawings were annotated by child psychologists into four balanced classes; happy, sad, angry, and fear. After preprocessing and augmentation, data were split 92%/8% using FastAI's RandomSplitter, and a DenseNet201 CNN was trained with FastAI. A React, TypeScript, and FastAPI web application enabled Realtime uploads, emotion prediction, and colour visualization.

Results & Discussion: The model reached 0.72 accuracy, with F1-scores of 1.000 (happy), 0.833 (angry and sad), and 0.692 (fear). Clearly expressed emotions were easiest to classify, whereas fear overlapped visually with other negative emotions, indicating a need for richer data. These results confirm the objective was substantially met, while the colour-preference visualization and functional web application demonstrated effective real-time performance for practitioners.

Conclusion: The framework confirms deep learning's applicability for AI-assisted emotional analysis in education and art therapy. Limitations include a modest dataset and lower accuracy for fear; future work should enlarge and balance the dataset, add explainability, and validate with practitioners to benefit academia and society.

Keywords: Art therapy, Children's drawings, Colour preferences, Deep Learning, Emotion recognition.



BaggageLensAI-Powered Luggage Identification System for Passengers

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Introduction: Mishandled baggage remains a major challenge for the aviation industry. SITA's 2019 Baggage IT Insights report recorded 24.8 million mishandled bags among 4.3 billion passengers in 2018, costing airlines approximately \$2.4 billion annually. Existing barcode and RFID-based systems remain vulnerable to damaged tags, scanning failures, network issues, and high infrastructure costs. Despite advances in baggage handling, no production-ready solution supports instance-level luggage reidentification without additional infrastructure. BaggageLens addresses this gap through a vision-only deep learning approach for faster and more reliable luggage recovery.

Objectives: This research aims to develop a tag-independent luggage identification system that enables passengers to upload images and track recovery status, build an AI-driven Siamese Neural Network to identify luggage under significant appearance variations, and integrate flight itinerary validation to improve matching reliability.

Methodology: BaggageLens adopts a microservices-based architecture consisting of AI model services, auxiliary embedding services, and a backend API for similarity search and database management. The system combines a triplet-loss convolutional model, object detection, attribute extraction and a vision-language model to generate robust luggage representations. A Siamese network computes cosine similarity between query and gallery images, while a flight verification module validates candidate matches using passenger itinerary information.

Results & Discussion: Evaluation on a multi-view baggage dataset demonstrates that the proposed ensemble outperforms single-model baselines in exact-match accuracy and top-k retrieval. The system remains reliable under variations in lighting, viewpoint, and occlusion. Its vision-only design eliminates dependence on RFID infrastructure, enabling cost-effective deployment, while flight verification reduces false positives and improves the reliability of lost-and-found operations.

Conclusion: BaggageLens demonstrates the effectiveness of vision-only luggage identification for airports, providing an accurate, low-cost, and practical solution for baggage recovery. Future work will focus on multi-camera tracking and integration with airline systems.

Keywords: Deep learning, Lost baggage, Luggage identification, Siamese networks, Vision-language models



EduGuide: Personalized Career Path and Academic Progress Analyzer for Secondary School Students using Artificial Intelligence

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Introduction: Traditional career guidance in Sri Lanka faces an 11% dropout rate after Grade 9 due to obsolete standardized tests. EduGuide bridges academic performance and career readiness for secondary students aged 14 to 18 using a bi-directional feedback mechanism across three engines: Academic Analytics, Adaptive Improvement, and Hybrid Recommendations.

Objectives: The project aims to develop OCR/NLP algorithms for mark sheet analysis, generate personalized study strategies, align academic achievements with professional requirements, and validate system impact through a quasi-experimental pilot study while adhering to ethical AI (Explainable AI/IBM AI Fairness 360) and data protection standards (GDPR/PDPA).

Methodology: Developed using Agile SDLC (Nov 2025 - April 2026), the system ingests student mark sheets via a Flask-based platform using Tesseract OCR and spaCy NLP. TensorFlow and Scikit-Learn perform regression analysis to feed a hybrid recommendation engine (60% content-based, 20% collaborative, 20% interest-based). The stack includes MongoDB and AWS, secured with AES-256 encryption. A pilot study was conducted with 68 participants from 2025-06-01 to 2025-09-30 and evaluated using Pytest and ANOVA.

Results & Discussion: EduGuide resolves limitations found across 11 existing systems. Pilot study results with 68 students demonstrated a 12% improvement in academic performance, an 18% increase in student motivation ($p = 0.015$), and a 22% reduction in career compatibility disparities ($p = 0.012$). Low-bandwidth, bilingual (Sinhala/Tamil) mobile-friendly design ensures accessibility for rural areas.

Conclusion: EduGuide presents a proactive, performance-grounded framework for educational advising. Future development targets native iOS/Android applications with offline capability, parent/teacher dashboards, and LMS integration (Moodle and Google Classroom).

Keywords: Academic analytics, Career recommendation, Machine learning, Natural language processing, Optical character recognition



Emotion-Adaptive Focus Mode Browser Extension: A Privacy-Preserving Client-Side Affective Computing System for Enhancing User Productivity and Digital Wellbeing

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Introduction: Digital burnout among knowledge workers and university students is an emerging problem in response to ubiquitous engagement-first designs prevalent in the attention economy, leveraging cognitive limitations and exacerbating technostress. Current mitigation approaches such as generic, context-insensitive blocking applications or cloud-based emotion recognition solutions suffer from significant shortcomings.

Objectives: To fill the research gap, this paper introduces the design and implementation of an Emotion-Adaptive Focus Mode Browser Extension. The creation of a web browser plug-in for real-time multi-modal emotion recognition, without sending the data to cloud, involves the development of a closed-loop interface and privacy-by-design compliance with the EU AI Act and PDPA 2022.

Methodology: The iterative approach utilized Chrome Manifest V3, the TensorFlow.js Offscreen API, and Content Scripts. Facial expressions (MobileNetV2 fine-tuned on the FER2013) and Mouse Tracking metrics (velocity/jitter) are combined into one metric, with weighting factors of facial expression: 0.7 and behavioral metrics: 0.3. Data collection involved a questionnaire ($N \geq 50$), a pilot study to set thresholds ($N = 15$), and User Acceptance Testing ($N = 30$).

Results & Discussion: Based on detected emotions, e.g. stress, confusion, and distraction, the system automatically deploys one of four CSS/HTML DOM interface overlays: Sky Lounge for relaxation effects, Sky Bar for productivity boosting, Concierge for help desk functionality, and Auto-Focus for avoiding distractions. Face emotion recognition accuracy of 63.96% (Precision: 0.67, Recall: 0.58, F1-score: 0.58). TensorFlow.js achieves frame latency of less than 50ms; duty-cycling keeps CPU utilization under 15%. The entire model is built using ephemeral biometric computations in RAM to ensure data minimization.

Conclusion: This is a strong baseline for real-time, lightweight browser inference. This browser-native, privacy-by-design interface advances affective computing, providing a robust, regulatory-compliant solution to mitigate digital burnout effectively.

Keywords: Affective computing, Browser extension, Digital wellbeing, Emotion recognition, Privacy-by-design



TinyML-Based Edge AI System for Elephant Intrusion Detection and Fence Monitoring in Rural Sri Lanka

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Introduction: Human-Elephant Conflict (HEC) in Sri Lanka causes over 155 human and 348 elephant deaths annually. Existing detection systems rely on cloud connectivity, GPS collaring, or high-computation hardware, limiting deployment in remote areas, while electric fences, the primary intervention, lack automated damage monitoring. TinyML enables on-device inference without cloud dependency, yet no study has combined TinyML and elephant detection into a deployable edge AI system for HEC.

Objectives: This study aims to design, develop, and field-validate a TinyML edge AI system for elephant intrusion detection and fence integrity monitoring. Objectives are to develop multi-modal TinyML classifiers achieving at least 90% accuracy on microcontroller hardware, implement a fence health monitoring module, integrate multi-modal decision fusion to reduce false alarms and validate the system through field trials.

Methodology: Following a Design Science Research approach, acoustic data will be collected under Wildlife Conservation permits, supplemented by open datasets, and seismic data recorded via SM-24 geophones. Models will be trained in TensorFlow/PyTorch, quantized to 8-bit, pruned, and deployed via TFLite Micro on an Arduino Nano 33 BLE Sense, fused with an ACS712 fence-monitoring module; nodes will communicate via LoRa to a solar-powered Raspberry Pi 4 gateway.

Results & Discussion: This work is at the design/pre-implementation stage; the architecture, sensor selection, and fusion approach are finalized, and dataset acquisition is in progress. Next steps are model training, bench-level validation of the fence monitoring circuit, on-device quantization, and field trials. The unified, offline, multimodal design is expected to outperform existing single-modality or cloud-dependent HEC systems in accuracy and deployability.

Conclusion: This study addresses key gaps in HEC mitigation: the absence of a TinyML pipeline, automated fence monitoring, cloud independence, and unified multimodal fusion. If field results confirm the design targets, the system could reduce human and elephant casualties and offer a replicable solution for Asian elephant range countries.

Keywords: Edge AI, Elephant intrusion detection, Fence monitoring, Human-Elephant conflict, TinyML



AI-Enhanced Repair Cost Estimation and Real-Time Defect Detection in Underwater Welding using Audio-Visual Sensors

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Introduction: Underwater welding is essential for maintaining offshore structures and marine vessels. However, poor visibility and hazardous working conditions make manual defect inspection unreliable. Current practices rely on post-weld inspections, delaying maintenance decisions and increasing repair costs. Moreover, defect detection and repair cost estimation are typically performed as separate processes.

Objectives: To develop an AI-based framework that detects underwater welding defects in real time using audio-visual sensor fusion and simultaneously estimate repair costs based on defect type and severity.

Methodology: The proposed framework combines underwater camera footage and hydrophone acoustic signals. A CNN is used to identify visual welding defects, while an RNN analyses temporal acoustic patterns associated with defects. Features from both models are fused for accurate classification. A regression model then predicts repair costs using historical repair records and detects defect severity.

Results & Discussion: As this research is currently at the proposal stage, experimental results are not yet available. The proposed multimodal approach is expected to achieve higher defect detection accuracy than single-modality methods while providing repair cost estimates comparable to professional quotations. This integrated framework is anticipated to improve maintenance planning by enabling real-time decision-making and reducing delays associated with post-inspection workflows.

Conclusion: The proposed AI framework integrates defect detection and repair cost estimation into a single real-time system. Following implementation and validation, it has the potential to improve maintenance efficiency, reduce downtime, and support informed decision-making in offshore and maritime industries.

Keywords: Artificial Intelligence, Audio-visual sensor fusion, Repair cost estimation, Underwater welding



AI-Based Spam Detection in Website Inquiry Forms

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Introduction: Website inquiry forms are frequently targeted by spammers deploying promotional content, phishing links, and bot-generated messages. Unlike email spam, these messages are typically short, informal, and lack metadata, rendering traditional feature engineering-based spam filters ineffective.

Objectives: This study aims to develop a specialized deep learning model, specifically a Bidirectional Long Short-Term Memory (Bi-LSTM) system, to achieve reliable spam classification on short, metadata-free website inquiry form messages.

Methodology: A custom dataset of over 10,000 labelled inquiry form messages was compiled and preprocessed. After cleaning, tokenizing, and padding sequences to 25 tokens with an 814-word vocabulary, the final dataset comprised 9,999 records. The Bi-LSTM model, featuring multiple dropout layers, was trained using Binary CrossEntropy loss and the Adam optimizer with class weights. Performance was evaluated using rigorous 5-fold cross-validation.

Results & Discussion: The Bi-LSTM model achieved an average accuracy of 98.83%, with a macro F1-score of 98.80% and a weighted F1-score of 98.83% across all five folds. Crucially, out of 1,134 legitimate messages, the model recorded only a single false positive, resulting in a near-zero false positive rate of 0.09%. These results demonstrate that the proposed Bi-LSTM model effectively classifies short website inquiry messages with minimal false positives.

Conclusion: The proposed model offers a practical, scalable, and deployable solution for automated spam filtering in web-based communication systems. While current limitations involve ongoing deployment, future work will focus on completing a Flaskbased web application, expanding the dataset to improve recall, and exploring lightweight transformer models like Distil-BERT to benefit the web security community further.

Keywords: Bidirectional long short-term memory, Natural language processing, Spam detection, Text classification, Website inquiry forms



University Student's Stress Detection and Reduction through a Personalized Mindfulness Mobile Application: Development and Evaluation

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Introduction: University students frequently experience stress due to academic, financial, social, and personal challenges that negatively affect their mental well-being and academic performance. Although existing counseling services and digital mental health applications provide general support, they often lack personalized stress detection and tailored mindfulness interventions. This study addresses this gap by developing a personalized mindfulness mobile application that offers individualized stress management support.

Objectives: To develop and evaluate a personalized mindfulness mobile application for detecting and reducing stress among university students through personalized mindfulness interventions.

Methodology: A user-centered design approach was adopted with continuous feedback from university students and mental health professionals throughout the development process. The study involved 120 university students aged 18–30 from various academic disciplines. The application was evaluated over eight weeks using the Perceived Stress Scale (PSS) and user interviews.

Results & Discussion: The findings showed a significant reduction in perceived stress among students who are consistently engaged with the personalized mindfulness activities. Participants reported improved emotional regulation, greater self-awareness, and enhanced coping strategies for managing academic and personal stress. Positive feedback indicated that the personalized recommendations effectively addressed individual stress levels, demonstrating that the application successfully achieved its objectives and supported students' overall psychological well-being.

Conclusion: The developed application demonstrated strong potential for improving stress management and promoting mental well-being among university students. Future research should include larger and more diverse populations and integrate physiological indicators, such as heart rate or wearable sensor data, to further improve stress detection accuracy and enhance personalized intervention strategies.

Keywords: Mindfulness, Mobile application, Stress detection, Student stress



Enhancing Kindergarten Environment Using Emotion Detection of Young Children

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Introduction: Early childhood is a critical stage for emotional and social development, and kindergarten environments strongly influence children's learning experiences. Traditional methods of identifying children's emotions mainly rely on teacher observations, which may be subjective and inconsistent. The study presents a deep learning-based facial emotion recognition system for children aged 5-7 years to improve kindergarten learning environments.

Objectives: This study aims to develop a facial emotion recognition model for children aged 5–7 years, evaluate the model using computational and real-world validation, and identify the relationship between classroom stimuli and emotional responses.

Methodology: A custom dataset of 1384 labeled facial images representing four emotions; happy, sad, angry and fear was collected and preprocessed. The dataset was divided into 80% training and 20% validation sets. The proposed system used HaarCascade classifiers for face detection and a ResNet50 based CNN for emotion classification.

Results & Discussion: The model achieved 67.4% validation accuracy after 100 epochs. Real-world validation with kindergarten children using flashcard stimuli demonstrated clear relationships between environmental triggers and emotional responses.

Conclusion: Positive visual and social stimuli produced happiness, while negative situations triggered sadness, anger, and fear. The findings highlighted the potential of emotion aware technologies to support emotionally responsive kindergarten environments.

Keywords: Convolutional neural networks, Deep Learning, Emotion detection, Facial recognition, Kindergarten environment



Risk Management in Agile Projects: An Explainable AI for Sprint-Level Root Cause Risk Analysis

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Introduction: Despite the widespread adoption of modern software project management tools (e.g., Jira, Azure DevOps) alongside intelligent automation, Agile teams continue to struggle with early risk detection and mitigation. Empirical research indicates that over 55% of project risks remain undetected until they negatively impact delivery outcomes. Existing tools predominantly rely on static, manually maintained risk logs, lacking the ability to learn from historical sprint dynamics, prioritize risks dynamically, or provide interpretable insights to support managerial decision-making. **Objectives:** To address these limitations, this study presents and validates an Explainable AI (XAI)-based framework for sprint-level risk identification and prioritization using SHapley Additive exPlanations (SHAP).

Methodology: The proposed methodology evaluates 21 technical, process, and team-related risk features extracted from the TAWOS dataset across four machine learning classifiers: Logistic Regression, Support Vector Machine, Random Forest, and XGBoost.

Results & Discussion: XGBoost achieved superior predictive performance with an AUC-ROC of 0.9451, an accuracy of 86.27%, and an F1-score of 0.8246. SHAP feature attribution revealed that total status churn, title change count, and story point change count were the primary drivers of sprint-level risk, capturing workflow instability, requirement volatility, and estimation uncertainty, respectively.

Conclusion: The proposed framework enhances Agile risk management by combining predictive analytics with explainable AI. Future work will focus on validating the framework in industrial environments and extending it with prescriptive recommendation capabilities.

Keywords: Agile risk management, Explainable AI, Machine learning, SHAP, Sprintlevel prediction,



Mood Mate: A Multimodal System for Detecting User Emotional States for Personalized Content Delivery

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Introduction: The modern remote working and digital learning landscape creates significant psychological stress, but current productivity tools track tasks and not psychological well-being. Moreover, traditional recommendation systems are based on historical preferences and do not consider current change in emotions. So, Mood Mate has developed a multimodal emotion recognition approach combining visual, vocal, and behavioral cues for adaptive real-time personalized content.

Objectives: The main goals are to create a multimodal system that integrates facial, voice, typing, posture, and gesture information, test the accuracy of multimodal system compared to the accuracy of unimodal systems, and provide real-time personalized content delivery.

Methodology: Webcam, microphone, and keyboard data are collected simultaneously. Facial and posture images are processed and then classified with Convolutional Neural Networks (CNNs); the acoustic features (MFCCs, pitch) and keystroke dynamics (KD) are classified with Support Vector Machines (SVM) and Random Forest models. To tackle the problem of multimodal fusion for the prediction of discrete emotional states, two types of multimodal fusion strategies are compared: early and late.

Results & Discussion: Multimodal integration was more effective than unimodal methods in eliminating environmental noise and speech degradation and in giving realtime predictions. The system performed well in recognizing the emotions of Happiness (F1: 0.91), Anger (F1: 0.88), and moderately in Sadness (F1: 0.84), Surprise (F1: 0.81). Fear (F1: 0.76), Neutral (F1: 0.72) were the lowest classification accuracy results. It is shown that results obtained with multimodal fusion are valid, demonstrating that fusion of the two modalities improves overall accuracy and robustness in the delivery of dynamic content.

Conclusion: Combining different modalities enhances the reliability of emotion detection in digital environments. Future work includes integrating physiological sensors, adding more data to the database, and tuning the latency of the model for wider use in the fields of e-learning and mental health monitoring.

Keywords: Emotion detection, Human-computer interaction, Machine learning, Multimodal systems, Personalized recommendation



FlakyTestPrioritizer: An ML-Based System for Predicting and Prioritizing Order-Dependent Flaky Tests in Node.js CI/CD Pipelines

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Introduction: Flaky tests are tests that produce both passing and failing results without any code modifications. This poses a significant challenge to the reliability of CI/CD pipelines. Order-Dependent (OD) flaky tests are particularly common in Node.js and Jest, often caused by shared states, unclosed network sockets, or incomplete database teardown operations. Existing dynamic analysis tools provide high accuracy but are computationally expensive and time-consuming.

Objectives: This study aims to develop “FlakyTestPrioritizer”, a machine learning-based static analysis approach using a custom Abstract Syntax Tree (AST) feature extractor to predict and prioritize order-dependent flaky tests prior to execution.

Methodology: The study used 390 labeled test samples obtained from the JS-TOD replication package, with ground truth labels for OD flaky tests generated using dynamic dependency detection. Initial experiments at the file level produced a recall of 84.62%, limited mainly by “signal dilution” caused by the predominance of features from safe tests. To address this, a new test-level AST parser using Babel’s scoped inner traversal enabled the extraction of 38 fine-grained features from every test block. The XGBoost classifier was then trained using the extracted features with an emphasis on recall to minimize the negative impact of potential false negatives associated with missed flaky tests.

Results & Discussion: Following domain-specific threshold calibration, the model achieved a recall of 92.31% while maintaining an accuracy of 87.18%. These results show that the proposed test-level AST feature extraction and threshold calibration approach is effective for detecting order-dependent flaky tests.

Conclusion: The trained engine was integrated into a customized Jest sequencer and hosted on GitHub Actions using Docker containers to support CI/CD pipelines. The system provides a dashboard that visualizes actionable results for developers, displaying prioritized test execution orders together with the corresponding machine learning confidence scores.

Keywords: Abstract syntax tree, CI/CD pipelines, Flaky tests, Machine learning



Self-Powered AI Wearables for Offline Emergency Diagnosis and Prioritize in Low-Resource Areas

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Introduction: Emergency care delays cause preventable deaths, especially in lowresource areas lacking connectivity and infrastructure. In low- and middle-income countries, time-sensitive acute illnesses and injuries account for approximately half of the total disease burden. While current AI healthcare solutions offer continuous monitoring potential, they rely heavily on cloud computing, making them unsuitable for these remote regions. Therefore, this study proposes a self-powered edge AI wearable device to enable offline emergency diagnosis and patient prioritization.

Objectives: The primary objective is to develop a self-powered AI wearable system for offline emergency diagnosis in low-resource areas. Secondary objectives include integrating low-power IoT sensors, deploying lightweight cloud-independent AI models, enabling accessible voice/gesture recognition, and implementing renewable energy harvesting.

Methodology: The conceptual architecture integrates low-power physiological sensors, such as the MAX30102, MLX90614, and MPU6050, to monitor vital signs and motion. Edge-based lightweight AI models, like Random Forest and TensorFlow Lite neural networks, are proposed for emergency detection using public clinical datasets. The system incorporates offline voice and gesture recognition and solar/kinetic energy harvesting for continuous operation.

Results & Discussion: As a conceptual framework, the system is yet to be experimentally validated. The proposed integration of physiological sensing, edge AI, and energy harvesting theoretically enables reliable offline diagnosis. Future evaluations will assess the prototype's accuracy, sensitivity, response time, and energy efficiency using established medical datasets.

Conclusion: The proposed self-powered, AI-enabled wearable addresses critical healthcare gaps in low-resource and disaster-stricken environments. While currently conceptual, this architecture provides a scalable foundation for autonomous emergency healthcare, pending future prototype development and comprehensive clinical validation.

Keywords: Artificial intelligence, Offline emergency diagnosis, Patient prioritization, Voice and gesture recognition



Design and Implementation of a Vehicle Safety System for Hazard Detection

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Introduction: Road traffic accidents continue to pose significant safety challenges, especially during rain, fog, and low-light conditions where camera-based detection systems often experience reduced accuracy. In addition, many existing vehicle safety solutions rely on expensive sensing technologies, limiting their affordability. This research proposes a low-cost radar-based vehicle safety system capable of providing reliable hazard detection under all weather and lighting conditions.

Objectives: This study aims to design, develop, and evaluate a low-cost embedded vehicle safety system for real-time hazard detection under diverse environmental conditions. Objectives are to develop a radar-based forward vehicle and obstacle detection module, implement a lateral bird-strike detection subsystem using Doppler microwave sensing, integrate real-time onboard hazard processing and LED/voice alerts on an ESP32-S3 platform and validate the system through field testing under different weather and lighting conditions.

Methodology: An ESP32-S3 microcontroller integrates an HLK-LD2451 24 GHz mmWave radar for forward detection and RCWL-0516 Doppler microwave sensors for lateral bird detection. Embedded C/C++ firmware processes sensor data and generates real-time LED and audio alerts. The prototype was tested in clear, rainy, foggy and low-light conditions.

Results & Discussion: Experimental evaluation demonstrated that the proposed system achieved 98.2% forward hazard detection accuracy, 96.4% lateral bird detection accuracy, an average response time of 42 ms, and a false alarm rate below 2.1%. The radar-based sensing technology maintained reliable performance under rain, fog, and low-light conditions, where conventional camera-based systems often degrade. Its fully offline architecture minimized communication latency and implementation cost, demonstrating an effective and affordable solution for real-time vehicle hazard detection.

Conclusion: The proposed radar-based vehicle safety system provides a low-cost and reliable solution for real-time hazard detection under all weather and lighting conditions. The system enhances driver safety through accurate hazard detection and rapid alerts. Future work will focus on sensor fusion, hardware optimization, and largescale field validation.

Keywords: Bird strike prevention, Embedded systems, Hazard detection, Radar sensor, Vehicle safety system



Predicting Infant Attrition in Sri Lankan Garment Manufacturing Using Machine Learning

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Introduction: High employee turnover within the first twelve months (infant attrition) heavily disrupts production and inflates recruitment costs in Sri Lanka's labor-intensive garment manufacturing sector. Traditional HR tracking is reactive, and corporate privacy policies restrict access to sensitive financial or behavioural data often required by predictive models.

Objective (s): The primary objective is to architect a machine learning-based "Early Warning System" to predict infant attrition within the Sri Lankan garment manufacturing industry using only accessible, static demographic and logistical variables. The secondary objective is to transition this mathematical model into a practical software engineering artifact. This involves developing a user-friendly web application for HR professionals to conduct both individual and bulk employee risk assessments.

Methodology: Following the CRISP-DM framework, 5,000 historical employee records from Hela Apparel Holdings were pre-processed to remove right-censored survival bias, organically balancing the dataset. After evaluating four classification algorithms, a Random Forest model was selected and optimized via cross-validation to explicitly maximize Recall and avoid the accuracy paradox.

Results & Discussion: The optimized Random Forest model achieved 85.19% accuracy and a 96.15% Recall rate on the unseen test set, successfully identifying over 96% of high-risk employees. Recall was actively prioritized over accuracy to minimize costly false negatives, ensuring HR teams do not miss genuine resignation risks. Demographic analysis revealed that employee location and travel distance are the dominant predictors of early attrition. These capabilities were deployed into a Streamlit web application featuring Role-Based Access Control (RBAC) and Explainable AI (SHAP) overlays to justify individual risk flags transparently.

Conclusion: Localized demographic and commute data contain powerful warning signals for employee retention in developing economies, enabling highly accurate prediction without sensitive compensation records. This research transitions a theoretical data science framework into an accessible, data-driven tool for proactive HR retention management.

Keywords: HR analytics, Infant attrition, Machine learning, Random Forest, Explainable AI



Leveraging Technology to Enhance Mathematical Literacy among Hearing-Impaired Primary Students in Sri Lanka

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Introduction: Mathematical literacy is essential for the cognitive and learning growth of primary-level students. However, in Sri Lanka, hearing-impaired students experience challenges in learning mathematics in the absence of a Sri Lankan Sign Language (SLSL) supported learning environment. Existing studies in Sri Lanka provide limited support for number sign recognition and interactive mathematical learning.

Objectives: This study addresses this gap by developing an interactive SLSL-based mathematical learning platform for recognizing number gestures from 0 to 50.

Methodology: A novel dataset comprising 6,120 video samples (120 per class) across 51 numerical classes was collected from six signers under diverse lighting conditions, hand orientations, and backgrounds. Video preprocessing and frame extraction were performed using OpenCV, while MediaPipe Hands detected 21 hand landmarks, producing 63 spatial landmarks coordinates (x, y, and z) from each valid frame. In addition, 12 statistical descriptors, including the mean, standard deviation, maximum, and minimum of x, y, and z-coordinates, were computed across each gesture sequence, producing a 75-dimensional feature vector for each gesture. A range-based classification strategy divided the numerical classes into five groups (0–9, 10–19, 20–29, 30–39, and 40–50), and Random Forest, Support Vector Machine, K-Nearest Neighbors, and Decision Tree were trained to classify the numbers and evaluated for accuracy, precision, recall and F1 score.

Results & Discussion: The experimental results demonstrated that the Random Forest classifier performed the best overall classification accuracy of 95.29% for numbers 0–9, 94.71% for numbers 10–19, 89.69% for numbers 20–29, 87.78% for numbers 30–39, and 89.82% for numbers 40–50, and was selected for implementation in an interactive web-based learning platform.

Conclusion: The developed platform provides a foundation for interactive mathematics learning using SLSL and demonstrates the feasibility of integrating machine learning and computer vision into inclusive educational technologies.

Keywords: Gesture recognition, Machine learning, Mathematical literacy, Sign language, Sri Lanka



Environmental-Aware Multi-Criteria Personalized Route Recommendation System Using Real-Time Environmental Data

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Introduction: Traditional navigation systems recommend routes based on distance or travel time only, ignoring environmental hazards such as flash floods and poor air quality that endanger vulnerable travelers, including asthma patients, pregnant women, the elderly, and those with cardiovascular disease. This study addresses the lack of integrated, health-aware routing solutions in developing South Asian regions such as Sri Lanka and Bangladesh by developing a multi-criteria personalized route recommendation system.

Objectives: To integrate real-time environmental data with machine learning risk prediction, user health profiling, and a multi-criteria decision-making framework, generating personalized route recommendations that are validated against conventional shortest-path navigation.

Methodology: The system was built as a Node.js web application with a Python-based machine learning pipeline comprising four stages: live data acquisition, ML risk prediction, user health profiling, and weighted multi-criteria scoring. Real-time pollutants, weather, and traffic data were collected via OpenWeatherMap and TomTom APIs at three points per candidate route generated using OpenRouteService. A Random Forest Classifier predicted flood risk, and a Random Forest Regressor predicted AQI; a normalized weighted-additive cost function combining these predictions with health profile multipliers to rank candidate routes.

Results & Discussion: The flood risk classifier achieved 92.35% accuracy (weighted F1: 0.92, recall: 0.72), and the AQI regressor achieved R^2 of 0.8787 (MAE: 11.90), with PM2.5 contributing 80.6% of predictive importance. The scoring framework consistently re-routed users away from hazardous segments, directing respiratory patients toward lower-AQI routes and pregnant or elderly users toward lower-floodrisk routes, outperforming conventional shortest-path navigation in health-relevant outcomes.

