



*Advancements in Multidisciplinary Scientific Research toward
Environmental Sustainability*



**Proceedings of
10th RUHUNA INTERNATIONAL SCIENCE & TECHNOLOGY
CONFERENCE**

January 18, 2023

Abstracts and Plenary Lectures



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Editorial Note

Thanks to all the authors, we have received a high number of abstracts in diverse disciplines under science and technology for RISTCON-2023. First, all of the initial submissions were screened for novelty and plagiarism. We then used a double-blind review, with each blind (extended) abstract sent to three experts in the relevant field. The final decision of the submitted abstract was made by the editorial board by considering the decisions and comments made by the reviewers. We believe that this unbiased review process has ensured a high quality and standard in the publication of proceedings.

However, the responsibility for the content in each publication remains with the respective authors. No part of this serial publication will be reproduced in any form. When citing the published abstracts, this serial publication can be referred to as 'Proceedings of the 10th Ruhuna International Science and Technology Conference - 2023, Faculty of Science, University of Ruhuna, Matara, Sri Lanka'.

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Message from the Vice Chancellor, University of Ruhuna

Environmental sustainability is defined as meeting the needs of the current generation without compromising the needs of the future generations. This needs an interaction with the planet and environment in a responsible way so that the natural resources are not destroyed completely and the very survival of the future generations are not threatened. The environment has non-human renewable and non-renewable resources that needs harvesting in such a manner so that, these resources are not lost forever. This needs multiple disciplines to come together to work on a scientific approach to create policies for governance, protection and monitoring of protection and environment development activities involving the nature. The needs of the development may sometimes go into conflict with needs of the environment sustainability.

The disciplines of applied sciences, engineering, agriculture, sociology and many other fields will require to work together to protect environment. There are new strategies to monitor and promote environment sustainability. Carbon credit system is one such activity. Environmental policing is difficult. All citizens must understand the need for minimizing in damaging activities on environment. Apart from education and motivation with deep understanding of the need to protect free oxygen sources for breathing, there is hardly anything that could be done by monitoring forces to maintain the environment friendliness.

Hence the need to conduct research into current issues of difficulties in sustaining environment is of paramount importance. The scientific findings must be disseminated to the community in an effective manner by academics. I often see this not happening. We must take the responsibility to carry this message forward.

I wish to congratulate the organizing committee for their hard work to make this conference a success and thank them for inviting me to be the Chief Guest of the conference. I hope the conference to be a scientific feast.

Senior Professor Sujeewa Amarasena
Vice Chancellor
University of Ruhuna

Message from the Dean, Faculty of Science, University of Ruhuna

It is with my great pleasure that I issue this message for the 10th Ruhuna International Science and Technology Conference (RISTCON-2023), which is started in the year 2014 as a continuation of the Science Symposia of the Faculty of Science.

Research is generally considered one of the most important objective measures of a university's quality, prestige, and standing in the world. Research brings recognition to the faculty members of a university, improves the quality of students' education, and prepares the next generation of experts and researchers that are needed to find solutions for the global challenges. Among many other challenges, environmental degradation is one of the largest threats being looked at in the world today. It is now accepted worldwide that sustainable development is the solution to environmental degradation, which should be achieved through a scientific approach.

With this timely and important topic, the RISTCON-2023 Conference has been specifically focused on addressing the environmental challenges head-on under the theme of "Advancement in multidisciplinary scientific research toward environmental sustainability." I am confident that the conference will play an important role in encouraging activities in research and development to fill the gaps in the field by sharing knowledge among professionals and giving an excellent opportunity to forge collaborations between researchers both within the country and with international partners.

I would like to express my sincere gratitude to the distinguished guests and invited speakers for their presence and contributions to the conference. Furthermore, I would like to convey the gratitude of the Faculty of Science to Dr. T.G. Dayananda, the Chairperson of the organizing committee of the RISTCON-2023 and the team members for their efforts and dedication in making this event a success. Finally, I wish you a very successful conference with many deliberations that are important for your future endeavors.

Prof. D.H.N. Munasinghe
Dean and Professor in Zoology
Faculty of Science, University of Ruhuna

Message from the Chairperson – RISTCON 2023

As the chairperson of the RISTCON 2023, It is my great pleasure to share this message at the time when the Faculty of Science is celebrating the 10th anniversary of the Ruhuna International Science and Technology Conference. I feel that this opportunity I received as the chairperson of 10th RISTCON, RISTCON 2023, is a great honour for me to face the big challenge of organizing this remarkable and immense event of the Faculty of Science and to improve my skills and knowledge of the academic carrier. Organizing an International Research Conference is a big challenge, and I am confident that the organizing committee of RISTCON 2023 has taken every hard and painstaking step to make this conference to the expectations of the academic community. Since the beginning of RISTCON in 2014 in the Faculty of Science, university of Ruhuna, many scientists and researchers locally as well as internationally derived much benefits by publishing their important scientific findings in past RISTCON conferences.

I feel that the theme of the sessions “Advancements in multidisciplinary scientific research toward environmental sustainability” provides an appropriate and well timed platform for academics and researchers from various disciplines to present their scientific findings and exchange ideas on topics such as Agriculture, Botany, Chemistry, Computer Science & IT, Engineering, Fisheries & Aquaculture, Mathematics & Statistics, Medical & Health Sciences, Molecular Biology & Biotechnology, Physics & Geophysical Science, Veterinary Science and Zoology. I believe this occasion will be used as a platform for our academics to strengthen their links with other universities and research institutes in knowledge generation and sharing while same time provides the necessary thrust in collaborative research.

This year, RISTCON 2023 proceedings includes 125 of oral and poster abstracts presentations out of the 170 abstracts after reviewed by expert reviewers and invited keynote speech and two plenary speeches of eminent scientists from various fields.

As the chairperson of the organizing committee RISTCON 2023, I take this opportunity to extend my sincere gratitude to the Vice Chancellor, Deputy vice chancellor, Registrar, Bursar, and Engineer of the University of Ruhuna, and the Dean, Faculty of Science, for offering every type of assistance and guidance to make this event successful. The RISTCON 2023 would be more colourful by the presence of keynote speaker Associate professor Gomika Udugamasooriya from USA, and the plenary speakers; Professor Buddhi

Marambe and Professor Chandima Gomez who deliver very important and attractive speeches on timely based topics.

This event would be just a dream without the painstaking, untiring effort taken by the organizing committee. It was very hard them to find enough time to involve in RISTCON 2023 activities in the last couple of weeks amidst the bulk of academic activities specially the examinations. Also, the members of the advisory and editorial boards did their dedication at superior level to organize the event and finalize the editorial activities very successfully. I am very much thankful honestly to all of them. My thanks also due all the HODs/ Science, academic and non-academic staff too for their help of various level. I am highly thankful to the authors who submitted papers with novel research findings too. Their willingness to discuss their achievements, share experiences and confront their concepts is highly appreciated. Finally, I wish to extend my great thanks to our sponsors, especially, Harischandra Mills PLC, Sri Lanka Insurance, Nippon Paint, BOC and peoples banks, Hemsons International (Pvt.) Ltd., and Dr. Ajith Hettigama, NHS Foundation, University Hospital, Sussex, UK, for their financial contribution to RISTCON 2023.

Finally, I wish all the presenters and the participants a very successful and productive conference, RISTCON 2023.

Dr. T.G. Dayananda
Chairperson/ RISTCON 2023
Department of Botany
Faculty of Science, University of Ruhuna

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Session D: Engineering, Mathematics & Statistics, Modeling &
Simulation, Nanotechnology, Physics & Geophysical Science,
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Keynote Speech

The wisdom beyond chemistry: Novel technologies to expedite the modern drug-lead discovery process

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The conventional western drug discovery process is streamlined as biologist first defining disease specific biomarkers and then chemists developing drugs to target those biomarkers to attack the disease. However, the statistics indicates that only 1 out of initial 10,000 drug-leads become a drug and the process takes about 7-15 years with spending 1–2 billion dollars for the overall process. These statistics simply indicate major draw backs of this conventional approach. Vast majority of initially developed active drug-leads are thrown away during this long drug discovery process due to off target effects and also multiple other reasons. Therefore, novel approaches and technologies are needed to reduce the cost and further expedite this current drug discovery process.

The standard approach in drug development is to target biomarkers that have known functions related to a given disease state. The majority of these biomarkers are proteins such as enzymes, hormones, receptors, or signaling molecules. There are 3 major ways utilized in the initial drug-lead discovery, namely: (I) natural products, (II) structure based or rational drug discovery, and (III) combinatorial high throughput drug discovery. The drug leads are first developed or identified targeting those disease specific biomarkers at laboratory level, testing only on the targeted biomarker alone. These active drug-leads are then tested on cellular level, pre-clinical animal level and finally validated through 3 phases of human trials. As the exposure become more and more complex going through above stages, initial drug-leads start to show off targeted effects because those drug leads are first identified only targeting the intended biomarker alone. Therefore, one way of reducing this risk is to incorporate features of complex biological system into the very initial steps of the drug discovery. The latter part of this article describes an innovative technology developed for this purpose.

When look at the well-known molecular classes in the modern drug development arena, small organic molecules, antibodies, peptides, aptamers and nanoparticles, carry both useful as well as undesired properties as drugs.¹ Years ago, small organic molecules exclusively represented therapeutics as easy to handle and orally available chemical compounds. However, the synthesis of majority of biologically active complex organic compounds remains a challenge to date. In addition, these molecules clear through the kidneys and do not have adequate affinity and contact time for effective imaging or therapy of the target. During the last two decades, antibodies have been developed as high affinity and specificity drugs, but this is a costly approach and also antibodies have intermediate to poor biodistribution and tumor penetration. Other macromolecules such as nanoparticles virtually have no clearance from the body. Although the use of biodegradable materials in building nanoparticles addressed this issue to some extent, very large molecular size still causes various pharmacokinetic issues in biological systems. In the meantime, peptides as intermediate size molecules emerged as great therapeutics, but current development of peptide-based pharmaceuticals is hindered by their rapid *in vivo* degradation and the initiation of immune responses. Researchers have recently investigated alternative peptide-like constructs that may be able to circumvent such complications. This is the point where peptidomimetics molecular developments were initiated, and peptoids are emerged as one such a promising molecular class for both therapeutic and diagnostic applications.

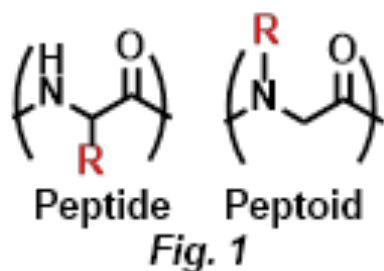


Fig. 1 Peptide vs peptoid.

Peptoids were originally invented in the early 1990s by Prof. Ronald Zukermann and major biological applications were begun around early 2000's, primarily spearheaded by Prof. Thomas Kodadek's group.^{2, 3} Peptoids comprise a peptide-based backbone and N-substituted glycines (**Fig. 1**). This means the side chain ('R' group) is placed on the nitrogen atom of the amide bond in peptoids as compared to the alpha-carbon in peptides, bringing unique and favorable characters over peptides and other conventional drug classes. The solid-phase (on resin beads) submonomer peptoid synthesis is very efficient, rapid, economical and straightforward.⁴ In order to add one residue (equivalent to an amino acid of a peptide), it needs only two chemical steps and each of these steps can be completed by 2 x 15 second microwave pulses.⁵ Bromoacetic acid coupling

brings the two carbon units and the Br can be replaced by *any amine* group, which dramatically expands the repertoire of chemical space. In peptides there are only 20 side chains available through natural amino acids, but in peptoids, virtually any organic moiety ('R' groups) can be incorporated into the backbone, thereby tremendously increasing the target biomarker recognition capacity. These oligomers are protease resistant, more cell permeable, non-immunogenic, achiral and adopt different conformations than peptides, yet retain the same density of functionality and backbone polarity.^{3, 6} Synthesis of peptoid sequences up to about 50 units in length allows for controlled sequence composition and incorporation of diverse side chain chemistries. It became clear very quickly that the most significant hurdle to compete in the drug discovery race was to access to large collections of compounds for high throughput screens. Large combinatorial libraries of peptoids (in millions) can be synthesized easily, inexpensively, and rapidly (less than one week).⁷⁻¹¹ Peptoid sequences can be deduced sensitively by Edman degradation^{8, 9} or mass spectrometry^{10, 12}.

Now a days the drug-lead discovery is mainly relying on structure based/rational approach or high throughput screenings of large combinatorial libraries. Peptoid libraries are synthesized through the "split-pool" approach, and these split-pool cycles will lead to development of 'one-bead one-compound' (OBOC) combinatorial libraries with huge diversity.¹³ For example, the Kodadek group initially developed several number of such peptoid libraries with diversities varied up to millions of permutations.^{3, 8-11, 14} These peptoid libraries can be developed in less than one week, using the very efficient and rapid microwave synthesis method. All other molecular classes are needed much more time and effort in order to develop similar size libraries and peptoids clearly display huge advantage in this initial development levels.

Once developed, these OBOC libraries can be utilized to rapidly identify peptoids for our favorite biological target (biomarker) that is important in the relevant disease applications. In protein screens, the interested protein is equilibrated with OBOC library beads and the protein is allowed to 'pick' the best binding sequences. Those protein-binding peptoid carrying beads ('hits') are identified via having a fluorescein tag (e.g. GFP) on the protein or by employing a secondary identification system (e.g. GST- or Fc-recognizing fluorescein/ quantum dot labeled antibodies). The peptoid sequence on that 'hit' bead is subsequently identified via Edman degradation or mass spectrometry.

As already mentioned, above high throughput screens also identify the initial drug-lead by only exposing to the intended targeted biomarker (e.g. protein). The drug-lead found here may bind to thousands of other biomolecules in cells and human body, and these off targets will be found later of the drug discovery process after spending years of time and money, as mentioned above. In order to expedite the drug discovery process, Dr. Udugamasooriya developed a unique on-bead two-color (OBTC) high throughput screen to identify the most selective drug-lead over rest of the biomarkers present in a cell surface. This OBTC combinatorial cell screen can directly identify peptoids that are highly selective for a particular cell-surface receptor, over all other shared cell surface proteins^{9, 15}.

The technology principle can be explained as follows: Two identical cell groups, which differ only by the presence (red stained) or absence (green stained) of a particular protein (e.g. VEGFR2), are exposed to one-bead one-compound peptoid library beads (Fig. 2). Each bead bears a unique peptoid sequence in many copies. If a bead is bound only by the red stained, targeted-biomarker expressing cells, the peptoid on this bead binds only to the intended target (e.g. VEGFR2) and not to all other shared cell-surface proteins (Fig. 2A and B). These beads are picked and mass spectroscopy sequencing is used to identify the peptoid sequence, which will be validated subsequently for binding, selectivity, and activity in many different assays. If the peptoid on a given bead binds to other shared cell-surface molecules non-specifically, it will be bound by green cells too and these are discarded (Fig. 2C).

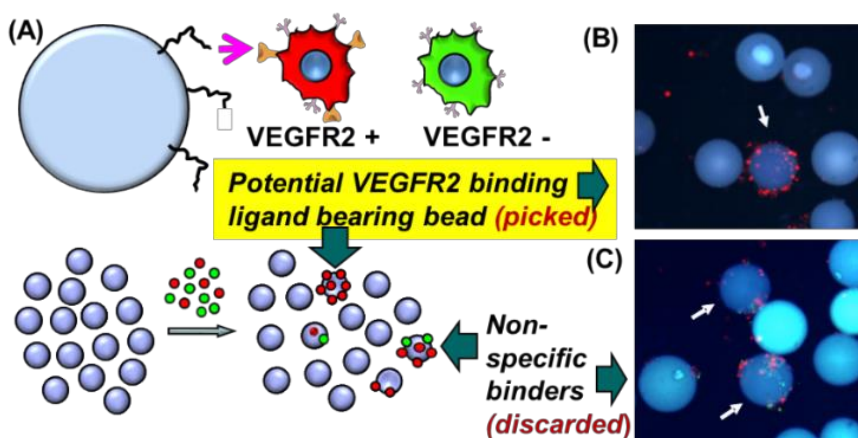


Fig. 2 On-Bead Two-Color (OBTC) high throughput cell screen technology. (A) the outline of the assay principle. (B) fluorescence microscopy image of a 'hit' bead with only red stained cells bound carrying highly specific peptoid drug-lead for VEGFR2 receptor. (C) beads that bound both red and green indicates non-specific peptoids carrying beads (discarded).