Conclusion: Integrating real-time environmental data, machine learning risk prediction, and health profiling produces meaningful, personalized route recommendations beyond simple distance optimization. Future work will focus on clinical validation, Sri Lanka-specific training data, and finer-grained road segmentation for improved flash-flood forecasting.

Keywords: AQI prediction, Flood risk prediction, Machine learning, Multi-Criteria personalized route recommendation



IOT-based Real-Time Landslide Detection and Early Warning System using Sensor Towers and Cloud Integration

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Introduction: Landslides represent one of the most destructive geo-hazards in Sri Lanka, particularly across the central highlands and south-western slopes. The monitoring methods managed by the National Building Research Organization (NBRO) lacks the real-time detection required for immediate community-level early warnings. This project aims to bridge the gap by developing an IoT-based, real-time landslide detection system.

Objectives: To design a real-time IoT monitoring system using multi-parameter sensor towers; to develop a cloud platform for storing, analyzing, and visualizing sensor data; and to generate automated early warnings via a mobile app.

Methodology: The system utilizes a three-layer architecture consisting of the Perception, Network, and Application layers. At the edge, sensor towers powered by ESP32 microcontrollers capture real-time geotechnical data, including angular displacement via MPU6050 sensors and soil moisture saturation levels. This data is transmitted to a cloud backend, where a Machine Learning module-specifically a Random Forest classifier-analyzes the data to assess risk levels that is trained using approximately 1000 records, with an 80% training and 20% testing split.

Results & Discussion: Preliminary implementation demonstrated successful real-time acquisition and transmission of sensor data from ESP32-based sensor towers to the Firebase cloud platform. The AI model, which has about 91% accuracy, has been developed for landslide risk classification, and comprehensive performance. The completed evaluation will determine the effectiveness of the proposed framework for reliable real-time landslide detection.

Conclusion: This project demonstrates that a decentralized IoT approach, combined with cloud intelligence, offers an alternative to conventional geological survey equipment. Future work will focus on integrating ultra-wideband technology for subcentimeter displacement accuracy and implementing edge AI to maintain detection capabilities during network outages.

Keywords: Early warning, ESP32, IoT, Landslide detection, Machine learning



AI-Based Historical Memory Restorer for Early-Stage Alzheimer's Patients

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Introduction: Alzheimer's disease (AD) is a progressive neurodegenerative disorder that impairs memory, cognitive function, and the ability to recognize familiars, affecting patients' emotional well-being while placing a burden on both patients and caregivers. However, a critical gap remains in existing technologies. This study proposes an AI-Based Historical Memory Restorer, that integrates facial recognition, audio-visual memory support to assist early-stage Alzheimer's patients. When a person is in front of the camera, the system recognizes the face, plays a personalized audio reminder, and displays associated memories through a mobile application.

Objectives: To develop and evaluate an AI-based facial recognition system with embedded Raspberry Pi, caregiver mobile support, and personalized audio-visual memory assistance.

Methodology: The face detection module was trained using a Kaggle dataset over 1000 images captured across varied lighting, poses, and expressions. The facial recognition pipeline employed MTCNN for face detection, FaceNet for feature extraction, and SVM for face classification. The prototype follows an offline first architecture, while the caregiver application and system communicated through same Wi-Fi network. Python based backend services, flask API communication was used. System was evaluated through developer-based testing, performance was assessed using recognition accuracy, precision, recall, F1-score, response latency, confidence threshold analysis, and cross-validation.

Results & Discussion: The prototype achieved a 96.5% recognition accuracy, with an average response latency of 1.74 seconds. The caregiver application successfully enabled memory management and audio generation. System operated reliably over the same Wi-Fi network and without internet using local data. Recognition confidence remained above the 0.60 threshold, while unknown persons were rejected. Recognition may vary with poor lighting and angles, while remote enrollment is limited to the same Wi-Fi network.

Conclusion: Future work includes integrating Firebase cloud storage by enabling remote internet-based enrollment, expanding the training dataset and evaluating the system with real patients and caregivers in clinical and care home environments.

Keywords: Alzheimer's disease, Caregiver application, FaceNet, MTCNN, Raspberry Pi



Smart Medical Reminder System with Integrated Mobile App and AI-Based Health Guidance

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Introduction: In the present, CAT-1 Tuberculosis (TB) patients have to take medicine dose daily morning and if they are missing dose, they can negatively impact treatment outcomes. Moreover, existing applications gave for patients only remind time but do not store data for future and not give AI personalized guidance together. This research presents Smart Medical Reminder System with integrates mobile app and an AI chat bot for health guidance to solve these problems.

Objectives: The first feature is Smart TB Medical Box with sensors for detecting medicine take or not and track taken time and keep their medicine history as report to show weekly progress to doctors. It helps doctors to plan next medicine schedule for TB CAT-1 Patient. The second feature is young patients can set their medicines schedules and get notifications on time using mobile app without medical box and keep of their medicine's history. The third feature is an AI chatbot to give recommendations to those who have weight and diabetics problems.

Methodology: The project is using Agile Methodology and developed with Flutter for mobile app, Firebase for cloud services and IoT technologies with Arduino with sensors like LDR modules for detect medicine take or not, LED sensor for use to detect day and buzzers to track the alarm to get time and Sim808 sensor use to pass data between medical box and Mobile app to keep their medicine history. AI chatbot develop with using NLP with Python technologies in the AI guidance module.

Results & Discussion: Medical boxes and system able to deliver timely reminders of medications and accurately maintain medicine data and chatbot has provided basic healthcare support for patients and results have verified that the purposes.

Conclusion: The system in future, the real-time tracking of the box's location along with the smart medical box to enhance monitoring.

Keywords: AI health, IoT, Medication reminder, Smart medical box, TB



A Multi-User Medicine Reminder App for Shared Notification and Improved Medication Adherence

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Introduction: Medication non-adherence is a major healthcare challenge that can lead to poor treatment outcomes and increased medical costs. This study presents a MultiUser Medicine Reminder App for Shared Notifications and Improved Medication Adherence, designed to help patients manage medications through reminder scheduling, medication history tracking, caregiver notifications, and AI-based medicine identification.

Objectives: The study aims to develop a mobile application that improves medication adherence through medicine reminders, secure user management and medication tracking. It also integrates an AI-based medicine identification feature using smartphone camera scanning to recognize medicines and provide relevant usage information.

Methodology: An iterative and incremental software development methodology was adopted. The application was developed using Android Studio with Java, Firebase Authentication, and Firebase Realtime Database. A MobileNetV2 deep learning model was trained using a custom dataset containing seven medicine classes, with the dataset divided into 80% training and 20% validation data. Model performance was evaluated using validation accuracy, loss, precision, recall, F1-score, and confusion matrix analysis. Black-box testing was conducted to validate the system functionality.

Results & Discussion: The developed application successfully implemented authentication, medicine scheduling, reminders, medication history, caregiver notifications, and AI-based medicine identification. Black-box testing achieved a 95% success rate. The MobileNetV2 model obtained a validation accuracy of 51.61% with a validation loss of 1.4529. Precision, recall, F1-score, and confusion matrix analysis confirmed the model's ability to classify medicine categories, although performance was limited by the small dataset and image variations.

Conclusion: The proposed application improves medication adherence by combining reminder management, shared notifications, and AI-assisted medicine identification. Future work includes expanding the dataset, improving model accuracy, supporting offline functionality, and integrating wearable devices and healthcare systems.

Keywords: AI-Based medicine identification, Medication adherence, Medicine scheduler, Notification system, Reminder system



A Decentralized Full-Stack Ecosystem for Translating Undergraduate IT Research into Commercial Ventures

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Introduction: Every year, students build good software for final projects. However, these are often abandoned because students cannot easily reach investors. This study introduces a web platform to solve this problem. It provides a secure space to showcase student ideas to local tech investors, helping turn academic projects into real startups.

Objectives: The primary objective is to build a full-stack web platform that easily connects IT undergraduates with industry investors to commercialize student software projects.

Methodology: Built with the MERN stack, the system uses JSON Web Tokens (JWT) for login and Role-Based Access Control (RBAC) to protect user data. A SHA-256 hash created a timestamp upon project upload. We clearly inform users that this only proves the upload time, not legal IP protection (which requires official patents). The platform matches projects with investors based on the industry sector, technology stack, and project readiness level. We tested the system with 50 students and 10 investors.

Results & Discussion: The pilot test was very positive. 42 students easily created profiles, noting that the timestamp feature made them feel safe sharing their ideas. The matching system successfully paired projects with investor interests. Importantly, three student projects received requests for actual follow-up meetings. Investors said using this platform was much faster than attending physical university exhibitions.

Conclusion: A dedicated digital platform successfully connects university students with the tech industry. It protects student work and directly supports startup growth. Future improvements include adding AI for better matching and expanding the system to other university departments.

Keywords: Academic synergy, Commercialization, Full-stack platform, Intellectual property, Student research



Smart Safari: A Mobile Cloud-Based Wildlife Information Sharing and Real-Time Tracking System for National Parks

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Introduction: Sri Lanka is a popular tourist destination and dissemination of wildlife information is currently done informally which leads to inaccurate wildlife locations, traffic jams, and wildlife not being spotted. This research introduces Smart Safari, a mobile cloud-based system to enhance wildlife tracking and real time communication.

Objectives: Design and make a mobile application which will help safari drivers, park rangers and authorized users to share verified sightings of wildlife with GPS and enhance tracking accuracy, tourist experience and sustainable wildlife tourism.

Methodology: Flutter, Firebase, Google Maps API, GPS services and cloud databases. It has features such as real-time GPS tracking, photo uploads, offline data caching, user verification, notification filtering and location validation. Functional, GPS and network & usability testing was done.

Results & Discussion: The system proposed was able to share information about wildlife with the help of accurate GPS tracking, reliable synchronization, and verified reports. The application was found to be user-friendly, stop misinformation, reduce the congestion of vehicles, and manage safaris effectively while maintaining the safety of wildlife and the environment.

Conclusion: Smart Safari is a practical and cost-effective solution for real-time tracking of wildlife in Sri Lanka. This system improves the experience of tourists, helps to preserve wildlife and encourages sustainable safari tourism. The enhancements planned for future are AI-based animal identification and advanced wildlife monitoring.

Keywords: Cloud computing, GPS tracking, Mobile application, Smart tourism, Wildlife conservation



An AI-Driven Personalized Skincare and Haircare Recommendation System Using Image Analysis and Interactive Chatbot Technology

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Introduction: Skin and hair problems have surfaced due to environmental, lifestyle changes, and/or improper use of cosmetics. There are people out there purchasing products that don't know what will work on their skin type, or their hair type, they were wasting money, and time on ineffective products. The study proposes an image analysis-based and interactive chatbot skin and hair care recommendation system to guide people in selecting appropriate skin care products, depending on their skin and hair characteristics.

Objectives: The aim is to develop a smart system which can analyse the condition of skin and hair, recommend the suitable product, provide immediate recommendations by an AI chatbot and provide secured customized recommendations for products.

Methodology: The system handles the user's image and information through image processing, AI classification and Chatbot technology. It contains image quality validation, secure handling of data, hybrid recommendation methods and dermatologist reference support if necessary. Functional test and usability tests were conducted to assess the system performance.

Results & Discussion: The proposed system was able to correctly diagnose skin and hair related issues and provide personalized recommendations. The questions were promptly answered by the chatbot and the image validation added to the reliability of the answers given by the chatbot. The user evaluations revealed that the system did a good job and was easy to use and helpful for choosing the best skin and hair care products.

Conclusion: The proposed system offers a realistic approach that incorporates AI technologies to offer individual recommendations for skin and hair care. It helps with product selection, enhances user experience and safe use of cosmetics. Further work will be undertaken to increase the accuracy of the model with larger datasets and other environmental factors.

Keywords: Image analysis, Interactive chatbot, Personalized recommendation, Skin care.



CloneEye: An AI-Powered Multimodal Assistive System Integrating Real-Time Vision, Conversational AI and Adaptive Guidance for Blind and Visually Impaired Individuals

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Introduction: Blind and visually impaired individuals continue to face significant challenges in mobility, navigation, environmental awareness, and independent interaction despite recent advancements in assistive technologies. Most existing assistive systems still provide isolated functionalities such as object detection, navigation, or voice assistance, requiring users to depend on multiple devices and applications. This fragmentation increases cognitive load, reduces efficiency, and limits independence in real-world environments.

Objectives: To address these limitations, this research presents CloneEye, an integrated AI-powered multimodal assistive system designed to improve independence, safety, accessibility, and quality of life for blind and visually impaired individuals through a unified intelligent ecosystem.

Methodology: The proposed system combines real-time computer vision, conversational artificial intelligence, adaptive learner - personalization, wearable smart-glass integration, navigation assistance, emergency response services, and IoT based tactile interaction within a single platform. CloneEye was developed using Flutter and TensorFlow Lite models for efficient cross-platform mobile deployment and real-time processing. A fine-tuned three YOLO11n model trained using COCO dataset containing approximately 120,000 images across 80 object classes, together with custom datasets containing over 5,000 images each, was integrated for pedestrian traffic light, and empty chair detection models. Google Gemini was utilized to provide conversational and context-aware assistance through natural voice interaction, achieving approximately 94% intent recognition accuracy.

Results & Discussion: Experimental evaluation demonstrated that CloneEye achieved 35.7 FPS real-time object detection performance with an overall weighted detection accuracy of 85.2%, while empty chair and pedestrian traffic light detection achieved above 80% and 90% accuracy respectively. The system also achieved approximately 70% improved battery efficiency compared to traditional fragmented assistive workflows through integrated optimization and centralized processing.

Conclusion: The findings demonstrate that integrating multimodal artificial intelligence, wearable vision systems, adaptive learner - personalization, and accessibility-focused interaction mechanisms can significantly improve usability, safety, contextual awareness, and independence compared to fragmented assistive technologies.

Keywords: Adaptive learning, Assistive technology, Computer Vision, Conversational AI





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Design and Experimental Optimization of Resonator Length and Stack Properties for Air Based Standing Wave Thermoacoustic Refrigerator

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Introduction: This study presents the design, fabrication, and experimentation for optimization of low frequency, air-based standing wave thermoacoustic refrigerator.

Objectives: This research is aimed to: (i) design and build a low-frequency air-based standing wave thermoacoustic refrigerator prototype with modular resonator lengths and stacks; (ii) investigate the effect of resonator length on acoustic resonance frequency and cooling performance; (iii) determine the optimized combination of resonator length and stack properties that achieve the best cooling performance.

Methodology: Two resonator lengths (0.90 m 0.70 m) and four stacks with different geometries in 4cm and 6cm lengths (spiral and honeycomb) were tested.

Results & Discussion: Frequency sweep showed that the system was operating on quarter-wave resonance. The Taguchi larger is better signal to noise ratio ($S/N=20 \cdot \log_{10} \Delta T$, where S = signal, N = noise and T = temperature) approach was used to rank three design parameters resonator length, stack type and stack length with the stack length being the most influential parameter ($\Delta = 4.09$ dB).

Conclusion: the optimized design 0.70m resonator length with a 6cm honeycomb stack 120Hz gave 11.2°C temperature difference and 18.6°C cold-side temperature at room temperature 25°C.

Keywords: Air-based cooling, Resonator length, Standing wave, Taguchi optimization



Behavior Analysis of a Cruciform Profile Beam Subjected to Transverse Loading between Two Web Planes

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Introduction: Structural beams are essential load-carrying members in engineering applications. Conventional I-beams provide high stiffness along the principal axis but are less effective under multi-directional loading. Cruciform profile beams offer balanced stiffness in multiple directions; however, their behavior under transverse loading between two web planes has received limited attention. This study investigates the structural performance and optimization of cruciform profile beams using analytical calculations and Finite Element Analysis (FEA) to improve deformation resistance and material efficiency.

Objectives: The objectives were to: (1) analyze cruciform beam behavior under different boundary conditions; (2) develop reinforcement concepts to reduce deformation; (3) perform FEA using ANSYS; (4) apply topology optimization; and (5) achieve approximately 40% deformation reduction.

Methodology: A baseline cruciform beam was analyzed using classical beam theory and ANSYS Workbench under fixed-fixed, fixed-hinged, and cantilever boundary conditions with transverse loading between two web planes. Based on stress and deformation results, three reinforcement concepts tapered web geometry, welded ribs, and hollow-core fillets were developed and combined into an optimized design. Topology optimization was then applied to improve material efficiency while maintaining stiffness.

Results & Discussion: The baseline beam exhibited significant deformation under transverse loading. Among the reinforcement concepts, the tapered web provided the greatest improvement. The fully optimized beam achieved approximately 40–43% deformation reduction, while topology optimization further improved material efficiency without compromising structural performance across different boundary conditions.

Conclusion: The optimized cruciform beam demonstrated enhanced deformation resistance and improved material efficiency, highlighting its potential for lightweight engineering applications. As the study is limited to static numerical simulations, future work will focus on experimental validation and the investigation of nonlinear and dynamic loading conditions.

Keywords: Cruciform Profile Beam, Finite Element Analysis (FEA), Multi Directional Loading, Structural optimization, Topology optimization



Development of Low-cost, Handheld RGB Imagine System with Optimized Internal Lighting for Nutrient Deficiency Diagnosis in Rice Leaves

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Introduction: Rice (*Oryza sativa*) provides 42% of Sri Lanka's caloric intake, yet improper Nitrogen(N), Phosphorus(P), Potassium(K) management causes 15-40% yield losses. Conventional diagnostics remain costly and slow for smallholders. Addressing this gap, this study presents a low-cost, portable IoT-embedded detection system with optimized internal LED lighting to eliminate ambient light interference, integrating a custom YOLO26n Deep Learning model trained on an experimental dataset for precise leaf-level NPK deficiency detection.

Objectives: To diagnose rice NPK deficiencies by deploying a novel-dataset-trained YOLO26n model on to a custom, internal-light-optimized handheld IoT embedded device.

Methodology: Controlled plots (one 100% control, three at 30% N, P, or K) induced distinct deficiency symptoms under IoT environmental monitoring system. A custom dataset of leaf images was color-balanced, annotated via LabelImg, and augmented for robustness. The YOLO26n model was trained over 100 epochs (16 batches, IoU threshold > 0.4). The model was deployed via UltralyticsHub to an IOT based ESP32-CAM device with an OLED display and custom LED lighting system for consistent field illumination.

Results & Discussion: The YOLO26n model achieved an overall mAP@0.5 of 93.05%, with class precision scores of 92.10% (N), 90.03% (P), and 97.54% (K). With an inference speed of 3.46 m/s, the system delivers real-time feedback on the OLED screen. The custom lighting effectively eliminated leaf glare, drastically reducing false negatives.

Conclusion: Delivering over 80% classification accuracy and 93.05% mAP@0.5 at 3.46 m/s inference speed, this handheld system offers a reliable, low-cost alternative to traditional testing, advancing Precision Agriculture 4.0 for smallholder farmers.

Keywords: Deep Learning, IoT, NPK Deficiency, Precision agriculture, YOLO26n



Investigation of the Mechanical Properties of Lightweight Concrete with Partial Replacement of Coarse Aggregate using Regiform/EPS

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Introduction: Lightweight concrete reduces structural dead load while maintaining performance. Expanded Polystyrene (EPS/Regiform) provides low density and thermal insulation but may reduce compressive strength due to weak bonding and increased porosity. Although EPS concrete and superplasticizers (SPs) have been studied separately, their combined effects require further investigation. This study examines their influence on workability, density, and compressive strength of lightweight concrete.

Objectives: (1) To investigate the combined effect of 0–7.5% EPS replacement and 0.5% polycarboxylate-based SP on the mechanical properties and density of G20 lightweight concrete. (2) To determine the optimum EPS replacement level to achieve strength with reduced self-weight in lightweight non-structural applications. (3) To evaluate the workability of EPS concrete at a constant water–cement (w/c) ratio.

Methodology: Concrete was prepared using a 1:2:4 mix with a w/c ratio of 0.50. EPS replaced coarse aggregate at 0%, 2.5%, 5%, and 7.5%, while 0.5% polycarboxylate-based SP was added to mixes. Slump, density, and 28-day compressive strength were measured using 150 mm cube specimens according to relevant BS EN standards.

Results & Discussion: Increasing EPS content reduced density and compressive strength. The control mix achieved 30.1 MPa and 2390 kg/m³, whereas the 7.5% EPS mix achieved 21.2 MPa and 2205 kg/m³. The reduction was attributed to low EPS stiffness, weak cement–EPS bonding, and increased porosity. The SP maintained slump values of 136–155 mm without increasing the w/c ratio. The 5% EPS mix achieved 24.7 MPa strength with approximately 5% lower density than the control, making it suitable for lightweight panels, partition walls, and non-structural applications.

Conclusion: EPS partial replacement of coarse aggregate produced lightweight concrete with reduced density and acceptable strength. The SP improved workability at a constant w/c ratio. The 5% EPS mix provided the best strength-to-weight balance. Further research should investigate durability, fire resistance, and microstructure.

Keywords: Compressive strength, Expanded polystyrene, Lightweight concrete, Regiform, Superplasticizer



Design and Performance Analysis of a Condenser Waste Heat Recovery System for Continuous Hot Water Supply in Refrigeration Application

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Introduction: In a vapor compression refrigerator, the condenser rejects waste heat while electricity is used to heat water. This study explores using waste heat for water heating.

Objectives: The aim is to calculate the waste heat available from a 3 TR cold room using R134a refrigerant and design a helical-coil heat exchanger to produce water at 40°C, 10 L/min, and 2 bar, while reducing energy consumption and environmental impact.

Methodology: A seven-phase method was followed such as thermodynamic, heat-exchanger, tank, hydraulic and control-system design, conceptual selection, and CFD (Computational Fluid Dynamics) validation. Recoverable heat was found from the condenser energy balance; an 18 m copper coil in an insulated tank was sized by the LMTD (Log Mean Temperature Difference) method. Hydraulics were sized with the Darcy-Weissbach equation. A straight-coil configuration was chosen over plate/shell-and-tube alternatives by weighted comparison, then CFD-validated.

Results & Discussion: According to the above calculations, the heat rejected by the condenser is 14.07kW and out of that, 11.26kW can be recovered, which exceeds the heating demand by 10.5kW. The heating coil required a length of 16.2m with a cross-sectional area of 0.61m² to heat the water, which was given a length of 18m. The required hydraulic head was 22m, which was met by a 0.25HP pump operating at 60W. CFD, using a 328 K coil wall and 300 K inlet conditions, predicted an outlet of ~313 K (40°C), which matched the analytical LMTD result. The effective COP (Coefficient of Performance) increased from 3.0 to 5.98 (~99%), the water heating power decreased from 10.5 to 0.22 kWh/hr (97.9%), and CO₂ emissions decreased to ~9.5 kg/hr.

Conclusion: This design uses low-cost materials and therefore can be expected to have a short payback period. It is also more efficient, sustainable and environmentally friendly.

Keywords: CFD validation, Condenser heat recovery, COP improvement, Heat exchanger design, Refrigeration system



Design of a Semi-Automated Fabric Elongation Testing Device

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Introduction: In textile manufacturing, the elongation impacts the comfort and fit of garments. ASTM D4964 requires specimens that measure 250 mm × 65 mm fabric sample. However, during early product development, customers often provide small fabric swatches. Standard testing machines cannot accommodate such small specimens, making it difficult or impossible to get reliable elongation measurements, which can lead to quality issues.

Objectives: The aim was to design and fabricate a semi-automated elongation testing device for small fabric specimens and compare its results with those obtained using a Zwick/Roell Universal Testing Machine to evaluate measurement accuracy.

Methodology: The device consisted of a horizontal frame with a T8 lead screw, a NEMA 17 stepper motor, and an A4988 driver operating at 305 mm/min, in accordance with ASTM D4964. A 20 kg load cell with an HX711 24-bit ADC measured the applied force, while an ESP32 microcontroller controlled the motor and logged the test data. Fabric specimens measuring 70 mm × 30 mm were tested in triplicate.

Results & Discussion: The prototype produced results comparable to the standard Zwick/Roell UTM. Warp elongation at 7.5 lbf was $70.0 \pm 0.91\%$ for the prototype and $76.4 \pm 0.80\%$ for the standard machine. The modulus values at 20%, 40%, and 60% elongation, and recovery percentage, remained nearly identical between both devices. Four of the five measured parameters closely matched those of the standard UTM, confirming that the custom device can reliably measure fabric stretch and recovery behavior.

Conclusion: This study confirmed that the prototype can reliably test small fabric samples, giving results comparable to an industrial UTM. The testing was limited to a single knitted fabric type, in future work should extend testing across more fabrics and sample sizes, and add features like a digital display, automated reporting and humidity sensing to improve accuracy.

Keywords: ASTM D4964, Constant rate of extension, Fabric elongation, Semi-automated testing, Small-scale specimens



The Negative Impacts of Incomplete Tender Drawings on Pre- Contract Cost Estimation in Sri Lankan Building Construction Projects

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Introduction: The construction industry is vital to Sri Lanka's economy, yet cost overruns persist, often due to incomplete pre-contract tender drawings. Although their causes and impacts are well documented, their significance varies across projects.

Objectives: This study identifies common forms, key impacts, and main causes of incomplete tender drawings in Sri Lankan building projects, focusing on pre-contract cost estimation and Quantity Surveyors' practice.

Methodology: This study adopts a qualitative research approach based on an interpretive research philosophy to explore the negative impacts of incomplete tender drawings on pre-contract cost estimation. Data were collected through semi structure interviews with twelve Quantity Surveyors who were actively involved in the pre-contract stage of residential and commercial building construction projects in Sri Lanka. A purposive sampling technique was used to select the participants. The collected data were analyzed using thematic analysis to identify the key patterns.

Results & Discussion: The findings indicate that architectural drawings were generally more complete than structural and services drawings. Missing dimensions, insufficient details, and inconsistencies between drawings were identified as the most common forms of incomplete information. Time constraints emerged as the most significant reason for issuing incomplete tender drawings, followed by inadequate coordination among design consultants, early tendering before design completion, and limited design review. These issues reduced the accuracy of pre-contract cost estimation, increasing reliance on assumptions, provisional sums, and risk allowances.

Conclusion: The study concludes that incomplete tender drawings significantly affect the accuracy and reliability of pre-contract cost estimation in Sri Lankan building construction projects. It provides a context-specific understanding of the common forms of incomplete information, their impacts, and the most significant contributing reasons from the perspective of Quantity Surveyors. The findings support improved design coordination and tender documentation practices to enhance cost estimation accuracy and project performance.

Keywords: Cost estimation accuracy, Pre-contract cost estimation, Tender drawings



Design and Computational Simulation of a 3D Printed Microfluidic Device for Blood Plasma Separation

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Introduction: Plasma carries important biomarkers for diagnosis, but conventional centrifugation needs continuous power sources, modern equipment, and skilled operators, difficult for rural or field work. Passive microfluidic systems separate plasma with just a syringe, and SLA 3D printing produces them at low cost without cleanrooms.

Objectives: The objective was to design, simulate, and optimize microchannel geometries for plasma separation and find the best design for SLA 3D printing.

Methodology: Five geometries straight, curved, zigzag, sinusoidal, and spiral (radius decreasing 1000 μ m to 200 μ m) were designed with a uniform 100 μ m $\times$ 50 μ m cross section and simulated in COMSOL Multiphysics 6 using Laminar Flow and Particle Tracing on a fine mesh of 24,180 elements (mesh independent within 0.5%). No-slip walls with elastic bounce reflection were used, and a 0.100 m/s inlet with 0 Pa outlets gave $Re \approx 2.02$. Blood was modeled as non-Newtonian at 40% hematocrit, with 500 rigid spherical particles (8 μ m, 1100 kg/m³) at each inlet. Plasma purity was $N_{main}/N_{total} \times 100$.

Results & Discussion: Straight 71%, curved 82%, zigzag 84%, sinusoidal 89%, and spiral 92% were the simulated plasma purities. The spiral geometry outperformed everything else. It gave the best purity per pressure drop efficiency, 0.420%/Pa, and the thickest cell-free layer, 9.7 μ m. All five geometries had wall shear stresses far below the hemolytic threshold of about 150 Pa, hence cell safety in all designs.

Conclusion: The spiral microchannel is the best design for passive plasma separation, the Rurales device. Prototypes will be SLA 3D printed in BioMed Clear resin under 100 μ m to avoid channel expansion. Blood was modeled with rigid spherical particles, so tests with human blood are needed, pending ethical approval.

Keywords: Blood plasma separation, COMSOL, Microfluidics, Microchannel, SLA 3D print



Reverse Power Flow Analysis in Solar Integrated LV Distribution Networks

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Introduction: Reverse power flow (RPF) occurs when rooftop PV output exceeds local demand, pushing feeder-end voltage beyond the PUCSL statutory band of $230\text{ V} \pm 6\%$ 1.2018 pu for seven hours, a growing risk as net-metering expands. PV curtailment discards usable energy; the Star-Connected STATCOM Soft Open Point (SCS-SOP) instead redirects surplus power to a neighboring feeder with reactive support, a trade-off unevaluated for Sri Lankan LV networks.

Objective(s): This study quantifies RPF's magnitude, duration, and voltage impact in a two-transformer radial LV feeder under high PV penetration, and compares SCS-SOP control against proportional curtailment using energy and voltage-compliance criteria.