By applying this OBTC methodology, Udugamasooriya research group has thus far successfully identified and validated peptoid compounds for: VEGFR2,⁹ T-cell receptors,¹⁶ IL-15, transferrin, lipid-phosphatidylserine,¹⁷ plectin,¹⁸ vimentin,¹⁹ and ACE2 (for COVID19)²⁰. All those novel compounds have been patented or patent applied. So far, these drug-leads have been validated all the way to pre-clinical studies on both therapeutic and imaging applications. Recent “unbiased” and improved cell screening technology developed using this OBTC assay provides a new approach for targeting various cancer cell sub-populations, capturing new biomarkers uniquely appear over spatial and times scales, simultaneously identifying high specific ligands to target those markers. One of these “unbiased” cell screens identified plectin protein as a new biomarker for cancer stem cells. On another study, high specific peptoids were identified targeting lipid-phosphatidylserine, which is uniquely exposed on cancer cell surface as compared to located in the inner cell membrane of normal cells.

In comparison to peptides, reported data indicates that peptoids have higher tissue accumulation, moderate excretion, and higher *in vivo* stability. Remarkably longer passage through the gastrointestinal (GI) tract without rapid digestion was observed for peptoids confirming the great *in vivo* stability. As already mentioned, peptoid synthesis and further optimizations are extremely versatile and economical to handle. As protease-resistant isomers of peptides, peptoids are being developed as useful molecular tools in biochemistry, and are becoming attractive candidates for therapeutic, diagnostic and many other applications in cancer. Peptoids have thus far demonstrated very promising bioactivities in oncology and also various other disease areas as peptide mimics. Therefore, peptoids can be considered as better alternative for small molecular, antibody and peptide drugs in the future.

The OBTC technology has also been evolved as a powerful tool to identify highly selective drug-leads for various biomarkers important in many different disease states. In particular, the technology is now capable of identifying new biomarkers and a drug-lead to target that biomarker at the same time. This OBTC technology has already been applied in disease types such as cancer, COVID19, macular degeneration, cardiovascular, autoimmune, rheumatoid arthritis, Alzheimer's, and Parkinson's etc. Utilization of peptoids in OBTC technology to identify highly specific, economical and biologically amenable drug-leads along with identifying new biomarkers together allows to expedite the modern drug-lead discovery process effectively.

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Strengthening the Food System in Sri Lanka to Overcome the Food Crisis

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A Food System comprises a complex set of activities, interactions and actors along the food value chain involving production, aggregation, processing, distribution, consumption and disposal of food products. These food products could originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded. Sustainability of a food system is focused on simultaneously generating positive values along the three dimensions, namely, economic, social and environmental. The challenges are multiple and multi-faceted, especially for countries like Sri Lanka, to make the food system more climate resilient, more productive and to make it more inclusive of poor and marginalized populations than the current scenario. The food systems link the cities with rural areas within a country, and operate in a complex operational setting with many actors, under many scenarios such as COVID-19 pandemic, variable and changing climate, man-made food crisis due to imposition of irrational policy decisions (e.g. the policy decision taken to ban the importation of synthetic fertilizer and pesticides), etc. Therefore, the vulnerabilities, weaknesses and strengths of food systems operating within geographic regions of Sri Lanka is a need by tracing food flows to help strengthening local food systems by eliminating inefficiencies in different operational nodes. Tracing the flows and sources of food (food flow analysis) is an important way of identifying food system activities taking place within city region boundaries and obtaining a sense of food system vulnerabilities, weaknesses and strengths. The path that food flows from production to consumption, and waste disposal, is important to determine where the potentially significant inefficiencies would occur. At each operational step in the flow, active management of food preparation and processes is an essential part of business operations that will strengthen the rural-urban connectivity in terms of food production, value addition, and food supply. Sri Lanka needs results of such scientific efforts to provide unique insights into the debates surrounding the sustainability of production and consumption at multiple scales.

Seeking the contribution of cross-disciplinary researchers to address the energy crisis

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The quality of living and the national security of a country is highly dependent upon energy. It is therefore becoming increasingly common for countries to include energy-related matters under the purview of the Ministry of Defence or Department of Defence of the country. As fossil fuels started fast diminishing in the last few decades and with firm predictions of a global energy crisis within the next few decades, many R&D and industrial sectors have shifted their focus to developing non-conventional energy sources and energy-storing devices to meet future demands. The scientific & technological communities have learned over the last five to ten years that single-field experts are unable to accomplish energy goals. Non-conventional energy sources are so diverse that even extracting energy from one source requires expertise in multiple disciplines; electrical, mechanical, physics, chemistry, microbiology, meteorology, environmental sciences, sociology, law, IT & AI, etc. A country's S&T frontiers need to realize this reality as soon as possible in order for its society to survive in the future. It is imperative that Sri Lanka, a low-income and oceanic-tropical country with limited land availability, develops its vision, mission, and roadmap concerning energy (national energy policy) in a way that optimizes resources and minimizes environmental impacts. With respect to energy sources, the country may give priority to solar PV (both on-land and floating), solar thermal (especially at the rural domestic level), biofuel (algae, purposely grown vegetables, non-edible plants, vegetable refuses such as potato peels, and food wastes), biomass (dendro power), mini/micro-hydro, mega/mini/micro-wind, ocean wave and ocean thermal. In the case of energy storage systems, the country may pay attention to batteries and hydrogen for the time being as many other technologies such as mechanical and thermal storage, flywheel, back-pump hydro etc. are not proven economically viable for a developing country. We propose the government appoint national task forces to investigate the risks and potentials of each identified energy source and to assess the availability of cross-disciplinary expertise in the country for capacity building. The human resources lacking in the country could be filled up with the knowledge and skills of expatriates who may be willing to volunteer in giving their services and support.

Screening of salinity and drought tolerance *Trichoderma* isolates for plant growth promotion traits and antagonistic against *Sclerotium rolfsii* and *Fusarium oxysporum* f. sp. *cubense*

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Trichoderma spp. are known biocontrol agents for many plant pathogens, especially against soil-borne pathogens. *Trichoderma* is also involved in salinity and drought tolerance of plants. The main objective of this study was to screen *Trichoderma* isolates to use them as potential biocontrol agents in agricultural fields under various salinity and drought conditions. For this purpose, screening of salinity and drought tolerance of *Trichoderma* isolates having plant growth promotion traits and antagonistic effects on *Sclerotium rolfsii* and *Fusarium oxysporum* f. sp. *cubense* were explored under *in vitro* conditions. In total, 36 *Trichoderma* isolates were isolated from various climatic zones in Sri Lanka. They were screened for salinity tolerance using different strengths of NaCl-amended PDA plates. *Trichoderma* Tmat2 was found to be the most salinity-tolerant isolate followed by T9 and T13. Drought tolerance was screened on KCl-amended PDA for osmotic potential and polyethylene glycol (PEG) for matric potential. Based on the results, Tmat2 and Tmaho4 isolates were found to be the best drought tolerance isolates whilst T9 and T13 were found as moderately drought tolerance isolates. All strains were screened for antagonistic activity by using *Sclerotium rolfsii* and *Fusarium oxysporum* f. sp. *cubense* as challenging fungal pathogens. Isolates T9, T13 and Tmat2 were found to be the most powerful antagonistic isolates and showed higher chitinolytic activity on plate assay. According to the IAA assay, Tmat2, Tkall1 and T13 showed the highest indole acetic acid production. However, in the phosphate solubilization assay T9, T13, Tmaho4 and Tuni2 showed the highest ability of phosphate solubilization. Accordingly, it can be concluded that *Trichoderma* T13 would be the best candidate to be developed as a biopesticide for field application under salinity and drought conditions considering the overall performances with IAA production, phosphate solubilization and antagonistic potential.

Keywords: Antagonism, Drought, Plant growth promotion, Salinity, *Trichoderma*

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Characterization of plant growth promoting bacteria isolated from *Megathyrus maximus* rhizosphere; potential candidates for biofertilizers

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Certain groups of bacteria live in rhizosphere are beneficial for plant growth, protect from disease and abiotic stress. Therefore, this group of bacteria are called plant growth promoting rhizobacteria (PGPR). *Megathyrus maximus* is a grass species, commonly found in Sri Lanka, is used as a fodder grass. This grass grows well under very harsh conditions and in nutrient poor soils. One of the reasons may be due to the microbial communities living in the root system which support acquiring minerals thereby capable to withstand under stress conditions. Therefore, the main objective of this study was to isolate bacteria from the rhizosphere of *M. maximum* and characterize the traits that are important for plant growth. In total, 36 bacterial isolates were isolated from exo-rhizosphere and six bacterial isolates from endo-rhizosphere. Differential abilities of bacterial isolates in nitrogen fixation, capacities of Zn, K and phosphates solubilizations, and IAA production *in vitro* were investigated in this study. Five exo-rhizospheric and one endo-rhizospheric isolate (E6) were found as good Zn solubilizers in ZnO and ZnCO₃ supplied as insoluble Zn sources. It was found that R19 showed significantly higher Zn solubilizing activity (100.78 mg/L) in ZnO supplemented broth whereas R24 showed the highest value (133.06 mg/L) in ZnCO₃ supplemented medium. Out of them three isolates were able to solubilize potassium in mica supplemented medium and the highest potassium solubilization was reported by R24 (23.41 mg/L) followed by E6 (21.81 mg/L). R19, R24 and E6 showed the highest phosphate solubilizing index. In total, seven isolates showed significantly higher nitrogen fixing ability in NFb medium. The highest amount of IAA (39.37 mg/L) was produced by bacterial isolate R24, followed by E6 (7.43 mg/L) and R8 (7.289 mg/L). According to our knowledge this is the first report of isolation and characterization of PGPR bacteria from grass species solubilizing Zn, potassium and phosphate along with other plant growth promoting traits such as nitrogen fixation and IAA production in Sri Lanka. These bacteria would be best candidates to develop as biofertilizers to be used in agriculture specially for fodder production.

Keywords: Grasses, mineral solubilization, plant hormones, PGPR

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Bacterial antagonists against tomato (*Solanum lycopersicum* L.) early blight causal agent *Alternaria alternata*

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Seven selected bacterial antagonists isolated from healthy tomato rhizosphere and phyllosphere were evaluated *in vitro* for their biocontrol efficacy against *Alternaria alternata*, the causal agent of tomato early blight. *A. alternata* was isolated from a tomato leaf sample which showed early blight symptoms and verified by their spore morphology according to literature. Disease-free tomato rhizosphere soil and phyllosphere extracts were used as the potential sources of antagonists from which 30 bacterial isolates and 22 bacterial isolates could be isolated using the serial dilution technique in order. Out of those, 24 different isolates were subjected to screening procedure of antagonists against *A. alternata*. It was observed that, 20 bacterial isolates out of 24, inhibited the growth of *A. alternata* significantly ($p < 0.05$) in co-cultivation and dual culture plate assays showing an average radial growth inhibition of 69%. Seven different bacterial isolates coded as RA 8, RA 12, RA 17, RA 18, RA 29, PA 4 PA 12 were selected for further studies. Microscopic observation of *A. alternata* hyphae dual cultured with bacterial antagonists showed alterations in hyphal characteristics such as thickening, swelling and vacuolation. Inhibition of *A. alternata* spore germination by selected antagonists was significant ($p < 0.05$) in which the average percent inhibition was 64%. All the selected antagonists produced diffusible antifungal substances and showed hyperparasitism and competition as their potential mechanisms in antagonizing the fungal pathogen *A. alternata*. These results suggested that above mentioned seven bacterial isolates can be further studied as potential biocontrol agents in controlling early blight disease of tomato.

Keywords: Antagonism, *Alternaria alternata*, Bacteria, Early blight, Tomato

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Applied nucleation affects soil restoration of degraded grasslands in the Knuckles conservation forest, Sri Lanka

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Sub-montane forests in the Knuckles conservation region in Sri Lanka had been cleared for cash crop cultivation during the colonial era. Those lands were abandoned due to low yield and subsequently, they developed into barren grasslands. Previous research found that the grassland soils had a lower nutrient content than the neighbouring forest soil. In the present study, we tested the hypothesis that the establishment of native tree islands with the presence of *Gliricidia sepium* as a shade plant, and with the application of Biofilmed Biofertilizer (BFBF) positively affects the soil nutrients status of the degraded land through soil restoration processes. The research design consisted of four blocks and each block consisted of two sets of an experimental plot with three different sizes of the island (2 m², 4 m², 8 m²). Inside the islands, four native plants (*Macaranga indica*, *Bhesa ceylanica*, *Symplocos cochinchinensis*, and *Eugenia bracteata*) were randomly established under four treatments [(+G+B), (-G+B), (+G-B) and (-G-B)], with and without *G. sepium* (+G and -G) as shade plant and with and without the application of BFBF (+B and -B). Soil Organic Carbon (SOC), Ammonium, Nitrate, Phosphate, and Cation Exchange Capacity (CEC) were determined in soil collected from islands of different sizes and the nearby grassland at the initiation of the field experiment as well as after two years. The treatment +G+B in the large island (8 m²) showed significantly higher (p<0.05) SOC, and ammonium than that of the initial soil samples and the grassland soil. Nitrogen, CEC, and phosphate levels were significantly (p<0.05) higher in the larger islands than in other island sizes. Higher Relative Growth Rates (RGR_h) and the survival of native plants were observed in the large islands. Microorganisms in the BFBF-treated islands helped to accelerate the decomposition of organic matter and release nutrients that soil receives from the native plants and *G. sepium*. The presence of *G. sepium* as a nurse plant and the application of BFBF (G+B+) improved soil nutrients in the large islands compared to medium and small islands.

Keywords: Biofilmed Biofertilizer (BFBF), *Gliricidia sepium*, native plants, Restoration

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Physico-functional and nutritional properties of banana based instant brownie mix

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Banana (*Musa acuminata* L.) is one of the significant sources of nutrients, which grown abundantly in tropical and subtropical countries, and it is consumed either in raw or processed form. Production of value-added food products from green banana flour is an excellent alternative to keep the nutritional value of fresh bananas while minimizing the post-harvest losses. The present study was aimed to assess the possibility of developing banana flour based instant brownie mix from three different banana varieties namely *Seeni* banana, *Ambul* banana, and Cavendish banana. The developed brownie mixes were subjected to sensory evaluation using 30 semi-trained sensory panelists. The nutritional and antioxidant properties of the selected best brownie mix were analyzed and its shelf-life was examined at both room temperature and refrigerated conditions in high-density polyethylene (HDPE) and Kraft paper packages. Further, physico-functional properties of brownie mixes from three different banana varieties were assessed. Based on their physico-functional characteristics, *ambul* banana instant brownie mix showed highest values for oil absorption capacity (237%), tapped density (0.82 g/mL), compressibility index (39.02), Hausner ratio (1.64), and swelling capacity (10 mL) compared to the other two brownie mixes. The instant brownie mix prepared with *seeni* banana flour showed highest mean rank values for all the sensory attributes followed by *Ambul*, and Cavendish banana. The proximate composition of the selected brownie mix showed 1.7±0.1% moisture, 1.8±0.3% ash, 6.5±0.7% crude fat, and 87.8±0.7% carbohydrates. The developed banana based instant brownie mix packed in HDPE packages and Kraft paper zip lock bags can be stored for 75 days at ambient temperature without adding any preservatives.

Keywords: Banana, instant brownie mix, physico-functional properties, shelf-life analysis

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Genetic diversity of *Calotropis gigantea* (L.) R. Br. with RAPD markers: Taxonomic implication

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Calotropis gigantea (L.) R. Br. (Asclepiadaceae) is a beneficial plant as a source of pharmaceutically active substances, commercially important fibers, etc. It plays an important role, both biologically and ecologically. These two forms of *C. gigantea* occurs in the wild, and the only polymorphic morphological character between them is the flower colour, either white or purple. Due to anthropogenic activities, this plant is disappearing. To conserve *C. gigantea*, correct identification and diversity studies are essential. Molecular analysis data could use to study genetic diversity without using flowers. Randomly Amplified Polymorphic DNA (RAPD) analysis was used to investigate the genetic variations between these two forms. Ten purple flower forms and ten white flower forms of *C. gigantea* were selected from different areas. The genomic DNA was isolated from fresh young leaves. PCR amplifications were performed for each sample by using ten different RAPD primers where a total of 92 polymorphic fragments out of 106 total fragments were observed. The polymorphism was 87%, and genetic similarity was 13% among these individuals. The dendrogram was constructed by using MINITAB-19 software. Two clusters were generated at similarity levels 59.8716 and 62.8512 for white and purple flower forms respectively. Out of ten RAPD primers, only the primer OPE3 has given a unique banding pattern for the white flower forms which is higher than 2000 bp. The results indicate a high genetic diversity between the two flower colour forms of *C. gigantea*, which would be important in the conservation of the species.

Keywords: *Calotropis gigantea*, Diversity, Genetic, Polymorphism, RAPD

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Evaluation of the potential ecotoxicity of textile industry effluent by using *Allium cepa* bioassay

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Textile effluents (TE) constitute colourants such as azo dyes and hazardous chemicals, including heavy metals. The release of untreated or improperly treated TE into the environment is an emerging issue mostly in developing countries. The present study aimed to characterize the potential ecotoxicity of TE by using *Allium cepa* bioassay which is highly applied in cyto-genotoxicity assessment. Two experiments were carried out by exposing healthy, and surface sterilized *A. cepa* bulbs and root segments to a series of TE in which concentration varied from 6.25% to 100%. To prepare the concentration series, the collected blue (B) and pink (P) coloured TE from the textile industry and a 1:1 mixture of B and P (BP) were diluted with distilled water. The experiment was arranged according to a randomized block design (RBD) with three replicates per treatment and control. At the end of 48 hours incubation period at room temperature (27°C), root growth inhibition (RGI), mitotic index (MI) and frequencies of abnormal cells with chromosomal aberrations (CA's) and nuclear abnormalities (NA's) were recorded. One-way ANOVA followed by Tukey's post hoc test was used for data analysis. The results showed a concentration-dependent significant ($p < 0.05$) upward trend for RGI and frequencies of abnormal cells with CA's or NA's compared to the control. In contrast, a downward trend was noticed for MI. The lowest RGI values recorded at 6.25% from B, P and BP were 55.56%, 25%, and 38.46%, respectively, and the highest (100%) inhibition was recorded for 25-100% TE concentrations. The calculated lowest MI for 100% TE of B, P and BP were 7.3 ± 0.1 , 4.6 ± 0.61 and 7.2 ± 0.0 , respectively. The highest frequency of abnormal cells for B, P and BP TEs were 6.73%, 17.13%, and 11.73%, respectively. The reported statistically significant ($p < 0.05$) RGI, and MI revealed the presence of potential cytotoxic agents, and the abnormal cells with NA's and CA's revealed the presence of genotoxic agents in the TE highlighting the applicability of *A. cepa* assay for assessing the potential ecotoxicity of the effluent.

Keywords: *Allium cepa*, cyto-genotoxicity, mitotic index, textile effluent

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A preliminary study on identifying factors affecting the hidden career paths for science graduates and the level of job satisfaction among the graduates of state universities in Sri Lanka

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The higher education landscape is changing due to increased globalization and Competition. The study aims to investigate the factors affecting the hidden career paths available for the science graduates in Sri Lanka and factors affecting the level of job satisfaction of graduates through various factors by employing statistical methodologies and descriptive and inferential statistical techniques. The analyzed areas were categorized into few thematic clusters and the study investigates two of them namely Hidden job market and Job satisfaction of science graduates. The data for determining the variables are being collected using a customized questionnaire. The study employed simple random sampling to obtain a sample consist of 115 graduates from various state universities in Sri Lanka. The P values obtained from the Tests of normality, Shapiro-Wilk Test ($P=0.00 < 0.05$) and Kolmogorov-Smirnov test ($P=0.001 < 0.05$) concluded that the job field is hidden as P value is below 0.05. Pearson Chi Square test results infer that the relationship between salary satisfaction and extra qualifications pursued other than the degree have a statistically significant difference. Within the above-mentioned thematic clusters, the major problem identified was the hidden job market which resulted in getting poor salaries for the employees comparatively for the work load they engage in and the qualifications they have. The study was concluded by outlining an agenda for future research, including introduction of job-oriented degree programs for BSc degree followers and to open ventures of the hidden job market and make aware graduates about the job fields they have in a systematic way.

Keywords: Job satisfaction, Career paths, BSc, job-oriented degree programs

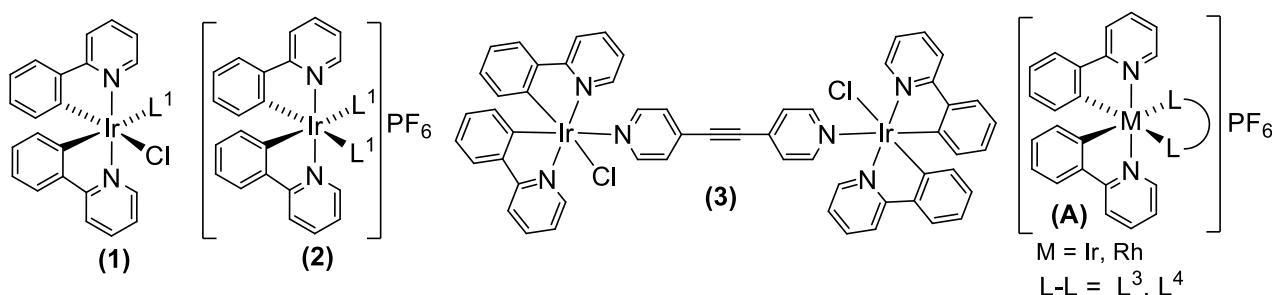
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Complexes of $[M(\text{ppy})_2\text{Cl}]_2$ ($M = \text{Ir}, \text{Rh}$) with N and P donor ligands

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Cyclometallated Ir(III) complexes have shown applications in photovoltaic cells, chemo-sensors, light-emitting devices (LEDs) and phosphorescent dopants in Organic LEDs. In this communication, the syntheses of cyclometallated Ir(III) complexes of the type $[\text{IrCl}(\text{ppy})_2(\text{L}^1)]$ (**1**), $[\text{Ir}(\text{ppy})_2(\text{L}^1)_2]\text{PF}_6$ (**2**), $[(\text{ppy})_2\text{ClIr}]_2(\mu\text{-L}^2)$ (**3**), and $[\text{M}(\text{ppy})_2(\text{L}^{\wedge}\text{L})]\text{PF}_6$ (**A**) ($M = \text{Ir}$ and Rh and $\text{L}^{\wedge}\text{L} = \text{L}^3$ and L^4); where $\text{ppyH} = 2$ -phenylpyridine; $\text{L}^1 = 4$ -dimethylaminopyridine; $\text{L}^2 = \text{di}(4\text{-pyridyl})\text{acetylene}$; $\text{L}^{\wedge}\text{L} = 6,7\text{-di}(4\text{-tert-butylphenyl})\text{-}5,8\text{-diphenyl-}1,12\text{-diazatriphenylene}$] (L^3) and diphenylphosphinomethane (dppm , L^4) are presented.



Treatment of L^1 with 0.5 equivalent of $[\text{Ir}(\text{ppy})_2\text{Cl}]_2$ dimer afforded the neutral yellow complex (**1**). The yellow salt (**2**) was produced in 92% yield when L^1 (4 equiv.) was reacted with an equivalent of $[\text{Ir}(\text{ppy})_2\text{Cl}]_2$ in the presence of NH_4PF_6 . $[\text{Ir}(\text{ppy})_2\text{Cl}]_2$ gave dark brown crystals of (**3**) with the bridging ligand L^2 . Four complexes of the type $[\text{M}(\text{ppy})_2(\text{L}^{\wedge}\text{L})]\text{PF}_6$ (**A**) ($M = \text{Ir}$ and Rh , $\text{L}^{\wedge}\text{L} = \text{L}^3$ and L^4) were prepared by reacting $[\text{M}(\text{ppy})_2\text{Cl}]_2$ with an appropriate bidentate ligand; the products were isolated in good yields as colored solids. The X-ray crystal structure of $[\text{Ir}(\text{ppy})_2(\text{dppm})]\text{PF}_6$ was determined. All complexes were characterized adequately by a combination of elemental analysis, IR, mass and NMR spectroscopy. Mass spectral data indicated the presence of $[\text{M-PF}_6]^+$ or $[\text{M-Cl}]^+$ ion.

Keywords: cyclometallation, Ir/Rh complexes, 2-phenylpyridine, N & P donor ligands

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A preliminary survey on macrobenthic communities in Nilwala river and Madu Ganga estuaries in Sri Lanka

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Macrobenthos are sensitive organisms to water quality and are thus used as indicators of ecosystem health. This study investigated the abundance and diversity of macrobenthos in relation to water quality parameters in Nilwala River (5°57'N, 80°32'E) and Madu Ganga (06°16'25"N, 80°02'05"E) estuaries in Sri Lanka. Triplicate samples were collected from each estuary representing the lower river stretch (L1) and two other locations about 2 km (L2), and 20 km (L3) upstream from L1 from March to October 2022. Dissolved Oxygen, biological Oxygen demand, chemical Oxygen demand (COD), pH, nitrate, orthophosphate, ammonium, turbidity, total dissolved solids, conductivity, and temperature were measured using standard methods. Macrobenthos sampling was done in scoop or surface core samples from the first 10 cm of the bottom sediment and sieved (300 µm-mesh) to separate components for identification. Biodiversity indices, namely, species diversity, species richness, and evenness were calculated using Shannon Weiner's diversity index (H), Simpson's dominance index (S), Margalef's richness index (D), and Pielou's evenness index (J). Forty-seven species of macrobenthos were identified in both locations, while species from families Thiaridae (Mollusca: Gastropoda) and Naididae (Annelida) were the highest. The highest density (526-1824 ind. m⁻²) and richness (7.06-12.87) were recorded from Nilwala estuary while the highest species diversity (0.1-0.56) and dominance (0.34-0.86) were recorded from Madu Ganga estuary. Pollution Tolerance Index (PTI) values revealed that lower streams in both Nilwala river and Madu Ganga estuaries are highly polluted (6 and 3 respectively; PTI<10 indicates poor quality) compared to the respective upper stretches of the rivers (PTI: 14 and 18). Canonical Correspondence Analysis confirmed that phosphate content, nitrates, COD, and turbidity have a significant correlation with the pollution status of both estuaries.

Keywords: pollution tolerance index, species diversity, water quality assessment

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Synthesis and Characterization of Graphene Oxide Using Boric and Phosphoric Acids as Protective Agents

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The discovery of graphene in 2004 stunned the scientific community due to its extraordinary properties. The exorbitant cost of production limits the use of graphene on an industrial scale. Graphene oxide (GO) offers most of graphene's characteristics along with a few additional ones. The production of GO requires a number of chemical reactions that need to be carefully controlled. Protective agents are used to maintain the sheet-like structure of GO and improve the safety of the reaction. This study is examining the impact of the type of protective agent on the final GO product. The Tour's method was used to produce GO, with small changes in time and temperature. Preparations involved the use of the most common protective agents, phosphoric and boric acids. XRD, Raman, and SEM analyses were carried out to characterize both samples to confirm the formation of GO. The d spacing values for GO produced with boric and phosphoric acid were 8.1402 and 8.0160, respectively. For both samples, the number of layers was about two, and the Id/Ig ratio was 0.87. GO produced without the use of protective agents frequently has more than 1.0 Id/Ig ratio values. However, the GO prepared with phosphoric acid is comparatively planner sheets and has sharp edges, while the GO prepared with boric acid is slightly wrinkled. It is clear from this that both acids have beneficial protective effects despite having very different final GO structures. Therefore, the protective agent may be selected based on the requirements of the GO's final application.

Keywords: Graphene Oxide, Phosphoric acid, Boric acid, Protective Agent

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Molecular dynamics simulation to investigate Glutamine/Arginine polymorphism at position 192 of serum paraoxonase-1(PON1)

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Serum Paraoxonase-1(PON1) is a hydrolytic enzyme which is closely associated with High-density lipoprotein (HDL). Even though recent studies have shown that these polymorphisms can cause the lowering of the activity of this enzyme, the mechanism of protein–HDL interaction is not clearly understood. Thus, this study was mainly focused on investigating the structural changes associated with Glutamine/Arginine polymorphisms at position 192 using molecular dynamics (MD) simulations. Accordingly, our main objectives were to model PON1 in lipid bilayer to understand the correct orientation and to identify the structural changes of the protein due to the polymorphism at position 192 using MD snapshots. The CHARMM GUI web server was used to model complexes with PON1 and lipid bilayer and 200 ns MD run was performed using AMBER 16 software. One lipid-unbound and three lipid-bound systems were investigated. Seven different substrates were docked to understand the different activities of the enzyme. Out of them 7-o-diethylphosphoryl-3-cyano-7-hydroxycoumarin (DepCyc) showed the highest binding affinity. The binding pockets of lipid-bound Q192 and R192 were observed to be larger than that of lipid-bound K192. This difference in the volume of binding pockets allowed the substrate selectivity of the enzyme.

Keywords: PON1, polymorphism, lipid bound protein, molecular dynamics

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Cardiac Troponin I as a marker to diagnose Non-ST Elevation Myocardial Infarction (NSTEMI) in patients presenting with acute chest pain and non-diagnostic ECG

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When the initial ECG of patients suffering from acute chest pain is non-diagnostic, it is difficult to arrive at a clinical diagnosis. Diagnosing NSTEMI and differentiation from unstable angina (UA) requires serial electrocardiograms (ECGs) and serial marker testing. Admitting all the patients diagnosing NSTEMI and differentiation from UA of acute chest pain for serial investigations create a high economic burden and risk of exceeding hospital capacity and limited healthcare resources. Failure to make an early diagnosis can cause significant morbidity and mortality. Cardiac troponins are cardiac-specific proteins detected in high levels even in microscopic areas of myocardial necrosis. Cardiac Troponin I is highly specific for myocardial tissues. In this study, we assessed the levels of cardiac Troponin I as a marker for NSTEMI when an initial ECG is non-diagnostic. We also assessed the potential of the cardiac troponin-I levels to accurately exclude acute coronary syndrome (ACS) when an initial ECG is non-diagnostic. ACS includes STEMI, NSTEMI, and UA. STEMI is diagnosed based on ECG criteria. Descriptive analysis carried out by statistical methodology was adopted for the study. Data were collected from 42 patients of which 36 were used for analysis based on descriptive sampling. With informed consent, data from 36 patients were used for statistical analysis (SPSS). 22.2% were diagnosed with NSTEMI from a single Troponin I result. HEART score was used to assess the risk for Major Adverse Cardiac Event (MACE) for the next six weeks. If MACE was more than 4%, further testing including repeat Troponin I, 2D-ECHO cardiogram, exercise ECG, and cardiologist referral were recommended. Some of them could still be NSTEMI on repeat testing few hours later depending on the time of onset of chest pain). 61.1% were diagnosed with UA or non-cardiac chest pain based on a combination of clinical evaluation, ECG, and single Troponin I result. NSTEMI cannot be excluded on a single troponin I result which requires clinical assessment and repeat troponin I. Therefore, troponin I levels can be used to diagnose NSTEMI in patients with acute chest pain when the initial ECG is non-diagnostic.

Keywords: STEMI, NSTEMI, unstable angina, ECG, Troponin I

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Development of 2D hexagonal nanoplates of α -Fe₂O₃/rGO composites via one step hydrothermal process

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Due to the extensive air pollution, it is crucial to detect many types of air pollutants. Due to their high sensitivity, low cost, good compatibility, and high surface to volume ratio, semiconductor metal oxides at the nanoscale have drawn more interest in utilizing them using gas sensing applications. Additionally, by combining 2D materials like graphene oxide (GO), the electron transport channel in these metal oxide semiconductor materials can be enhanced, raising the sensitivity of the gas sensor. In this study, the effects of time, temperature, and the amount of GO in the precursor solution were investigated in relation to the enhancement of the morphology and purity of hydrothermally synthesized reduced graphene oxide (rGO) / α -Fe₂O₃ nanocomposites. In order to explore the influence of temperature, a temperature series of 150, 160, 170, 180, 190, and 200 °C was used, and to study the effect of time, a time series of 16, 24, 32, 40, and 48 hours was used. The effect of graphene oxide amount on the morphology and purity of rGO/ α -Fe₂O₃ nanocomposites synthesized via a one-step hydrothermal process was studied using a series of 0.01 g, 0.02 g, 0.03 g, 0.04 g, 0.05 g, and 0.06 g graphene oxide in the precursor solution. The obtained SEM images demonstrated the presence of 2D hexagonal α -Fe₂O₃ nano-plates with well-defined sharp edges at 200 °C, 40-hour reaction conditions, and 0.05 g of GO in the precursor solution. XRD patterns of these samples showed the existence of the pure α -Fe₂O₃ phase with rGO.

Keywords: Hydrothermal synthesis, rGO/ α -Fe₂O₃ Nano composites, Gas sensing

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Comparisons of physicochemical properties of pumpkin (*Cucurbita maxima*) flour and isolated starches and their biofilms

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Synthetic polymeric thin films which are used to extend the storage time of fruits and vegetables are nonbiodegradable. Biofilms are biodegradable and the objective of this research was to develop biofilms from pumpkin starch. Pumpkin starches were isolated by filtering water paste of pumpkin flour through 250 μm sieve (starch 1) and by filtering the settled sediment (starch 2). In pumpkin flour, starch1 and starch 2 the percentage moisture content were 10.65 ± 0.26 , 5.72 ± 0.33 and 3.57 ± 0.13 respectively, and β -carotene contents were 74.75 ± 0.41 , 11.95 ± 0.08 , 4.36 ± 0.02 , mg/100-g -respectively. Pumpkin starch based biofilms were prepared by addition of Sorbitol/glycerol 10, 20, 30, 40 (%wt.) as plasticizers and 10, 15 and 20 (%wt.) of citric acid (CA) as a crosslinking agent. All biofilms were in good appearance and easily removable from the plates without bubbles or cracks. The density and thickness of biofilms were $1.0685\text{-}1.4138 \text{ g cm}^{-3}$ and 0.08 to 0.17 mm respectively. The effect of CA and sorbitol/glycerol on pumpkin biofilms was analysed using ANOVA and Tukey's post hoc tests at a confidence level of 95% ($P < 0.05$). Biofilms of pumpkin starch containing 30% sorbitol and 20% CA had accepted levels of transparency, renewability, biodegradability, and absence of odour or color. The optical micrographs of biofilms confirmed that the materials are totally plasticized. FT-IR spectra showed partial crosslinking between CA and sorbitol/glycerol in the biofilms matrix. In conclusion, pumpkin starch could be used to tailor biodegradable edible biofilms.