Methodology: A two-feeder radial LV network (Feeder A: 60 kWp PV; Feeder B: high demand, minimal PV) was modelled in OpenDSS using CEB parameters across four 24-hour cases: base, uncontrolled PV, SCS-SOP, and curtailment. A MATLAB closed-loop controller set SCS-SOP's active power and Volt-VAR droop setpoints hourly; curtailment triggered whenever voltage exceeded 1.06 pu, the PUCSL statutory upper limit.

Results & Discussion: Uncontrolled high PV confirmed severe RPF: peak T1 export reached 159.43 kW (39.9% of rated capacity), with feeder-end voltage reaching 1.2018 pu for seven hours of statutory violations. SCS-SOP reduced peak export to 145.01 kW and maximum voltage to 1.1650 pu, preserved the full PV yield of 1926.00 kWh/day, cut T2 import energy by 24.5%, and gave partial undervoltage relief on Feeder B. Curtailment achieved a lower peak export of 134.76 kW but wasted 131.55 kWh/day of usable solar energy, delivering no benefit to Feeder B.

Conclusion: SCS-SOP coordinated active-reactive control substantially reduces peak transformer export and overvoltage while preserving the full PV yield, offering a more energy-efficient alternative to curtailment for RPF mitigation in asymmetric LV feeders.

Keywords: Hosting capacity, Low-Voltage distribution networks, Reverse power flow, Soft open point, Voltage rise



Design and Development of Sustainable Marine Kitchen Waste Management System

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Introduction: The marine sector requires sustainable waste management to comply with MARPOL Annex V. Existing methods, such as incineration and vacuum systems, have drawbacks including high fuel consumption, emissions, and limited sustainability. This study proposes a kitchen waste management system that uses mechanical and thermal processing with engine waste heat to reduce waste moisture, mass, and volume. The design process included literature review, concept development, simulation, structural analysis, and system development.

Objectives: (1) To acquire the current knowledge related to marine kitchen waste management. (2) To develop an onboard system to manage waste with sustainability. (3) To validate a developed system by comparing existing marine kitchen waste management systems. (4) To help agriculture by producing organic fertilizers from organic galley waste. (5) To reduce operational costs and help the marine industry with extra income.

Methodology: The study was conducted on current methods of managing marine kitchen waste, and design constraints were identified. Several concepts for the crusher drying chamber and briquetting section were developed and analyzed using morphological analysis. The chosen concept was then modelled, and the drying chamber was analyzed thermally using ANSYS Fluent, while the frame, crusher, and briquetting section were structurally analyzed using ANSYS Static Structural.

Results & Discussion: An average cruise ship (3000 passengers), can save nearly 11.5 tons of fuel per year with this system. This results in a displacement reduction of 0.021%. Thermal and structural analysis confirmed that the proposed design satisfied the required operating conditions, demonstrating the feasibility of the integrated waste management system.

Conclusion: In the suggested system, the moisture level decreases from 40% to 10%, while the mass of the waste decreases from 1.00 kg to 0.667 kg. The results suggest the possibility of using recovered heat from engine jacket water for sustainable waste management onboard.

Keywords: Marine kitchen waste, Shipboard system, Sustainability, Waste heat recovery, Waste management



Quick Coupling for Brake Lines

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Introduction: Routine suspension corner repairs, such as caliper or wheel bearing replacement, often require brake line disconnection. This causes fluid loss and air entry, making bleeding necessary and adding significant repair time. This study proposes a permanently installed brake line coupling with independently sealing halves that retain fluid and prevent air entry during disconnection. The design adapts the flat-faced, double shut-off coupling principle used in industrial hydraulics for automotive brake systems.

Objectives: The study aimed to (1) enable easy brake line disconnection to reduce maintenance time, (2) design a coupling capable of withstanding 200 bar working pressure, and (3) eliminate brake bleeding by preventing fluid loss and air contamination.

Methodology: The coupling was designed based on flat-face coupling principles and -3AN brake hose specifications with a 4.76 mm bore. A design pressure of 200 bar was selected to ensure safe operation under extreme braking conditions. Calculations included hoop stress, valve pressure force, flow area, spring preload, and O-ring geometry. Material selection was performed using a weighted decision matrix, and all design iterations were modelled using CAD.

Results & Discussion: Initial designs were rejected due to flow restrictions caused by the poppet arrangement. The final design incorporates a 7 mm bore and three-spoke spider poppet support, providing a net flow area of 26.76 mm², greater than the hose bore area of 17.81 mm². The coupling withstands 200 bar pressure with a maximum hoop stress of 18 MPa and a safety factor of 48.9 using Ti-6Al-4V. Connection requires only 18 N hand force, while O-ring compression remains within the recommended sealing range.

Conclusion: The proposed coupling successfully eliminates brake bleeding, maintains unrestricted brake fluid flow, and provides safe operation under high pressure. It has strong potential to reduce workshop repair time, particularly for vehicles equipped with ABS and ESC systems. Further work should include prototype testing, pressure, fatigue, vibration, and long-term seal durability assessments.

Keywords: Brake bleeding, Flat-face coupling, Hydraulic brake system, Quick-Release coupling, Ti-6Al-4V



Aerodynamic Noise (Aeroacoustics) Simulation: Predict and Reduce Wind-induced Cabin Noises by Airflow Optimization in Automobiles

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Introduction: As vehicle electrification minimizes powertrain noise, Heating Ventilation and Air Conditioning (HVAC) systems dominate cabin acoustics. While high-fidelity aeroacoustics solvers are accurate, their computational cost remains inaccessible for early design cycles. This research addresses limitations by establishing an accessible, validated workflow that applies Broadband Noise Source (BNS) modelling to Reynolds-Averaged Navier-Stokes (RANS) data for a production vehicle HVAC system.

Objectives: The primary objectives are to establish experimental velocity and acoustic baselines, validate a steady RANS Computational Fluid Dynamics (CFD) model, pinpoint dominant aeroacoustics sources using the BNS model, and apply targeted geometric optimization to mitigate noise without sacrificing flow performance.

Methodology: Baseline vent velocities and cabin noise for a Nissan Sunny FB14 were captured using an anemometer and sound meter. The 3D-scanned ductwork was simulated in ANSYS via steady $k-\omega$ Shear Stress Transport RANS. Proudman's and Curle's formulations were applied during post-processing to isolate noise sources, directly guiding the widening of severe duct constrictions.

Results & Discussion: Following mesh independence testing, the CFD model demonstrated strong experimental agreement; simulated vent velocities deviated by only 0.0% to 5.2% from corrected physical measurements. Curle's surface fluctuations peaked at 60.76 dB around duct constrictions, whereas Proudman's volumetric sources remained under 6.9 dB. By widening the two narrowest sections, total integrated acoustic power reduced by 19.8%, and the area-weighted mean wall sound power decreased by 16.7%. This modification validated our optimization objective by preserving the system's core function, altering mass flow vent velocities by less than 3.1%.

Conclusion: A minor acoustic hotspot emerged downstream of the geometric modification, suggesting future studies should incorporate iterative geometric refinements. This validated RANS-BNS workflow successfully bridges simple empirical tools and resource-heavy high-fidelity models. By enabling accurate noise optimization on accessible hardware, this methodology empowers researchers and engineers to efficiently improve cabin comfort for vehicles.

Keywords: Aeroacoustics, Broadband noise source model, CFD, HVAC, RANS



Automated TDS Monitoring and Adaptive Blowdown Control System with Cost Estimation for Low-Pressure Industrial Boilers

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Introduction: During steam generation, TDS increases as dissolved solids accumulate. If the boiler operated under high TDS for long durations, it produces adverse effects thus necessitating blowdown. Blowdown process removes heated and treated water, resulting in economic losses. Commercial systems are focused on controlling the TDS level close to a defined setpoint with limited consideration to reduce blowdown volume. This study addresses the above gap by proposing an adaptive blowdown strategy.

Objectives: 1) Develop a TDS mass-balance model. 2) Simulate and compare five control strategies. 3) Evaluate and verify the proposed adaptive strategy.

Methodology: The scope was narrowed down based on representative similar low-pressure industrial boiler data, boiler blowdown data collected from an experienced operator working in similar boiler system, and standard steam-table properties. Pressure 10 bar(g), capacity 5000 kg/h, boiler volume 16000 L, initial TDS 3600 ppm, TDS setpoint 3400 ppm, blowdown flow rate 2.5 L/s, feedwater TDS 50–200 ppm, and simulation duration 24 hours.

Results & Discussion: Among the automated methods, the adaptive strategy achieved the lowest losses, with 6348 L blowdown volume, 4811 MJ energy loss, and 31,337 LKR total cost. In contrast, hysteresis control produced the highest total cost of 35,557 LKR due to overcorrection below the setpoint. The 3 objectives were achieved through MATLAB simulation and a physical concept demonstration system, which verified purge sampling and flow-based discharge control. Cost was estimated using furnace oil at 194 LKR/L, calorific value of 40 MJ/kg, fuel density of 0.95 kg/L, boiler efficiency of 80%, and water cost of 0.1 LKR/L.

Conclusion: The adaptive method reduced the blowdown and energy loss while maintaining boiler TDS close to the setpoint. Further testing under real boiler conditions is required. This study can influence improvements for energy-efficient boiler operation and provides a practical foundation for low-cost retrofittable control systems for industrial boilers.

Keywords: Adaptive control, Boiler blowdown, Energy loss, Simulation, TDS



Design and Development of a System to Optimize the Usage of CNC Coolant

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Introduction: CNC machining is an essential part of manufacturing and is widely used in many industries. During machining, heat is generated between the tool and workpiece, which can adversely affect tool life, dimensions, and surface finish. Therefore, coolants are used to reduce heat, provide lubrication, remove chips, and ensure dimensional stability. However, coolants are often contaminated with metal chips, abrasives, tramp oil, and other materials. Contamination reduces coolant life, increases tool wear, microbial activity, bad odor, and costs. This paper addresses this gap through the innovative design of a low-cost panel filter machine.

Objectives: (1) To acquire current knowledge of CNC cooling filter systems. (2) To design a system to optimize the filter system of CNC cooling systems. (3) To analyze the designed system. (4) To validate the system in real-world conditions.

Methodology: Several concepts were evaluated based on filtration efficiency, cost, maintenance, complexity, setup time, and space requirements. The system includes several filtration stages including a mesh filter, paper belt filter, magnetic separator, settling chamber, oil skimmer, and cartridge filter. Design calculations were performed for flow rate, tank capacity, pipe diameter, and pump power. ANSYS Workbench simulations confirmed efficient flow behavior, effective particle removal, and strong structural integrity.

Results & Discussion: The inlet tank had a small pressure drop (8.66 Pa) and provided uniform flow without stagnation or bacterial growth. The pressure loss in the S-bend pipe flow was 64.4 Pa and was within the pump's ability to provide uniform movement of the coolant. Justifications should be provided to validate that the objectives have been achieved.

Conclusion: The efficiency of the settling chamber is 75-85%, which provides capture of most particles larger than 0.5 mm and reduces the workload for other filters. Structural analysis showed that there are little stress and low deformation with high safety factors.

Keywords: Ansys simulation, CFD analysis, CNC coolant, Multistage filtration, Recycling



Development of a Smart Condition Monitoring System for Workshop Machines for Predictive Maintenance

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Introduction: Workshop machines such as lathes and milling systems depend on induction motors that degrade due to bearing wear, thermal stress, and rotor imbalance. These failures can cause operational delays and safety issues. Conventional maintenance methods based on corrective actions or fixed schedules do not represent actual machine conditions. Temperature and vibration variations provide early fault indications; however, many IoT monitoring systems focus on single parameters and lack compliance with ISO and IEC standards. This study develops a low-cost, dual-parameter, real-time monitoring system for small-scale workshops.

Objectives: The study aims to develop a sensor-based condition monitoring system, monitor temperature and vibration indicators, implement IoT-based data transmission with GUI visualization, and evaluate results against IEC 60034-1 and ISO 20816-3 standards.

Methodology: The system was tested on 1.5 kW center lathe and milling machines equipped with three-phase induction motors. Temperature was measured using a DS18B20 sensor, and winding temperature was estimated through copper loss calculations. Vibration data were collected using an ADXL345 accelerometer mounted on the motor casing. An ESP32 processor enabled data acquisition and wireless transmission to ThingSpeak, while a web dashboard supported real-time and historical data analysis. A total of 1,988 samples were collected over seventeen operating sessions.

Results & Discussion: The system achieved over 90% data transmission reliability. Both motors remain within the IEC 60034-1 Class B temperature limit. The milling motor showed stable thermal behaviour, while the lathe motor experienced increased temperature at high speeds. Vibration analysis indicated that the lathe motor mainly operated within ISO Zone A, whereas the milling motor reached Zone D levels, suggesting possible mechanical faults.

Conclusion: The developed USD 16 monitoring system successfully detected thermal and vibration abnormalities and is suitable for small-scale industrial applications. Future improvements include machine learning-based fault diagnosis and enhanced hardware protection.

Keywords: Condition monitoring, Induction motor, IoT, Predictive maintenance, Vibration analysis



Design and Development of a Machine to Remove the Midrib of Coconut Leaves to Make Sustainable Products

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Introduction: Sri Lanka is a major coconut-producing country, generating substantial quantities of coconut leaf biomass. Despite its potential for value-added applications, coconut leaves are commonly burned or discarded, contributing to environmental pollution and greenhouse gas emissions. Growing plastic pollution has increased demand for biodegradable alternatives such as drinking straws. Coconut leaf blades are promising straw materials due to their flexibility, strength, and hydrophobicity. However, manual midrib removal is labour-intensive and unsuitable for large-scale production, while existing machines are mainly designed for broom manufacturing.

Objectives: This study develops a semi-automatic coconut leaf midrib extraction and trimming machine to improve productivity, minimize leaf damage, and reduce labour requirements. The study also evaluates a locally developed adhesive to reduce reliance on imported materials and enhance the economic feasibility of coconut leaf-based biodegradable straws.

Methodology: Study included a literature review, training, design, fabrication, and testing. Practical training at the Sri Lanka Industrial Development Board, Chilaw, identified straw production challenges. Based on these findings, a machine using local materials and an electric motor was developed. It incorporated separation and trimming mechanisms. Tests were conducted using dried and semi-dried coconut leaves, and processed blades were used to manufacture biodegradable straws.

Results & Discussion: The machine separated midribs without damaging leaf surfaces, producing quality material. It provided higher productivity with less effort than manual separation, making it suitable for production. The motor reduced energy use. The leaf material retained flexibility and strength, while straws remained wet for over three hours. The locally developed adhesive successfully bonded leaf strips without imported glue.

Conclusion: The semi-automatic machine improved productivity and quality while providing an economic solution for coconut leaf straw production. Future work should focus on feeding automation, durability testing, food-safety certification, industrial production, and other coconut leaf products such as plates, mats, and baskets.

Keywords: Agricultural waste valorization, Biodegradable straws, Coconut leaf, Midrib separation, Sustainable manufacturing



IoT-Based Smart Multi-Circuit Energy Monitoring System with Real-Time Billing Estimation and Electrical Load Analytics

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Introduction: Circuit-level electrical energy monitoring is essential for improving energy efficiency, reducing electricity costs, and enhancing safety. Conventional electricity meters provide only total energy consumption and cannot identify individual circuit usage or support real-time cost estimation. This study presents an IoT-based smart multi-circuit energy monitoring system capable of tracking multiple electrical loads with real-time data analysis and safety alerts.

Objectives: The study aimed to create and test a low-cost smart energy monitoring system. This system can track eight electrical circuits at once, estimate electricity bills based on the Sri Lankan tariff structure, examine load behavior, and provide safety alerts through an IoT platform.

Methodology: The prototype consists of ESP32 master and slave controllers, voltage sensing circuits, and eight current sensing channels connected to separate loads. It measures voltage, current, active power, power factor, frequency, and energy consumption for each circuit. Processed data are transmitted through Wi-Fi to the Blynk IoT platform for real-time visualization. The estimated electricity cost is calculated using the Sri Lankan domestic tariff, and system accuracy is validated against standard measuring instruments under different household load conditions.

Results & Discussion: The developed system successfully monitored eight independent circuits with approximately one-second data updates. Comparison tests showed an overall measurement accuracy of 98%. The system provided real-time electricity cost estimation, identified high-energy-consuming circuits, analyzed individual load patterns, and generated five types of safety alerts for abnormal conditions.

Conclusion: The self-developed multi-loop real-time energy monitoring system presented in this paper provides a practical, low-cost deployment solution for real-time multi-loop energy monitoring, utility bill estimation, and electrical load analysis. Prototype tests verify that the system can accurately measure electrical parameters and enhance users' awareness of their energy consumption. Future work will expand the number of monitoring loops, integrate machine learning to enable energy consumption prediction, and develop automated load management functions for smart buildings.

Keywords: Billing estimation, Electrical load analytics, ESP32, Internet of things, Smart energy monitoring



Vibration-Based Piezoelectric Energy Harvesting System with IoT Monitoring for Low Power Applications

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Introduction: Industrial machines and rotating equipment generate significant vibration energy that is typically wasted.

Objectives: This study presents a piezoelectric vibration energy harvesting system designed to capture ambient industrial vibrations and convert them into electrical energy for low-power sensor applications.

Methodology: A single spring vibration mechanism coupled with a piezoelectric transducer was mounted on a motor casing to harvest mechanical vibration. The generated AC voltage was rectified, stored through a capacitor, and monitored using an ESP32 microcontroller connected to an IoT dashboard for real-time data logging.

Results & Discussion: Experimental results showed that increased vibration intensity improved electrical output, with the piezoelectric element generating 0.8–3.2 V and approximately 3–6 μJ per vibration cycle. A feasibility assessment demonstrated that multiple piezoelectric elements with suitable power management could meet the requirements of low-duty-cycle IoT sensor nodes, enabling compact and self-powered solutions for industrial condition monitoring.

Conclusion: This research successfully demonstrated the practical implementation of capturing wasted industrial vibration energy using piezoelectric technology. The developed system converted external machine vibrations into electrical energy using a spring-assisted piezoelectric mechanism integrated with IoT monitoring.

Keywords: IoT monitoring, Low-Power sensing, Piezoelectric energy harvesting, Self-powered sensor, Vibration energy



A Predictive Multilingual Framework for Aspect-Based Sentiment Analysis and Version-Aware Risk Assessment in Play Store App Reviews

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Introduction: User reviews on the Google Play Store are an underutilized source of feedback. Existing tools mainly classify overall sentiment polarity and are primarily trained on English data. This study develops a multilingual, aspect-based sentiment analysis (ABSA) framework for WhatsApp and Instagram reviews in English, Sinhala, and Tamil, enabling sentiment tracking across different application versions.

Objectives: This study aims to: (1) develop a multilingual ABSA framework for English, Sinhala, and Tamil Play Store reviews of WhatsApp and Instagram; (2) evaluate sentiment across five aspect categories; and (3) classify version-to-version sentiment changes into High Risk, Stable, or Improved categories using percentile-based thresholds.

Methodology: Reviews were scraped via google-play-scraper across ten application versions. A 7500-review language-balanced pool (2500 per language) was combined with human-annotated data; 200 gold-labelled reviews (inter-annotator kappa 0.666 sentiment, 0.963 aspect) formed the test set, with 7,055 training and 1,245 validation reviews. Five classifiers, a majority-class baseline, TF-IDF with Logistic Regression, TF-IDF with XGBoost, XLM-RoBERTa, and threshold-tuned XLM-RoBERTa, were compared on identical splits. Five aspects were extracted via keyword mapping, and sentiment deltas were classified as High Risk, Stable, or Improved using percentile thresholds.

Results & Discussion: The threshold-tuned XLM-R model achieved the best performance (accuracy 0.840, macro F1 0.818, MCC 0.748), improving macro F1 by 15.8 points over XGBoost (0.661) and 64.4 points over the majority-class baseline (0.175). Accuracy was highest for English (86.1%), then Tamil (84.9%) and Sinhala (82.1%). Performance and Crashes were most negative in absolute terms, while delta analysis flagged only Privacy as High Risk, showing trend and absolute sentiment surface different priorities.

Conclusion: This study shows that a multilingual, transformer-based ABSA framework can deliver interpretable, trend-based risk assessment for low-resource-language app reviews. Future work will narrow the Sinhala cross-lingual gap and extend risk classification into a predictive model.

Keywords: Aspect-Based sentiment analysis, Low-resource language, Multilingual NLP, Version-Aware Risk Assessment, XLM-RoBERTa



Design and Kinematic Validation of a Dual Region Five Bar Robot for Low-Cost Tabletop Automations

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Introduction: Affordable planar automation remains difficult to adapt into the small workshops where when we come into commercial robots exceed available cost and space limits.

Objectives: This study presents a compact five bar parallel robot designed to move a pen type end effector in both the upper and lower cartesian regions relative to the motor axis baseline.

Methodology: The five bar robot mechanism uses 100 mm proximal links, 200 mm distal links and a 200 mm base joint separation between the two motors. MATLAB was used to evaluate several target points in the upper and lower regions. A prototype was assembled using 3D printed PLA parts, NEMA 17 motors, TB6600 drivers and an ESP32 Controller.

Results & Discussion: The forward and inverse kinematic results matched closely, with round trip errors below 0.001 mm. The workspace analysis clearly showed that the robot can reach up to 300 mm. However, the working limit was safely reduced to 270 mm, which is 90% of the maximum reach. The prototype also moved repeatedly in both directions supporting the feasibility of the dual region design. The main limitation is that ending effector position should still be measured physically before making a full performance claim.

Conclusion: The results demonstrate the viability of dual region motion on a low-cost tabletop platform for small scale automation.

Keywords: Dual region workspace, Five bar robot, Inverse kinematics, Low-cost automation, Planar robot



Design and Development of a Wearable Tremor Monitoring and Suppression Device

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Introduction: Parkinson's disease is a progressive neurological disorder affecting millions of people worldwide. Their involuntary resting hand tremors occur at frequencies between 3-12 Hz which represents one of its most functionally debilitating symptoms. Most existing tremor suppression devices are a bit expensive, heavy and hard for daily use, creating a clear gap between wearable alternatives.

Objectives: This study aims to design and develop a low-cost wearable prototype capable of monitoring and suppressing Parkinson's disease-related hand tremors.

Methodology: This system uses an MPU6050 an Inertial Measurement Unit (IMU) for real-time tremor detection, interfaced with an ESP32 microcontroller running at 143 Hz. Suppression is achieved using a stepper-motor-driven metal counterweight. The control system uses closed loop feedback architecture that integrates a Kalman filter for sensor fusion & two stage exponential filter to isolate the tremor frequency band (3-12 Hz) from intentional movement. In addition, uses a PID controller that drives a NEMA17 motor via a DRV8825 motor driver to detect tremor magnitude. Automatic gyroscope bias calibration and a dead-band threshold prevent false activation and sensor drift.

Results & Discussion: Experimental validation demonstrated significant amplitude reduction of simulated hand tremors. Optimal suppression was achieved in the 4-10 Hz range typical of essential tremors. Performance decreased above 10 Hz due to stepper-motor bandwidth limitations. The system successfully activated three response levels, "SLOW", "MEDIUM", and "FAST" proportional to tremor magnitude. An integrated OLED display provided real-time feedback of the current tremor level and motor activation status. The 77.2% torque safety margin proved sufficient. The gyroscopic counterweight reduced tremor amplitude without frequent direction reversal. These results confirm real-time performance and strong potential for wearable essential tremor management.

Conclusion: Currently, optimal suppression occurs at 4-8 Hz. Future work will extend the system up to and beyond 8 Hz with clinical evaluation in Parkinson's patients.

Keywords: Hand tremor suppression, Parkinson's disease, PID controller





Faculty of Humanities & Education

“Humanities in National Development:
Shaping a Sustainable Society through
Education”



Investigating Digital Addiction among Grade 11 Students and its Impact on their Academic Performance

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Introduction: The introduction of digital technology into the lives of students, particularly teenagers, is now common. These adolescents have been observed spending many hours on their mobile phones, computers, and even on social media platforms. While there are numerous benefits of these digital technologies in terms of communication and learning, there are growing concerns regarding the potential dangers of too much time spent online on various websites.

Objectives: Hence, this research will focus on studying digital addiction among Grade 11 students enrolled at ABC School by assessing their average daily time on digital technologies and the impacts of such addiction on their academic performance, physical well-being, and behavioral changes.

Methodology: This study utilized a mixed method approach. Data was collected quantitatively from 50 Grade 11 students through questionnaires. Qualitative data was obtained from class teachers through interviews. It has been found that most of the Grade 11 students spend more than three hours each day engaging with digital technologies for non-academic purposes like playing games and watching videos.

Results & Discussion: Some of the impacts identified by this research include eye strain, headaches, sleep disorders, separation anxiety, poor concentration during classes, and lack of interest in academic work. The correlation analysis found that there was a very high negative correlation between the amount of time spent using screens and academic achievements ($r = -0.82$). Furthermore, the teacher interview results showed that excessive screen time users were less focused and interested in studying and classroom activities than their peers.

Conclusion: Thus, excessive screen time is shown to negatively affect the academic success, physical health, and behavior of students. It is vital to take necessary actions to reduce excessive screen time in schools and at home, encourage extracurricular activities, and develop good screen use practices among young people

Keywords: Digital addiction, Academic achievement, Behavioral changes



Women's Economic Individualism in *Une Si Longue Lettre* by Mariama Bâ : A Qualitative Literary Analysis

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Introduction: Economic individualism is defined as an individual's autonomy over their own economic decisions, such as earning, spending, and investing, rather than having these decisions controlled by external forces. This study examines the representation of economic individualism among female characters in early Francophone literature.

Objectives: The objectives of this research are to examine how female characters construct economic individualism in Francophone literature, identify key economically independent characters, and analyze the strategies that enable their economic autonomy.

Methodology: To achieve these objectives, the semi-autobiographical epistolary novel *Une Si Longue Lettre* (1979) by Senegalese writer Mariama Bâ was used as the primary source. Secondary sources include existing research and scholarly articles on the novel and its socio-political context. The qualitative character analysis of the female Senegalese characters in the novel was conducted through a close reading, focusing on instances that illustrate their strategies for achieving economic individualism. The collected data were then organized into categories such as polygamy, social hierarchy, education, work, and freedom to identify behavioral patterns and the economic responses of these characters.

Results & Discussion: The findings of the study show that some characters accept the integration of all categories, while others reject the role of polygamy in their pursuit of economic individualism.

Conclusion: This study emphasizes the importance of adopting an economic perspective in analyzing character behavior, particularly within a postcolonial context.

Keywords: Economic individualism, Female characters, Francophone, Polygamy, Society



Job Satisfaction among International School Teachers: A Study Based on Selected International Schools in the Western Province, Sri Lanka

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Introduction: International Schools in Sri Lanka has a growing demand among parents due to its recognition in favour of globalization and related outcomes.

Objectives: The aim of this study is to investigate job satisfaction among international school teachers in selected schools in the Western Province with focus on identifying the factors that promote and detract from job satisfaction.

Methodology: The data was collected in a mixed method under two phases. In the first phase of the study, quantitative data was gathered via an online survey. It contained 108 questions with open ended and Likert scale questions. Demographic data, satisfaction based on Maslow's needs theory, satisfaction in work environment and management, and overall job satisfaction based on a survey tested by Paul E. Spector were measured through the online survey.

Results & Discussion: 112 responses were received through snowball sampling method. Received data were analyzed measuring the mean value scores and standard deviation. At the second phase of data collection, ten international school teachers were randomly selected for the interviews and the qualitative data collected was thematically analyzed.

Conclusion: The findings indicated a lower level of satisfaction across all three categories of satisfaction. Student, Self-esteem, support from co-workers were some of the positive factors while salary, and supervision were highlighted strongly as negative aspects.

Key words: International School Teachers, Job Satisfaction, School Management, Teacher Well-being Work Environment



Urban-Rural Inequalities in Educational Technology Integration: A Multiple Case Study of Sri Lankan Secondary Schools

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Introduction: Educational equity remains a significant challenge and digital learning opportunities are unevenly distributed. Though Sri Lanka's national education policies advocate equitable access to educational technology, disparities between urban and rural schools continue to exist. There is a dearth in qualitative research regarding the experiences and underlying causes of this divide.

Objectives: The study aimed to compare integration of educational technology in teaching and learning, examine disparities in access to resources, and assess the teachers' preparedness, attitudes, and technological competence in urban and rural schools.

Methodology: A qualitative multiple-case study design was adopted using two government schools in the Colombo District of Sri Lanka, one urban and one rural secondary school. The urban school, in the center of Colombo, had approximately 4000 students, from upper middle class, and affluent middle-class families, while the rural school, situated in a remote suburban area, served around 1304 students from lower-income households. Data was collected through classroom observations of sixteen lessons (two lessons each for eight teachers), a school infrastructure checklist, and semi-structured interviews with the participating teachers. Observation notes and interview transcripts were evaluated by thematic analysis, while checklist data using descriptive statistics.

Results & Discussion: The findings revealed marked differences in technology integration between the two schools. The urban school demonstrated adequate technological infrastructure, confident and regular use of digital tools by teachers and integration of technology into classroom instruction. In contrast, despite teachers' positive sentiments in interviews, observations at the rural school showed limited or ineffective use of technology, frequent connectivity issues, and teachers reluctance or difficulty in using digital tools.

Conclusion: The study concludes that without targeted investment in rural technological infrastructure and sustained, practice-oriented professional development for teachers, educational technology may reinforce rather than reduce existing educational inequalities in Sri Lanka.