Keywords: pumpkin, physicochemical properties, starch, flour, biofilms

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Photocatalytic degradation of textile dyes by Graphene Oxide and Graphitic Carbon Nitride Nanocomposite (GO/g-C₃N₄)

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Photocatalytic activity of nanoparticles has become an emerging research field in the world. Attention on nanocomposites of graphene oxide (GO) and graphitic carbon nitride (g-C₃N₄) is increasing because of the metal-free composition and higher photocatalytic activity. Synthesis, characterization, and application of these nanocomposites (GO/g-C₃N₄) for degradation of organic dyes under visible light are reported. The objective of the present study was to study photocatalytic degradation of the textile dye Reactive black 5 (RB 5) by GO/g-C₃N₄ nanocomposites under visible light irradiation. According to literature methods, GO was prepared by oxidizing graphite powder via the modified Hummers method, g-C₃N₄ by thermal polycondensation of urea and the nanocomposite GO/g-C₃N₄ (1:1) by mixing aqueous suspensions of GO and g-C₃N₄ at pH= 3. The above nanocomposite was characterized by UV-visible, FTIR, X-ray diffraction spectroscopy, and scanning electron microscopy. Maximum absorbance for GO, g-C₃N₄, and GO/g-C₃N₄ (1:1) were 232 nm, 415 nm, and 423 nm respectively. In the absence of the catalyst and visible light, photodegradation did not take place. The optimum condition for photocatalytic degradation of RB 5 by GO/g-C₃N₄ (1:1) was solar irradiation of a mixture of an aqueous solution of RB 5 (60 ppm, 100 mL) and the catalyst (30 mg), at pH = 4. Under these conditions, 97 % of degradation occurred within 60 min. The reusability of the catalyst five times was successful. Studies with the scavengers Na₂-EDTA, t-butanol, and p-benzoquinone suggested that the above photocatalytic degradation process is mainly by superoxide radicals.

Keywords: Nanocomposite, Photocatalytic degradation, Reactive Black Five, Graphene Oxide, Graphitic Carbon Nitride.

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Degradation of Reactive Black 5 dye by Fenton Process Using Fe₃O₄/Zeolite

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Along with industrialization, most of the water resources get contaminated and the increased levels of pollutants present in water affect the water quality and aquatic life. While the textile industry contributes largely to the world's economy, it releases huge quantities of dyes and pigments to the environment. Fenton oxidation process is one of the advanced oxidation processes that shows remarkable and promising results in the field of wastewater treatment. However, the homogeneous Fenton process has several disadvantages including production of large volumes of sludge. The main objective of the current research is to develop an efficient, cost-effective and reusable zeolite based heterogeneous Fenton catalyst to treat wastewater containing Reactive Black 5 (RB5) dye. Zeolite was synthesized from ball clay using hydrothermal process. Synthesized zeolite was characterized by FT-IR, XRD and SEM analysis. Heterogeneous Fenton catalyst (Fe₃O₄/Zeolite) was prepared by impregnating Fe(II) into the zeolite and subsequently characterized using FT-IR, XRD and SEM spectroscopy. Iron loading percentage of 0.875% on zeolite was achieved in the catalytic preparation. The catalyst successfully removed of RB5 in water and the optimum heterogeneous Fenton reaction conditions for the decolorization of 100 ppm RB5 were determined as catalytic dosage of 0.05 g, [H₂O₂] of 4 mM, pH of 3 and reaction time of 25 minutes at 600 rpm at 30 °C. Under these optimum reaction conditions, 97% decolorization efficiency was achieved. Reusability studies showed higher decolorization efficiencies even after 5 cycles. Results of the current study will be useful to design new textile wastewater treatment systems.

Keywords: Zeolite, ball clay, heterogeneous Fenton reaction, Reactive Black 5

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Novel silica supported CaO rich catalyst from rice husk and coral rubble to produce biodiesel from waste cooking oil.

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Biodiesel from waste cooking oil (WCO) is an environment friendly renewable energy source. Generally, NaOH or KOH are used as catalysts to produce biodiesel from vegetable oil via transesterification reaction. Although, these homogeneous catalysts have high catalytic activity they have certain drawbacks such as difficulty in catalyst separation, high soap formation and requirement of large amount of water to wash biodiesel product. Alternatively, CaO has been used as catalyst for this reaction but its efficiency is poor. Coral rubbles are abundantly found in southern coast of Sri Lanka and calcinating them to 900 °C yield CaO rich coral rubble catalyst (CRC). In this research, the catalytic performance of CRCs against the transesterification reaction to produce biodiesel and its improved efficiency by incorporating rice husk silica was tested. Rice husk contains around 20% of biogenic silica. Therefore, initially, silica was extracted from pyrolyzed rice husk ash via alkaline extraction. Subsequently, SiO₂ was incorporated to the CRC via wet impregnation. Catalytic efficiency of CRCs with different weight percentages of silica was investigated. Accordingly, 20% wt silica loaded CRC showed the highest catalytic performance. Optimum biodiesel yield was obtained at a methanol to oil molar ratio of 18:1 and catalyst dosage of 8% wt at 60 °C for 2 hrs. Catalyst reusability was tested for 5 runs and it has shown a significant yield over 75%. Fourier transform infrared spectroscopic (FTIR) data revealed the presence of Ca-O-Si bond in silica incorporated CRCs. pH, density, acid value and saponification value of the produced biodiesel were tested and they were within the accepted ASTM limits.

Keywords: Rice husk, Silica supported catalyst, Coral rubbles, Transesterification, Biodiesel

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Development of polybutyrate (PBAT) based biodegradable film with wheat flour as a filler material

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Plastic has become an important part of every aspect of modern life. But excessive and unwise use of plastic results in the deterioration of the environment and has harmful effects on human health. To solve this problem, there is a need to search for an alternative, such as biodegradable plastic. Polybutylene adipate terephthalate or polybutyrate (PBAT) is a biodegradable random copolymer with good features for packaging applications. However, its high cost limits its current usage at the commercial level. To reduce the cost, fillers and other additives can be used. In this study, a starch-based biodegradable composite (for food wrapping and shopping bags) was successfully prepared by incorporating wheat flour (WF) into the PBAT matrix. WF and PBAT were mixed to form a uniform sheet at different composition ratios (10%, 20%, 30%, and 40% of WF) using the extrusion method. Mechanical properties such as tensile strength, elongation at break, and tear resistance were examined using a universal testing machine. Comprehensive characterization was done including FT-IR, SEM, and particle size distribution. Test for overall migration was done according to SLS 1718:2021 for aqueous and fatty food. According to the results obtained, the mechanical properties of the sheets we developed, decreased with increasing filler content, but three composites had sufficient values to be used as food wrapping material. No heavy metals were detected from the analysis by ICP-MS. Migration test data proved that 20% WF composite was ideal for aqueous food wrapping purposes and 30% WF composite can be used for other packaging purposes.

Keywords: Biodegradable polymer, filler, PBAT, starch-based, extruder

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Histopathological changes in the pancreas of high-fat diet fed streptozotocin induced Wistar rats

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Histopathological changes in the pancreatic tissue of diabetic animal models are important to elucidate pancreatic mechanisms of novel antidiabetic agents. This study aimed to describe histopathological changes of haematoxylin and eosin (H&E) stained sections of the pancreatic tissues of high-fat diet (HFD) fed streptozotocin (STZ) induced Wistar rats. Wistar rats fed with HFD for four weeks were injected with STZ (30, 40, and 50 mg/kg, IP). Rats with fasting serum glucose concentration >11.1 mmol/L were considered as 'diabetic' and grouped (n=10 per group) as HFD+STZ (30 mg/kg), HFD+STZ (40 mg/kg) and HFD+STZ (50 mg/kg) rats. At the end of the study, pancreatic tissues were excised and stained with H&E. The pancreatic islets of healthy rats were normal in size and spherical with well-demarcated borders. HFD feeding resulted in hyperplasia of islets and irregular borders. The density of islets was reduced by 16.7% (p>0.05), 36.7% (p>0.05), and 50.0% (p=0.028) upon STZ 30, 40, and 50 mg/kg injections, respectively. Hypertrophy of islet cells was noted while some islet cells showed evidence of cell death. Furthermore, marked fatty change in the exocrine pancreas was observed in STZ-induced rats. The degree of observed changes increased in a dose-dependent manner in which HFD+STZ (50 mg/kg) rats showed the most prominent reduction of pancreatic islets with prominent fatty change in the exocrine pancreas. In conclusion, STZ (30–50 mg/kg) produces partial destruction of the pancreatic islets in a dose-dependent manner in HFD-fed rats. Prominent alterations in the pancreatic tissue of the Wistar rats fed with HFD, followed by STZ (50 mg/kg) could be useful in elucidating pancreatic mechanisms of novel antidiabetic agents.

Keywords: High-fat diet, streptozotocin, diabetes mellitus, histopathology

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Rediscovery of the endemic firefly, *Harmatelia bilinia* Walker (Coleoptera: Lampyridae: Ototretinae) from Ranmale Forest Reserve, Sri Lanka

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The firefly genus *Harmatelia* is endemic to Sri Lanka, and *H. bilinia* was originally described by Walker (1858) based on a specimen collected from 'Udawaththa' Forest Reserve, low-wet zone of Sri Lanka. After the original description, there has been no confirmed record of this species in type locality, hence the status of this species in Sri Lanka remained uncertain. However, a male specimen of *H. bilinia* was rediscovered from 'Ranmale' Forest Reserve (6°14'36.7"N, 80°39'09.1"E, 184m above sea level, Walasmulla) in the Southern-Intermediate Zone of Sri Lanka, almost after 164 years of its first record. A living specimen was observed during a recent visual encounter survey of fireflies (2022). It was captured using an insect hand net for close examination and photographs (Nikon Digital Camera D90/60mm-12mpxl), and released back to the same location. Obtained photographs were compared with the pictures of syntype male *H. bilinia* (NHMUK014006260) in Natural History Museum, London. The external morphology of the observed specimen appeared identical to the original description of *H. bilinia*. The morphology of the recorded male *H. bilinia* is presented herein. *H. bilinia*, male: 8 mm long; antennae flabellate and dark reddish brown, black mesoscutellum and pronotum, lateral and fore edges of pronotum yellowish gold, elytra sub-parallel, black with a yellowish gold oblique vitta in each elytron; apex of elytra deflexed, legs yellowish brown, six visible abdominal ventrites yellowish brown, eight marginal luminous spots in both sides of ventrites II-VI. It is vital to note the rediscovery of endemic *H. bilinia* from the Southern intermediate forest after their first record from the wet zone forest in Sri Lanka. Therefore, future studies are recommended on the distribution of *H. bilinia* in different floristic zones of Sri Lanka.

Keywords: *Harmatelia bilinia*, rediscovery, Southern-Intermediate zone, Sri Lanka

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A preliminary study on water quality assessment and pollution status of Madu Ganga

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Madu Ganga drainage basin covers an area of 700 acres and was designated as a Ramsar Convention site in 2003. The main objectives of the research were to assess the water quality in Madu Ganga and thereby identify its pollution status. Water quality parameters, both physicochemical and biological, were studied for a period of four months. Five sampling sites were selected from the mouth of the estuary to the upper reaches of the river, namely Balapitiya, Galmanduwa, Kothduwa, Kadapaunuduwa, and Wathugedara, primarily based on ease of access. Physicochemical parameters, *viz.* water temperature, pH, conductivity, DO, BOD₅, COD, salinity, alkalinity as well as nitrate and phosphate content were assessed. Biological parameters, *viz.* phytoplankton and zooplankton densities, benthic macroinvertebrates (*Littorina* sp., mussels, clams, red midge larvae, *Penaeus indicus*, *Penaeus monodon*, *Metapenaeus dobsoni*, *Macrobrachium rosenbergii*), and most probable number (MPN value) of *E. coli* bacteria were studied. The range of mean values of the above parameters at five sampling sites was water temperature: 29 - 33 °C, pH: 7.20 - 8.32, conductivity: 0.8 - 21.3 mS, DO: 2.78 - 8.35 mg/L, BOD₅: 8.08 - 10.63 mg/L, COD: 18.52 - 27.13 mg/L, alkalinity: 0.0005 - 0.0018 mg/L, salinity: 0.94 - 4.17 ppt, nitrates: 0.05-0.45 mg/L, and phosphates: 0.007-0.029 mg/L. Zooplankton density and phytoplankton density was 19-35 ind/ml and 22-48 ind/ml, respectively. MPN values were recorded below 10. Based on the results of this preliminary study, Madu Ganga is polluted by *E. coli* bacteria, and its water is saltier than pure freshwater, hence its water appears unsafe for human consumption. It is recommended to have regular monitoring and implement appropriate measures to reduce the extent of pollution in Madu Ganga.

Keywords: Madu Ganga, pollution, water quality

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Forecasting of fish production, export and import of Sri Lanka Using Machine Learning Models

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Fish forecasting is important to manage available resources, implement new rules and regulations for sustainable economic growth, and ensure food and nutrition security. It is a global trend to use machine learning based on artificial intelligence in many aspects of the fisheries sector. In this study, Support Vector Regression (SVR) supervised machine-learning model was used to forecast fish production, fish imports, and exports in Sri Lanka. Using the Mean Absolute Percentage Error (MAPE) accuracy of the model was calculated. A sixteen-year retrospective analysis (2005-2021) of five-year catch forecast indicates that although the total fish production is predicting a decrease (from 415518 ± 14340 metric ton for 2022 to 276525 ± 14340 Mt for 2026), inland aquaculture and fisheries production is predicting an increase (from 105340 ± 2817 Mt for 2022 to 2122740 ± 2817 Mt for 2026) for the next five years. Forecasted imports values show an increase of fish and fishery products (from 59960 ± 2038 Mt for 2022 to 82584 ± 2038 Mt for 2026) for the upcoming five years, and the predicted fish exports values for 2022 and 2026 are 30202 ± 350 Mt and 22023 ± 350 Mt, respectively. MAPE for total fish production, total marine capture, inland and aquaculture fish production, fish import and export are 4.2, 4.4, 4.2, 2.3, and 1.7 respectively. The established SVR model provides high accuracy (MAPE values are less than 10) even with sixteen years of data, indicating the benefits of using machine-learning models for forecasting.

Keywords: Fisheries Forecast, Support Vector Regression, fish catch, Fish imports and exports

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Phytochemical screening and anthelmintic activity of four plant extracts on earthworm, *Eisenia fetida*

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Helminthiasis has medical and veterinary health concerns globally. The development of resistance against synthetic anthelmintic medicines is a major constraint. This leads to a demand for medicinal plants and their products as potential natural substitutes for synthetic drugs. The present study examined the medicinal herbs that possess anthelmintic potential, as an alternative remedy for conventional drugs which was tested on the earthworm, *Eisenia fetida*. Crude methanolic seed extracts of *Nigella sativa* and *Panicum antidotale* and methanol and aqueous leaves extracts of *Justicia gendarussa* and *Clerodendrum phlomidis* were tested with different concentrations on *E. fetida in vitro*. All forms of extracts exhibited significant anthelmintic activity ($p < 0.01$). Dosage dependent decreased paralysis and death time were found when compared with Albendazole. A higher concentration of methanolic seed extract of *P. antidotale* (5%) took less time for paralysis and death of the worm at 3.61 ± 0.33 min and 8.35 ± 0.19 min, respectively when compared to *N. sativa*. Methanolic leaf extracts were more potent than aqueous leaf extracts where methanolic leaf extracts of *J. gendarussa* (30 mg/ml) took less time, 65 ± 0.27 min and 137 ± 0.14 min for paralysis and death of the worm, respectively. The finding from this study shows that methanol extract was more potential than aqueous extracts and increasing concentration of extracts were more potential for anthelmintic activity. The presence of phytochemical properties like alkaloids, tannins, glycosides, flavonoids and saponins exhibited significant anthelmintic potential of *N. sativa*, *P. antidotale*, *J. gendarussa* and *C. phlomidis* with natural protective source.