Keywords: Digital divide, Educational technology integration, Secondary schools, Sri Lankan education, Urban-rural inequality



AI Conversational Tools in ESL Learning: Interaction Patterns and Learners' Perceptions of Pragmatic Competence Development among Sri Lankan Undergraduates

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Introduction: AI conversational tools generate grammatically accurate language; however, since they produce language from statistical regularities rather than social awareness, the language produced may be excessively polite or culturally insensitive. Currently, Sri Lankan undergraduates widely use AI tools, yet their diverse interaction patterns and how their pragmatic development is shaped by such tools are poorly understood.

Objectives: Thus, this study aimed to identify the interaction patterns of ESL undergraduates with AI conversational tools and to explore their perceptions of the usefulness and limitations of these tools for developing pragmatic competence.

Methodology: Employing a mixed-method approach, a structured questionnaire was administered to 96 ESL undergraduates of CINEC Campus, selected through convenience sampling. Additionally, semi-structured in-depth interviews were conducted with 03 ESL undergraduates to obtain a deeper understanding of their perceptions.

Results & Discussion: The findings indicated that the interaction was predominantly transactional: learners mainly requested corrections, revisions, examples, and accepted the output with little follow-up. Further, ESL undergraduates valued the instant feedback and exposure to polite expressions provided by the tools, reporting greater confidence in making requests and apologies. However, many claimed that the indirect forms were too formal for everyday interactional purposes.

Conclusion: In conclusion, the study indicates that even though AI tools are helpful in improving the pragmatic competence of undergraduates on transactional use, they may fail to develop genuine, pragmatic competence of users. As such, users must be encouraged to analyze the AI-generated language, ideally with the support of an instructor or a purposefully designed task, from which they learn to recognize the contextual factors that shape appropriate language use, such as politeness, formality, and the relationship between speakers. Ultimately, this reflective process transforms mere familiarity with AI into the genuine ability to use language appropriately across diverse social contexts, thereby developing pragmatic development.

Keywords: AI conversational tools, ESL undergraduates, Indirect speech acts, Pragmatic competence



Vampires as Forceful Assimilators: A Heuristic Character Analysis of the Vampires in *Sinners*, *Midnight Mass*, and *Castlevania: Nocturne* through the Colonization Model of Forceful Cultural Assimilation

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Introduction: Vampires have been popular character types in cinema for decades. Since their inception as iconic monsters in the horror genre, filmmakers have continuously interpreted the character in innovative ways, in certain times viewing the vampire as a romantic interest or sometimes viewing them as complex antagonists or anti-heroes with unique motivations behind their actions. Prior studies indicate that vampires as a character type have been placeholders for artistic intentions and themes since the introduction of the character into literature, and subsequently to cinema.

Objectives: The study aimed to analyze the vampires Remmick in *Sinners*, Monsignor Pruitt and the “Angel” in *Midnight Mass*, and Drolta and Erzsebet in *Castlevania: Nocturne* and attempted to define them as forceful assimilators in accordance with the Theory of Forceful Cultural Assimilation.

Methodology: The research followed a qualitative approach, emphasizing interdisciplinary design. It intended to conduct a Heuristic Character Analysis of the selected characters to observe how closely they resemble the characteristics of a forceful assimilator.

Results & Discussion: The study utilized primary data provided by a close analysis of the selected works which were then analyzed using the *Mise-en-scène* technique, and secondary data was derived from prior research. The study confirmed that the selected characters were indeed forceful assimilators with Remmick providing a direct metaphor for the dangers of assimilation, Monsignor Pruitt and his vampire “Angel” depict religion as a tool of assimilating communities forcefully, and Drolta and Erzsebet showcasing human desperation to survive and how that drive to survive can be a potential exploitation point for those who would practice forceful assimilation.

Conclusion: The study provides new knowledge to the research lacunae by inviting academics to view a classic character type in a modern sociological perspective and to evaluate the vampire as more than a one-dimensional monster or antagonist.

Keywords: Cinema, Forceful assimilation, Heuristic character analysis, Vampires



Media Narratives of the Post-War Moment: A Discourse Analysis of Front-Page Coverage of Selected Sri Lankan English Newspapers (2009-2010)

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Introduction: Newspaper discourse played a significant role in shaping narratives of Sri Lankan civil war, particularly through front-page coverage. Systematic analyses of post-war representations remain underexplored within discourse-oriented media studies.

Objectives: By examining the narratives constructed by two Sri Lankan English newspapers, Sunday Observer and Daily Mirror, this study analyzes representation and discourse patterns in front-page news articles from May 2009 to May 2010. It further investigates recurrent themes and framing strategies, emphasizing the role of ownership in reflecting or diverging from government perspectives.

Methodology: This study is theoretically grounded in Norman Fairclough's three-dimensional model of Critical Discourse Analysis, which informs the examination of textual, discursive and social practices within media narratives. The analysis adopts a qualitative design, employing a purposive sample of thirteen front-page articles each from the two newspapers, selected within the defined study period.

Results & Discussion: The findings reveal recurring discursive patterns in front-page reporting, characterized by national unity, post-war economic development and reconciliation between Sinhalese and Tamil communities, consistently aligning with the three dimensions of Fairclough's model. Texts display similar linguistic and visual strategies, while narratives construct a unified post-war identity at discursive layer. Drawing socio-cultural relations to discourse, these representations predominantly reflect a state-centered perspective, as objectives aimed to investigate. Tamil political actors and international groups are portrayed as supportive of the state, while consistently delegitimizing the LTTE. Despite subtle variations in framing, both state-owned and privately-owned newspapers reproduce dominant narratives, highlighting the influence of political and ideological positioning in shaping post-war discourse.

Conclusion: The study contributes to understanding the relation between language and society by revealing how newspaper discourse constructs post-war narratives while acknowledging the limitations of purposive sampling.

Keywords: Discourse analysis, English, Newspapers, Ownership, Post-war moment



Cultural Expectations and the Representation of Romantic Relationships in 21st Century Fiction: A Comparative Study of Normal People and Red White and Royal Blue

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Introduction: Contemporary fiction is increasingly romantic relationships through themes of identity, intimacy, emotional vulnerability, and societal influence. While heterosexual relationships are more accepted by society than LGBTQ+ relationships, both often experience similar cultural and emotional hardships. As David R. Shumway argues, modern relationships are shaped by “emotional fulfillment, desire and companionship” rather than social obligation alone.

Objectives: This study comparatively examines how cultural expectations shape romantic relationships in twenty-first century fiction through *Normal People* by Sally Rooney and *Red White and Royal Blue* by Casey McQuiston.

Methodology: The research particularly focuses on themes such as social pressure, emotional vulnerability, intimacy, identity and self- discovery, public versus private desire, and challenges exist beyond sexual orientation.

Results & Discussion: Framed through the queer theoretical perspective, the study shows sexuality as socially constructed and fluid, reflecting Eve Kosofsky Sedgwick's argument that “the closet” continues to shape social understanding of identity and desire. Applying queer theory and social constructivism as theoretical frameworks, the study evaluates how both heterosexual and same sex relationships are influenced by the internal and external factors including family expectations, social class, public image, fear of rejection, emotional conflict, and miscommunication. Utilizing a qualitative comparative textual analysis, the research applies thematic coding to identify text segments such as family expectations, social class, public image, fear of rejection, emotional conflict and miscommunication within the selected text before comparatively analyzing their similarities and differences in their portrayal of romantic relationships. The study demonstrates that despite differing levels of social acceptance, both heterosexual and LGBTQ+ relationships experience comparable struggles related to communication, intimacy, identity, and societal expectations.

Conclusion: The study contributes to contemporary literary criticism by demonstrating that emotional conflict within romantic relationships cannot be explained solely through sexual orientation but should be understood through broader cultural expectations governing intimacy, identity, and belonging.

Keywords: Contemporary fiction, Cultural expectations, Queer theory, Romantic relationships, Social constructivism



Narrative Visibility and the Indirect Construction of Female Psychological Experience in Selected Short Stories

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Introduction: This study examines the indirect narrative construction of female psychological experience in *The Divorcee* by Ken Saro-Wiwa, *The Day They Burned the Books* by Jean Rhys and *A Curtain of Green* by Eudora Welty. Existing studies primarily examine these short stories in relation to gender oppression, colonialism, grief, racial tension and patriarchy, while comparatively limited focus has been given to how external narrative perspectives mediate access to female psychological experience.

Objectives: This study investigates how narrative voice, focalization, narrative distance, together with symbolism, behavioural cues, and imagery, contribute to the indirect construction of female psychological experience in the selected short stories.

Methodology: This study adopted a qualitative approach combining close textual analysis with questionnaire responses, and semi-structured interviews. Guided by narratology and reader-response theory, the textual analysis employed a deductive approach by applying predefined narratological categories, while a comparative analysis identified recurring patterns and variations across the three texts. Questionnaire and interview data were used to examine readers' interpretations of the narrative cues through which female psychological experience is constructed.

Results & Discussion: The findings demonstrated that external narrative perspectives constructed varying degrees of narrative visibility through which readers inferred female psychological experience. The comparative analysis revealed that each story employs different configurations of narratological techniques, resulting in varying degrees of narrative visibility. Questionnaire responses and semi structured interviews further indicated that readers actively construct psychological meaning by interpreting narrative cues. Collectively, the findings demonstrated that female psychological experience emerges through the dynamic interaction between narrative mediation and reader interpretation.

Conclusion: This study contributes to existing literature by constructing a narratological and reader-oriented understanding of the indirect representation of women's psychological interior in short fiction. It extends existing discussions of thematic and ideological interpretations to foreground the significance of narrative form in constructing meaning.

Keywords: Female interiority, Narrative Visibility, Narrative Voice, Narratology, Reader-response theory



Re-assessing Feminism: A Comparative Analysis of “The Thing Around Your Neck” by Chimamanda Ngozi Adichie, “Everyday Use” by Alice Walker, and “The Defeated” by Nadine Gordimer

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Introduction: This study comparatively examines Chimamanda Ngozi Adichie's “The Thing Around Your Neck”, Nadine Gordimer's “The Defeated”, and Alice Walker's “Everyday Use” through the lenses of intersectionality, victim feminism, and power feminism. Drawing on Kimberlé Crenshaw's theory of intersectionality, this study explores how race, class, gender, and culture shape women's negotiations of power and vulnerability. While existing feminist readings of these texts primarily emphasize gender-based oppression and resistance, limited attention has been given to how intersecting identities challenge the assumption that women occupy fixed positions of marginalization or empowerment. The study argues that women's identities and social positions are context-dependent, demonstrating that marginalization does not always result in victimhood, nor does agency always indicate complete empowerment.

Objectives: To demonstrate that women's experiences of marginalization and empowerment are context-dependent rather than fixed categories.

Methodology: This study is a qualitative research approach based on textual analysis. Secondary sources based on criticism on feminism, intersectionality, power and victim feminism were intensively read.

Results & Discussion: The selected narratives show various dimensions of feminism based on agency, class, gender and are context specific and cannot be explained as a general theory of oppression, nonetheless a multi-layered shaping of unique experiences of self-victimization.

Conclusion: To view feminism as a theory with pluralism which needs more modern interpretations aligning with the contemporary views based on feminism.

Keywords: Intersectionality, Power feminism, Victim feminism



The Weaver of Souls: A Critical Analysis of the Evolution of the Modern Fantasy Heroine Through a Jungian Archetypal Lens in “Wild Reverence”

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Introduction: This study examines the psychological development of the modern fantasy heroine through Carl Jung’s concepts of shadow and individuation in an archetypal analysis of Matilda in “Wild Reverence” by Rebecca Ross. While existing studies on fantasy literature primarily focus on mythology, fantasy narratives, genre-based themes, and archetypal structures in video game narratives, this study interprets archetypes as interconnected stages of identity formation within the modern fantasy heroine.

Objectives: Therefore, this research aims to critically examine how Matilda emerges as a modern fantasy heroine through Jungian concepts of shadow and individuation in relation to archetypal transformation.

Methodology: Thus, this study employs a qualitative approach utilizing close reading and thematic analysis of the novel to examine Matilda’s character development throughout the narrative. Furthermore, archetypes within shadow and individuation were critically analyzed across different stages of the heroine’s journey.

Results & Discussion: The analysis revealed that Matilda’s journey undergoes a gradual archetypal transformation shaped by shadow and individuation. Archetypes within the shadow, particularly the orphan, lover, explorer, and magician, reflect emotional vulnerability, and unrecognized potential in the early narrative. In contrast, archetypes linked to individuation, including the hero, rebel, explorer, and magician, represent Matilda’s growing autonomy and emotional maturity. Furthermore, this transformation redefines Matilda beyond the conventional fantasy heroine into a modern heroine shaped by agency, sacrifice, and inner transformation. These findings validate the study’s objective by demonstrating how archetypal progression shapes Matilda’s journey.

Conclusion: In conclusion, Matilda’s archetypal transformation through shadow and individuation reconstructs the modern fantasy heroine. Although limited to a single literary text, the study contributes to contemporary fantasy studies and archetypal criticism. Future research could further explore fantasy heroines through comparative theoretical perspectives.

Keywords: Archetypal transformation, Individuation, Jungian archetypes, Modern fantasy heroine, Shadow



The Impact of Social Media Influencers on Spoken English Pronunciation Styles among Undergraduates in Western Province

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Introduction: This study investigates the influence of social media influencers, in their diverse roles as YouTube celebrities, Facebook content creators and vloggers on the pronunciation styles of urban youth in higher education institutions in Western Province, Sri Lanka. Modern research recognizes digital media as a powerful tool for linguistic diffusion. However, there remains a clear research gap concerning how digital content creators specifically influence localized pronunciation within Spoken Sri Lankan English (SLE), which has evolved into a distinct, autonomous variety with its own sociolinguistic norms.

Objectives: To examine the precise ways these creators, alter youth speech patterns and to evaluate the extent of their linguistic impact.

Methodology: In contemporary Sri Lanka, digital content creators act as modern trendsetters. As youth consume their content, they are exposed to a blend of global English trends and localized colloquialisms. This study used qualitative methods design targeting English - speaking undergraduates (aged 20–25) in Western Province. Methodology involved a 15-hour audio-visual data from trending Sri Lankan YouTube talk shows and selected Facebook contents were compiled and analyzed using AntConc for text frequencies. Additionally, 20 interviews with target undergraduates were conducted to evaluate spoken English styles.

Results & Discussion: The data show that the target undergraduates' pronunciation styles (such as word-final rhoticity and American accent) were characterized by the adoption of the social media celebrities they follow. This validates global findings on celebrity linguistic mimicry. Furthermore, celebrity code-mixing between Sinhala and English has legitimized non-standard variations of pronunciation styles. Youth treat this hybrid speech style as a high-prestige register.

Conclusion: Social media influencers exert a significant, observable impact on the pronunciation style of spoken English of urban Sri Lankan youth by globalizing accents, and they accelerate changes within spoken SLE. This imitation is driven by a psychological desire for social prestige and identity alignment.

Keywords: Code-mixing, Pronunciation styles, Social Media Influencers, Sri Lankan English (SLE), Undergraduates



Factors Affecting Grammatical Accuracy in Undergraduate English Literature Essays

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Introduction: While English undergraduates are expected to demonstrate advanced language proficiency, a noticeable gap often emerges when they shift from studying linguistic theory to writing literary analysis. Many BA in English undergraduates continue to make persistent grammatical errors in literature essays, revealing a disconnect between literary understanding and language execution. Although undergraduates complete foundational grammar and writing modules during their first semester, this knowledge often fails to transfer effectively into literature-based academic writing, ultimately affecting their academic performance.

Objectives: This study investigates the most frequent grammatical errors found in undergraduate literature essays, examines the factors contributing to these mistakes, and proposes practical solutions.

Methodology: A mixed-methods approach was employed, combining quantitative and qualitative content analyses. Data was collected through Google questionnaires completed by students and a linguistics-based error analysis of thirty randomly selected literature answer scripts. The assessment of student scripts revealed that subject-verb agreement was the most common grammatical error, alongside tense inconsistency and incorrect preposition usage.

Results & Discussion: Questionnaire responses identified several contributing factors; exam time pressure often causes students to prioritize the analysis of complex literary themes over grammatical accuracy. In addition, students sometimes transfer sentence structures from their native language into English, influencing word order and agreement patterns. Findings also showed that, although grammar is considered important in assessment, students require more detailed guidance and constructive feedback to improve their academic writing skills. Students further emphasized the need for both institutional and academic support.

Conclusion: The study, therefore, concludes that literature programmes should incorporate practical interventions such as academic writing workshops, structured proofreading checklists with model examples, and clearer grading rubrics that address grammatical accuracy alongside literary analysis.

Keywords: Grammar, Literature, Undergraduates



Evaluating Teaching English Literature Using Integrated Lecture-Discussion and Technology-Enhanced Teaching Methods

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Introduction: The increasing integration of technology into education has transformed teaching practices, encouraging educators to adopt technology-assisted approaches. However, teaching English literature requires not only the delivery of information but also interpretation, critical thinking, discussion, and personal engagement with literary texts. Therefore, it is important to examine whether technology-enhanced approaches can effectively support literature learning compared to discussion-based teaching methods.

Objectives: This study aimed to compare the effectiveness of the Integrated Lecture-Discussion Method and the Technology-Enhanced Teaching Method in teaching English literature among undergraduate students while exploring students' perceptions of both approaches.

Methodology: The study employed a qualitative research approach, using purposive sampling to select two groups of undergraduate students from a non-state higher education institution in Sri Lanka. The poem 'A Poison Tree' by William Blake was taught using two different approaches: the Integrated Lecture-Discussion Method and the Technology-Enhanced Teaching Method. Students' understanding was evaluated using short-answer comprehension questions, and their performance was compared. Additionally, students' perceptions were collected through a Google Forms questionnaire.

Results & Discussion: The findings revealed that students taught through the Integrated Lecture-Discussion Method achieved relatively higher performance scores and demonstrated better comprehension compared to those taught through the Technology-Enhanced Teaching Method. Student feedback indicated that the Integrated Lecture-Discussion Method encouraged deeper discussion, critical interpretation, and the connection of literary concepts with personal experiences.

Conclusion: The study concludes that although technology-enhanced teaching can support engagement, the Integrated Lecture-Discussion Method appears to be more effective for developing deeper understanding in English literature instruction at the undergraduate level.

Keywords: English literature, Integrated lecture-discussion, Qualitative research, Technology-enhanced teaching method, Undergraduate education



Mimesis and Allegory of the Cave: A Comparative Analysis of the Sri Lankan Drama Take Care and the Novel “The Road from Elephant Pass”

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Introduction: This study is a comparative analysis of the Sri Lankan novel “The Road from Elephant Pass” and the drama “Take Care” examined through the theoretical framework of Aristotle’s Mimesis and the Allegory of the Cave.

Objectives: Primarily, this study examines the contribution of illusion, perception and subjectivity in the construction of social reality in the selected genres. Further, the study also explores the gradual shift from absolute ignorance to complete awareness within the specified character population.

Methodology: The study conducts both character and thematic analyses of both the genres to identify the endearing impact of Plato’s and Aristotle’s Classical Theories on the two selected genres within the contemporary field of Literature and drama. The research explores the thematic concerns of violence, discrimination and marginalization in relation to the novel while Take Care focuses on domesticity, marriage, infidelity and gender norms. The study features a qualitative approach relying on close textual interpretation of specific plot instances, dialogues and characterization that reinforce the theoretical frameworks. Additionally, the study also utilizes a questionnaire administered to a purposively selected sample thereby triangulating the data while reducing the researcher bias.

Results & Discussion: Moreover, the research demonstrates the degrees of reality when perceived through social and individual lenses whilst it also highlights the gradual transformation of individuals into philosophical reawakening.

Conclusion: Consequently, this study aims to provide valid conclusions involving the profound influence of Classical Theories within the contemporary field of Literature and drama despite belonging to two separate and distinctive genres.

Keywords: Aristotle’s mimesis, Classical literary theories, Plato’s Allegory of the Cave, Take care, The Road from Elephant Pass



Factors Influencing Language Preference for Emotional Expression on WhatsApp: A Cross-Sectional Study of Bilingual Sri Lankan Undergraduates in Two Selected Universities

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Introduction: Despite stronger emotional resonance in one's first language, Sinhala-English bilinguals in Sri Lanka often prefer English for emotional expression in their WhatsApp Status captions.

Objective: To investigate four factors influencing language preference for emotional WhatsApp Status captions among Sri Lankan Sinhala-English bilingual undergraduates: social and cultural standards, peer network influence, technological convenience, and modern aesthetic appeal.

Methodology: A convergent parallel mixed-methods design was employed for this cross-sectional study. Using purposive sampling, data were collected from Sinhala-English bilingual undergraduates at CINEC Campus and Horizon Campus through a questionnaire (n = 100), semi-structured interviews (n = 10), and a collection of voluntarily submitted WhatsApp Status screenshots (n = 20). Quantitative data from the questionnaire were analyzed using descriptive statistics and Spearman's rho, while qualitative data from interview transcripts and screenshots underwent thematic and content analysis, respectively.

Results & Discussion: Quantitative findings revealed a clear preference for English in emotional WhatsApp Status captions, despite Sinhala remaining emotionally closer. Specifically, 75.0% reported using English exclusively or predominantly for such captions, while only 16.0% identified English as the emotionally closer language, compared with 56.8% for Sinhala and 27.2% reporting equal emotional resonance in both languages. Technological convenience (M = 3.59) and social and cultural standards (M = 3.51) emerged as the strongest influences, with ease of typing in English and the perception that Sinhala feels too personally revealing identified as the principal reasons for this preference. Qualitative findings further revealed emotion-dependent code-switching, with English generally preferred for love and joy, and Sinhala for grief, anger, and other vulnerable emotions. Together, the results suggest that bilingual undergraduates strategically balance emotional authenticity with self-presentation when expressing emotions on WhatsApp.

Conclusion: These findings provide empirical evidence from the underexplored Sri Lankan sociolinguistic context and contribute to understanding language choice in bilingual digital communication.

Keywords: Bilingualism, Emotional expression, Language preference, Sri Lanka, WhatsApp



A Comparative Analysis of Marital Relationships of Societal Expectations in 'The Story of an Hour, The Necklace, The Yellow Wallpaper' and 'A Doll's House'

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Introduction: This comparative study examines the representation of domestic space in late 19th-century literature as a site of struggle for female autonomy, by analyzing across different cultural and distinct geographical contexts such as Kate Chopin's *The Story of an Hour* (1894), Guy de Maupassant's *The Necklace* (1884), Charlotte Perkins Gilman's *The Yellow Wallpaper* (1892), and Henrik Ibsen's *A Doll's House* (1879) during the *Fin de Siècle*.

Objectives: This paper strives to analyze the construction and symbolic use of domestic space within and between distinctly American, French, and Scandinavian literary traditions during the late 19th century.

Methodology: Qualitative research methods involving comparative textual analysis and close reading are applied here to decode such thematic patterns, linguistic details, and symbolic motifs as Gilman's wallpaper and Ibsen's domestic masquerade in isolating gendered power structures.

Results & Discussion: These findings are anticipated: the cultural manifestations of patriarchal pressures explored range from the medicalized confinement, as in Gilman, to Maupassant's bourgeois materialism; all four protagonists are, however, struck very deeply at the sense of limitation that causes psychological or physical alienation. Crucially, the paper argues that these protagonists employ subversive strategies such as psychological strategies – such as psychological withdrawal, structural deception, and physical departure, that disrupt both the power structures of marriage and conventional narrative expectations. In this sense, the texts here craft a joint discourse whereby, finally, marriage becomes the institution whereby women's passivity becomes inscribed and reinforced. Ultimately, this study demonstrates radically transcultural critique of institutionalized denial of female autonomy in and through its several varied forms.

Conclusion: In that light, this article situates itself within a much better constructed and nuanced feminist literary criticism of the late 19th century.

Keywords: 19th Century Literature, Domesticity, Feminist literary criticism, Patriarchal structures, Transcultural analysis



An Interdisciplinary Study on the Metamorphoses of Shakespearean Protagonists in Two Selected Tragedies Concerning Psychological Impact and Rhetorical Manipulation

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Introduction: The profound impact of Shakespearean tragedies has advocated a new relevance to literature as a cognitive artifact. Although, there is a plethora of research conducted to examine the character struggles pertaining to various fictional characters, the dearth in existing literature for studies investigating the impact of emotional turbulences and rhetorical manipulation on the metamorphosis of selected Shakespearean tragic protagonists Othello and Macbeth delineates the stance of the study within the purview of existing literature. Contextually, within the study, the term metamorphosis conveys the idea of the downfall of the selected Shakespearean Protagonists, both psychologically and physically.

Objectives: Moreover, this study aims to investigate the dependent variable metamorphosis of selected Shakespearean protagonists in relation to the dependent variables which are psychological impact and rhetorical manipulation.

Methodology: Correspondingly, it utilized a qualitative interdisciplinary approach and is grounded on the theoretical framework developed in relation to Freudian psychoanalytic theory and Aristotle's theory of persuasion. Relatedly, primary data was collected through the meticulous reading of the selected texts "Othello and Macbeth" while focusing on specific quotations, soliloquies and scenarios. Secondary data was sourced from scholarly articles, theses, and academic research that enhanced the scope of understanding on the efficacy of the utilized theories and selected texts within the study.

Results & Discussion: The findings of the study reveal certain inherent characteristics and behavioral patterns, which were common to both protagonists such as masculine ego, martial prowess and lack of moral compass that made their downfall inevitable.

Conclusion: In conclusion, the study delineates the parameters of psychological intricacies such as paranoia and insomnia observed within Shakespeare's most masterfully crafted tragic protagonists.

Keywords: Macbeth, Metamorphosis, Othello, Psychological intricacy



Reading for Social Awareness: Early Pregnancy, Sexual Vulnerability and Adolescent Decision-Making in Two Prescribed A/Level Novels

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Introduction: Adolescence is a critical developmental stage marked by heightened emotional sensitivity, and early pregnancy and sexual vulnerability remain a pressing developmental concern among Sri Lankan secondary level learners, shaped by patriarchal structures limiting young women's autonomy. Limited attention has been given to how pedagogical engagement with prescribed texts shapes adolescent readers' awareness of relationship risks and decision making, a gap this study addresses.

Objectives: This study examines the pedagogical role of two prescribed G.C.E. A-Level English Literature texts, *Tess of the d'Urbervilles* and *Nectar in a Sieve*, in shaping adolescent awareness and decision-making, grounded in Reader-Response Theory. It aims to identify how early pregnancy and sexual vulnerability are portrayed, examine how pedagogical engagement shapes students' recognition of relationship risks, and assess how this translates into reflective decision-making.

Methodology: A qualitative exploratory case study design gathered data from forty G.C.E. A-Level students in the Matara District through open ended questionnaires, analyzed using thematic analysis.

Results & Discussion: Thematic analysis revealed that students consistently attributed the vulnerability of Tess, Rukmani and Irawaddy to limited awareness and unequal power rather than personal fault, identifying patriarchy, poverty, and social judgement as structural forces shaping both narratives. Findings further indicate that pedagogical engagement extending beyond examination requirements enables students to recognize warning signs of unhealthy relationships, reflect meaningfully on their own decision making, and draw on these literary representations as a resource for real life awareness. These findings suggest that pedagogical engagement itself, rather than exposure to the texts alone, determines whether such representations are internalized as meaningful life lessons or remain confined to examination content.

Conclusion: The study contributes to a limited body of research connecting literary pedagogy with adolescent psychosocial development in the Sri Lankan context, offering practical benefit for literature teachers addressing sensitive social issues; further research with larger, diverse samples is recommended to strengthen these findings.

Keywords: Adolescent vulnerability, Early pregnancy, Pedagogical engagement, Reader-response theory, Sexual vulnerability



Perceived Factors Influencing the Development of Informal English Fluency among Bilingual Sri Lankan Youth

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Introduction: English plays an important role in Sri Lanka as a medium of instruction and a tool for social mobility. Yet, English fluency outside the classroom is rather inconsistent in the Sri Lankan bilingual context. This study explores how Sri Lankan bilinguals aged 20 to 30 perceive their informal English fluency development, considering different English exposure patterns.

Objectives: The study investigates whether Sri Lankan bilinguals describe their fluency development as conscious or subconscious, identifies the most influential factors, and explores informal and formal exposure patterns, including views on academic English. It also explores perceptions of whether high fluency is attainable despite limited formal learning or late exposure, and whether early exposure guarantees similar fluency levels.

Methodology: An explanatory sequential mixed-methods design was employed, comprising a questionnaire with 73 conveniently selected participants, followed by semi-structured interviews with 10 purposively selected participants. Questionnaire data were analyzed using descriptive statistics. Interview data were analyzed using Braun & Clarke's Reflexive Thematic Analysis (2019).

Results & Discussion: Questionnaire findings showed that 43.8% of participants perceived fluency development as natural; another 43.8% viewed it as both natural exposure and deliberate practice. Watching movies & TV shows (91.8%), reading (75.3%), and digital interaction (69.9%) were the most common influential factors. Informal exposure (family, peers, media) emerged as the main driver of fluency, with formal learning being linked to grammatical accuracy (a few participants nonetheless credited formal education as their primary source). Interviews contextualized these trends: fluency was mostly viewed as naturally acquired, influenced by English-speaking environments, movies, reading, and texting. Interviewees believed that fluency can be attained despite limited formal instruction or late exposure, given current exposure, active language use, motivation, and confidence.

Conclusion: Findings highlight the psychology behind perceived informal fluency development and suggest better integration of informal learning experiences alongside formal teaching in Sri Lanka. Future research could expand samples and include objective fluency measures.

Keywords: Bilingual Sri Lankan Youth, English Exposure Patterns, Influential Fluency Factors, Perceived Informal English Fluency



Lexicogrammatical Deviations in Academic Written Discourse of BEd Undergraduates in a Selected Non-State Higher Education Institute in the Western Province

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Introduction: Bachelor of Education undergraduates are expected to demonstrate a solid understanding in the interactions grammatical and lexical aspects have with each other and with the communicative purpose of the text in English language. Any gaps found in these interactions that are defined as lexicogrammatical features, appear as lexicogrammatical deviations. Although it is essential for BEd undergraduates to demonstrate clarity and meaning through strong lexicogrammatical choices in academic writing, many struggle to produce lexicogrammatically appropriate written discourse and it is essential to address this gap to mitigate their impact on meaning construction.

Objectives: Despite this importance of examining lexicogrammar in Academic Writing of undergraduates, limited research has investigated this phenomenon within the Sri Lankan undergraduate context and therefore, this study aims to identify patterns of lexicogrammatical deviations in the academic writing of BEd undergraduates in a selected non-state higher education institute in the Western Province.

Methods & Analysis: The study adopts a mixed-method research design with qualitative analysis as the primary approach supported by quantitative analysis. Contextual data that measures how context affects language acquisition is collected through a background questionnaire followed by an in-class writing task. Both these instruments measure the academic writing production of BEd undergraduates. Using purposive sampling, several answers from the test are selected as the primary data source of the study. Compiling these answer scripts into a learner corpus, the answers are analyzed through manual reading together with assistance from AntConc corpus tool.

Conclusion: The analysis examines the lexicogrammatical deviations in the academic writing of these undergraduates and how they affect the clarity of language.

Keywords: Academic writing, BEd undergraduates, Corpus-based analysis, Learner Corpus, Lexicogrammatical deviations, TESL



A Study of Contrasting Judgements towards Female and Male Transgression: Gendered Morality of Adultery in Leo Tolstoy's Anna Karenina

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Introduction: Research aiming to understand and explore the gendered and societal morality towards male and female transgression while studying the reasons lay behind the controversial judgements towards wrongdoings, based on the gender.

Objectives: This study examines the way of which Leo Tolstoy has represented adultery as a gendered issue and to analyze the contradictory social judgements on male versus female transgression aligning with participants perspectives.

Methodology: This is a mixed method design, compromised with 20 participants including both males and females between the ages of 20 and 30. This selection will include both married and unmarried participants from different religions. Specifically, there will be 5 married males and 5 married females, 5 unmarried males and 5 unmarried females. The justification of this selection of participants is that religious beliefs, marital status will affect the opinions of individuals regarding the concern of adultery. The collected data will be analyzed with further readings of the subject “adultery” and “society” along with the thematic analysis.

Results and Discussions (Expected): Data collection is still in the process, yet the expected results are expected to be different from each individual based on their marital status and religion. The responses will denote that transgression of males and females are judged differently depending on their perspectives.

Conclusion: This study cannot be appropriately concluded as it is not completed. Hence, it will conclude in a way that explores how and why the moral perspectives regarding gender-biased transgression differs regarding individuals' beliefs and opinions.

Keywords: Adultery, Gender-biased, Mixed- method, Social condemnation, Transgression



Exploring Identity and Societal Role Construction in War Time through Characters of Wasantha and Kamala in the Road from Elephant Pass

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Introduction: The goal of this paper is to explore the relationship between identity and societal role construction in wartime through the characters of Wasantha and Kamala in the novel *The Road from Elephant Pass*. The novel displays a complex representation of how the identity is constructed as a dynamic process in which both the characters and their behaviours are shaped by the changing circumstances as they share experiences throughout their journey.

Objectives: Therefore, the study aims to analyze how the identity is constructed and reconstructed based on gender expectations, societal roles, political ideologies, ethnicity, psychological trauma and wilderness during wartime.

Methodology: This research adopts a qualitative approach through textual analysis of Stuart Hall's identity theory to examine the characterization, narrative progression, dialogue and key events.

Results & Discussion: The findings reveal that Kamala's Tamil identity and political affiliation with the LTTE place her in a socially marginalized and politically liable position, whereas Wasantha's identity as a Sinhala army captain positions him within the state- authority, nationalism, conventional norms and gender expectations. These identities are further transformed through their shared struggle for mere survival as the narrative progresses. The wilderness serves as a transformative space encouraging both Wasantha and Kamala to depend on each other while weakening these rigid ethnic, gender and political boundaries.

Conclusion: The research concludes that the identity is portrayed as a fluid, two-way social role construction while conveying that there is a potential to redefine interpersonal relationships and individual identities during wartime.

Key words: Identity, Political ideology, Social expectations, Societal role, Two-way construction



Effectiveness of Human Rights Representation based on Narrative Styles in Twenty-First Century Sri Lankan Novels

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Introduction: Literature has increasingly been recognised as an important medium for documenting, remembering, and critically examining experiences of violence, oppression, and injustice. Human rights (HR) literature amplifies marginalised voices and enables readers to engage with the lived experiences of victims and survivors. This study examines how contemporary Sri Lankan novelists employ different narrative styles to represent HR issues shaped by conflict, post-war realities, and social stigmatization. Despite growing scholarship on HR literature, limited research has explored the distinctive narrative approaches developed within the Sri Lankan context and the particular effects of such styles.

Objectives: Examine how twenty-first-century Sri Lankan authors represent HR issues through narrative style and analyse their influence using theories of HR literature.

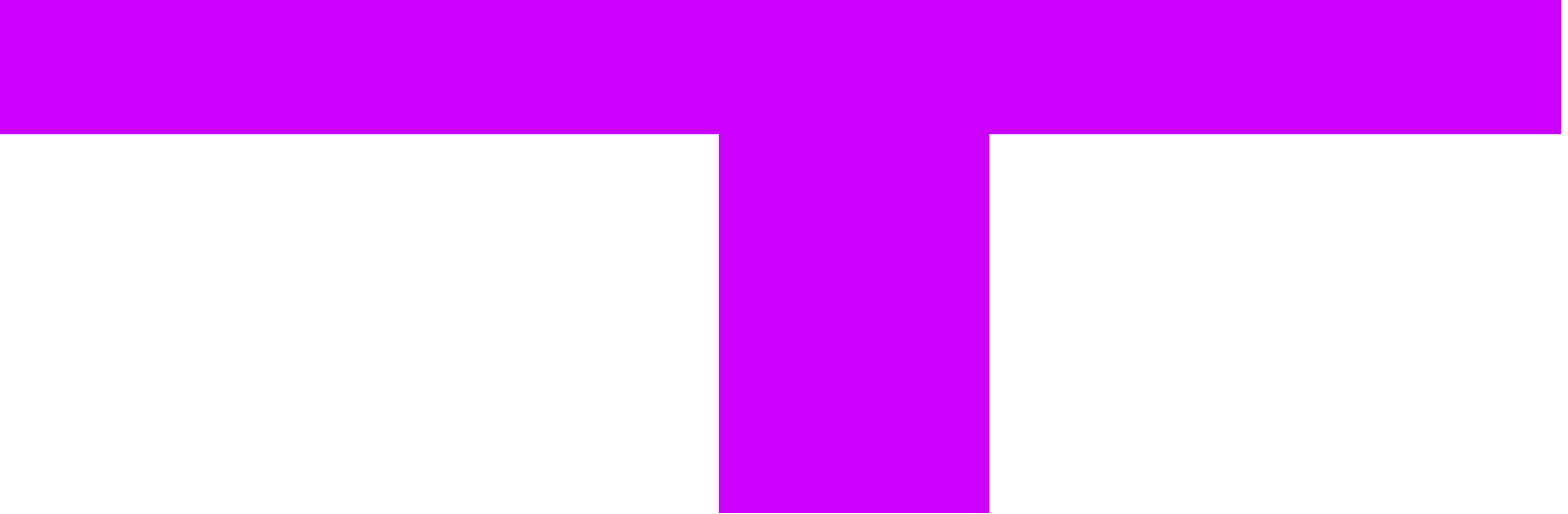
Methodology: The study adopts a qualitative comparative literary analysis of *The Seven Moons of Maali Almeida*, *The Giniralla Conspiracy*, and *Brotherless Night*. The novels are analysed through theories of HR literature, including victim narration, to compare their narrative structures and representations of HR.

Results and Discussion: The analysis identified recurring themes of violence, trauma, memory, justice, reconciliation, and identity. *Brotherless Night* employs first-person narration to foreground personal testimony and emotional engagement. *The Seven Moons of Maali Almeida* combines satire, magical realism, and multiple perspectives to challenge official histories and expose silenced narratives. *Giniralla Conspiracy* adopts an investigative narrative highlighting structural violence, institutional failures, and contested national identity. First-person narration strengthens emotional engagement with victims, while broader perspectives provide wider socio-political insights. Collectively, the novels demonstrate locally grounded narrative strategies shaped by Sri Lanka's history, culture, and post-conflict realities, contributing to a distinctive Sri Lankan mode of HR narration.

Conclusion: The study concludes that narrative style significantly shapes HR representation in contemporary Sri Lankan literature. Future research should examine broader literary genres to further develop an indigenous framework for interpreting Sri Lankan HR narratives.

Keywords: 21st century, Human Rights Literature, Narrative Style, Novels, Sri Lankan Literature





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Governance, Transparency, and Cost Overruns in Public Construction Projects: A Social-Behavioural Perspective

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Introduction: Cost overruns continue to be a major challenge in public construction projects, particularly in developing countries where weak governance, limited transparency, and behavioural dynamics among stakeholders often intensify project inefficiencies. Although many studies examine technical and financial causes, the influence of governance quality, accountability, and social-behavioural factors on project costs remains comparatively underexplored. This gap is significant because governance failures and weak transparency can lead to inefficient use of public funds, project delays, and reduced public trust. Understanding these dimensions is essential for improving cost performance and strengthening management practices in the public sector.

Objectives: This study explores how governance practices, transparency mechanisms, and stakeholder behaviour contribute to cost overruns in public construction projects. It also aims to identify governance-driven strategies that can reduce these risks and support more reliable project outcomes.

Methodology: A survey-based quantitative approach was used, involving 200 public-sector professionals, including quantity surveyors, engineers, project managers, and procurement officers. The questionnaire assessed perceptions related to governance quality, accountability, communication behaviour, and procurement transparency. Reliability analysis yielded a Cronbach's alpha value of 0.87, while content validity was confirmed through expert review. The data collected were analyzed using descriptive statistics, correlation tests, and multiple regression to determine which governance and behavioural factors are most strongly associated with cost overruns.

Results & Discussion: The findings indicate that limited procurement transparency, unclear decision-making processes, biased judgement, and weak communication are closely linked to higher cost overruns. In contrast, projects supported by stronger governance systems, clear accountability measures, and transparent procurement procedures experienced noticeably fewer cost deviations. These results highlight that cost overruns stem not only from technical challenges but also from broader issues related to institutional culture and human behaviour.

Conclusion: Improving governance structures, enhancing transparency, and promoting ethical and evidence-based decision-making can help substantially reduce cost overruns in public construction projects. Strengthening accountability and communication among project stakeholders supports better cost performance and reinforces public trust in government-funded infrastructure. The study underscores the need for governance-focused reforms to foster more effective and responsible public construction management.

Keywords: Accountability, Cost overruns, Governance, Public construction, Transparency



Impact of Workforce Diversity on Employee Performance with Special Reference to Five-Star Hotels in Colombo District, Sri Lanka

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Introduction: Workforce diversity is increasingly recognized as a strategic factor in enhancing employee performance, particularly in dynamic industries such as hospitality. Employee performance is considered the most important aspect for any organization's success. The study examines the impact of workforce diversity considering factors like age, gender, education, and ethnicity on employee performance in five-star hotels in Colombo, noting that the effects can be either positive or negative depending on management practices.

Objectives: The study objectives, to evaluate the impact of workforce diversity on employee performance, identify the relationship between specific diversity dimensions (age, gender, education, ethnicity) and performance, and determine which dimension most significantly affects performance.

Methodology: In this study, a deductive approach to data gathering was used. This involved collecting data through a questionnaire that was created based on a review of 20 research articles on the topic. The questionnaire was sent via email to the Human Resource department of five-star hotels in the Colombo District, distributed it to the operational staff through their official email accounts and WhatsApp. Data was collected for a month and received 384 responses. Data analysis was done using SPSS software, through descriptive statistics, Pearson correlation and multiple regression analyses.

Results & Discussion: It indicated that there is a substantial positive effect of workforce diversity on employee performance at the operational level in five-star hotels in the Colombo District. It was observed that all four aspects of workforce diversity including age diversity, gender diversity, educational diversity, and ethnic diversity have a positive effect on employee performance, where educational and gender diversity have the maximum contribution.

Conclusion: The study concludes that workforce diversity has a significant positive impact on employee performance. Emphasizing inclusive HR policies, diversity training, and team development is essential. Future research should consider a broader regional focus and adopt mixed methods for deeper insight.

Keywords: Employee performance, Five-star hotels, Operational employees, Quantitative research, Workforce diversity



Factors Influencing Passenger Perceptions in Adopting NFC-Based E-Card Payment System in Public Bus Transportation with Special Reference to the Western Province, Sri Lanka

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Introduction Despite the increasing adoption of digital payment technologies worldwide, Sri Lanka's public bus transportation system continues to rely heavily on cash-based fare collection, resulting in operational inefficiencies, longer boarding times, and passenger inconvenience. This study investigates the factors influencing passenger perceptions in adopting an NFC-based e-card payment system for public bus transportation in the Western Province of Sri Lanka.

Objectives The study aims to identify key factors influencing passenger perception of NFC-based e-card payment systems in public bus transportation in the Western Province, Sri Lanka, and to explore the relationship between these factors and passenger perception.

Methodology Based on the Unified Theory of Acceptance and Use of Technology (UTAUT), this study investigates how Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions affect passenger perceptions. Utilizing a quantitative approach, a structured Likert-scale questionnaire was distributed to 385 respondents, with sample size determined via the Krejcie and Morgan table. Participants were selected through convenience sampling from Colombo, Gampaha, and Kalutara districts. Data analysis employed SPSS software, incorporating reliability analysis, descriptive statistics, Spearman's correlation, multiple regression analysis, and residual diagnostics.

Results & Findings The findings revealed a high overall willingness among passengers to adopt the proposed NFC-based e-card payment system. Effort Expectancy emerged as the most influential factor ($M = 4.23$), followed by Facilitating Conditions ($M = 4.15$) and Performance Expectancy ($M = 4.08$), while Social Influence ($M = 3.96$) also demonstrated a significant positive effect. Reliability analysis confirmed excellent internal consistency, and the statistical analyses supported the proposed research model. The findings indicate that passengers are more likely to adopt NFC-based fare payment systems when they are easy to use, secure, and supported by adequate infrastructure.

Conclusion The study provides practical insights for policymakers, transport authorities, and technology providers seeking to modernize Sri Lanka's public bus transportation through digital fare payment solutions.

Keywords: E-Card payment, NFC, Passenger perception, Public bus transportation, Sri Lanka



Impact of Privatization on Airport Operational Efficiency in Sri Lankan Airlines

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Introduction This study examines the impact of airport privatization on operational efficiency in Sri Lanka, with reference to Sri Lankan Airlines. Specifically, it aims to examine the relationship between airport privatization and operational efficiency and to identify the key factors influencing airport operational efficiency. The performance of Sri Lankan Airlines is closely linked to the effectiveness of the country's airport infrastructure, which currently faces challenges such as aging facilities, management inefficiencies, and declining service quality. These issues have adversely affected operational performance, flight punctuality, and customer satisfaction.

Objectives The research objectives are to assess the effects of privatization on airport efficiency within Sri Lankan Airlines, particularly focusing on the relationship between privatization and operational efficiency, along with identifying key factors influencing this impact.

Methodology A quantitative, deductive research approach was adopted for this study. Primary data were collected using a structured, self-administered questionnaire through face-to-face interviews with 384 respondents selected using a stratified random sampling technique. The participants comprised airport management personnel, airline employees, policymakers, regulatory authorities, and other industry professionals within Sri Lanka's aviation sector. The collected data were analyzed using SPSS through descriptive statistics, reliability analysis, Pearson correlation, and multiple regression analysis.

Results & Discussion

The findings suggest that airport privatization significantly enhances operational efficiency by improving management practices, accountability, investment in technology, and service quality. These enhancements lead to reduced delays and better flight performance, ultimately benefiting Sri Lankan Airlines. Policymakers and stakeholders are encouraged to consider well-planned privatization strategies with regulatory oversight to boost efficiency and competitiveness in Sri Lanka's aviation sector.

Conclusion The study also contributes to the broader literature on airport privatization and offers guidance for developing countries seeking to modernize their airport infrastructure.

Keywords: Airport privatization, Operational efficiency, Sri Lankan airlines



Factors Affecting the Perception towards the Usage of Bicycle as a Transport Mode among Daily Commuters in Colombo District

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Introduction: Urban mobility is a critical component of social and economic development, particularly in rapidly urbanizing regions such as Colombo District, Sri Lanka. Despite the economic, environmental, and health benefits of cycling, its adoption as a daily mode of transport remains limited due to infrastructural and socio-cultural barriers. So, the study aims to identify the factors affecting the adoption of cycling among daily commuters in Colombo District, by providing an insight for promoting cycling as a viable transport mode.

Objectives: The objectives of the study are to identify factors influencing daily commuters' perceptions of using bicycles as a mode of transport in the Colombo District, assess the impact of these factors, and explore the relationships between them and the perceptions of bicycle usage.

Methodology: This study employs quantitative research design to explore factors affecting the perception of bicycling as a transport mode among daily commuters in Colombo District. Data from 385 commuters were collected via a structured questionnaire, utilizing convenience sampling for practicality. Analysis was conducted using SPSS Software, applying descriptive statistics, reliability and validity tests, correlation analysis, and multiple regression analysis.

Results & Discussion: The findings indicate that cycling perceptions are significantly influenced by three categories: Route-Related Factors, Journey-Related Factors, and Socio-Economic Factors. Socio-Economic Factors, such as affordability and income level, are the strongest predictors of positive perceptions, followed by Journey-Related Factors like convenience and safety. Route-Related Factors, including road conditions and traffic congestion, are important but less influential compared to the other categories.

Conclusion: The study concludes that promoting cycling as a sustainable transport mode requires a comprehensive and integrated approach. Policy interventions should focus on expanding and improving cycling infrastructure, developing dedicated bicycle lanes, enhancing road safety measures, and implementing awareness campaigns to address social perceptions. The study also discusses the limitations and recommendations for future research in the field of sustainable urban mobility.

Keywords: Journey related factors, Passenger perception, Route- related factors, Socio- economic factor



Factors Influencing the Purchase Intention for Chinese Electric Vehicles (EV) Among the Youth in the Western Province of Sri Lanka

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Introduction: Understanding factors influencing EV purchase intention is of utmost importance in emerging markets such as Sri Lanka with the growing demand for sustainability in the sector of mobility. Gaining a deeper perspective into factors influencing the purchase decision for EVs, particularly in emerging markets like Sri Lanka, is vital considering the increasing emphasis on sustainable mobility.

Objectives: The objective of this study is to find the factors that affect young consumers' (18 to 35 years) purchase intention for Chinese EVs in Western Province of Sri Lanka and to analyze the strength and weakness of the key factors.

Methodology: The study employs a positivist, cross-sectional descriptive approach, guided by the Technology Acceptance Model (TAM) and Theory of Planned Behaviour (TPB). TAM addresses how perceptions of product reliability and performance influence purchase intent, while TPB accounts for external and social factors in decision-making. Utilizing convenience sampling, a questionnaire featuring a five-point Likert scale was distributed to 384 licensed young drivers across Colombo, Gampaha, and Kalutara. Data analyses included multiple linear regression, reliability and validity tests (Cronbach alpha), and factor analysis.

Results and Discussion: The five variables significantly influenced purchase intention, with country of origin being the most impactful, as high-tech EVs from China are now preferred due to their advanced features over price. Social media and peer influence also play an important role, particularly among younger consumers, enhancing their confidence and reducing range anxiety linked to battery reliability. Price and affordability are crucial factors in the market, while charging infrastructure ranks lowest among the predictors. Youth in the Western Province exhibit both actual and perceived motivations for purchasing EVs.

Conclusion: To enhance the adoption of vehicle-to-grid (V2G) systems, it's essential to improve infrastructure accessibility, build confidence in battery reliability, promote V2G's value, and utilize digital channels more effectively by policymakers and industry.

Keywords: Chinese electric vehicles, Purchase intention, Sri Lanka, Western province, Youth



Content-Based Learning (CBL) in Management Education: Advancing SDGs' Quality Education and Economic Growth

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Introduction: Over the years, Content-Based Learning (CBL) has emerged as an impactful pedagogical paradigm connecting language acquisition and disciplinary knowledge. This qualitative case study evaluates the long-term impact of a first-year CBL English curriculum on a group of third- and fourth- year management undergraduates following their major fields on study in English-medium.

Objectives: Aligned with Sustainable Development Goal 4 (Quality Education) and Goal 8 (Decent Work and Economic Growth), the study investigates how early linguistic scaffolds transfer to major disciplines and identifies systemic curricular gaps.

Methodology: Thematic analysis of 12 student narratives was used to evaluate the pedagogical impact of the CBL curriculum on students' management-specific vocabulary acquisition and presentation structures.

Results & Discussion: Thematic analysis of student narratives revealed high pedagogical impact on management-specific vocabulary acquisition and presentation structures. However, operational limitations were identified in spontaneous professional communication and advanced corporate report writing where students state the need of more attention. The study highlights how integrating specialized second language with business concepts optimizes higher education quality (SDG 4) and strategically prepares a workforce capable of driving sustainable economic productivity (SDG 8).

Conclusion: The study emphasizes that CBL could possibly be implemented in English curriculum prepared for ESL undergraduates who follow different major fields of study, in this case, the field of management studies.

Keywords: Academic transfer, Content-based learning, Curriculum development, Management education, Sustainable development goals



Analyzing Operational Efficiency in Multi-Counter Public Services: A Simulation-Based Case Study of a Sri Lankan Divisional Secretariat

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Introduction: Public sector institutions often experience long waiting times due to high demand and limited resources, affecting efficiency and customer satisfaction. Providing quality and efficient services is essential to improve customer loyalty and satisfaction.

Objectives: This study aims to quantitatively examine the functional inefficiencies of the existing waiting lines in a selected Sri Lankan Divisional Secretariat with three high-demand service counters for ASWASUMA application registration by evaluating its performance parameters and recommending improvements to evaluate customer waiting times in queues.

Methodology: Data collection was conducted over two non-consecutive days during peak hours with a sample of 201 customers. The queuing system was modelled using the Rockwell 16. The arrival times were calculated and inserted into the input analyzer to find the corresponding arrival patterns of customers to the counter queues.

Results & Discussion: It showed non-uniform arrival rates explained by different patterns. The modelled system was run for one hour to find average values of waiting time of customers separately in three queues, the number waiting in queues, and the number of arrivals and service receipts. The existing system resulted in 72.07, 15.11, and 37.62 minutes of waiting time in queues 01, 02, and 03 respectively. The numbers waiting in queues 01, 02, and 03 were 15, 6, and 10.

Conclusion: Since the existing system showed a low-performance rate, the proposed model 01 suggested doubling the resources at counters 01, 02, and 03. The proposed model 02 introduced an additional server in the process to evaluate its impact on system efficiency. Compared to model 01, model 02 showed a significantly lower average waiting time and number of waiting. Therefore, this study recommends model 02 as the best-fitted model. It reduced waiting time from 34 to 10 minutes. Therefore, Proposed System 2 is recommended as the optimal solution, providing significant performance improvements while remaining cost-effective and practical for implementation.

Keywords: Divisional secretariat, Multi-Server, Queuing theory, Rockwell ARENA, Simulation



Factors Influencing for the Selection of Reliable Container Shipping Lines by Freight Forwarders in Sri Lanka; Special Reference to Western Province

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Introduction: Container shipping is a critical part of global trade, enabling the efficient movement of goods across international markets. Selecting a reliable shipping line is essential for ensuring timely and dependable logistics operations. Freight forwarders play a key role in this process by evaluating and choosing shipping lines based on multiple performance criteria.

Objectives: This study focuses on identifying and prioritizing the key factors that influence freight forwarders in the Western Province of Sri Lanka when selecting container shipping lines. Using a multi-criteria decision-making approach, the research aims to determine the relationship between these factors and the selection of shipping lines, evaluate their impact, and pinpoint the most influential factor in these decisions.

Methodology: A quantitative research approach was used to collecting data via a structured questionnaire from 338 professionals, specifically those registered with the Sri Lanka Logistics and Freight Forwarders Association (SLFFA) in the Western province. The study used convenience sampling technique and SPSS Statistics has been used for data analysis, incorporating descriptive statistics, reliability analysis, Pearson correlation, and multiple regression analysis to meet research objectives.

Results and Discussion: The study identifies ten key factors influencing the selection of reliable container shipping lines: service capability, reputation, facilities, reliability, freight rates, infrastructure, documentation accuracy, environmentally friendly operations, container availability, and IT orientation. Correlation analysis shows positive relationships among these variables. A multiple regression model accounts for 41.8% of the variation, highlighting service capability ($\beta = 0.237$) as the most significant factor. Freight forwarders prioritize service capability, documentation accuracy, reputation, and infrastructure over freight rates in their decision-making.

Conclusion: The findings enhance maritime logistics literature, offering practical insights for freight forwarders, shipping lines, and policymakers to boost service quality and operational reliability. Future research should adopt broader geographical coverage and qualitative or mixed methods to deepen understanding of shipping line selection in Sri Lanka.

Keywords: Container shipping, Freight forwarders, Freight rate



Factors Affecting the Shift from Diesel to Electric Trucks in Intra Freight Transportation toward Promoting Sustainable Logistics: Study of Colombo Port Sri Lanka

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Introduction: Global greenhouse gas emissions have reached a significant level, and transportation is a main contributor of greenhouse gas emissions. Within Sri Lanka also it had reached a significance with a high contribution of the transport sector. At present Sri Lankan transportation sector is moving toward sustainable logistics. Before moving those new technologies, they need to understand what factors will affect new technology adoption.

Objectives: This study was conducted to analyze the factors affecting behavioural intention to shift from diesel to electric trucks in intra freight transportation within Colombo port operations by employing Unified Theory of Acceptance and Use of Technology model. Further, studying the relationship between identified factors and behavioural intention to adopt electric trucks in Port of Colombo was also planned. Our team also planned to identify the most significant factor impacting behavioural intention to shift from diesel to electric trucks in intra freight transportation in Port of Colombo. This study uses quantitative research choice with convenience sampling.

Method: Data was collected through distribution of questionnaires among 170 respondents which includes the operational department staff members above executive level in four container terminals of Port of Colombo. The collected data were analyzed using IBM SPSS software.

Results: The study identified four factors influencing behavioural intention to adopt electric trucks: cost concern, effort expectancy, performance expectancy and social influence. Results of correlation test revealed that all these variables have a strong positive relationship with dependent variables. Regression analysis revealed that 57.7% of the dependent variables are explained by independent variables. Results of multiple regression analysis revealed that cost concern has the highest coefficient of 0.280 β value indicating highest impact.

Conclusion: Behavioural intentions to adopt electric trucks are influenced by cost concern, effort expectancy, performance expectancy and social influence. Government support, collaborations and partnerships, awareness programmes, training programmes are crucial for electric truck adoption.

Keywords: Colombo port, Electric trucks, Port operations, UTAUT



Analyzing the Impact of Reverse Logistics on the Profitability of the Supermarket Industry with Special Reference to Large Scale Supermarkets in the Colombo District

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Introduction: Reverse logistics has emerged as a strategic supply chain practice that supports the management of product returns, damaged goods, recycling and disposal while improving operational efficiency and profitability. Although previous studies have examined reverse logistics in manufacturing and other industrial sectors, limited empirical and context evidence exists regarding its influence on supermarket profitability in Sri Lanka. This study addresses these gaps by examining the impact of reverse logistics on the profitability of large-scale supermarkets in the Colombo District.

Objectives: The objective/s are to analyze how reverse logistics impacts the profitability of large supermarkets in the Colombo District, with a focus on the relationship between different aspects of reverse logistics and profitability, and to identify the most significant influencing factor.

Methodology: A quantitative, deductive approach under the positivist philosophy of a cross-sectional survey design was adopted. Primary data were collected using a structured questionnaire from 234 managers, executives and supervisors representing major supermarket chains in the Colombo District. Returns Management, Cost of Disposal and Recycling, Consumer Return Behaviour and Return Policy were examined as independent variables, while Profitability was the dependent variable. A convenience sampling used and data were analyzed using SPSS through reliability analysis, descriptive statistics, Pearson correlation, multiple regression and ANOVA.

Results & Discussion: The regression model accounted for 59.7% of profitability variation ($R^2=0.597$) and was statistically significant ($p<0.001$). The strongest predictor was Return Policy ($\beta=0.502$), followed by Returns Management ($\beta=0.316$) and Consumer Return Behaviour ($\beta=0.104$). Cost of Disposal and Recycling was not significant. The results indicate that effective reverse logistics boosts profitability through better inventory recovery, customer satisfaction, operational efficiency, and cost optimization, offering practical guidance for supermarket managers and enriching Sri Lankan literature.

Conclusion: The study emphasizes the strategic importance of reverse logistics in Sri Lanka's supermarket sector, providing actionable insights for managers and supply chain professionals to improve profitability through organized practices.