Keywords: Anthelmintic, *Clerodendrum phlomidis*, *Eisenia fetida*, *Justicia gendarussa*, *Nigella sativa*, *Panicum antidotale*

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Sunscreen activity of *Punica granatum* (Pomegranate) leaf extract

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This study aimed to evaluate in vitro sunscreen activity of methanol and aqueous extracts of *Punica granatum* leaves and formulate an effective sunscreen lotion. The phytochemical screening revealed that both extracts were rich in phenols and flavonoids. The total phenolic contents for methanol and aqueous extracts were 2003.925 ± 31.551 and 1244.212 ± 23.893 mg Gallic acid equivalent (GAE)/100 mg dry weight of the leaves, respectively. The Total flavonoid contents were 524.264 ± 12.842 and 360.168 ± 10.403 mg Catechin equivalent (CAE)/100 g dry weight of leaves, respectively. A concentration series of 0.05, 0.1, 0.2, 0.3 mg/ml in methanol was prepared for both *P. granatum* extracts along with a commercial product, Dermatone® (the reference, SPF 36). The Sun Protection Factor (SPF) was determined at all concentrations and methanolic extract gave a SPF of 30.493 ± 0.058 at 0.3 mg/ml which is significantly higher than Dermatone® at the same concentration. However, 0.3 mg/ml aqueous extract gave the SPF of 19.662 ± 0.033 which is less than the reference. It is established that SPF 15 sunscreens block roughly 93% UV rays when applied thoroughly. Interestingly, both extracts have exceeded the SPF of 15 at the concentration of 0.3 mg/ml. The UV spectra of both extracts have shown more efficient UV absorption over 250-400 nm range than the reference. Methanol extract was used for the preparation of herbal sunscreen lotion with 3% (F₁) and 5% (F₂) of the dried extract. The SPF obtained for 0.3 mg/ml solution of F₁ and F₂ were 1.817 ± 0.025 and 3.172 ± 0.023 , respectively. *Punica granatum* leaves with efficient UV absorbing constituents could be used in sunscreen products as a safe alternative to harmful synthetic compounds.

Keywords: Sunscreen activity, *Punica granatum*, leaf extracts, SPF, Dermatone®

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Gray Level Co-occurrence Matrix (GLCM) texture feature analysis for brain tumor classification using MRI

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The global prevalence of cancer is significant, and all are susceptible including young and elderly, active and inactive, underweight and overweight. According to the epidemiology, brain tumors account for 85% to 90% of all primary central nervous system tumors. Brain tumors can be divided into benign (non-cancerous) and malignant (cancerous). When using MRI to diagnose tumors, it takes a lot of time and effort to manually classify MRI images. Automatic or semiautomatic classification approaches are required in order to distinguish between various tumor types because human observations can result in classification errors. The purpose of this study is to perform a statistical analysis to distinguish between benign and malignant brain tumors and to develop a new method that can be used to reduce misclassification of manual MRI observations. Using the MicroDicom viewer, T1-weighted and T2-weighted axial images were selected. Tumor ROIs (region of interest) were drawn using MATLAB. Some image features were calculated for each image slice. Certain feature values were discovered for selected regions of benign and malignant tumors. Features were compared to one another to determine how they had changed. Machine learning (ML) algorithms for supervised learning have a variety of formats. In this research work, LDA (Linear Discriminant Analysis) was used to differentiate tumors using python. The accuracy of LDA algorithm was 92.59%. This analysis can be used to differentiate the tumors with high accuracy.

Keywords: Brain tumors, MRI, GLCM texture features

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Improving the effectiveness of cupola furnace with air blower

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This research was inspired by the need to enhance the design of air blower impellers and air blast intake structures in foundry industries in order to improve product quality, minimize energy costs, and reuse cast iron scrap metals in the country. This research is mainly focused on increase the rate of air flow and pressure of the cupola furnace. The design of this impeller is important with noise reduction and maximum efficiency. Therefore, different blade thicknesses (from 1.5mm - 3mm) and rotating speeds (from 2550 rpm – 2850 rpm) have been taken into the consideration. And also adjust the blade angle and number of blades. Then the four different model shapes of air blast intake structures are design. A model design is done for the numerical study using the software ANSYS Workbench. After that the effectiveness air blower was selected using the result of ANSYS Workbench. The results show that an impeller blade with a thickness of 1.5 mm produces less noise and vibrations at its maximum rotation speed (2650 rpm). Then fix the Air blower into the four different model shapes of air blast intake structures. After that the effectiveness air blast intake structures were selected using the result of ANSYS Workbench. The Static Pressure (981 N/m²), Discharge flow rate (0.5m³/s) and the Outlet velocity of impeller (42m/s) were calculated. Therefore, final design of improved air blast intake structures with air blower was more effectiveness than other three designs. It is advised that the design be used as a foundation for building better and cheaper foundry industries.

Keywords: Furnace, Impeller blade, Geometric parameter, Pressure, Centrifugal fan

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Comparison of greedy method and greedy estimate in generating initial solutions to closed small-scale capacitated vehicle routing problems

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In the population based meta-heuristic methods, initial solution plays a significant role to reach a near optimal solution in a reasonable computational time. Initial solution is usually generated randomly but it consumes more time to reach the optimal solution. Greedy approach is a better way than the results obtain through randomly generated initial population approach to reach an optimal solution in a lesser time. Two heuristic techniques to generate initial solutions to meta-heuristic algorithms are compared in this study. The Greedy Method (*GM*) is purely based only on travelling cost. However, the Greedy Estimate (*GE*) incorporates not only travelling cost but also quantity requested by each customer. In *GE* approach, the ratio of travelling cost and quantity is considered. The *GM* and *GE* are compared with the optimal solution obtained by the Branch and Bound (*BB*) algorithm. To compare the results, randomly generated small scale capacitated vehicle routing problems are employed. It can be concluded that the *GE* method is much more efficient than the *GM* method in terms of reaching the near optimal solutions in a reasonable computational time. Moreover, when generating initial solutions to solve vehicle routing problems using population based meta-heuristic methods, it is recommended to hybridize *GM* and *GE* with random method for not only to preserve the diversity of solution space, but also to reach optimal solution with less computational time. It is observed from this study that the *GE* method is more appropriate for the instances with high variance among both quantities requested by customers and travelling cost between them.

Keywords: Greedy estimate, Greedy method, Heuristic method, Initial solution

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Parametric efficient portfolio rebalancing incorporating transaction costs

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The purpose of this study is to choose an efficient portfolio and rebalance it with transaction costs to enable account holders who desire to invest in the financial markets to achieve their goals in the most convenient way. Rebalancing is the process of restoring the asset allocation values of a portfolio back to the levels specified by an investment strategy. These levels are meant to correspond to an investor's risk tolerance and rewards. The Modern Portfolio Theory (MPT) reduces portfolio risk by choosing and balancing assets based on statistical methods that measure the level of diversity by computing expected returns and standard deviations of individual securities to assess their risk. When a portfolio is expected to produce the maximum return at the lowest risk, or at a specific level of risk, it is said to be efficient. Here, we contrast the results of the three major efficient portfolios by considering a portfolio of 10 stocks randomly selected from the FTSE100 index (Financial Times Stock Exchange) and closing stock prices of the stocks over the preceding five years. By using MATLAB software the parametric efficient portfolio is found to be more appropriate and the investment was more diversified than with the variance efficient and expected return efficient portfolios. Using optimized weights and the traded quantities of each investment, the quadratic programming model was developed to rebalance the portfolio while accounting for transaction costs. Risk and returns are investigated using the developed model while accounting for transaction costs and rebalancing the parametric efficient portfolio.

Keywords: Portfolio optimization, Efficient portfolio, Expected return, Risk, Rebalance, Transaction cost

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Identifying the students' satisfaction of online learning activities using the factor analysis: A case study

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Education is one of the sectors which mostly effected due to the current pandemic situation. In this context, online learning contributed a lot for students to continue their education. Therefore, the purpose of this study was to determine the impact of online learning activities on satisfaction of the students. An explorative factor analysis was done in order to discuss the students' perception on online learning. To identify the factor solutions for the set of 24 observed variables, the data was gathered through an online survey using 165 respondents who follow a particular course module which randomly selected out of the course modules offered by the department of Mathematics, University of Ruhuna. This online questionnaire was initially distributed to all the students who registered for the course module. According to the results, there were 87.5% students who satisfied with online learning. Using the factor analysis, 24 observed variables have been reduced to six independent factors; quality of the lecturer, attitude of the student, method of online assessments, online learning resources, learning environment and enthusiasm of the students. In this analysis, principal component extraction method and varimax rotating method were used to identify the above factors. According to the Bartlett's Test (p -value = $0.000 < 0.005$) it was confirmed that the original variables are correlated and the factor analysis is useful with data. The validity of factor analysis was determined using the Kaiser-Meyer-Olkin (KMO) statistics with a value of 0.761 (> 0.6). Identified six independent factors would be important to have more satisfaction of online courses and by focusing on these identified factors, teacher can change the method of teaching where necessary, to offer a better online learning environment for students. Overall results indicated in this study would be helpful to take useful decisions in future implementation of online teaching and learning process.

Keywords: Bartlett's Test, Factor analysis, Kaiser-Meyer-Olkin (KMO) Test, Online learning.

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Modelling non-linear exchange rate data in Sri Lanka that exhibit disturbed trends over time

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Most free market economies worldwide depend heavily on demand and supply, which is influenced by exchange rates. As a developing country, Sri Lanka should emphasise exchange rates more than other factors to maintain its economic sustainability. It is important to study the characteristics and behaviour of exchange rates to maintain sustainability. Studies show that monetary and non-monetary factors affect the exchange rate. As a result, currency exchange rates frequently exhibit nonlinear trends, including sharp fluctuations induced by events such as the recent scenario of the sudden devaluation of the Sri Lankan rupee in early 2022. Modelling exchange rate data under these nonlinear tendencies is difficult, and this difficulty is made challenging by the abrupt shifts in the overall trend brought on by unforeseen disruptions. On that account, the combination of semi-parametric and interrupted time series models was proposed to develop a flexible model that describes the exchange rate movement in Sri Lanka. The Bayesian approach was employed for model fitting with R2Winbugs because it enables rigorous handling of uncertainty. The next value of the exchange rate was obtained by applying first-order bivariate Taylor series approximation to the mean response of the model. The result from the posterior predictive evaluation shows that the developed model accurately captured the trends and variability of the exchange rate. Furthermore, all model parameters are significant, indicating that the monetary (inflation, trade balance, tourist arrivals) and non-monetary (sudden devaluation of Sri Lankan rupee) variables are important for studying exchange rate variabilities. The findings suggest that the developed model provides information about predicting and forecasting the future exchange rate movement in Sri Lanka. These predictions and forecast values would help to balance the economic sustainability in Sri Lanka.

Keywords: Exchange rate in Sri Lanka, non-linear trends, sudden interruptions in trends, semi-parametric regression, interrupted time series

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A new highly accurate fourth-order approximation for Fisher equation

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Fisher Equation (FE) is a nonlinear partial differential equation which is used to model many physical systems involving effects of both linear diffusions and nonlinear reactions. FE arises in numerous applications including brain tumor dynamics, population dynamics, chemical reactions, etc. Finite Difference Approximation (FDA) method has widely been used to obtain discrete solutions of FE. Combined with Crank-Nicolson (C-N) technique, some second and fourth order accurate FDA's were also derived in the literature. In these methods, the nonlinear part of FE is discretized to its corresponding linear form using the lagging technique. In this study, a new fourth-order C-N scheme is developed for FE with a new linearization technique. Our approach is two-fold. First, a pre-conditioned operator (P_h) for the second derivative (D_2) is constructed. The pre-conditioned D_2 ($P_h D_2$) is computed with order 4 accuracy, using the order 2 central FDA for D_2 . Second, the nonlinear part of FE is discretized at the middle point of two consecutive time steps with the order 2 accuracy using concepts of arithmetic and geometric means. The resulting C-N scheme (CN1) is second-order accurate in time and fourth-order accurate in space. Furthermore, using Richard extrapolation, the accuracy of the spatial variable is raised to order 6. Numerical results obtained from CN1 and a recently developed order 4 compact C-N scheme (CN2), with and without extrapolation, demonstrated that CN1 is more accurate than CN2, for example, the maximum errors of the extrapolated CN1 and CN2 are $2.764e-14$ and $1.121e-06$, respectively for grid steps $h = 0.0125$ (space) and $\tau = 0.00015625$ (time).

Keywords: Crank-Nicholson scheme, Geometric mean, Order 2 central difference approximation, Preconditioned operator, Richardson extrapolation

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A novel procedure for identifying an initial feasible solution to the transportation problem

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The problem with transportation is figuring out how much has to be carried from each source to each destination to maintain the total cost of transportation as minimal as possible while still satisfying supply and demand constraints. The Transportation Problem (TP) is concerned with choosing routes to distribute the goods to the various destinations to either minimize the overall transportation cost or maximize the overall revenue of the problem by satisfying the needs of the various destinations and supplying quantities from various sources. Many approaches to solving TP have been developed in the literature. In TP, two-step procedures are possible, including an Initial Feasible Solution (IFS) and an Optimal Solution (OS). For the TP, an OS may be found using the Modified Distribution (MODI) Method or the Stepping Stone Method, and an IFS can be found using the North-West Corner Method (NWCN), the Least Cost Method (LCM), and Vogel's Approximation Method (VAM), and so on. In this study, a novel procedure for identifying an initial feasible solution to both balanced and unbalanced TP is examined using the penalty cost method. To determine the optimal or near-optimal solution for TP, the suggested method could be used. The results can be compared to those of other current algorithms.

Keywords: Demand, Initial feasible solution, Optimal solution, Penalty cost, Transportation cost

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Off-line signature verification by using proper orthogonal decomposition

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A signature is a legally accepted key to use in document authentication and personal verification. Especially, in the fields such as banking, insurance and document management. Many verification methods have been used to verify a person's identity using signatures. In this study, we present a novel approach for off-line human signature verification using Reduced Order Modeling (ROM) based on Proper Orthogonal Decomposition (POD). This method is a mathematical approach that converts the high dimensional data into a lower dimensional model, which extracts the most important features that represent the more characteristic features of the original data set. Here, we consider 30 different real signatures as our training data set to create the ROM and use a test data set, containing 10 images of different signatures to test the model performances. Main objective of this study is to test the performance of the ROM by reconstructing an input signature and verify the signatures in the test data set as genuine or forgeries. The required basis functions for the ROM are obtained by using the proper orthogonal decomposition. The eigenvalue spectrum is used to obtain the required number of basis functions. The results show that 15 Eigenfunctions are required to create the reduced order model. We showed that the ROM is able to successfully reconstruct the signatures. The quality of the signature is tested by the Structural Similarity Index Measure (SSIM). Future work will focus on identifying the signature as genuine and forgery using the reduced order model.

Keywords: Dimension reduction, Proper orthogonal decomposition, Reduced order model, Signature verification

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A new algorithm for finding the basic feasible solution for bottleneck transportation problem

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Transportation problems are a common part of the category of linear programming problems. The cost of transportation is typically the basis on which the transportation problem is considered. But it is not enough to consider only the cost of transportation in goods transportation. Accordingly, the purpose of this paper is to discuss another important factor, which is transportation time, through the bottleneck transportation problem (BTP). The main purpose of BTP is to minimize the maximum time for all suppliers to reach the destination by transport. Meanwhile, many researchers have presented algorithms that provide an efficient initial solution that satisfies the above objective. Accordingly, this paper proposes a new algorithm to obtain a better basic feasible solution (BFS) for the bottleneck transportation problem. For that, we introduced a new method that is based on the average times of each column and row of the transportation problem. The purpose of this is to obtain basic solutions by the proposed method, which considers the order in which the average value of each column and row calculated in this way decreases. Accordingly, the proposed method was used to determine the basic solutions for the bottleneck transportation problems. Also, the obtained solutions were compared with the existing methods, and the effectiveness of the proposed method was determined. According to the obtained results, as the final conclusion, a basic solution to balanced and unbalanced bottleneck transport problems was obtained, and it was discussed whether it is the optimal solution.

Keywords: Bottleneck transportation problems, Basic feasible Solution, Optimum Solution, Time Minimize

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A mathematical model for annual transfers of officers in combined services: An application of assignment problem

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In this study, we develop a model for automating annual transfers of officers in combined services. Annual transfers are a yearly based process conducted by the Ministry of Public Administration, Home Affairs, Provincial Councils, and Local Government. Due to a large number of applications, annual transfers become a complex process, and therefore it is significant to have an automated process. We propose a model for automating annual transfers of officers in combined services as an application of the assignment problem. Our approach consists of two phases. In the first phase, we develop a model to find places for applicants based on their given preferences. Considering the factors such as the number of years of service and the number of years of service at the current working place, the applicants are assigned to offices maximizing their preferences. Since it is not possible to assign all the applicants based on given preferences alone, the applicants who do not get places based on preferences, the second phase, constructing an integer programming model, is devoted to finding places based on the minimum distance either from home or the current working place to the new place. The model is tested on a sample of the annual transfers of combined services obtained from the Ministry of Public Administration, Home Affairs, Provincial Councils, and Local Government. Two corresponding integer linear programming problems are solved using MATLAB solver and out of the 100 applicants tested, 81 applicants are assigned on a preference basis and the remaining ones are assigned on a distance basis. The proposed model can be adapted for all applicants for annual transfers and transfers in other categories.