Keywords: Consumer return behaviour, Returns management, Reverse logistics, Return policy, Supermarket profitability



Impact of E-Procurement Practices on Effectiveness of Procurement Performance in the Sri Lankan Apparel Industry: A Study with Special Reference to the Western Province

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Introduction: In the rapidly evolving corporate environment, effective procurement processes are crucial for companies to cut costs and keep pace with market developments. Procurement encompasses various aspects of purchasing, including buying, renting, and managing resources from external vendors. E-procurement provides benefits such as real-time data access and enhanced supplier communication. In Sri Lanka's apparel sector, challenges in adopting this online strategy include high initial costs, insufficient technological skills, and resistance to change. The purpose of the study is to find the impact of e-procurement on procurement performance, focusing on practices that enhance effectiveness despite challenges such as customer expectations and global competitiveness.

Objectives: The objectives are to evaluate practices within the Sri Lankan apparel industry and determine the most impactful e-procurement practice that enhances procurement performance.

Methodology: A descriptive research design within the positivism paradigm employed a quantitative approach to explore the relationship between e-procurement practices and procurement performance. It identified four independent variables: E-Tendering, E-Sourcing, E-Communication, and E-Ordering, all demonstrating a significant positive impact on procurement performance, supporting the proposed hypotheses. The study utilized convenience sampling with 384 employees, gathering data through questionnaires. Analysis conducted using SPSS software included response rate, demographic analysis, descriptive statistics, reliability and validity testing, correlation, and multiple regression analysis to evaluate the relationships between e-procurement practices and performance.

Results & Discussion: The analysis revealed that 46.6% of respondents were female and 53.4% male. A Pearson correlation at the 0.01 level indicated a statistically significant positive relationship between e-procurement practices and performance outcomes. The multiple regression model demonstrated an R-squared value of 0.484, indicating that e-tendering, e-sourcing, e-communication, and e-ordering explain 48.4% of the variance in procurement performance.

Conclusion: The study found that e-procurement improves accuracy, cost-effectiveness, supplier collaboration, and reduces lead time. Future research should explore regional differences, particular e-procurement practices, organizational factors, and long-term effects using longitudinal and mixed-method approaches.

Keywords: Apparel, E-procurement, Performance



Exploring the Impact of Implementing an Automated Storage and Retrieval System (ASRS) on Stakeholder Convenience in a Raw Material Warehouse of a Leading Apparel Manufacturing Company in Sri Lanka

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Introduction: Automation has become a key driver of operational efficiency and productivity in modern warehouse management. Although previous studies have extensively examined the technical advantages of Automated Storage and Retrieval Systems (ASRS), limited attention has been given to their influence on stakeholder convenience. This study therefore investigates the impact of implementing an ASRS on stakeholder convenience within the raw material warehouse of a leading apparel manufacturing company in Sri Lanka.

Objectives: The study examines the effects of an Automated Storage and Retrieval System (ASRS) on stakeholder convenience within the raw material warehouse of a major apparel manufacturer in Sri Lanka, exploring the impact and relationship of ASRS implementation in this context.

Methodology: The study applies the Technology Acceptance Model (TAM) to explore how System Design Features, Perceived Ease of Use, Perceived Usefulness, and Attitude Toward Using affect stakeholder convenience. Utilizing a quantitative approach, a structured Likert-scale questionnaire was administered to a stratified sample of 201 stakeholders, with sample size guided by the Krejcie and Morgan table. Data analysis employed SPSS software, utilizing descriptive statistics, reliability analysis (Cronbach's Alpha), and Spearman's rank correlation analysis, chosen due to the non-normality of the data.

Results & Findings: The findings revealed positive stakeholder perceptions towards ASRS, with all study variables recording mean values above 4.00. Spearman's correlation analysis indicated significant positive relationships between all independent variables and stakeholder convenience, with Perceived Ease of Use demonstrating the strongest relationship ($p = 0.835$). Reliability analysis confirmed excellent internal consistency across all constructs, supporting the robustness of the measurement instrument.

Conclusion: The findings suggest that successful ASRS implementation depends not only on technological capabilities but also on stakeholder acceptance and convenience. Organizations planning warehouse automation should therefore prioritize user-friendly system design, comprehensive training, effective technical support, and active stakeholder involvement to maximize successful implementation and long-term operational benefits.

Keywords: Acceptance model (TAM), Automated Storage and Retrieval System (ASRS), Stakeholder convenience, Technology warehouse automation



From Investment to Impact: How Sri Lankan Firms Can Harness Generative AI for Strategic Outcomes

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Introduction: Generative Artificial Intelligence (GenAI) has rapidly transitioned from an emerging novelty to a defining force in corporate strategy, yet the degree to which organizational investment in GenAI translates into tangible strategic outcomes remains an open empirical question, particularly within the context of developing economies.

Objectives: This study investigates the impact of GenAI investment levels on four key strategic outcome dimensions: strategic outcome achievement, competitive advantage, financial performance, and innovation capacity among corporate firms operating in Sri Lanka.

Method: Grounded in Dynamic Capabilities Theory and the Technology Organization Environment (TOE) Framework, the study adopted a quantitative survey design, administering a structured thirty-item instrument to fifty-one respondents drawn from diverse industry sectors, including technology (41.7%), banking, healthcare, manufacturing, and education.

Results & Discussion: Pearson correlation analysis revealed statistically significant positive relationships between GenAI investment level and all four dependent variables, with correlation coefficients ranging from $r = 0.505$ to $r = 0.560$ ($p < .001$). Innovation capacity recorded the highest mean outcome score ($M = 3.56$, $SD = 0.79$) and the strongest correlation with GenAI investment ($r = 0.560$), suggesting that firms directing resources toward GenAI derive the most pronounced benefit in their capacity to develop novel products, services, and business models. Notably, 69.4% of respondents represented firms at early stages of GenAI investment of fewer than two years, while only 19.4% had achieved enterprise-wide deployment, underscoring the nascent and predominantly exploratory nature of GenAI adoption in Sri Lanka. Institutional context, comprising regulatory environment, AI talent availability, and digital infrastructure, was tested as a moderating variable and recorded a moderate mean of 3.13 ($SD = 0.87$). Moderated regression analysis confirmed that institutional context significantly weakens the relationship between GenAI investment level and all four dependent variables,

Conclusion: GenAI investment yields the greatest strategic returns for firms operating under weaker institutional conditions.

Keywords: Competitive advantage, Dynamic capabilities, Financial performance, Generative AI investment, Innovation capacity



Geospatial and Temporal Analysis of Tourist-related Violent Crimes in Sri Lanka: A Data Driven Approach to identify Crime Hotspots

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Introduction: Tourism industry is a key contributor to Sri Lanka's economy and foreign exchange earnings. However, disruptions such as COVID-19, and political instability emphasize the need for accurate forecasting. Tourist-related crimes refer to criminal activities committed against individuals travelling or visiting a destination where tourists are the identified victim.

Objectives: This study aims to analyze trends and patterns of violent crimes against tourists in Sri Lanka from 2020 to 2024. It seeks to develop ARIMA-based time series models for different violent crime categories, by examining yearly, monthly, and seasonal variations, and analyzing the geographic distribution of crimes across districts. The study also provides recommendations to enhance tourist safety and strengthen crime prevention strategies.

Methodology: This study uses a quantitative approach based on the monthly crime data available in the Sri Lankan Tourist Police. It employs time series analysis in Minitab to examine trends and forecast crimes, and geospatial analysis in QGIS to map distributions and identify hotspot areas.

Results & Discussion: The Augmented Dickey-Fuller test confirmed that violent crimes, aggravated assault, and sexual harassment series were stationary at the 5% level, while robbery became stationary after the first differencing. For violent crimes, ARIMA (1,0,0) (0,0,0)₁₂ was the best model, with a 69% forecasting accuracy, with significant parameters and well-behaved residuals (Ljung-Box $p > 0.05$). Geospatial analysis using GIS (2020–2024) identified Galle and Matara as hotspots for violent and robbery, Matara, Colombo and Ampara for aggravated assaults, Gampaha and Galle for sexual crimes. ARIMA validation showed discrepancies due to the impact of COVID-19 and limited data.

Conclusion: Future research may focus on extending the dataset and applying advanced forecasting approaches, such as machine learning techniques, to enhance the ability to capture complex patterns in crime data. It is recommended for provincial authorities implement region-specific crime mitigation strategies targeting identified high-risk areas.

Keywords: ARIMA, GIS mapping, Time series, Tourism, Violent crime



From Graduation to Exclusion: Employment, Gender Disparities, and Labour Market Barriers among Female Arts Graduates in Sri Lanka

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Introduction: Sri Lanka presents a striking paradox: despite women outnumbering men in higher education with a Gender Parity Index of 1.4 (World Bank, 2022), female labour force participation stood at 32.4% in 2025, still near the decade's low of 29.8% recorded in 2024 (DCS, 2025). This disconnect is most acute among Arts graduates, where approximately 80% of students are female yet unemployment rates are the highest of any discipline.

Objectives: The study examines whether gender significantly influences the employability and labour market status of female Arts graduates and identifies the personal and structural factors preventing them from sustaining long-term employment.

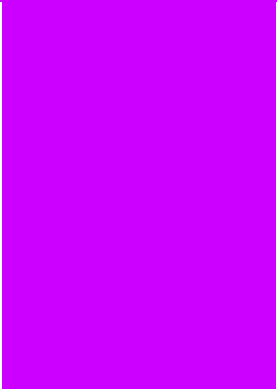
Methodology: A quantitative, cross-sectional research design was employed. Primary data were collected from recently graduated students, using a structured questionnaire administered to a purposive sample of 300 graduates from each university. Employer perception data were collected from 45 private sector companies. Secondary data were drawn from the DCS Labour Force Survey 2024 and the ILO (2024). Data were analysed using SPSS for descriptive statistics, Pearson Chi-square tests with Cramer's V, and one-sample t-tests at $\alpha=0.05$.

Results & Discussion: Gender is significantly associated with labour market status ($\chi^2=18.377$, $df=3$, $p<0.001$, Cramer's $V=0.200$), with female graduates recording an unemployment rate of 69.9% compared to 47.4% for males. Employer data indicate that private sector companies do not refuse female candidates at recruitment, but express concern about long-term retention and career progression of female employees (mean=3.56/5, $p<0.001$) a retention, not recruitment, gap.

Conclusion: Structural barriers disproportionately affect female Arts graduates post-entry, compounding their discipline-specific exclusion. As these are retention-stage rather than recruitment-stage barriers, the study recommends affordable childcare, flexible work arrangements, and equal pay enforcement to sustain employment.

Keywords: Arts graduates, Feminisation of unemployment, Labour market barriers





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A Quantitative Study for the Development of an Automated IoT-Based Condition Monitoring and Automatic-Change-Over System for Essential Marine Pumps and Motors

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Introduction: In commercial vessels, pumps and motors run continuously for fuel, cooling, and lubrication. These are essential for propulsion and safety. Current maintenance practices, which are reactive or done periodically, come with financial risks due to unexpected breakdowns and off-hire periods. To combine human oversight with industrial automation, this study suggests a "Digital Watch Keeper." It will use IoT smart sensors for predictive maintenance 24/7.

Objectives: The primary objective is to develop a Smart Predictive Maintenance System (SPMS) based on a "Quintuple-Parameter" check (Speed, Current, Heat, Vibration, Fluid Pressure). It targets to automate engine room logging, reduce manual data errors, prevent catastrophic equipment failure, and transition the Electro-Technical Officer from manual troubleshooting to a systems administrator role.

Methodology: A quantitative methodology used to build a prototype using a penta-sensor array: proximity sensor (RPM), current sensor (Current), PT100 (Temperature), pressure transducer (Pressure), and accelerometer (Vibration). A PLC/microcontroller integrates data with a three-level response protocol to prevent false trips and trigger standby motors. A secure Wi-Fi web interface and mobile app enabled real-time monitoring.

Results & Discussion: The SPMS prototype successfully combined multi-sensor parameters into a unified digital health profile. Experimental results confirmed that the autonomous command logic reliably detects pre-failure and immediately switches to standby units without operational interruption, verifying enhanced vessel reliability and safety.

Conclusion: The SPMS demonstrates technical feasibility for continuous and accurate monitoring of critical marine machinery. Automating predictive maintenance system minimizes downtime, reduces maintenance costs and elevates ETO workflow through data-driven decision-making.

Keywords: Autonomous, Data integrity, Digital watch keeper, Internet of things, Smart predictive maintenance



A Critical Review of Large-Scale Hydrogen Storage Systems in Maritime Transport and Port Operations

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Introduction: Hydrogen is considered a promising alternative marine fuel due to its potential to reduce greenhouse gas emissions. However, large-scale hydrogen storage in ships and port facilities remains challenging due to low volumetric energy density, safety concerns, and infrastructure requirements.

Objectives: This review aims to evaluate major hydrogen storage technologies and compare their safety, efficiency, integration feasibility, maintenance requirements, and suitability for different maritime applications.

Methods and Analysis: A systematic literature review based on the PRISMA framework was conducted using academic publications from 2015 to 2025. Compressed gaseous hydrogen, liquid hydrogen, cryo-compressed hydrogen, and chemical carrier-based storage systems were analysed using criteria including storage efficiency, operational feasibility, safety risks, integration complexity, and economic considerations. The assessment indicates that liquid hydrogen provides high storage density for large vessels, while compressed hydrogen offers easier integration for smaller vessels.

Conclusions: Hydrogen storage technology selection depends on vessel type, operational requirements, and infrastructure availability. Although significant safety and technical challenges remain, improved risk management, advanced storage systems, and further research can support the future adoption of hydrogen in sustainable maritime transport.

Keywords: Hydrogen storage, Hydrogen safety, Maritime decarbonization, Port infrastructure, Sustainable transport



A Review of the Environmental, Economic and Technological Challenges of Fossil Fuel Combustion

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Introduction: Fossil fuels such as coal, oil, and natural gas remain the world's primary energy sources because of their high energy density, reliability, and widespread availability. However, their combustion releases greenhouse gases and harmful pollutants, including carbon dioxide (CO₂), nitrogen oxides (NO_x), sulfur oxides (SO_x), methane, and particulate matter, which contribute to climate change, air pollution, and serious health risks. As global energy demand continues to increase, improving combustion efficiency and reducing emissions through advanced technologies are essential for achieving sustainable energy development.

Objectives: This study aims to identify the environmental, technical, and operational challenges associated with fossil fuel combustion in marine and industrial applications. It also evaluates the effects of inefficient combustion on greenhouse gas emissions, air pollution, and energy losses while assessing existing technologies and strategies that improve combustion efficiency and reduce harmful emissions. In addition, the study proposes practical recommendations to support sustainable energy use, environmental protection, and operational efficiency.

Methodology: A desk-based research approach was adopted using secondary data from peer-reviewed journals, industry reports, government publications, and international regulations. Relevant literature was collected from databases such as Scopus and Web of Science to examine fossil fuel combustion, emissions, alternative fuels, and environmental regulations in marine and industrial sectors. No primary data were collected during this study.

Results and Discussion: The review found that conventional fossil fuels remain major contributors to greenhouse gas emissions and environmental pollution. Alternative fuels such as green hydrogen, biomethanol, biodiesel, and ammonia have significant potential to reduce emissions but face challenges including high costs, limited infrastructure, storage difficulties, and safety concerns. Advanced combustion technologies improve efficiency and reduce emissions, while long-term decarbonization requires technological innovation, supportive policies, investment, and international cooperation.

Conclusion: Fossil fuel combustion remains a significant environmental challenge despite its importance for global energy production. Cleaner fuels, advanced combustion technologies, and effective emission control systems provide practical solutions for reducing environmental impacts. Continued research, technological innovation, investment, and supportive policies are essential to achieve sustainable, low-carbon energy systems while ensuring long-term energy security.

Keywords: Climate change, Energy sustainability, Emission reduction. Fossil fuel combustion, Greenhouse gas emissions



A Literature Review on Optimal Energy Storage Integration for Solar Photovoltaic System on Modern Ships

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Introduction: The maritime sector is under increasing pressure to reduce greenhouse gas emissions and improve energy efficiency. Solar photovoltaic (PV) systems provide a renewable energy option for ships; however, their intermittent generation requires effective energy storage solutions. Battery energy storage systems (BESS) can improve power reliability and support cleaner maritime operations.

Objectives: This review aims to evaluate optimal energy storage integration strategies for shipboard solar PV systems and assess their impact on energy efficiency, emissions reduction, operational reliability, and economic performance.

Methodology: A literature-based analysis was conducted using published research papers, technical reports, and maritime energy databases. Solar PV systems, lithium-ion battery energy storage systems, and energy management strategies were evaluated based on energy efficiency, fuel reduction, greenhouse gas emissions, battery performance, and operational suitability.

Results & Discussion: The reviewed studies indicate that integrating solar PV with battery storage can reduce dependence on conventional ship generators and improve onboard power stability. Optimized battery systems have demonstrated potential fuel savings of approximately 10–20% and greenhouse gas emission reductions of 8–18%. Although initial installation costs remain high, reduced fuel consumption and operating expenses improve long-term feasibility.

Conclusion: Solar PV combined with optimized energy storage provides a practical pathway toward sustainable maritime operations. Future research should focus on improving battery technology, reducing costs, and developing advanced energy management systems for wider adoption in modern ships.

Keywords: Battery energy storage, Maritime industry, Renewable energy, Solar photovoltaic system, Sustainable shipping



Hydrodynamic Degradation of Marine Hulls: A Literature Review on Flow-Induced Erosion and Cavitation Effects

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Introduction: The pressure of the maritime industry to improve the lifespan of their vessels and the reduction of the environmental impact from traditional maintenance and operational methods is increasing. Alloys as sacrificial anodes for cathodic protection and protective coatings like glass-flake vinyl ester are the two most common methods, but these methods are not always effective in suppressing synergistic effects of flow-induced cavitation and corrosion over long periods.

Objective: The purpose of this study is to determine the feasibility of using advanced experimental alternatives which will decrease the need for dry-docking, decrease hull drag, and improve overall fuel efficiency.

Methodology: The desk research technique was used, which included a comparative study of recent literature and technical reports on high-performance structural integrity solutions. Two new technologies are analyzed in particular; self-repairing anti-cavitation and antifouling epoxy modified polyurethane composite coating and active vibration control of smart hull structures driven by piezoelectric actuators.

Results & Discussion: The findings show that anodes and traditional coatings provide protection from spalling, but the self-healing composites offer a groundbreaking decrease in spalling, and the piezoelectric systems focus on the physical causes of cavitation damage.

Conclusion: The study is based on the premise that these “smart” and “responsive” technologies offer a more permanent solution rather than the “consumable” technologies used for classical protection and therefore will be necessary to extend the operational life of the vessel and to achieve modern environmental impact goals.

Keywords: Cavitation, Erosion, Experimental alternatives, Marine industry



A Quantitative Study of the Psychological Support Mechanisms for Sri Lankan Seafarers in the Maritime Industry

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Introduction: The perceived health and stress of seafarers was studied in relation to work Stressors and personality characteristics (self-concept).

Objectives: To identify the common mental health challenges faced by seafarers, such as stress, anxiety, depression, and loneliness. To understand the factors affecting seafarers' mental well-being during long voyages and isolated working conditions.

Methodology: A survey-based research method is used to collect data about mental health support for seafarers. A questionnaire is created using Google Forms & to gather responses from seafarers and maritime students.

Results & Discussion: The survey conducted using Google Forms showed that many seafarers face mental health challenges such as stress, loneliness, and anxiety due to long periods at sea and separation from family. Most participants agreed that family communication, counseling, and onboard support help improve mental well-being. The results also highlighted the need for better mental health awareness and support programs onboard ships. Overall, proper mental health support is important to improve seafarers' well-being and safety.

Conclusion: Mental health support is essential for seafarers, as they face unique challenges such as stress, isolation, and long periods away from family. The study shows that proper support systems, including counseling, regular communication with loved ones, and onboard welfare programs, can significantly improve their mental well-being. Therefore, increasing awareness and providing better mental health resources are important to ensure healthier, safer, and more productive seafarers.

Keywords: Mental health, Maritime industry, Psychological well-being, Seafarers, Stress management



A Mixed Method Investigation into Shore Leave Policies: Implications for Seafarer Welfare Using Digital Technology

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Introduction: Shore leave is crucial for seafarers' welfare, supporting health, morale, and performance. Although recognized under the Maritime Labour Convention 2006, access is increasingly restricted by ISPS Code security, immigration rules, and operational pressures. This study addresses regulatory, operational, and human-factor challenges through a mixed-method approach using online surveys, interviews, and literature. Findings will highlight barriers and impacts, proposing digital solutions to streamline procedures, enhance welfare, and improve maritime safety.

Objectives: Examine restrictions on shore leave and their effects on seafarers' welfare, mental health, fatigue, morale, and operational performance. Identify inefficiencies in current procedures, including delays from security checks, immigration processes, and poor coordination among authorities. Evaluate possibilities for regulatory flexibility without compromising port security. Investigate the role of modern digital technologies.

Methodology: This study adopts a mixed-method approach, combining qualitative and quantitative data through secondary sources such as IMO documents, international regulations, academic literature, and maritime reports, alongside primary data from online questionnaires, interviews, and maritime community discussions.

Results & Discussion: The study is expected to show that strict security, immigration rules, short port stays, and heavy workloads make shore leave difficult, leading to fatigue, stress, low morale, and isolation. Administrative inefficiencies, poor coordination, and reliance on manual systems add further delays. The research will stress shore leave's importance for welfare and safety, while recommending digital tools like mobile apps and online clearance systems to simplify procedures and improve efficiency.

Conclusion: The study highlights that shore leave is vital for seafarers' welfare, mental health, and operational performance, yet access is increasingly restricted by security rules, operational pressures, and administrative inefficiencies. Limited shore leave contributes to fatigue, stress, low morale, and safety concerns. Findings reveal gaps between regulatory intentions and practice, stressing the need for better coordination and digital solutions such as mobile apps and online clearance systems to improve efficiency without compromising security. Ultimately, enhancing shore leave is essential for safer and more sustainable maritime operations.

Keywords: Digitalization in ports, Fatigue management, Maritime safety, Seafarers' wellbeing, Ship-port interface



Marine Safety and Survival Systems: A Literature Review on the Effectiveness of Life-Saving Appliances On-board Ships

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Introduction: Life-saving appliances are safety equipment on board a boat that saves lives in the event of a marine emergency. Ships face risks including fire, collision, flooding and harsh weather, making effective emergency equipment vital for crew and passengers. However, reported cases at sea show that effectiveness can be limited by poor maintenance, operation and design.

Objectives: The primary purpose of this research work is to evaluate the design and performance of life-saving equipment in a ship, highlight common operating problems, identify the effects of maintenance and crew training, and discuss the effects of environmental and human factors on LSA performance in emergency situations.

Methodology: The study involved detailed analysis of SOLAS regulations and the Life-Saving Appliances (LSA) Code, together with marine accident reports, safety manuals and onboard procedures, maintenance practices and emergency crew preparedness. The review indicates that most ships comply with international safety standards, but limitations include design-related problems during emergency deployment, sub-optimal maintenance, infrequent inspections and lack of regular maintenance training. Rough seas, low visibility, human error and lack of time to respond can negatively affect LSA operational efficiency and survivability at sea.

Conclusions: The reliability and effectiveness of life-saving appliances can be improved through better appliance design, regular maintenance, improved crew training and continued adherence to maritime safety regulations.

Keywords: Emergency response, Life-saving appliances, Lifeboats, Maritime safety, SOLAS



Floating Dry Docks as a Strategic Maritime Infrastructure Solution for Sri Lanka: A Literature Review

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Abstract: Sri Lanka's strategic location along major international shipping routes provides significant opportunities for maritime services, particularly ship repair and maintenance. However, existing dry-docking infrastructure remains limited compared to global demand. Although approximately 70,000 vessels pass near Sri Lanka annually, only around 200 are serviced locally, indicating a major gap in repair capacity and underutilization of its maritime potential.

Objective: This study evaluates the feasibility of establishing a floating dry dock in Sri Lanka by analyzing technical, economic, and coastal conditions. Floating dry docks are considered more practical than land based dry docks due to lower initial investment, faster construction, and reduced land requirements, making them suitable for Sri Lanka.

Methodology: The methodology is based on secondary data from SLPA publications, Colombo Dockyard information, journal articles, expert opinions, and international case studies of floating dry dock operations.

Results and Discussion: The findings suggest that Sri Lanka has a basic maritime infrastructure and engineering foundation capable of supporting such a project. However, improvements are required in ballast automation systems, mooring technology, power infrastructure, environmental management, and skilled workforce development to ensure safe and efficient operation. Despite challenges such as high capital cost and regulatory requirements, the project has strong potential to enhance ship repair capacity, reduce dependency on foreign shipyards, and generate long-term maritime revenue.

Conclusion: Overall, the study concludes that a floating dry dock is feasible for Sri Lanka and can strengthen its role as a regional maritime hub.

Keywords: Floating dry dock, Marine engineering systems, Maritime economic feasibility, Port infrastructure development, Ship repair industry



A Mixed-Methods Investigation into the Shortage of Experienced Senior Engineering Officers in the Sri Lankan Maritime Industry and its Operational Implications

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Introduction: The maritime industry is vital for global trade and economic growth. In Sri Lanka, despite steady sector expansion, there is a severe shortage of experienced senior officers, particularly Captains, Chief Engineers, and Second Engineers. Although many young professionals enter as cadets or junior officers, few advance to senior roles due to skill and experience gaps. To sustain industry growth and meet rising demand, Sri Lanka must invest in targeted training and career development programs to help junior officers transition into senior positions.

Objectives: The study investigates Sri Lanka's shortage of senior marine officers by analyzing career advancement barriers, educational gaps, and overseas migration. In addition, the research aims to suggest strategies to resolve this critical workforce deficit in the Sri Lankan context.

Methodology: To examine the causes, trends, and impacts of officer shortages in Sri Lanka's marine industry, this study analyzed survey results, stakeholder interviews, and job market data from various platforms.

Results & Discussion: This study used a mixed-method approach, combining questionnaires, interviews, and secondary data from reports and social media. Data from marine professionals and job platforms highlighting vacancies for Captains and Chief Engineers were analyzed to identify key causes, trends, and impacts of the shortage in Sri Lanka's marine industry.

Conclusion: Despite global awareness of senior maritime officer shortages, Sri Lanka lacks specific empirical research. Existing studies focused on global trends rather than national data on workforce distribution, promotion rates, and the true extent of the local deficit.

Keywords: Marine industry, Shortage, Senior officers, Sri Lankan



A Review of Air Lubrication Systems for Energy Efficiency in Ships

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Introduction: The maritime industry contributes significantly to global trade but faces high fuel consumption and greenhouse gas emissions. Air Lubrication Systems (ALS) reduce hull-water friction by introducing air bubbles beneath the hull, thereby lowering drag and improving fuel efficiency. This study examines the working principles, merits, and drawbacks of ALS in Marine Engineering.

Objective: Assessment of the suitability and feasibility of ALS for fuel savings, emission reduction and sustainable shipping operation.

Methodology: This study used desk research and literature review. Data was collected from journal articles and reports and analyzed by comparing findings to evaluate the effectiveness and feasibility of Air Lubrication Systems for improving fuel efficiency and supporting sustainable shipping.

Results & Discussion: The results indicate that ALS could improve fuel efficiency and reduce emissions by lowering friction between the hull and water. The literature shows fuel savings of around 5%–10%, depending on ship type, operating conditions, and sea state. Fuel savings also support IMO environmental objectives by reducing greenhouse gas emissions. ALS has already been adopted by commercial shipping companies, demonstrating its practical applicability. However, challenges include installation costs, maintenance requirements, dependence on sea conditions, and additional power consumption by compressors. Overall, ALS is a promising technology for reducing fuel consumption and supporting sustainable shipping, although further development is needed for wider adoption.

Conclusion: ALS could improve ship fuel efficiency and reduce emissions by lowering hull resistance. However, challenges include installation complexity, energy use, maintenance, and performance under different sea conditions. Future research should focus on improving efficiency, reducing compressor power, and conducting long-term studies. Overall, ALS has strong potential to support sustainable shipping and IMO decarbonization goals.

Keywords: Air lubrication system (ALS), Fuel efficiency, Hull resistance reduction, Marine engineering



A Quantitative Study on the Causes of Heat Stress in Ship Engine Rooms and Its Physiological Implications among Sri Lankan Seafarers

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Introduction: Heat stress occurs when the body absorbs more heat than it can dissipate. Engine room workers face disproportionate heat exposure from heavy machinery, reporting significantly higher stress levels than other crew members. Identified as a primary ergonomic hazard, this extreme heat impairs seafarer performance during maintenance, raising the risk of human error, injuries, and fatalities.

Objectives: This study assesses heat exposure levels in ship engine rooms, examines long-term health risks for marine engineers, and outlines engineering, operational, and safety controls to mitigate heat stress.

Methodology: Beginning with a literature review on heat stress, this study collects quantitative survey data (via Google Forms) to evaluate the link between engine room temperatures and chronic health conditions in marine engineers.

Results & Discussion: Analysis of the survey using google forms of 26 personnel between ages 20-50, indicates a clear relationship between engine room heat exposure and reported health symptoms among marine engineers. Respondents who worked in higher temperature ranges particularly 40–50 °C and above and those exposed for longer daily durations (8–12 hours) showed a higher frequency of heat-related issues such as fatigue, excessive sweating, dehydration, headaches, and reduced concentration. Poor ventilation further intensified these effects, with participants noting discomfort and difficulty performing tasks during peak heat periods. Also, there is a need to highlight the lack of heat stress training that the respondents received with only 20% having completed it.

Conclusion: This study confirms heat stress (>40 °C) and long hours significantly harm engine room personnel, causing fatigue, dehydration, and reduced focus. Poor ventilation worsens these risks, but proper hydration, rest breaks, PPE, and heat stress training effectively mitigate exposure.

Keywords: Chronic diseases, Engine rooms, Heat stress, Safety, Seafarers



Literature Review on Common Rail Fuel Injection Systems in Marine Diesel Engines: Limitations in Transition to Modern Injection Technologies and Effects on Fuel Consumption

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Introduction: Fuel injection technology is important for fuel consumption, engine performance, reliability, and emission control in marine diesel engines. Common Rail Fuel Injection (CRFI) systems are widely used because they provide accurate control of fuel injection pressure and timing, improving combustion efficiency, and reducing emissions. Although newer technologies such as Fuel Flexible Injection (FFI) and fully electronic systems have been developed, most ships continue to use conventional CRFI systems.

Objective: This study examines why the marine industry has been slow to adopt advanced fuel injection technologies. The research focuses on the technical, operational, and economic factors affecting the transition from conventional systems.

Methodology: Information was collected from academic journals, technical reports, engine manufacturer publications, and marine industry documents.

Results and Discussion: The findings show that high retrofit costs, maintenance complexity, compatibility issues, and reliability concerns are the main reasons limiting the adoption of advanced systems. Marine conditions such as vibration, heat, humidity, and salt exposure can also affect electronic components and increase maintenance requirements. In addition, current IMO regulations mainly focus on emission reduction targets rather than directly promoting advanced fuel injection technologies.

Conclusion: The study concludes that Common Rail Fuel Injection systems will likely remain the dominant technology in marine diesel engines until newer systems become more reliable, affordable, and practical for commercial ship operations.

Keywords: Common rail fuel injection, Fuel consumption, IMO regulations, Marine diesel engines



Exploring Mental Health Challenges Faced by Seafarers: A Quantitative Approach in the Sri Lankan Maritime Sector

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Introduction: Mental health is a major concern in the maritime industry due to prolonged isolation, heavy workloads, fatigue, and extended separation from family. These conditions increase the risk of stress, anxiety, depression, and sleep problems. Limited social support and poor communication onboard further affect wellbeing, reducing concentration and decision-making, which may compromise both seafarer health and maritime safety.

Objectives: To assess the prevalence and severity of stress, anxiety, and depression among Sri Lankan seafarers using validated assessment tools. The study also aimed to identify key occupational risk factors, examine the relationship between mental health, safety, and work performance, and evaluate existing coping strategies and support systems to recommend practical improvements.

Methodology: A quantitative cross-sectional survey was conducted among active Sri Lankan seafarers with at least one year of sea experience using convenience and snowball sampling. Data were collected through a Google Forms questionnaire incorporating adapted DASS-21 items and questions on working conditions and coping strategies. The data were analyzed using descriptive statistics, Pearson correlation, and chi-square tests in SPSS.

Results & Discussion: The findings revealed moderate to severe stress (68%), anxiety (52%), and depression (47%) among respondents. Long working hours, family separation, insufficient sleep, fatigue, and poor communication facilities were significantly associated with higher DASS scores. Additionally, 55% had considered leaving the profession due to mental strain, while 64% believed poor mental health increased accident risk.

Conclusion: This study highlights the significant impact of occupational stressors on seafarers' mental health and emphasizes the need for improved workplace support. Implementing enforceable rest hours, reliable communication facilities, mental health training, and supportive leadership can enhance both wellbeing and maritime safety. Future studies should use larger, probability-based samples to improve the generalizability of the findings.

Keywords: DASS-21, Mental health, Occupational stress, Quantitative research, Seafarers



Decarbonization of Maritime Fuels: A Literature Review of the Challenges and Opportunities in the Shipping Industry

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Introduction: The global transformation toward decarbonization has become a major priority in particularly within the transportation, maritime, and energy sectors. These sectors significantly contribute to greenhouse gas emissions due to their heavy usage of fossil fuels. Recent studies have highlighted the importance of cleaner fuels, renewable energy integration, and sustainable transport systems to reduce carbon emissions while maintaining economic growth and energy security. However, challenges and opportunities are also remaining in the industry.

Objectives: This study aims to review current challenges and opportunities in the industry and the decarbonization strategies used in transportation, maritime, and energy sectors with special focus on alternative fuels.

Methodology: A literature review was taken for this study. Recent academic journals, institutional reports, and policy studies related to global transportation decarbonization, maritime alternative fuels and sustainable energy systems were reviewed to identify major challenges and opportunities associated with decarbonization.

Results & Discussion: The findings indicate that renewable energy integration, alternative marine fuels are among the most effective pathways for achieving long-term emission reduction. Low-carbon fuel standards and international policy cooperation were also identified as important factors supporting cleaner transportation systems. Furthermore, successful decarbonization requires collaboration between governments, industries, and research institutions to improve infrastructure, technology development, and energy security.

Conclusion: The study concludes that the decarbonization of transportation and maritime sectors requires a combination of technological innovation, infrastructure investments, renewable energy adoption, and good policy frameworks. Alternative fuels such as e-ammonia, e-diesel and hydrogen show significant potential for reducing carbon emissions and to achieve the goal of net-zero emissions by 2050.

Keywords: Alternative fuels, Greenhouse gas emissions, Maritime decarbonization



Mental Health and Psychosocial Hazards among Seafarers in Sri Lanka: Survey on Officer In Charge of Engineering Watch Phase (III) Cadets

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Introduction: Seafarers in engineering departments face physical hazards as well as psychosocial pressures arising from demanding workloads, long working hours, isolation and prolonged separation from family. These factors may affect mental wellbeing and safe work performance, yet psychosocial wellbeing among Sri Lankan engineering cadets remains insufficiently examined.

Objectives: To identify psychosocial and occupational hazards experienced by Officer In Charge of Engineering Watch (OICEW) Phase III cadets, assess their perceived association with concentration, decision-making and self-reported performance, and recommend measures to improve psychosocial wellbeing.

Methodology: A quantitative cross-sectional survey was conducted among 30 Sri Lankan OICEW Phase III cadets, of whom 27 completed the questionnaire (90% response rate). Convenience sampling was used. Data were collected through a structured Google Forms questionnaire containing 5-point Likert-scale items adapted from previous literature. Content validity was established through expert review, and responses were analyzed using descriptive statistics.

Results & Discussion: Most respondents agreed or strongly agreed that long working hours, fatigue, isolation, heavy workload and separation from family negatively affected their mental wellbeing and occupational performance. Higher perceived psychosocial stress was associated with reduced concentration and decision-making. These findings are based on the survey responses; no causal relationships were inferred.

Conclusion: Psychosocial hazards are commonly perceived among Sri Lankan OICEW Phase III cadets and are associated with poorer self-reported concentration, decision-making and occupational performance. The findings support stronger mental health awareness and psychosocial support programmes. Larger studies using validated psychological instruments are recommended.

Keywords: Cadets, Maritime safety, Occupational hazards, Psychosocial stress, Seafarers



The Comparison between Traditional Fuels and Green Shipping Technology

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Introduction: The maritime industry is one of the major contributors to greenhouse gas emissions and environmental pollution due to the extensive use of fossil fuels. Although traditional fuels are widely available and cost-effective, they produce high levels of sulphur oxides, nitrogen oxides, and carbon dioxide.

Objective: This study compares traditional marine fuels such as Heavy Fuel Oil (HFO) and Marine Diesel Oil (MDO) with green shipping technologies and alternative fuels including LNG, hydrogen, ammonia, methanol, and biofuels. Green shipping technologies are introduced to reduce emissions, improve energy efficiency, and support sustainable maritime transportation. This research aims to compare the environmental impact, operational efficiency, economic feasibility, and future potential of traditional and green shipping fuels.

Methodology: The study is based on literature reviews, IMO reports, and comparative analysis of different fuel technologies used in the shipping industry.

Conclusion: The study concludes that green shipping technology is essential for achieving sustainable maritime operations and meeting future international environmental regulations.

Keywords: Emission reduction, Green shipping, Hydrogen, LNG, Sustainable maritime transport



Literature Review on: Navigating the Waves of Change: Minimizing Environmental Impacts of Marine Fuels and Contribution of LNG-Powered Shipping

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Introduction: Shipping contributes approximately 3% of global greenhouse gas (GHG) emissions, with the sector's choice of fuel serving as the primary driver of environmental impact. As the industry strives to meet International Maritime Organization (IMO) emission targets for 2030, 2040, and 2050, the transition from conventional fuels such as Heavy Fuel Oil (HFO) and Marine Diesel (MDO/MGO) to cleaner alternatives is critical. Conventional fuels produce high CO₂ per MJ and emit significant levels of SO_x, NO_x, particulate matter (PM), and black carbon, which harm both the climate and local air quality near shipping lanes.

Objective: This study evaluates the life-cycle environmental impacts of marine fuels and analyzes the role of Liquefied Natural Gas (LNG) in minimizing maritime pollution.

Methodology: Using a Well-to-Wake (W t W) methodology encompassing extraction, liquefaction, transportation, and onboard combustion; the research compares the emissions profile of LNG against traditional petroleum-based fuels.

Results and Discussion: Key findings indicate that LNG-powered shipping offers a practical and scalable solution, providing up to a 25% reduction in CO₂ emissions compared to HFO. Furthermore, LNG virtually eliminates SO_x emissions (approx. 99% reduction) and significantly lowers NO_x and particulate matter. However, the study identifies "methane slip" as a critical challenge that can diminish the overall GHG benefits during the lifecycle. Technical mitigations, including High-Pressure Dual-Fuel (HPDF) engines, oxidation catalysts, and the strategic transition toward Bio-LNG and synthetic e-LNG, are recommended to maximize environmental gains.

Conclusion: In conclusion, LNG serves as an essential bridge fuel that facilitates the maritime industry's journey toward total decarbonization.

Keywords: Assessment (LCA), IMO emission targets, LNG powered shipping, Marine fuels, Methane slip



Literature Review: Combined Environmental Stressors Effects on Shipbuilding

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Introduction: Shipbuilding materials such as high-strength steel, aluminium alloys, and composites are continuously exposed to seawater, ultraviolet (UV) radiation, temperature fluctuations, and chemical treatments. Although these environmental stressors have been extensively investigated individually, their combined effects remain insufficiently understood. This creates a significant gap between laboratory testing and the actual marine environment, reducing the reliability of material selection and performance prediction.

Objectives: This study aims to examine how multiple environmental stressors interact to influence the degradation of shipbuilding materials and to identify research gaps in current testing approaches. The study also seeks to provide a foundation for more realistic material evaluation methods for future shipbuilding applications.

Methodology: A desk-based research approach was adopted through a systematic literature review and bibliometric analysis of scientific publications, technical reports, and industry documents published during the last decade. The collected literature was critically analysed to identify trends, limitations, and interactions between multiple environmental stressors affecting marine structural materials.

Results & Discussion: The review revealed that most previous studies investigate corrosion, UV exposure, thermal cycling, and chemical treatments independently rather than simultaneously. Analysis of approximately fifty key publications indicates that combined stressors often accelerate material degradation beyond the effects observed under single-factor testing. For example, UV exposure increases polymer brittleness while chlorinated seawater accelerates corrosion, producing synergistic deterioration mechanisms. Current testing standards therefore fail to accurately represent real marine service conditions, limiting the prediction of long-term structural reliability and maintenance requirements.

Conclusion: The findings demonstrate a substantial gap between existing laboratory testing methods and real marine operating environments. Future research should prioritize multi-stressor testing and predictive modelling to improve the durability assessment of shipbuilding materials. Such approaches will support safer vessel design, enhanced maintenance planning, and the development of more sustainable marine structures.

Keywords: Combined environmental stressors, Marine degradation, Material performance prediction, Multi-stressor testing, Shipbuilding materials



Critical Barriers in Modern Maritime Communication Systems: A Research Gap Analysis from Peer-Reviewed Literature

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Introduction: Maritime communication systems support global shipping worth over \$14 trillion, using VHF radio, satellite links, AIS, and emerging UAV networks. As ships operate more in deep-sea and polar areas and adopt Internet of Ships (IoS) and autonomous technologies, communication systems face growing challenges. Earlier studies looked at range limits, cyber threats, and radio propagation gaps separately, but no study has combined these barriers into one complete picture.

Objective(s): The objectives of this study are to (1) identify the technical, security, and integration barriers reported in three peer-reviewed studies, (2) examine how these barriers affect each other, (3) assess their safety and economic impact, and (4) suggest recommendations for research and policy.

Methodology: Three peer-reviewed papers were selected for their complementary focus. Barriers reported in each paper were extracted and compared against IMO, ITU, and IEEE standards to identify common patterns and gaps between existing research and practical solutions.

Results & Discussion: The review found six major barriers: poor connectivity in deep-ocean and polar regions, satellite latency unsuitable for autonomous vessel control, cyber security risks from IT/OT convergence such as AIS and GPS spoofing, unresolved radio resource management, missing Internet of Ships protocols, and no unified Maritime Communication Network (MCN) standard. These barriers reinforce one another, and IMO data show that communication failures cause over 75% of maritime incidents. This confirms the objective of showing how unresolved barriers threaten safety and the \$135 billion autonomous shipping market expected by 2030.

Conclusion: The study has some limitations, as it is based on only three papers and would benefit from wider validation through sea trials. Future work should test the proposed SDN/SDR framework and unified standards under real conditions. Addressing these barriers can improve maritime safety and support the shipping industry's move toward safer, more connected operations, benefiting both the academic community and society.

Keywords: Cybersecurity, Internet of ships, Maritime communication systems, Research gap analysis, Satellite latency



Perception of Seafarers on Gaps, Opportunities and User Needs for Future E-navigation Technology

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Introduction: The maritime industry is undergoing rapid digital transformation to improve navigation safety, operational efficiency, and environmental sustainability. The International Maritime Organization (IMO) introduced the e-navigation strategy to enhance the collection, integration, exchange, and analysis of maritime information between ships and shore-based operators. However, existing systems continue to experience challenges, including fragmented information exchange, limited interoperability, inconsistent navigational data, and insufficient user-centered design. These issues affect decision-making and the effective implementation of e-navigation technologies.

Objectives: This study aims to identify gaps in current e-navigation systems, examine the information needs of maritime stakeholders, evaluate barriers to effective ship–shore information exchange, explore opportunities offered by emerging technologies, and recommend improvements for future user-centered e-navigation systems.

Methodology: A qualitative desk-based research approach was adopted using the sociotechnical systems perspective. Data were collected from academic journal articles, IMO publications, conference proceedings, and previous maritime studies. Existing qualitative findings on maritime operations, communication practices, and technology adoption were reviewed to identify recurring themes related to e-navigation.

Results & Discussion: The review identified major challenges, including fragmented information systems, communication barriers, inconsistent navigational information, incomplete AIS data coverage, and cybersecurity concerns. The findings also highlighted the need for integrated, interoperable, and user-friendly technologies that better support operational workflows and strengthen collaboration between shipboard and shore-based personnel.

Conclusion: The study concludes that future e-navigation systems should prioritize interoperability, cybersecurity, and user-centered design to improve maritime safety and operational efficiency. These findings support the IMO's e-navigation vision and provide recommendations for future research, policy development, and the advancement of reliable maritime information exchange systems.

Keywords: AIS, Digital navigation, E-navigation, Maritime safety, Maritime technology



Quantitative Modelling of Ship Drag, Fuel Consumption, and Greenhouse Gas Emissions in Maritime Operations

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Introduction: Maritime shipping is essential for global trade but contributes significantly to fuel consumption and greenhouse gas emissions. Increased hydrodynamic drag raises ship resistance, requiring greater engine power and resulting in higher fuel consumption and emissions. Understanding this relationship is essential for improving energy efficiency and supporting sustainable maritime operations.

Objectives: To quantitatively evaluate the relationship between ship drag, fuel consumption, and greenhouse gas emissions, and to identify practical drag reduction strategies for improving fuel efficiency under different operating conditions.

Methodology: A quantitative research approach was adopted using structured survey data collected from experienced maritime professionals. The responses were analyzed using descriptive statistical methods in Microsoft Excel to evaluate operational factors influencing ship resistance, fuel consumption, and emissions. The survey findings were used to validate the identified relationships and operational trends.

Results & Discussion: The analysis indicates that hull fouling, vessel speed, and adverse weather conditions are the primary contributors to increased ship resistance and fuel consumption. Slow steaming, trim optimization, hull cleaning, weather routing, anti-fouling coatings, and propeller polishing were consistently recognized as effective drag reduction strategies. The findings further reveal that fuel efficiency depends not only on hull condition but also on operational decision-making, including voyage planning and speed management, demonstrating a clear relationship between drag, fuel consumption, and greenhouse gas emissions.

Conclusion: The study confirms that reducing ship drag can improve fuel efficiency and lower greenhouse gas emissions. Integrating engineering practices with effective operational strategies can support sustainable shipping. Future work should incorporate larger datasets and advanced quantitative modelling techniques to strengthen the reliability and applicability of the findings.

Keywords: Drag reduction, Fuel consumption, Greenhouse gas emissions, Hydrodynamic resistance, Ship drag



The Human–Machine interactions and Maritime Safety: A review of Technological and Human Factors

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Introduction: The maritime industry increasingly depends on automation and digital technologies for ship operations and safety management. Human–Machine Interaction (HMI) refers to the communication between seafarers and automated ship systems used for monitoring and controlling operations. Modern vessels use advanced navigation systems, alarms, sensors, and automated engine controls to improve efficiency and safety. However, maritime accidents still occur due to human error, poor interface design, automation dependency, and lack of situational awareness. Experienced seafarers may sometimes become less mindful because of overconfidence and routine familiarity with operations, leading to reduced attention during critical situations. In addition, complex alarm systems and excessive information displays can confuse operators and increase operational risks. Therefore, understanding both technological and human factors is essential for improving maritime safety.

Objectives: The main objective of this study is to review the technological and human factors influencing Human–Machine Interaction in maritime safety. The study aims to understand how HMI systems affect seafarer performance, operational safety, and decision-making while also examining how factors such as human error, operator mindfulness, training, and interface design contribute to maritime accidents.

Methodology: The study has been conducted through desk research (secondary sources) related to Human–Machine Interaction and maritime safety. Academic journals, books, conference papers, maritime safety reports and online publications were the sources used for the collection of information. The technological challenges, human factors and safety issues related to ship operations and automation systems were identified through previous studies and accident reports. Information collected was analyzed to gain insight into the relationship between HMI systems, human behavior and maritime safety performance.

Results & Discussion: The research revealed that the Human–Machine Interaction systems are effective in enhancing maritime safety, offering live monitoring and automatic alarm and supporting marine operations. These systems assist operators in recognizing issues in a timely manner and aid in decision making in emergencies. The results also reveal, however, that poorly designed interfaces, over-automation, and alarm overload can diminish situational awareness and trigger human errors. Another key factor found is that of less mindfulness among some experienced seafarers. Operators can sometimes become complacent using the same methods over a long period of time and forget to pay attention to warning signs and changes in operations. This can make for slow response times and accident causation. The research emphasizes the need for good design of interfaces, ongoing training and keeping the operators alert for safe operation at sea

Conclusion: Provide any shortcomings/improvements/suggestions for further progression of the research and future directions, while elaborating on how the research outcomes may benefit the scientific and academic community and society.

Keywords: Automation, Human error, Human factors, Human-machine interaction, Maritime safety



A Mixed Study on the Impact of Smart Port Technologies on Operational Efficiency and Sustainability in Port Logistics

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Introduction: Technological innovation and the growing demand to improve efficiency, sustainability and resilience in ports is transforming the global maritime industry. While Sri Lanka is strategically located in the shipping lanes, there are still technical integration, infrastructure upgrading, and operational coordination issues in the country's ports. The recent global disruptions, such as the COVID-19 pandemic and the blockage of the Suez Canal, underscored the need for smarter and more resilient port systems. This study explores the potential of smart port technologies, including artificial intelligence, Internet of Things, automation, and digital operating systems, to enhance berth productivity, container handling efficiency, safety, and sustainability standards in Sri Lankan ports and boost competitiveness by benchmarking against top international ports.

Objectives: The study aims to explore the potential of modernizing port engineering and logistics operations in Sri Lankan ports to enhance shipping efficiency, operational performance, and resilience by leveraging the use of smart technologies, including automation, advanced cranes, digital systems, and automated equipment.

Methodology: The study used a mixed method with a comparative case study design to explore the contribution of smart port technologies to operational efficiency and sustainability. The data was gathered from secondary sources like academic journals, industry reports, case studies of Colombo, Rotterdam and Singapore ports, and primary sources like questionnaires and interviews with the port professionals. Descriptive and comparative analysis of the data was used to assess performance and environmental outcomes.

Results & Discussion: This study investigated the efficiency gains, cost and emission reductions, energy savings, and implementation barriers of smart port technologies, to ensure a balance between economic and environmental gains in ports.

Conclusion: Evaluating key areas such as cargo handling, turnaround time, cost-effectiveness, safety, sustainability, and technology adoption can help ports identify weaknesses and improve operations. Digitalization, automation, IoT, automated cranes, terminal operating systems, and predictive maintenance can increase productivity, reduce delays, and improve resource management. Smart technologies can also help address cybersecurity, climate, and operational risks while reducing emissions and environmental impacts.

Keywords: Maritime logistics, Operational efficiency, Port, Port digitalization, Smart port technologies



Renewable Energy Generation from Ship Rolling Motion Using Pendulum and Hydraulic Technology

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Introduction: This study presents a hybrid renewable energy system that harvests electrical power from the multi-degree-of-freedom (multi-DOF) motions of a ship at sea by integrating a gimbal-based pendulum mechanism with a hydraulic liquid-transfer system. Conventional onboard power relies heavily on diesel generators increasing fuel consumption, emissions, and long-term unsustainability. Traditional single-axis pendulum systems respond only to rolling motion, leaving energy from surge, sway, heave, pitch, and yaw unharvested, and they suffer misalignment errors and unstable output in irregular seas. To address these limitations, this research proposes a 2-axis gimballed pendulum that responds simultaneously to coupled multi-DOF ship oscillation.

Objectives: Seakeeping analysis and wave-spectrum statistics show that harvestable mechanical power scales with the number of degrees of freedom engaged, so capturing motion across multiple axes substantially increases total power compared with a single-axis pendulum. Numerical modelling and motion-simulator prototype testing confirm that at sufficient oscillation angles, the gimballed pendulum develops coupled motion between its two pivot axes, enriching power output across varying sea states.

Methodology: The pendulum is coupled with two side-mounted hydraulic tanks positioned symmetrically across the hull. Ship motion transfers liquid between tanks driving pistons that pressurize an onboard generator, while the pendulum's angular oscillations provide supplementary output via a secondary generator. This dual-path architecture is complementary: the hydraulic system dominates during heavy rolling and multi-axis excitation, while the pendulum sustains steadier generation in mild seas.

Results & discussions: Expected results showed the combined system achieving greater total power output and improved stability than a single-axis pendulum or a standalone hydraulic system alone, reducing diesel auxiliary generator dependence, fuel costs, and emissions. Future work will target full-scale prototype optimization, refined dynamic coupling equations for asymmetric configurations and sea-trial validation across diverse vessels and ocean conditions.

Keywords: Auxiliary power generation, Hydraulic technology, Gimbal-based pendulum, Marine renewable energy, Sustainability





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Analysis of Risk Assessment Failures in Heavy Weather and Enclosed Space Entries

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Introduction: According to the International Safety Management (ISM) Code, marine navigators and shipboard management are strictly required to identify operational hazards, calculate associated risks, and implement robust control measures prior to executing hazardous operations onboard. Despite these regulatory frameworks, accident investigation authorities consistently identify poor risk assessment as the critical root cause of severe maritime casualties.

Objectives: This study aimed to analyze how poor communication and inadequate operational decision-making serve as primary catalysts for catastrophic maritime accidents.

Methodology: Utilizing a qualitative comparative framework, the paper examines three seminal maritime casualties.

Results & Discussion: In the *Johann Schulte* case study, deficient risk assessment regarding severe meteorological conditions resulted in two fatalities and multiple crew casualties. In the vessel *Sava Lake*, a failure to recognize a localized enclosed space and inadequate risk assessment of cargo dynamics led to the asphyxiation of two crew members. Similarly, the *Saga Rose* incident demonstrated critical failures in enclosed-space risk profiling, resulting in the death of a seafarer. This paper synthesizes these findings to demonstrate how environmental stressors like heavy weather compound structural and procedural breakdowns.

Conclusion: It concludes that proactive hazard recognition, stringent enforcement of safety management systems, streamlined communication, and continuous crew training are indispensable to mitigating operational risks at sea.

Keywords: Communication failures, Enclosed space entry, Heavy weather, ISM code, Risk assessment



Assessment of Communication Gaps in Congested Areas between Two Vessels

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Introduction: Maritime industry is an important sector of world trade. In busy areas such as port areas, narrow channels, and congested areas, thousands of vessels are in use every day. Effective communication is vital for safe navigation and preventing collisions.

Objectives: This study aims to identify communication gaps between vessels, explore the effects of improper VHF communication and human factors on accidents and assess how important COLREG and Bridge Resource Management (BRM) improve navigational safety.

Methodology: Qualitative and analytical approach that we adopted was using secondary data, which comprised of accident reports, IMO publications, articles and previous studies including analyses of collisions.

Results & Discussion: The results clearly show that reliance on informal VHF communication, miscommunication of COLREG requirements, lack of teamwork on bridges, language issues and human factors (stress, fatigue and poor situational awareness) all contribute to a higher risk of collisions and near misses. Poor communication does not decrease the incidents at sea; the modern communication equipment like AIS, ARPA and ECDIS can improve navigational safety.

Conclusion: The study finds that making the COLREGs stricter, implementing better BRM practices, and providing a better communication training are required to enhance maritime safety in congested areas.

Keywords: Bridge Resource Management (BRM), Maritime communication, COLREGs, Navigational safety, Situational awareness.



Calibration Practices of Portable Gas Detectors and Associated Equipment for Enclosed Space Entry on Merchant Ships

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Introduction: Enclosed spaces on merchant ships present severe atmospheric hazards, including oxygen deficiency, toxic gases, flammable vapors, and elevated carbon dioxide (CO₂) levels. To mitigate these lethal hazards and safeguard crew members entering confined areas, merchant vessels rely heavily on portable multi-gas detectors. However, the operational reliability of these safety-critical devices depends entirely on consistent maintenance and precise calibration, making robust shipboard calibration protocols essential for maritime safety.

Objectives: This study evaluates current shipboard gas detector calibration and maintenance practices against international safety standards to identify compliance gaps.

Methodology: A qualitative and quantitative assessment was conducted involving structured interviews with safety officers alongside detailed maintenance log evaluations across vessels.

Results and Discussion: Approximately 62% of evaluated vessels exceeded recommended calibration timeframes, and only 41% consistently performed required daily bump tests. Key underlying factors included outdated detection units lacking monitoring CO₂ capabilities, expired calibration gas canisters, insufficient crew training, and procurement delays. Crucially, vessels maintaining rigorous calibration logs demonstrated a lower incidence of safety near-misses, underscoring a direct link between compliance and incident reduction.

Conclusion: Addressing these critical onboard deficiencies requires standardizing shipboard operational procedures, deploying automated bump-testing stations, enhancing crew training programs, and establishing reliable supply lines for certified calibration gas. Implementing these practical strategies will significantly reduce enclosed space entry risks, enhance overall maritime safety compliance, and effectively prevent future shipboard injuries and fatalities.

Keywords: Calibration, Enclosed space, Gas detectors, Marine safety, Merchant ships



Contribution of Human Elements in Grounding Incidents in the Maritime Industry

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Introduction: The shipping industry is now considered to be the backbone of global trade, transporting over 80% of goods worldwide. Despite advances in technology and regulations maritime accidents still occur with groundings as the most prominent accidents, which accounts for nearly 30% maritime incidents. Ship grounding not only damages ships but also causes significant environmental damage. While these incidents may occur due to technical failures as well as human errors, this specific study explores the role of human error in grounding incidents by analyzing three cases which are M/V interlink utility, CMA CGM Libra and M/V Wakaisho.

Objective: This study aimed to identify human factors which cause groundings and to provide recommendations to mitigate similar incidents in the future.

Methodology: While conducting this study a qualitative thematic analysis approach was adopted, examining the three above stated maritime accident case studies to identify recurring human factor themes.

Results & Discussion: Findings revealed that poor team play, negligence during navigation on bridge, poor passage planning were the primitive causes behind these incidents. Apart from the above main reasons for the contribution of fatigue, poor situational awareness, over relying on technology were also significant.

Conclusion: Finally, this study concludes that ship groundings are usually a combination of various factors rather than a single main problem. Thereby improving fatigue management, encouraging and training for proper teamwork passage planning and compliance with safety standards, regulations and procedures are essential to reduce the grounding risks which are due to human error.

Keywords: Fatigue, Grounding, Human error, Seafarers



Critical Analysis of Occupational Risk Management Failure in Heavy Weather-The M/V Giulia I Forecastle Incident

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Introduction: The maritime industry carries 80-90% of global trade. Spurling pipe covers prevent chain locker flooding in heavy weather. The M/V Giulia I incident shows the danger when they fail, causing flooding and safety risks. Forecastle accidents are predictable and linked to SMS failures. Weak ISM Code implementation pressures Masters to work in dangerous conditions instead of waiting for safer weather.

Objectives: Aims of this study were to Identify reasons for maritime accidents in heavy weather and to provide precautions to prevent accidents in rough weather.

Methodology: A quantitative case study approach was used. Data was collected from the M/V Giulia I incident report, weather records, Beaufort scale logs, and ISM Code documentation.