Keywords: Assignment Problem, Combined Services, Annual Transfers

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An integer linear programming model in university examination timetable scheduling: a case study at the university of Ruhuna

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In this study, a two-phase procedure that consists of integer linear programming models is developed for a case study in the university examination timetabling problem. Educational timetable scheduling problems are difficult NP-Hard combinatorial optimization problems. Because of the complexity and practical importance, the examination timetable scheduling problem is prominent among other scheduling problems. Examination timetabling is the process of assigning examinations to time slots, and halls while satisfying a given number of constraints and achieving certain objectives. The students, as well as the staff, surely benefit from the well-planned examination timetabling. Since the examination timetabling problem is a computationally expensive optimization problem, we propose a two-phase procedure for constructing examination timetabling. In the first phase, we constructed an integer linear programming model to assign halls to each examination considering the hall clashes, halls, and exam capacities to minimize the unnecessary space assigned while maximizing hall preference. In the second phase, another integer linear programming problem is obtained to assign each examination to time slots considering several hard and soft constraints and the objective of minimizing the length of examination for each student group and assigning examinations with a large number of students at the beginning. The proposed two-phase procedure is applied to the examination timetabling scheduling of the level I, semester II examination of the faculty of science, the University of Ruhuna as a case study. Better feasible solutions are obtained for each integer linear programming problem by applying the branch and bound algorithm implemented in MATLAB.

Keywords: Integer Linear Program, Examination Timetables, Combinatorial Optimization.

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Swimming performance prediction of elite swimmers

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As a result of technological advances, there is an abundance of game performance data available in several sports. Accordingly, performance prediction models also have become increasingly popular in sports science. These models help to plan and improve their training activities. In this study, two different machine learning approaches were used to predict the performance time of elite swimmers for the 100 m freestyle and butterfly swimming events. Physiological features and performance times of 100 m freestyle and butterfly stroke on 1235 swimmers were obtained from World Olympic games database. After analyzing and pre-processing the dataset, Multiple Linear Regression (MLR) and Artificial Neural Networks (ANN) models were optimized using k-fold cross-validation and hyperparameter tuning. The performance of models was compared using accuracy metrics (Mean Absolute Percentage Error (MAPE), R-squared (R^2), root mean square error (RMSE), Median Absolute Deviation (MAD)). The models were deployed in the same data segmentation for consistency. A multi-layer perception (MLP)-based ANN was trained to predict the performance times of swimmers. The obtained results indicated that the MLP-based ANN model achieves a higher accuracy (97.89%) when compared to the MLR model (97.76%). Moreover, the results showed that the age, height, weight, reaction time and types of swimming styles have a significant effect on the performance times of the elite swimmers. Overall, the ANN model outperformed the MLR model in predicting the performance times of elite swimmers for 100 m freestyle and butterfly events. The results also show that ANN perform well due to large number of data used in the study.

Keywords: Artificial Neural Network, k-fold cross-validation, multiple layer perception, multiple linear regression

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Analysis of survivability, trends, and status of sea turtle species found in Sri Lanka

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Five of the seven living sea turtle species are reported in Sri Lanka. The main objective of this study is to investigate the impact of decreasing the number of sea turtle inhabitants in Sri Lanka due to the rapid growth of civilization and anthropogenic activities. The deterioration of the sea turtle population has been examined using the total number of eggs, number of dead eggs, number of living hatchlings, and number of dead hatchlings. In this study, the stability of the system of ordinary differential equations which were initially formulated in previous literature is evaluated, and proven that the population of sea turtles in Sri Lanka may decrease when both prey and predator coexist. The distribution analysis of the total number of eggs proves that the prime nesting season in Sri Lanka is from January to June and November to December. Based on the statistical analysis it proves that a significant difference exists ($P < 0.05$) and nesting in each destination has decreased throughout the years. The Lefkovitch matrix proves that the reduction of the number of green sea turtles, hawksbill, and olive ridley sea turtles will happen in Sri Lanka within 12, 15, and 24 years respectively. By examining the matrix model's sensitivity analysis, the present study proposes to head start conservation by protecting the juvenile sea turtle population to prevent the reduction of sea turtle inhabitants in Sri Lanka. Therefore, conducting awareness programs, and declaration of protected areas strictly following and implementing existing laws are recommended for their conservation.

Keywords: Extinction, Lefkovitch, Predator-prey, Sea turtles, Sensitivity analysis

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The genus of maximal embedding of the generalized Petersen graph, $GP(n, k)$ for the cases $k = 1, 2$

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In Topological graph theory, the maximal genus of graphs has been a fascinating subject. For a simple connected graph G , the maximal genus $\gamma_M(G)$ is the largest genus of an orientable surface on which G has a 2-cell embedding. $\gamma_M(G)$ has the upper bound $\gamma_M(G) \leq \left\lfloor \frac{\beta(G)}{2} \right\rfloor$, where $\beta(G)$ denotes the Betti number and G is said to be upper embeddable if the equality holds. In this study, the maximal genus of $GP(n, k)$ is established as $\gamma_M(GP(n, k)) = \left\lfloor \frac{n+1}{2} \right\rfloor$ for $k = 1$ and $k = 2$ by proving the upper embeddability of generalized Petersen graph, $GP(n, k)$ for the cases $k = 1$ and $k = 2$. The proof is done by obtaining spanning trees T and examining the components in the edge complements $GP(n, k) \setminus T$ for the cases $k = 1$ and $k = 2$ of $GP(n, k)$.

Keywords: Generalized Petersen graph, Maximum genus, Upper embeddability, Spanning tree, Splitting tree

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Odd Prime Labeling of the Irregular Snake Graphs

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Graph labeling is one of the most prominent research areas in Graph theory. The history of graph labeling can be traced back to the 1960s. There are numerous graph labeling techniques such as graceful labeling, radio labeling, antimagic labeling, prime labeling, etc. There are a lot of variations of prime labeling and in this research, we discuss one of the variations of prime labeling named odd prime labeling which is very much compelling. There is a very famous conjecture related to this area such that all the prime graphs are odd prime graphs. There is a vast number of publications regarding odd prime labeling of snake graphs. Recent works on odd prime labeling investigate different types of snake graphs such as complete graphs, triangular-type snake graphs, different types of ladder graphs, families of cycle-related and path-related graphs, etc. A graph got from a path graph by replacing each edge with a cycle graph is called a snake graph. In this research, we introduce odd prime labeling for the irregular snake graph which is designed by replacing random edges of the path graph with different sizes of cycle graphs and prove that irregular snake graphs admit odd prime labeling if $k_i - 2 \neq f(V_i)(q + 1) - 1$ where $q \geq 0$ & $q \in \mathbb{Z}$, $f(V_i)$ is the odd prime label of the initial vertex of the cycle and $k_i - 2$ denotes the number of inner vertices of the i^{th} cycle which begins at V_i where V_i is the i^{th} vertex on the horizontal path graph of the irregular snake graph.

Key words: Irregular snake graphs, Odd prime labeling, Snake graphs

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Some topological indices of banana tree graphs

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A molecular graph is a simple graph whose vertices correspond to the atoms and the edges correspond to the bonds of some molecule. Chemical graph theory is a branch of mathematical chemistry that plays a vital role in the development of the chemical sciences. A topological index is a numerical value associated with chemical structures or a molecule that describes the relationship between a chemical structure and its various physical properties or biological activities. Topological indices of various types of graphs have been studied in the literature. In this study, we focus on Banana tree graphs. Banana tree graph $B(n, k)$ is the graph obtained by connecting one leaf of each of n copies of a k star graph with a single root vertex that is distinct from all the stars. Banana tree graphs were studied from different perspectives. Some degree-based topological indices of Banana tree graphs and their line graph was studied in the literature. Chromatic number, graph labeling methods such as graceful labeling, Harmonious, residual closeness domination set, and domination number of Banana trees were also discussed in the literature. M. Ghorbani, and M. A. Hosseinzadeh introduced an updated version of Zagreb indices using eccentricity. In this study, we derived formulas for the topological indices such as the Modified Zagreb index, Atomic Bond connectivity, Geometric Arithmetic index, Randić index, Fourth geometric arithmetic index, Fifth geometric arithmetic index, Sanskruti index, and the new version of Zagreb indices for $B(n, k)$.

Keywords: Banana Tree Graph, Topological indices, Zagreb index, Fifth Geometric Arithmetic index

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Clustering of Financial Development Indices using AGNES and AGNES-PCA algorithms

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Global financial indices play a prominent role in the prior identification of future economic growth and shrinking trends, developing financial strategies, and reviewing financial and economic policies. Annual financial indices published by the International Monetary Fund [IMF] associated with the 2020 financial year gauging the development of financial institutions and markets in terms of depth, accessibility, and efficiency were considered. In this study, hierarchical clustering was carried out through two main approaches to identify recurring economic and financial patterns and development trends across countries and territories. Clustering was initially implemented with all six financial indices using the traditional agglomerative nesting (AGNES) algorithm. Subsequently, clustering was executed through AGNES after conducting dimensional reduction in financial indices through principal component analysis (PCA). Internal validation measures: connectivity, Silhouette and Dunn index were improved by 46.45%, 39.48% and 96.55%, respectively through AGNES with PCA (AGNES-PCA) compared to the AGNES without PCA. All stability measures, including average proportion of non-overlaps (APN), average distance (AD) between data points, average distance between means (ADM), and figure of merit (FOM) were increased by 91.55%, 230.81%, 26.78%, and 54.42% respectively during AGNES-PCA. Unstable economies like Bangladesh, Sri Lanka, El Salvador, Estonia, Honduras, Lebanon, Nigeria, Pakistan, Tunisia, Venezuela, and Zambia were clustered into a common group during AGNES-PCA. This study is helpful in effectively identifying the best clustering method for a group in stable and unstable economies around the globe. Moreover, clustering financial indices using AGNES-PCA could be used to identify future financial and economic crises.

Keywords: Economies, Financial Crisis, Financial Development Indices, Hierarchical Clustering

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Green synthesis of zero valent iron particles using *Coffea arabica*

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Zero valent iron particles (ZVIPs) have received extensive attention due to their remarkable activity and effectiveness in groundwater treatment and site remediation. Green synthesis of metal materials using plant extracts is recognized as potential remediation to treat contaminated water in the environment due to the availability of polyphenols and reducing sugars. Here we opted for a novel, simple and cost-effective green synthesis of ZVIPs by the reduction of Fe²⁺ into Fe⁰ using bioactive substances obtained from the leaf extract of *Coffea Arabica*. ZVIPs were synthesized by adding the green extracts to 0.01 M FeSO₄ with a volume ratio of 2:1 at room temperature and constantly stirring for 1 hr. ZVIPs were characterized by Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM). According to the SEM analysis, the ZVIPs are spherical shaped, and the mean particle size was found to be between 50 - 200 nm. The FT-IR spectrum confirms the formation of the ZVIPs which were later oxidized into iron oxide due to the exposure to air and water. The absorption peaks at 550.10 cm⁻¹ and 500.83 cm⁻¹ correspond to Fe-O-Fe and Fe-O stretching vibrations, respectively. Also, other peaks indicate the attachment of compounds such as polyphenols of the green extract onto the iron particles which act as capping and dispersive agents. The presence of organic molecules on ZVIPs facilitate no toxicity and less effects on the aquatic organism's growth, photosynthesis, reproduction, suggesting a lower risk in utilizing these functional iron particles for environmental applications.

Keywords: Zero valent Iron particle, Water treatment, Green synthesis

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Mapping active stars in open clusters of the Milky Way galaxy - A preliminary study

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Precise mapping of star-forming regions in galaxies is essential to understand the formation of galaxies. Stars that belong to O and B spectral types are considered hot young stars and can be found in active star-forming regions. This study focuses on identifying active star-forming regions in the Milky Way galaxy. A sample of 39 million stars that belong to 3006 open clusters in the Milky Way galaxy was selected for the study. Position, B-R color magnitude, apparent G-band magnitude and parallax angle for each star were selected from GAIA data release II. The surface temperature and spectral class of each star were calculated based on the B-R color-magnitude. The apparent magnitude and the distance for each star were used to calculate the absolute magnitude in G-band. A total of 60982 stars with a surface temperature greater than 10,000 K were filtered. This was confirmed by locating the O and B-type stars in H-R diagrams for a sample of open clusters. The regions where O and B type stars (Stars with surface temperature $> 10,000$ K) were located are considered the most active star-forming regions. Position coordinates of each of these stars were converted to the galactic coordinate system and a map with star locations was created.

Keywords: Star formation, Milky Way, HR diagram, Galaxy

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A modified mathematical model for diabetic population dynamics with optimal control strategies

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Diabetes is a chronic disease due to problems with the insulin hormone. Although diabetes cannot be cured, it can be managed with the right medications, proper exercise, and a diet low in carbohydrates and sugar. Multiple problems are exacerbated by uncontrolled diabetes. The objective of this study is to investigate the behavior of the diabetic population dynamics under control strategies, assuming that the total population grows logistically. To achieve this objective, we modify an existing mathematical model, which is a system of nonlinear ordinary differential equations for diabetic population dynamics with optimal control strategies. We derived the necessary condition for optimal control using Pontryagin's maximum principle, which is usually used to characterize the optimal control for a system of ordinary differential equations. The optimality system was solved using the forward-backward sweep iteration with the fourth order Runge-Kutta method. The results of our model demonstrate that the incidence rate could not remain constant over a long period of time. Furthermore, we can conclude that by implementing a control, the number of cases of pre-diabetes and diabetes with and without complications, can be reduced.

Keywords: Diabetes Population Dynamics, Optimal Control, Pontryagin's maximum principle, Runge-Kutta method

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Fabrication of bioplastic using cotton waste generated from Sri Lankan apparel industries

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The apparel sector is the foremost contributor to the Sri Lankan economy. A significant amount of cotton waste is generated during different processing steps of the apparel industry which has posed a severe environmental threat. Due to its high cellulose content and substantial manufacturing volume, cotton waste has great potential for sustainable application. The main objective of this research is to fabricate bioplastic using extracted cellulose from cotton waste. Firstly, cellulose was extracted from collected cotton waste followed by a three-step purification process including alkaline pulping, bleaching, and acid hydrolysis. Bioplastic films were prepared by mixing 0.5g of dried cellulose with different ratios of carboxymethyl cellulose (CMC), and glycerol, and then the solution was cast into a glass mold. The accuracy of the isolation method and fabrication process of bioplastic film was verified by Fourier-transform infrared spectroscopy by comparing the functional groups. The biodegradability and swelling properties (water and oil) of bioplastic film were investigated. The film was dissolved immediately in water. The oil resistance of the film increased with the increasing glycerol content. The optimum level was observed in 3 % of CMC and 5 % of glycerol contents. After 20 days of soil burial, it was observed that biodegradability decreases when increasing the CMC and glycerol amount, and the maximum weight reduction of 94.5% was recorded at 1.2% of CMC and 1.5% of glycerol contents. In conclusion, cotton waste can be effectively utilized for bioplastic production which has the potential application in the packaging industry.

Keywords: cotton waste, cellulose, bioplastic, textile industry, biodegradability

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Investigation of an effective evaporation pond for sea salt extraction

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Salt (sodium chloride) is a food flavoring and seasoning agent, which plays a considerable role as an essential nutrient, texture provider, and color enhancer. However, the production of salt is insufficient to the nation, since between 10,000 and 40,000 metric tons of salt are imported annually. By examining the causes, it was identified that only a few companies are operating in Sri Lanka and using the solar evaporation method to produce salt. This research aims to make an improvement in salt production to meet the annual demand by identifying the key evaporation factors and making it more efficient by reducing time duration up to (20% -30%). Several crystallizer pools have been experimented with modifications; a pool covered with heat-absorbing material; a pool with a greenhouse model; a pool edge with a reflective panel; a pool with an instant roof system; and a sample of a salt plant pool was used as a reference to compare the improvement of salt production. The improvement rate in salt production of the above mentioned methods were found to be 7.66%; 21.42%; 22.74% and 36.69%, respectively, when compared with the reference crystallizer pool. Further temperature, humidity, wind speed, and brine concentration have been recorded on the daily basis.

Keywords: Brine concentration, Crystallizer pool improvements, Salt production

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Intelligent based monitoring and controlling method for aquaponic systems

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Aquaponics refers to a method that combines aquaculture with hydroponics to achieve a healthy life balance for both plants and fish. Fish and plants typically suffer in aquaponic systems because regular monitoring and control are usually neglected. Fish need clean water that is regularly treated to supply oxygen and maintain temperature. Plants, on the other hand, need fertilizer and frequent watering, which takes time and effort to complete the entire process. This system is proposed as a remedy to reduce fish and plant mortality and to ensure their safety. The primary objective was to build an intelligent-based aquaponics monitoring and controlling system that continuously monitors, controls, and displays metrics such as water pH level, dissolved oxygen (DO), conductivity, light intensity (LUX), humidity and temperature of the green house and temperature of water. Sensors collect and transmit data to the Adafruit IO (Web server) platform. The data server maintains the values of the system parameters and continually transfers the information to the web server, allowing the user to access the data using the Adafruit IO platform. The stability of the aquaponics system can also be precisely determined using K Nearest neighbors (KNN) machine learning technique.

Keywords: Aquaponics, dissolved oxygen (DO), Internet of Things - IOT, pH level, light intensity, K-nearest neighbors (KNN)

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IoT-based smart water quality monitoring system

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Water is essential for human survival. Most infectious diseases are transmitted through contaminated water, resulting in millions of deaths annually. Thus, it is necessary to establish a monitoring system to assess if the water quality is adequate for the intended purposes. This study describes the design and development of a portable real-time water quality monitoring system based on Machine Learning and the Internet of Things (IoT). Moreover, the system consists of multiple sensors for detecting physical and chemical properties of water, including pH, Total Dissolved Solids (TDS), Turbidity, Electric Conductivity (EC), and Temperature. The ESP32 microcontroller processes the measured values from the sensors, and it interacts with the cloud-based interface. In this regard, this system was formed through supervised machine learning while utilizing a binary classification method. Consequently, the data set was split into two categories with one thousand data points. The algorithms were tested with following accuracies; Random Forest - 95%, Decision Tree - 91%, Navie Bayes - 88%, and K-Nearest Neighbors - 87%. The random forest algorithm was chosen to minimize human interference. Therefore, the developed system provides an online platform for real-time monitoring and analysis of water quality parameters, accessible from anywhere through the website. Examination of a water sample from this system displays whether water requires treatment or whether its quality is acceptable based on the parametric values.

Keywords: Water quality monitoring, physical and chemical properties of water, Machine learning, IoT

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Study on factors affecting effective virtual project management in IT companies in Badulla district

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Virtual software organizations and virtual project management are emerging concepts. With the COVID-19 pandemic, the IT industry was influenced by the work-from-home strategy which has already been initiated but earlier it was not fully virtual. This study focuses on IT companies in Uva Province, Sri Lanka. The study investigates the current project management practices, challenges in virtual project management and factors affecting effective virtual project management and it evaluates the relationship between the factors and effective project management. The evaluation inspires to improve the virtual project management practices in virtual software organizations. Work in different time zones, communication methods, monitoring mechanisms, and flexibility of work environment have been identified as the most critical challenging factors that influence effective virtual project management through literature review. Hypotheses were created considering the above factors and correlation analysis was used to present the relationship between each factor and effective virtual project management. The quantitative approach and purposive sampling method have been selected to collect data through an online questionnaire. The population of this study is 145 and it has administrated to a sample size of 105 according to Krejcie and Morgan tables. The responses are subjected to appropriate statistical procedures for validating the hypothesis and identifying specific weak areas for improvement. According to the study, monitoring mechanisms (0.713) and communication methods (0.656) have a significant influence on effective virtual project management while different time zone and flexible work environments have a moderate impact.

Keywords: Effective virtual Project Management, Monitoring Mechanism, Different Time Zones, Flexible Work Environment, Communication Methods.

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Tracking Twitter data during the Covid-19 pandemic: A comparative analysis of tourism industry movement

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In Sri Lanka, the tourism industry acts as one of the main roles in its economic growth. However, as this industry was heavily affected by the Covid-19 pandemic, this dominant income source of the country has become unstable. Hence, if we could identify the issues associated with this, we can be ready for the safety of the industry before any other pandemic in the future. Therefore, studying people's ideas becomes very important and Twitter is one of the best places for collecting their ideas. This study proposes a model for the analysis of the tourism industry-related tweets during Covid-19 in Sri Lanka into four categories; positive, negative, advertisement, and neutral. Here, 18980 tweets were collected from the period between years 2020 to 2022. After preprocessing, 6257 tweets were selected and used for extracting the feature vectors. Three different machine learning algorithms; Support Vector Machine, Long Short-Term Memory, and Artificial Neural Networks (ANN) were used to create a forecast paradigm and these were compared to find the best model. Among the four percentages of training data (62%, 67%, 72%, and 77%) 67% of training and 33% of the testing data set was selected. According to the results, ANN's 91% highest accuracy was achieved. Also, the study considered precision, recall, f-measure, and error values for the evaluation. According to the final result, the ANN algorithm showed the best results for sentiment analysis for tracking tourism industry movement in Sri Lanka. In this period, industry declined and negative sentiments help to identify the main issues.

Keywords: Covid-19, Machine learning, Sentiment Analysis, Tourism industry, Twitter

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Sinhala word suggestion algorithm for ad hoc Romanized Sinhala transliterations using a Trie.

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With the revolution in social technology, Sinhala and Romanized Sinhala became the main language among the general Sri Lankan community. Informal shorthand typing used with Romanized Sinhala encourages the researchers to dive into the new arena of transliterations. As Sinhala is a low-resource language, the current system uses a rule-based approach for transliteration and suggestion generation on Romanized Sinhala to Sinhala. Therefore, different shorthand typing-based word predictions cannot be achieved. This proposed novel Suggestion transliterator uses an enhanced Trie which is an efficient information retrieval data structure for word prediction. The survey collected was used to identify the different typing patterns and adapted them as rules. Based on the rules, Sinhala dictionary was annotated and used to train the Trie. The trained model was used to identify the possible word prediction. The Romanized Sinhala words predicted by the model are compared with a Romanized Sinhala to Sinhala Knowledge base, which will return the unique Sinhala words as the suggestions. As an example, the shorthand Romanized Sinhala word “Adaraya” can be transliterated and suggested to its Sinhala representation as “අදරය, අදරය”. The model was tested with 200 unique Romanized Sinhala test data. Each Romanized Sinhala sentence was fed to the model and word-level suggestions were compared with the expected output. The model achieved a word-level prediction accuracy of 84%. So, this novel transliterator can gap the ambiguity issue in Romanized Sinhala to Sinhala transliterations which will help future products to enhance the typing experience of their Romanized Sinhala users.

Keywords: Romanized Sinhala, Rule-based approach, Suggestion, Trie, Transliteration

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Suicidal thoughts influenced by the COVID-19 pandemic: A comparative study using Twitter data

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The COVID-19 pandemic may have caused unanticipated behavioral changes that may have led to the upward trend in reported suicidal attempts. COVID-19 period was one reason to change pre-existing mental health, domestic violence, anxiety, and depression. And self-isolation and quarantine, may raise feelings of isolation, sadness, alcohol and drug use, and suicidal thoughts. When compared, people's mental health changed before, during and after the pandemic period. Therefore, gathering information on the prevalence of suicide and suicide attempts worldwide during the pandemic is essential and crucial. Twitter is one of the main places to share people's thoughts in different situations. Here we have focused on tweets of those who had suicidal thoughts and tweets of others who tell the facts of people who have committed suicide. The labeling was done by reading the full tweets manually one by one instead of observing only the keywords to increase the labeling accuracy. Out of the 9750 tweets, 3200 expressed suicide-related to COVID-19 and 3000 expressed suicide-related to other reasons. This study's main objective is sentiment analysis of suicide-related tweets whether they are Covid-19-related suicides or not. After collecting data, pre-processing was completed. Then the feature vectors are produced to apply machine learning algorithms like Long Short-Term Memory, Artificial Neural Networks and Support Vector Machine to create a forecast paradigm for suicides during the pandemic. In terms of classification, the findings demonstrated that ANN performed better than SVM and LSTM with 91.33% accuracy as well as it had higher recall, precision, f-measure, and lowest errors.

Keywords: Covid-19 Pandemic, Deep Learning, Machine Learning, Suicide, Twitter

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A framework to identify tea plant varieties in Sri Lanka using Convolutional Neural Networks (CNN)

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Tea cultivation is one of the main sources of foreign exchange earnings in Sri Lanka and the Tea Research Institute (TRI) is the only national institution in Sri Lanka for generating and disseminating related new technologies. TRI has introduced tea clones under several series. These clones cannot be grown everywhere in the country. Clones should be grown in cultivation zones recommended by the TRI. When obtaining tea shoots for tea nurseries, it is very important to know what kind of tea clones that the mother plant belongs to. The selected clone types should be clones recommended for the cultivation zone we are going to plant. Otherwise, diseases in the tea plantation may increase and the cultivation may be destroyed. The subtle differences between tea clones make it difficult to distinguish them. It is the main problem for tea growers (especially novices). The major aim of this research is to minimize the difficulty of identifying the three most widely grown tea clones in Sri Lanka, namely TRI 2023, TRI 2025, and TRI 2026. This study found that tea clones can be distinguished using the second and fourth normal leaves. A Convolutional Neural Network (CNN) was trained using images of these leaves to distinguish these three types of tea clones, achieving 97% accuracy in 30 epochs. The implemented framework was tested using the test dataset contained (30) images collected from small tea holdings. This study significantly proposes a web application and a framework which are to provide predictions for distinguishing above tea clones.

Keywords: Tea, Clone, TRI, Plant, Shoots

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Translation of Sinhala Braille characters into Sinhala language using image processing techniques

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The Braille system is the most valuable and indispensable method that enables blind or visually impaired people to write and read through the concept of the Braille cell. Braille is a great help in bridging the written communication gap between the blind and braille-illiterate people. Also, written materials used by the visually impaired can only be read by those proficient in Braille, so there is no precise way for ordinary people to assist the visually impaired in written communication. This study aimed to develop a model for ordinary people who do not know the Sinhala Braille system to understand the Sinhala Braille. The image datasets of 55 Sinhala Braille characters were collected using a mobile phone camera to develop this model. All the input images were resized to 28X28 pixels during the preprocessing process. After, the images are binarized with local adaptive thresholding. Then, those images were subjected to procedures such as grayscale, histogram normalization, gaussian filter, threshold binarization, erosion, and dilation. Finally, the preprocessed images were fed into a well-trained Convolutional Neural Network model. The developed model tested for 55 Sinhala Braille characters with eight punctuation marks and achieved an overall accuracy of more than 97%. The model will be further developed as a simple mobile and web application to overcome the limitations of written communication between the blind and Braille illiterate sighted people in Sri Lankan society.

Keywords: Convolutional Neural Network, Image processing, Sinhala braille

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Oral potential malignant disorder prediction using supervised machine learning techniques

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Precursor lesions, pre-cancer, intra-epithelial neoplasia, and pre-malignant, are all terms used to refer to Oral Potential Malignant Disorder (OPMD) in the literature to characterize clinical manifestations that have the possibility to develop into Oral Cancer. This is the most common malignancy among Sri Lankan men and has the utmost death rate of all types of malignancies. The main problem with this OPMD which is known as a pre-cancer stage is the risk factors of it could vary according to the region and country because of its nature. Hence, this research will expose the risk factors of OPMD in Sri Lanka, the impact of risk factors, and the transformative potential of OPMD. Around 1000 data samples available at the Faculty of Dental Science, University Peradeniya was collected, preprocessed, and analyzed by handling null values. The Inter Quartile Range method is used for the outlier handling for this identification. Machine learning techniques, such as Random Forest classification, Support Vector Machine, Logistic Regression, and Variance Analysis were used for the identification of risk factors. Moreover, Random Forest, Support Vector Machine, Decision Tree, Logistic Regression, K Nearest Neighbors, Gradient Boosting Tree, and XGP classification algorithms were used to predict the Malignant Transformation Potential. The most important risk factors, the habits of patients and medical history attributes were identified, and the Gradient Boost Classifier, Logistic Regression, and K Nearest Neighbors were identified as best models to predict transformation potential with 97% of accuracy for each.

Keywords: Machine learning, Malignant transformation potential, Oral Potential Malignant Disorder, Pre Cancer, Risk factors.

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Betel leaf classification using image processing techniques

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The betel leaf is a commercial product, which is mostly chewed with areca nut, slaked lime, tobacco, and other substances. In Sri Lanka, over 10 wild betel varieties have been discovered and betel leaves are exporting as a minor export crop. Exported betel leaves should be in good quality and exporters usually verify varieties and quality of the leaves manually. Therefore it is a disadvantage for Sri Lankan exporting industry due to lack of knowledge about varieties of betel leaves and mistakes can be happened as a manual process. This research is mainly focused on classification of betel varieties using image processing techniques. The two main varieties named Getathodu and Mahamaneru and two subcategories call Kanda betels and Ran betels are considered for this classification process. 800 images of betel leaves are captured as training data set and 200 images of betel leaves are used as testing dataset. The captured images are preprocessed and segmented using image processing techniques. The unique features of leaves, shape and veins pattern are extracted as features to develop the classification model using convolutional neural network and the classification model is developed with accuracy of 57%. Finally the trained model is able to classify the above mentioned two main varieties and sub varieties of betel leaves successfully. The average testing accuracy of the classification model is around 81%. The developed model will be a great advantage for the exporters' market as well as anyone can obtain correct awareness about betel varieties.

Keywords: Betel leaves, Feature extraction, Image Processing, Convolutional neural network

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Predicting the job satisfaction of freelancers using machine learning algorithms: A study based in Sri Lankan context

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As a result of technological enhancement, freelancing has become a significant business field all over the world. During the COVID-19 pandemic, millions of people worldwide lost their jobs, and some countries are facing financial crises in different ways because of the low foreign exchange reserves. Therefore, freelancing is a proper solution for those kinds of situations and it is become important to find the freelancers' job satisfaction. The main objective of this study is to create a model to predict the job satisfaction of freelancers in Sri Lanka using machine learning algorithms. It's potential to do this study since no previous research is directly relevant to this study. Primary data is gathered through social media platforms like Facebook, WhatsApp, and LinkedIn from freelancers in Sri Lanka using a Google form. Initially, the collected data is pre-processed and the model is created by analyzing the data set using five supervised machine learning algorithms such as Naïve Bayes, Support Vector Machine (SVM), Decision tree (J48), Random Forest, and Multilayer Perception (MLP). In this study, the cross-validation test option is used, and 10 folds showed a better output. The decision tree shows the best results among those algorithms shown as 92.5% accuracy rate as the highest accuracy including the highest precision, recall, and f-measure. Root Mean Square Error (RMSE) and Mean Absolute Error is the lowest in the decision tree algorithm. The result will help to predict the job satisfaction of freelancers and make relevant arrangements at the earliest for the freelancers' issues.

Keywords: Classification, Freelancing jobs, Machine learning, Prediction, Supervised learning

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Quality characteristics and shelf life of chicken eggs coated with different edible oils and stored at room temperature

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Chicken eggs have been considered as an energy source of protein. The quality of egg decreases with increasing storage time. Therefore, this research aimed to investigate the effect of different edible oil coating on egg shells and study the qualities and shelf life of chicken eggs. Freshly laid eggs were coated with sunflower oil, coconut oil, palm oil and gingelly oil and stored at 30°C for 5 weeks. Albumin pH, Haugh unit, Yolk Index and sensory qualities were determined at weekly intervals during storage. Initially, Albumin pH, Haugh unit and Yolk Index of the non-coated eggs were 8.74±0.01, 71.93±3.10 and 0.34±0.01 respectively and these parameters were unable to measure at the end of 5 weeks because non-coated egg yolks were spoiled. Eggs coated with sunflower oil, coconut oil, palm oil and gingelly oil had the Albumin pH of 8.80±0.08, 8.75±0.03, 8.76±0.01 and 8.74±0.02 respectively on the initial day and at the end of the 5th week storage the albumin pH was increased. The freshly laid egg albumin pH is 7.6 to 8.5 and this increased up to 9.7 during storage. Also, the Yolk Index were 0.33±0.003, 0.36±0.03, 0.34±0.01 and 0.32±0.008 respectively on the initial day and these values were decreased during storage. There was no significant ($p > 0.05$) difference observed for Haugh Unit in oil-coated eggs during storage. Microbial changes were within the acceptable limit during 5 weeks of storage. The sensory evaluation showed that the palm oil-coated eggs had the best quality at end of the storage. Therefore, Palm oil could be used for coating of chicken eggs to extend the shelf life without affecting the quality for 5 weeks of storage at 30°C.

Keywords: Chicken eggs, Edible oil coating, Quality parameters, Shelf life, Storage

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Comparative antioxidant activities of different vegetative parts of *Artocarpus heterophyllus* Lam.