Results & Discussion: Over 250,000 Sri Lankans serve at sea, often in deck roles. Protecting them requires preventing heavy weather disasters. A forecastle injury increases P&I premiums fleet-wide. For VSL Dry Bulk Ltd, this incident likely cost more than replacing all spurling pipe covers. IForecastle flooding reduces reserve buoyancy. In Force 8, this becomes a survivability issue. Delay for calm weather is a stability calculation, not lost time. Two-Man Rule & Shore Authority: No deck work at Force 6+ without live video approval from the DPA. Treat Spurling Pipes as Safety Equipment: Quarterly testing of bitter ends and pins, logged as a Class item. Redefine “Urgency” in SMS: Flooding <5% of forward reserve buoyancy is not an emergency requiring deck work in >Force 7.

Conclusion: Forecastle flooding is preventable, not accidental. Strengthening SMS procedures, treating spurling covers as critical safety equipment, and empowering Masters to prioritize safety over schedule can significantly reduce injuries and financial loss.

Keywords: Chain locker flooding, Heavy weather, Maritime accidents



Importance of Proper Weight Distribution on Container Vessels Lesson Learned from the Container Carrier ONE APUS

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Introduction: The correct loading and unloading of a container carrier is a very important aspect to ensure stability, integrity and safe loading and unloading process of the vessel at sea. Improper loading of cargo and improper planning of containers can create too high a hull stress, cargo shift, loss of container overboard, loss of manoeuvrability, and in extreme situations, capsizing. International maritime regulations and cargo securing procedures offer guidelines which seafarers and ship operators need to follow on board container ships to ensure the loading and the weight distribution is safe.

Objectives: In this study, the importance of proper weight distribution in container carriers and the consequences of non-compliance with established loading procedures are examined.

Methodology: A qualitative approach is used with case studies of the incidents of container carriers on improper distribution of cargo and comparing it to the regulations and stability requirements for loading cargo.

Results & Discussion: Comparative analysis has shown the importance of making proper cargo weight declaration, planning stowage, managing ballast during cargo operations, and monitoring cargo stability during all operations.

Conclusion: The results from this research highlight the significance of following the correct weight distribution protocols to enhance vessel safety, efficiency, and reduce maritime incidents in container shipping.

Keywords: Ballast management, Cargo stowage, Container carriers, Vessel stability, Weight distribution.



A Quantitative Study on the Impact of Leisure-Based Coping Mechanisms for the Wellbeing of Sri Lankan Seafarers

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Introduction: Improving entertainment during onboard work in marine working environments could directly impact maritime safety, operational efficiency, and the long-term mental health of the global workforce, given that high stress impairs a seafarer's ability to remain vigilant and make sound decisions; research indicates that approximately twenty-seven percent of maritime accidents are linked to emotional dysregulation. Seafaring is a stressful and high-risk occupation, contributing to considerable numbers of seafarers leaving the profession early in their careers.

Objective: The present study aimed to investigate the stress levels of Sri Lankan seafarers and the entertainment-related coping mechanisms they use to manage that stress.

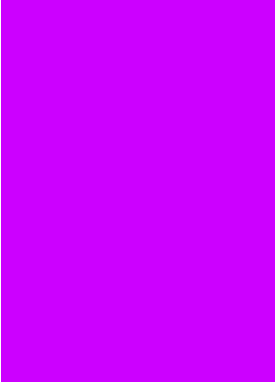
Methodology: A structured questionnaire was distributed among 9 Sri Lankan seafarers, both currently serving and retired.

Results & Discussion: The study found that even with high working stress, most Sri Lankan seafarers reported strong psychological wellbeing and happiness, with a high level of job satisfaction attributed to high earnings, clear career progression, and adherence to international standards. Fifty-seven percent of participants reported struggling with lack of sleep and pressure from shore-based management, yet most (66.6%) reported feeling homesick only rarely or never. Findings suggest that although seafaring is a high-risk, high-stress occupation, Sri Lankan seafarers tend to engage in relaxing activities such as watching movies, playing games, sleeping, and having conversations with others during their leisure time to cope with stress. Almost all participants agreed that ships should provide good-quality internet facilities, but with limited access to avoid negligence of work responsibilities and unnecessary stress caused by family matters. Sri Lankan seafarers tend to report high job satisfaction and good mental wellbeing.

Conclusion: This study data shows largely positive attributes among Sri Lankan seafarers. Collected data indicate that Sri Lankan seafarers do face high working stress, they manage to entertain themselves, cope positively and maintain a strong psychological wellbeing.

Keywords: Leisure-based coping; Maritime; Seafarers; Stress; Work-related stress





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Metal-Curcumin Complexes Formation for Heavy Metal Reduction in Food Matrices

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Introduction: Metal contamination remains a pervasive environmental challenge, with even trace exposure linked to neurological damage, reproductive failure, and increased cancer risk. Curcumin, turmeric's main bioactive polyphenol, possesses an enolizable β -diketone moiety flanked by phenolic hydroxyl groups that confer strong metal-chelating capacity, forming stable, physiologically inert complexes. This study explores curcumin's potential as a dietary heavy metal detoxifier.

Objective: To evaluate curcumin's capacity to attenuate heavy metal bioaccumulation in the body.

Methodology: Curcumin was isolated via silica gel column chromatography (hexane: ethyl acetate, 5:0 to 0:5), monitored by TLC (6:4), purified by ethanol–water recrystallization, and characterized by UV-Vis, fluorescence, FTIR, Raman, and XRD. The Cd-curcumin complex (1:2) was synthesized via NaOH deprotonation in ethanol, refluxed at 80°C for 4 h, and isolated by rotary evaporation. Stability was tested at pH 2.10–7.60 (0.05 g complex in water, 4 h). Carrot was dry-ashed (480°C) and dissolved in 1.0 mol dm⁻³ HNO₃. As proof-of-concept, a Cd-spiked carrot sample (42.55 ppm) was reacted with curcumin under the same conditions, filtered, and analyzed by AAS for residual free Cd²⁺.

Results & Discussion: The purity of recrystallized curcumin was confirmed by UV-Vis, FTIR, Raman, and XRD. Synchronous fluorescence gave near-identical maxima for curcumin and turmeric (499.2 nm vs. 498.4 nm), confirming the structural integrity of curcuminoids. Cd and Cu-curcumin complexation was confirmed by colour change, blue-shifted UV-Vis absorption, attenuated FTIR C=O stretching, Raman peak loss, and altered crystal structure. Complexes remained water-soluble and stable across pH 2.10–7.60. In Cd-spiked carrot (42.55 ppm), direct synthesis reduced free Cd to 0.92 ppm, confirming chelation within a food matrix.

Conclusion: Metal-curcumin complexation is a viable strategy to reduce heavy metal accumulation. Further validation via replicate trials, environmentally relevant Cd concentrations, and an in vivo study is needed.

Keywords: Curcumin, Heavy metals, Raman spectroscopy, Synchronous fluorescence spectroscopy



Impact of Zinc Application on Cadmium and Arsenic Accumulation and Nutritional Quality of Rice Grains

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Introduction: Paddy soil contamination has become a critical threat for the soil's ecological balance and food safety. Toxic elements in soil can accumulate in rice grains leading to potential health risks. Therefore, an effective mitigation strategy is urgently needed to reduce their accumulation in rice grains. Zinc application has gained attention as a potential soil remediation through competitive inhibition.

Objectives: This study evaluated the influence of different Zn application levels on toxic (Cd and As) and essential (Zn, Fe, Cu, and Mn) element accumulation in rice grains grown in co-contaminated soil and aimed to identify the optimum Zn application rate for improving rice grain quality.

Methodology: The pot experiment was conducted using a complete block design with triplicates, applying Zn levels at 0, 15, 30, and 60 mg/kg to soil contaminated with Cd (3.0 mg/kg) and As (15 mg /kg). Grain samples were analysed using microwave digestion followed by inductively coupled plasma mass spectrometry (ICP-MS).

Results & Discussion: The results revealed that increasing Zn application significantly reduced Cd and As concentrations in rice grains at 30 and 60 mg/kg, with no significant difference between them ($p > 0.05$). Arsenic concentrations at 30 and 60 mg/kg Zn applications were below the permissible limit of 0.2 mg/kg. Additional studies evaluating Zn rates above 60 mg/kg are needed to determine whether further reductions in Cd can be achieved. Moreover, Zn application resulted in a significant increase of Zn, Fe and Mn content in grains across treatments while Cu increased at 30 and 60 mg/kg.

Conclusion: The findings elucidated that Zn incorporation has significantly improved the safety and nutritional integrity of rice grains highlighting its potential as a soil remediation strategy.

Keywords: Co-contaminated, Remediation, Rice, Toxic, Zinc



Impact of Degree of Milling on the Essential Elemental Profiles of Rice

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Introduction: Rice (*Oryza sativa* L.) is a staple food consumed by more than half of the global population and serves as an important dietary source of essential mineral elements. However, post-harvest processing, particularly milling, significantly affects the nutritional quality of rice by removing nutrient-rich bran and germ layers. Despite extensive studies on rice nutrition, limited information is available on how different degrees of milling (DOM) affect essential elemental profiles across diverse rice varieties.

Objectives: This study aimed to investigate the impact of the DOM on the essential elemental profiles in rice and to determine which rice types are most affected by milling in reducing elemental levels.

Methodology: A comprehensive dataset was compiled from a comprehensive evaluation of the effect of DOM on the composition of Ca, Cu, Fe, K, Mg, Mn, Na, and Zn in twenty-six rice varieties utilizing the ICP-MS-based method, and the DOM levels were applied at 3%, 5%, 7%, and > 10%.

Results & Discussion: Results revealed a significant inverse relationship between DOM and elemental concentrations in rice grains. Milling significantly reduced Fe and Mn concentrations in pigmented rice varieties ($p < 0.05$). As the DOM increases from 0% to over 10%, the concentrations of K, Mg, and Fe in traditional pigmented rice varieties decrease compared to other varieties, with the maximum reduction rates of 49.69%, 68.00%, and 82.42%, respectively. Among all the analyzed rice varieties, improved-pigmented varieties showed the highest reductions in Ca, Zn, Mn, Na, and Cu, at 57.40%, 37.84%, 71.45%, 67.92%, and 36.79%, respectively.

Conclusion: The findings demonstrate that milling substantially decreases health-beneficial mineral concentrations in rice and that nutrient loss patterns vary among rice groups due to variations in mineral localization, grain structure, and genetic characteristics. Therefore, optimizing the DOM based on the rice group is essential to preserve nutritional quality and enhance dietary mineral intake among rice-consuming populations.

Keywords: Degree of milling, Essential elements, ICP-MS, Rice varieties



Differentiation of the Volatile Profile of Aged Virgin Coconut Oil from Fresh Virgin Coconut Oil

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Introduction: Aged coconut oil can be identified by its volatile profile. During aging, fatty acids undergo auto-oxidation, photo-oxidation, and lipoxygenase-mediated oxidation. As a result of auto-oxidation, hydroperoxides are the primary products. From these hydroperoxides, ketones, aldehydes, acids, and hydrocarbons are formed as secondary products. This process, lipid rancidity, alters the physical properties of edible oils. Aging was assessed using chemical parameters such as peroxide value, free fatty acids, and p-anisidine value. The peroxide value indicates primary oxidation of fatty acids, while the p-anisidine value, total oxidation value, and conjugated diene value indicate secondary oxidation. None of the above methods could identify the secondary compounds.

Objectives: The identification of secondary compounds can be done by analyzing the volatile profile of aged coconut oil.

Methodology: Virgin coconut oil (VCO) samples were prepared under laboratory conditions in accordance with the SLS 32:2017 standard. The volatile compounds of fresh VCO and two-year-aged VCO were determined by headspace solid-phase microextraction mass spectrometry (HS-SPME-GC-MS). The volatile compounds were identified using the NIST 11 GC-MS library, and quantification was performed using the internal standard Linalool.

Results & Discussion: Twelve new volatile compounds were identified in aged VCO that were absent in fresh VCO. Among them, 4-hydroxyhexa-3-ne-2-one, Acetonyl acetone, acetic acid, propanoic acid, and butanoic acid were present at higher concentrations (>50 ppm). During the auto oxidation initiate abstracting allylic hydrogen and produces an allylic radical. This allylic radical reacts with molecular oxygen, producing peroxy radicals. Further reactions with these peroxy radicals produce ketones, epoxy hydroxy, and dihydroxy compounds. This process ends with the delocalization of a few carbons from fatty acid compounds. With aging, auto-oxidation increases, reflected in the formation of several different compounds in aged oil compared to fresh oil.

Conclusion: The presence of these compounds can be used to distinguish aged coconut oil from fresh coconut oil.

Keywords: Age & fresh oil, HS-SPME-GC-MS, Lipid rancidity, Virgin coconut oil, Volatile compounds



Ambient Chloride Assessment by Ion Chromatography: A Tool for Corrosion Risk Assessment of Reinforced Concrete Structures

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Introduction: High levels of chloride are recognized as one of the main durability issues for reinforced concrete buildings in the Colombo Municipal Council (CMC) area due to salty aerosols, high humidity, and monsoon winds, which lead to premature failure and reinforcement corrosion reducing their lifespan and functionality. According to past research studies in Sri Lanka, atmospheric salinity was identified as an important parameter determining the corrosion rate. However, information on spatial chloride distribution in the CMC area is lacking.

Objectives: The present research aimed to determine ambient chloride concentration using the Ion Chromatography (IC) method for subsequent corrosion risk assessment.

Methodology: Air samples were collected from six locations of the study area using an air pump with 10% H₂O₂ impinger absorption from December 2025 to April 2026, with one sample per month per location, totalling 30 samples. The samples were filtered through 0.45 µm micro-filter and analyzed with IC.

Results & Discussion: The mean concentration of chlorides was found between 1.38 and 4.14 µg/m³. One-way ANOVA did not show any statistically significant spatial (p =0.426) and temporal (p =0.791) variability of chloride concentration. The spikes in ambient chloride at Maradana and the Department of Meteorology can be attributed to localized marine aerosol transportation or urban re-suspension impacts.

Conclusion: Ambient chloride levels in Colombo (1.38 to 4.14 µg/m³) exceed low-corrosive standards (<1 µg/m³) but remain below severe-risk thresholds (>10 µg/m³), which would lead to accelerated corrosion of reinforced concrete structures. The results indicate moderate corrosion exposure and highlight the need for surveillance for durable structural designs.

Keywords: Ambient chloride, Building durability, Ion Chromatography



Light Absorption Enhancement in Organic Solar Cells Using Plasmonic Silver Nanostructures: An FDTD Computational Study

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Introduction: Organic solar cells (OSCs) have drawn significant attention as next-generation photovoltaics due to their low cost, light weight, flexibility, and compatibility with large-area fabrication. However, their power conversion efficiency remains limited by weak light absorption in thin active layers and poor charge transport stemming from short exciton diffusion lengths. Effective photon management strategies are therefore essential to maximize optical absorption.

Objectives: To investigate light absorption enhancement in organic solar cells using plasmonic silver (Ag) nanostructures with various geometries.

Methodology: In this computational study, plasmonic silver (Ag) nanostructures with various geometries including nanocubes, nanospheres, nanorods, nanocylinders, and nanocuboids were embedded into a P3HT active layer. Using 3D Finite-Difference Time-Domain (FDTD) simulations (ANSYS Lumerical FDTD 2020 R2), the size and periodicity of the nanostructures were systematically optimized.

Results & Discussion: The results reveal that OSCs incorporating Ag nanocylinders achieve the highest light absorption, yielding an 11.5% enhancement in short-circuit current density (J_{sc}) compared to the reference device. Electric field profiling confirms that this absorption gain is driven by localized surface plasmon resonance (LSPR) in the vicinity of the nanocylinders. Furthermore, the cylindrical geometry supports multiple resonant modes, resulting in a broader absorption enhancement window in the near-infrared region compared to highly symmetric nanostructures.

Conclusion: Ag nanocylinders achieve the highest light absorption among the investigated geometries, demonstrating their potential to enhance the performance of organic solar cells through localized surface plasmon resonance (LSPR).

Keywords: FDTD simulation, Light absorption, Organic solar cells, Plasmonic nanostructures



Simulating Lysozyme Stability: Effects of Denaturants and Protective Agents

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Introduction: The native structure of a protein is essential for its biological function. Urea destabilizes proteins by disrupting non-covalent interactions, while TMAO stabilizes proteins under stress conditions. Molecular dynamics simulations provide atomic-level insight to observe these structural variations.

Objectives: To investigate lysozyme stability in 8 M urea, 4 M TMAO, and their mixtures, and to analyze denatured protein behaviour in water and TMAO. Additionally, investigate the TMAO-induced renaturation at 290-310 K.

Methodology: MD simulations were performed on native lysozyme (PDB ID: 2LYM) in water, 8 M urea, 4 M TMAO, and urea-TMAO mixtures using the KBFF20 force field, chosen for its accurate thermodynamics parameterization of aqueous cosolvents. Denatured lysozyme was simulated in water and 4 M TMAO, with temperature-dependent simulations (290-310 K) performed in 4 M TMAO. Given lysozyme's rigid four disulfide network, 50 ns trajectories were sufficient to capture early-stage conformational kinetics and local solvent equilibration. Conformational changes were quantified using RMSD, Rg, SASA, and hydrogen bonding analysis.

Results & Discussion: Urea unfolds lysozyme, increasing RMSD and Rg, and reducing the number of H bonds between water and protein. TMAO counteract this, maintaining structural compactness. The urea-TMAO mixture shows partial stabilization. On this 50 ns timescale, the system has not equilibrated; because urea hasn't yet disrupted the protein core, TMAO's protective compaction temporarily dominates. Temperature influences the formation of a more compact, more folded state.

Conclusion: Urea denatures lysozyme, while TMAO promotes structural compactness and offsets unfolding. TMAO significantly reduces structural deviations and enhances thermal stability, demonstrating how protective osmolytes preserve global protein compactness under thermal and chemical stress.

Keywords: Molecular dynamics, Protein stability, Thermal renaturation, TMAO



Optimization and Fuel Characterization of Blended Biomass Briquettes from Guinea Grass (*Megathyrsus maximus*) and Tea Industry Waste

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Introduction: The industrial sector accounts for a significant fraction of the energy consumption in Sri Lanka, while many industries still rely heavily on firewood. The tea industry alone consumes around 44% of forest timber as the primary energy source contributing to deforestation and resource depletion. While energy generation from biomass-derived briquettes is still gaining popularity, several potential waste materials remain underutilized, such as refused tea generated by tea factories and widespread grass species like *Megathyrsus maximus*, commonly known as guinea grass, which is abundant in Sri Lanka.

Objectives: This study investigates the potential of using dried guinea grass and waste tea from tea factories for biomass briquette production and evaluates their fuel characteristics through blending optimization.

Methodology: Proximate and elemental analyses, calorific value determination, and Fourier Transform Infrared (FTIR) spectroscopy were conducted on the raw materials, and five briquette blends, namely B1 (0:90:10), B2 (90:0:10), B3 (45:45:10), B4 (30:60:10), and B5 (60:30:10) with Tea:Grass:Binder ratios, that were prepared using corn starch as the binder.

Results & Discussion: Results showed that calorific values of 5 blends ranged from 16.25 to 19.46 MJ/kg, with tea-rich blends, B2 and B5 showed higher calorific values 19.457 MJ/kg and 18.389 MJ/kg, associated with their increased fixed carbon contents (19% and 18.35%). FTIR results confirmed the presence of key lignocellulosic functional groups associated with biomass fuel behaviour. Meanwhile, all five blends showed ash contents ranging from 4.88%-9.18%, which is relatively lower than rice husk-based briquettes, that are commonly used.

Conclusion: Among all 5 blends, B2 and B5 demonstrated a greater potential as complementary feedstocks for sustainable briquette production, supporting their potential application as alternative solid fuels for thermal energy and co-firing applications in the Sri Lankan industrial sector. However, combustion performance, emissions, mechanical durability, and long-term performance under industrial conditions were not evaluated and warrant further investigation.

Keywords: Biomass briquettes, Fuel characterization, *Megathyrsus maximus*, Tea industry waste



Fish Waste Based Composite Film as a Slow-Release NPK Fertilizer

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Introduction: Rising fertilizer imports costs and nutrient leaching pose serious economic and environmental challenges for developing nations such as Sri Lanka. Commercial Slow-releasing Fertilizers (SRFs) reduce these losses but rely on costly, non-biodegradable coatings. This study addresses that gap by developing a biodegradable NPK-SRF film from locally generated fish and cassava waste.

Objectives: The primary objective of the study is to fabricate and evaluate a biodegradable slow-release NPK fertilizer film from fish waste protein and cassava peel starch.

Methodology: Protein and starch were extracted from fish waste and cassava peel waste by alkaline isoelectric precipitation and aqueous sedimentation, respectively. Films were fabricated by solvent casting using fish protein, cassava starch, polyvinyl alcohol, and NPK fertilizers then characterized by ATR-FTIR, XRD, SEM, and Kjeldahl analysis. Biodegradability was assessed by CO₂ evolution (ASTM D5988-12). Nutrient release was quantified from soil column leaching; N by Kjeldahl, P by colorimetry, K by AAS.

Results & Discussion: Fish protein (24.73±1.49% w/w) and starch (8.28±0.05% w/w) yields confirmed effective waste valorization. The composite film (0.75–0.85 mm) was homogeneous and flexible. FTIR confirmed biopolymer presence and fertilizer entrapment. XRD revealed an amorphous polymer matrix with crystalline fertilizer particles, while SEM showed surface transformation from smooth to rough and particle-laden (50 nm–10 µm) upon fertilizer incorporation. Kjeldahl analysis indicated fish protein contributes 44.6% additional nitrogen beyond urea content. Films degraded faster than the positive control (cellulose tissue) within first five weeks. The control (neat fertilizer) released 82% Nitrogen and 95% Potassium within two weeks then plateaued, while the film delivered sustained release of all three macronutrients over six weeks. Phosphorus release from the film (32.90±5.07 mg) exceeded the control (23.42±0.90 mg) from week three onward attributed to microbially-mediated phosphate solubilization.

Conclusion: The biodegradable NPK fertilizer film demonstrated significant biodegradability and sustained nutrient release confirming its promise as an affordable waste-valorizing SRF. Field-scale trials are currently underway.

Keywords: Biodegradable, Cassava-Peel, Fertilizer, Slow-Release, Waste



Assessment of Organic Pollution in Kurunegala Lake, Sri Lanka, using Microalgal Bioindicators

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Introduction: Microalgae and cyanobacteria are widely recognized as sensitive bioindicators of aquatic ecosystem health due to their rapid response to environmental changes.

Objectives: This study aimed to assess microalgal diversity and evaluate the organic pollution status of Kurunegala Lake, Sri Lanka, using the Palmer Algal Genus Pollution Index.

Methodology: Water samples were collected from 12 potentially impacted sites (KUT1–KUT12) and 10 reference sites (KUC1–KUC10) in November 2025. Samples were preserved and cultured in Bold's Basal Medium (BBM) under controlled laboratory conditions, followed by microscopic examination and taxonomic identification using standard algal taxonomic keys. A total of 62 phytoplankton taxa belonging to green microalgae, diatoms, and cyanobacteria were recorded.

Results & Discussion: Pollution-tolerant bioindicator genera, including *Chlorella*, *Euglena*, *Oscillatoria*, *Phormidium*, *Nitzschia*, and *Microcystis*, were frequently observed at potentially impacted sites. Compared with reference sites, potentially impacted sites exhibited higher abundances of eutrophic and pollution-tolerant species with greater taxonomic representation. Palmer Index values ranged from 4 (less organic pollution) to 22 (high organic pollution), with the highest scores recorded at KUT11 (22) and KUT12 (20). Across all sampling sites, a cumulative Palmer Index score of 35 was obtained, reflecting the widespread occurrence of pollution-tolerant genera, including *Ankistrodesmus* (2), *Chlamydomonas* (4), *Chlorella* (3), *Closterium* (1), *Cyclotella* (1), *Euglena* (5), *Melosira* (1), *Microcystis* (1), *Navicula* (3), *Nitzschia* (3), *Oscillatoria* (5), *Pandorina* (1), *Phormidium* (1), and *Scenedesmus* (4). Pollution-tolerant algae dominated the potentially impacted sites, while reference sites showed more balanced phytoplankton communities. These findings indicate spatial variation in organic enrichment associated with anthropogenic inputs around Kurunegala Lake.

Conclusion: The study demonstrates that microalgal community structure, combined with the Palmer Index, provides a reliable tool for distinguishing spatial differences in water quality and assessing the ecological status of Kurunegala Lake.

Keywords: Cyanobacteria, Kurunegala Lake, Microalgae, Organic pollution, Palmer Algal



Development of a Microalgal-Based Hydroponic System for Rice Cultivation using Oil Station Wastewater

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Introduction: The current study aimed to develop a multifaceted hydroponic rice cultivation technique using oil station wastewater inoculated with the green micro-alga *Chlorella* sp. (photobioreactor), targeting especially small-scale, export-oriented paddy growers.

Objectives: To develop a multifaceted hydroponic rice cultivation technique using oil station wastewater inoculated with *Chlorella* sp. and to evaluate the growth, physiological responses, and yield performance of rice.

Methodology: Rice seeds (BW367) were soaked for 24 hours, sprouted on banana leaf trays, and placed on mud-covered bubble sheets. Seedlings were transplanted into a hydroponic system after 12 days with seven treatments: mud with chemical fertilizer (T1), wastewater with chemical fertilizer (T2), wastewater with *Chlorella* (T3), mud with wastewater (T4), mud with wastewater with *Chlorella* (T5), mud with wastewater with chemical fertilizer (T6), and Albert solution (T7), each containing three replicates. Seedlings were monitored through vegetative, reproductive, and maturation phases to evaluate growth and physiological responses. During the vegetative phase, shoot length, leaf number, water physicochemical parameters (TDS, EC, pH), and algal growth were measured. Reproductive assessments included shoot diameter and panicle initiation, while maturation measurements included number of florets, seed filling percentage, and chlorophyll content. After harvesting, yield weight measurements and seed germination assay were performed.

Results & Discussion: Statistical analysis demonstrated significant differences in shoot length across treatments ($P < 0.05$), with T5 showing better shoot growth compared to the conventional treatment. The number of leaves showed no statistically significant difference ($P = 0.987$). Also, T5 showed the earliest panicle formation, higher seed filling percentage ($P < 0.0001$), and greater floret number ($P < 0.0001$), indicating enhanced reproductive and maturation performance. But there was no significant difference in seed germination percentage ($P = 0.416$) and yield weight ($P = 0.215$) among treatments. In terms of water quality, T5 showed excellent correlation ($r = 0.974$) between TDS and EC, indicating strong improvement of water quality compared to the conventional treatment, highlighting the synergistic effect of mud and algae, which produces the best water quality.

Conclusion: Finally, it can be concluded that algal inoculation helps to detoxify oil containing wastewater while demonstrating the potential of developed hydroponic system towards achieving climate smart agriculture

Keywords: BW367, *Chlorella*, Climate-smart agriculture, Photobioreactor



Beyond Classical Force Fields: Physics-Driven Assessment of the Grappa Machine-Learned Force Field on the FoldBind Dataset

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Introduction: Classical force fields such as AMBER ff14SB and CHARMM36 rely on fixed functional forms, while machine-learned force fields trained on quantum mechanical data offer a promising alternative but remain validated mainly on near-native structures. Robust benchmarks are needed to test their performance across large-scale conformational sampling of protein folding and binding.

Objectives: To integrate the machine-learned force field Grappa into the MELD Bayesian inference sampling framework and benchmark its performance against classical force fields using the newly developed FoldBind dataset, spanning protein-folding and peptide-protein fold-upon-binding systems.

Methodology: Systems were built in OpenMM using Grappa-derived bonded parameters with ff14SB/GBN2 nonbonded and solvation terms. PSIPRED-predicted secondary structure, hydrophobic packing, and strand-pairing restraints guided MELD replica-exchange simulations (30 replicas, 300-550 K, 20,000 exchange steps, 2.0 fs timestep), with MELD-Adapt dynamically updating active restraints. Peptide-binding simulations initialized peptides 30 Å away from the receptors, and the simulations were carried out over 40,000 steps. Clustering used CPPTRAJ and HELM; RMSDs were computed with MDAnalysis.

Results & Discussion: Native-like structures within 2 Å were obtained for all 14 folding benchmarks, with 9 (MELD-Grappa) and 10 (MELD-Adapt-Grappa) systems reaching sub-Å accuracy; 12/14 and 13/14 most-populated clusters corresponded to native basins, respectively. Three previously challenging proteins, 2HBA, 1POU, and ubiquitin, improved markedly, with ubiquitin's best-structure RMSD dropping from 4.24 Å to 1.65 Å (MELD-Grappa) and 2.72 Å (MELD-Adapt-Grappa). All four miniproteins folded within 2 Å of native, and MELD-Adapt-Grappa recovered the native cluster for T0773, raising native-like walkers from 2/30 to 15/30. For fold-upon-binding, MDM2-PDIQ reached 0.81 Å interfacial RMSD with 77% cluster population, and BRD3-ET-TP produced a native-like cluster at 2.12 Å, confirming that the objectives were achieved.

Conclusion: MELD-Grappa and MELD-Adapt-Grappa reliably recovered native states across folding and binding benchmarks, accurately reproducing folding pathways of protein G, Protein L, and their mutants. The FoldBind Benchmark Dataset offers a rigorous, extensible testbed for evaluating machine-learned force fields, supporting future development of more accurate biomolecular simulation tools.

Keywords: Force Fields, Grappa, Machine Learning, MELD, Molecular Dynamics