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In traditional systems of medicine in Sri Lanka, *Artocarpus heterophyllus* Lam., which is commonly known as the ‘jackfruit’ tree (Moraceae) is widely used to manage the different health conditions which are typically linked to oxidative stress. Natural antioxidants in plants are able to counteract the deleterious effects of oxidative stress. Therefore, there is an increasing interest in employing natural antioxidants as therapeutic agents against different health conditions. The objective of this study was to compare the antioxidant activities of methanolic extracts of leaf, bark, fruit and seeds of *A. heterophyllus*. For this purpose, DPPH and ABTS assays were carried out by using a spectrophotometer following standard procedures in which trolox was used as the standard. Free radical scavenging capacity was determined for three replicates of each sample extract. Based on the results, the methanolic leaf and bark extracts showed the highest DPPH radical scavenging activity (IC₅₀: 112.58±0.25 and 119.94±0.41 mg/ml) while the lowest radical scavenging activity was detected in methanolic seed and fruit extracts (IC₅₀: 512.65±0.5 and 517.56±0.79 mg/ml) compare with the trolox. The ABTS activity was higher in methanolic leaf extract (IC₅₀: 124.54±0.22 mg/ml) while lower values were recorded in methanolic bark, seed and fruit extracts (IC₅₀: 253.69±0.18, 478.88±0.95 and 525.41±0.89 mg/ml) respectively. When considering the assays carried out of the methanolic extracts of *A. heterophyllus* the following decreasing order was founded: leaf > bark > seed > fruit. These findings suggest that *A. heterophyllus* leaves possess the highest antioxidant properties, and therefore could be used for the production of herbal medicines in future.

Keywords: Antioxidant, *Artocarpus heterophyllus*, ABTS, DPPH

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Effect of selected pretreatments on phytochemicals and antioxidant activity of commercially available horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.) seeds

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Macrotyloma uniflorum (Horse gram) shows remarkable health effective antioxidant potential. As raw seeds are hard to cook; pretreatments are used to reduce cooking time. However, the scientific information of the effects of these pretreatments on phytochemicals and antioxidant activity is not available. Hence, this study was designed to determine the impact of selected pretreatments, i.e. soaking and germination, on phytochemicals and antioxidant potential in commercially available horse gram seeds. Using purchased seed samples from a retail shop in Matara, Sri Lanka., qualitative phytochemical screening, quantitative determination of total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity using DPPH assay and FRAP assays were performed with triplicates of methanolic extracts of a) soaked (8h), b) soaked (8h) and germinated (24h and 48h) seeds, after c) cooking or d) in uncooked conditions. The results were compared with those of raw seeds. Data were statistically analyzed by One- way ANOVA, 2-sample and paired T tests using Minitab 17 software. Phytochemical screening revealed the presence of highly important bioactive compounds irrespective of the type of pretreatment. TPC, TFC and FRAP contents were significantly higher in the raw seeds compared to other treatments. In treated samples, TPC was the highest in the cooked seeds after 24h germination pretreatment ($P=0.001$). TFC and FRAP were highest in the cooked after 8h soaking pretreatment ($P < 0.001$ for both). IC_{50} values of DPPH assay showed no significant difference ($P < 0.05$) between soaking and 24h germination. The best antioxidant capacity (300 mg/mL) was observed in the raw soaked seeds for 8h. Hence, the soaked (8h) seeds are better to cook for human consumption due to relatively less effect on phytochemicals and antioxidant properties compared to other selected treatments and germination does not affect much on major antioxidant groups.

Keywords: Antioxidants, *Macrotyloma uniflorum*, phytochemicals, pre-treatments

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Utilization of oyster mushroom powder (*Pleurotus ostreatus*) in the development of biscuits

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Oyster mushroom (*Pleurotus ostreatus*) is commercially important in the world and many people admire them due to their taste, flavour, high nutritional value, and medicinal properties. Therefore, this study was carried out to develop biscuits using oyster mushroom powder. The biscuits were developed using wheat and oyster mushroom powder in the ratios of 100:00 (T₁), 95:5 (T₂), 90:10 (T₃), 85:15 (T₄) and 80:20 (T₅) respectively. Each biscuit was tested for its physiochemical and sensory characteristics. The data were analyzed using SAS statistical software package at p<0.05 significant level. According to the results, the physical parameters of biscuits such as diameter and spread ratio were decreased from 5.02±0.01 to 4.62±0.01 cm, 9.4±0.14 to 4.77±0.03 and thickness, volume and density increased from 0.54±0.01 to 0.97±0.01 cm, 10.60±0.09 to 16.19±0.13 cm³, and 0.73±0.01 to 1.05±0.01 gcm⁻³ respectively while increasing oyster mushroom powder from 0 to 20%. The proximate analysis of biscuits showed that the ash, protein, fat and fibre content increased from 0.84±0.02 to 1.82±0.01%, 6.61±0.01 to 8.01±0.01%, 27.61±0.01 to 33.56±0.02% and 1.45±0.02 to 2.42±0.01% respectively and moisture content decreased from 2.39±0.01 to 2.17±0.01% while increasing oyster mushroom powder from 0 to 20%. In sensory evaluation, T₄ gets the highest mean value compared with other treatments in terms of colour, texture, flavour, taste and overall acceptability. Therefore, the biscuit prepared from 85% wheat flour with 15% mushroom powder (T₄) is highly acceptable in terms of nutritional and sensory parameters. Therefore, a successful combination of oyster mushroom powder with wheat flour for biscuit production could be nutritionally advantageous.

Keywords: Biscuits, composite flour, nutritional quality, oyster mushroom.

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Investigating the potential of using jackfruit by-product flour in producing instant pasta

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Jackfruit (*Artocarpus heterophyllus* L.) is a popular seasonal food crop grown in Sri Lanka. During the jackfruit season a huge amount of by-products are generated and they are mostly used as animal feed or ended up in land filling without any usage. Therefore, this study was conducted to investigate the potential of utilizing jackfruit by-products (core and rags; 3:1 w/w) flour in manufacturing instant pasta. Proximate composition, physico-functional properties and antioxidant properties of jackfruit by-product flour were analyzed and compared with wheat flour. Composite flour mixtures were prepared by replacing wheat flour with different percentages of jackfruit by-product flour (25%, 35% and 40% w/w). Sensory analysis was conducted to select the best pasta prepared using a composite flour mixture using 30 semi-trained panelists. Proximate composition, physical properties and shelf-life (by total plate count, pH and color) of the selected best product were analyzed. Jackfruit by-product flour showed higher water absorption ($8.77\pm 0.06\%$) and swelling capacities (46.00 ± 5.66 mL) compared to wheat flour ($1.74\pm 0.14\%$; 17.35 ± 0.21 mL, respectively) showing its potential to use in making value-added bakery products. Further, jackfruit by-product flour contained a significantly higher ($p<0.05$) amount of crude fiber ($13.00\pm 1.13\%$) compared to the wheat flour ($2.24\pm 0.23\%$). Total phenolic and flavonoid content of jackfruit by-product flour were 40.9 ± 0.02 mg GAE/100 g and 65.7 ± 0.02 mg QE/100 g, respectively. The pasta made from 25% (w/w) jackfruit by-product flour showed the highest mean rank values for all the tested sensory attributes. The developed product can be stored in Low Density Poly Ethylene (LDPE) laminated packages at ambient temperature for 6 weeks. It can be concluded that the jackfruit by-product flour can be effectively used to replace wheat flour partially in the preparation of pasta products.

Keywords: Jackfruit by-product flour, physico- functional properties, total phenolic content, sensory analysis

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Root morphological traits of selected rice varieties exposed to salinity at the seedling stage

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The root morphological traits in plants can be used as a proxy to determine the varietal performance under varying environmental conditions. Our study aimed to identify root morphological traits that can impact the salinity susceptibility of rice varieties at the seedling stage. The study compares the root morphologies of salinity-tolerant (Bg 369, At 354) and salinity-susceptible (Bg 360, Bg 352) rice varieties under two conditions (saline stress:12 dS/m, without saline stress). The rice varieties were grown in a hydroponic (Yoshida) medium under non-stress and saline stress. The standard evaluation score for visual salt injury was taken using visual observation 5, 10, and 15 days of salinity induction. After 16 days, the treated roots were extracted and scanned using WinRHIZO root scanner (2015) to obtain root morphological parameters including root average diameter (AD), root surface area (SA), root volume (V), and total root length (TL). Analysis of variance was conducted using STAR 2.0.1 (IRRI, Philippines) using a 5% significance level followed by turkey pairwise comparisons. The percentage reduction for each trait was calculated. The reduction percentages of the root traits due to the salinity treatment are significantly lower in salinity-tolerant varieties compared to the salinity-susceptible varieties with regard to V, SA, and TL. Under non-stress conditions, the AD of the salinity-susceptible varieties was significantly different from the AD of the salinity-tolerant varieties. Our findings indicate that the root morphological traits investigated can be used to distinguish between the selected salinity-tolerant and susceptible rice varieties under saline-stress and non-stress conditions.

Keywords: Rice varieties, root morphology, salinity- tolerance, salinity-susceptible

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Physicochemical and functional properties of selected banana varieties in the southern province, Sri Lanka

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Bananas (*Musa spp.*) are one of the commonly grown fruit crops in Sri Lanka, and 29 different varieties grown in the country. However, detailed studies on comparison of their physic-chemical and functional properties are limited, and in the current study was conducted to compare physicochemical and functional properties of four different banana varieties (*Seeni*, *Ambul*, *Kolikuttu* and *Embon*) commonly grown in the Southern Province of Sri Lanka. Bananas from sixth stage of ripening level were randomly taken from two different hands of the same bunch, and their physical, chemical and functional properties were measured in triplicates. Statistical significance of the obtained data was tested using Turkeys post-hoc multiple comparison test. Amongst all the tested varieties, the significantly ($P<0.05$) highest weight (111.1 ± 11.7 g), inner length (16.3 ± 0.14 cm), outer length (20.8 ± 0.5 cm), top (12.5 ± 0.7 cm), mid (15 ± 00 cm) and bottom (11.25 ± 0.07 cm) girth was recorded in variety *Embon*, while the variety *Seeni* showed significantly highest pulp firmness. The variety *Ambul* had showed the highest total soluble solids (16.5 ± 0.84) and fiber ($2.33\pm 0.46\%$) content, while the highest sugar content (11.70 ± 0.02 g/100 g) was recorded by the variety *kolikuttu*. The highest titratable acidity (0.4 ± 00 g/100 mL) and vitamin C content (19.5 ± 3.1 mg/100 g) were observed in both *Kolikuttu* and *Seeni*. Considering the functional properties, the variety *kolikuttu* recorded the highest phenolic content (55.1 ± 0.6 mg/100 g) and total antioxidant content ($94.8\pm 4.24\%$). The study findings show that the tested banana varieties are a rich source of nutrients and the physicochemical and functional properties differ from each other.

Keywords: Antioxidant content, nutrient content of banana, phenolic content, physical properties

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Identification of Gall midge (*Orseolia oryzae*) resistant genes in selected rice varieties/ lines by molecular markers

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Asian Rice Gall Midge (*Orseolia oryzae*) (RGM) is a major insect pest, that affects at tillering stage of rice and causes about 30%-40% of yield loss. Cultivation of resistant rice varieties is the most successful approach to controlling the pest and therefore development of RGM-resistant rice varieties is a solution for prevention of an outbreak. So far 12 gall midge-resistant genes have been identified. Those resistant genes can be used for RGM resistance development. Molecular screening was done using SSR markers RM 23956, LLR_del and gm3del3 to identify RGM-resistant genes *Gm1*, *Gm4* and *gm3* respectively. Molecular screening results revealed that out of the 24 tested varieties, 20 varieties carried at least one resistant gene. Among those 20 varieties, the variety 'Heen sulai' carried *Gm1*, *Gm4* and *gm3* genes. 'Gires' and 'Ptb 21' varieties harbored *gm3* and *Gm4* genes. 'Duru wee', 'Bg 406', 'IRBB 65', 'Bg 305', 'Bg 360' and 'Bg 380' carried *Gm1* and *gm3* genes. The variety 'IR 36' carried *Gm1* and *Gm4* genes. 'Bg 359', 'Bw 78' and 'Bg1492' varieties had only the *Gm1* gene. Seven varieties/lines, 'Bg 366', 'Bw 367', 'IRGC 9091-1', 'IRGC 9070-1', 'Zenith', 'Local 2.5' and 'Bg 304' carried only the *gm3* gene. These results confirmed that most varieties contained at least one resistant gene. Therefore, these RGM-resistant rice varieties can be effectively applied as donor parents for gene pyramiding to develop a rice variety with durable RGM-resistance.

Keywords: Asian Rice Gall Midge (*Orseolia oryzae*), *Gm1*, *gm3*, *Gm4*, RGM - resistant

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Soil carbon stock of coconut plantations in southern coast of Sri Lanka

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Coconut plantations have been identified as common cultivation providing a significant contribution to the economy of coastal communities. However, considering the coconut plantations as a coastal ecosystem, information on the carbon storage in the soil is scanty. Therefore, the current study aimed to fill that knowledge gap by assessing the Soil Organic Carbon (SOC) stock of coastal coconut plantations in Southern coast of Sri Lanka. Soil samples (189) were collected from selected coconut plantations in Galle, Kalametiya, and Hambanthota areas (5-soil-cores; 45-soil-samples, each site) while another set of soil samples was collected from mangrove vegetation's in Galle (6-soil-cores; 54-soil-samples) for comparison, as mangroves identified as the most carbon-rich ecosystem in the world. Soil samples were taken using a soil corer (diameter=4.8cm, depth=1.8m), following random sampling approach. The SOC contents of the soil samples (5g) were analyzed in triplicates using the Loss On Ignition (LOI) method. Wilcoxon signed-rank test was performed to analyze data using R-statistical software. Results showed that the average SOC contents of coconut plantations in Galle, Kalametiya, and Hambanthota were 150.51(±44.09), 130.12(±87.00), and 143.91(±13.36) Mg C/ha respectively. The average SOC content of mangroves was 861.95(±131.3) Mg C/ha. According to the analysis, SOC content in coconut plantations was significantly lower ($p < 0.05$) compared to mangroves. Less variation was observed for SOC contents in coconut plantations between sites. The SOC content of adjacent coconut plantations was estimated 16% of that of SOC content in mangroves. Therefore, as a win-win step, coconut plantations are recommended for non-productive coastal areas (e.g., coastal bare-lands, underutilize-areas) considering their economic importance and carbon science.

Keywords: Carbon stock assessment, coconut plantations, mangroves, Southern Sri Lanka

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Characterization of Naturally Occurring Clay Deposits in Ampara District, Sri Lanka

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Man recognized the importance of solid mineral resources, since the dawn of time. Clay has its unique properties such as strong cation exchange capacity, swelling behavior, specific surface area, adsorption capacity, etc and these superior properties make the clay be used in many applications including in the cement industry. Therefore, it is important to study the mineralogical contents and physical and chemical properties of clay using different analytical techniques. Clay deposits are commonly found in various parts of Sri Lanka. However, only a few deposits have been studied in detail. The aim of this research is to study the properties of clay at Irakkamam in Ampara district to determine its potential as an alternative pozzolan in concrete. This clay mineral could be used as a substitute for the Portland Cement and the replacement of this material will reduce the cost and emission of greenhouse gases. The chemical composition and the morphology of the clay were analyzed by XPS and SEM, respectively. The FT-IR analysis was performed to identify the functional groups of the raw clay. The semi quantification of clay minerals was done using X-ray diffraction (XRD). According to XRD analysis, the primary clay minerals are vermiculite and kaolinite, although it also contains cordierite and quartz as non-clay minerals. Cation exchange capacity (CEC) of this clay is 122 meq/100 g. The raw clay's SEM pictures revealed a well-defined layered structure with polygonal sheets, flaking borders, and substantial vermiculite layer crystals. IR bands observed at 1114 cm^{-1} and 1025 cm^{-1} were assigned to stretching vibrations of Si-O-Si and Si-O in amorphous silica respectively.

Keywords: Clay, Characterization, Cation exchange capacity, Minerals.

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Mineralogical and Chemical Evaluation of Sri Lankan Calcite and Dolomite

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Calcite and dolomite are the most abundant minerals in carbonatite, limestone and marble in Sri Lanka. Primarily, they are used in ceramic, steel, cement, paint and coating, food additives, pharmaceutical, PVC and latex manufacturing industries as essential raw materials. However, mineralogical and chemical composition and the impurity incorporations of the selected calcite/ dolomite raw materials have a specific action in the manufacturing process and the final product quality. Importantly, different aspects of the manufacturing processes have critically depended on the CaCO₃ and MgCO₃ content. Previous studies have only focused on the geological occurrence and distribution of the calcite and dolomite deposits. Therefore, the present study aims to conduct a mineralogical and chemical evaluation of currently mining calcite and dolomite deposits in Sri Lanka. Mineralogical and chemical analyses were performed by X-ray diffraction and X-ray fluorescence techniques respectively. Except few, most of the selected deposit compositions have shown the 2:1 ratio of Calcite: Dolomite. Further, quartz is present as the major impurity mineral while forsterite, phlogopite, iron-oxide, kaolinite, and illite, are present as associated impurity minerals. Considering the industrial suitability, Kolambagearaba, Moratuwagama, Ulpathaha and Okkampitiya deposits are suitable for the ceramic, paint, PVC and latex industry due to the high Ca with low Mg and silica content. Though silica is present, raw materials from Naula, Palapathwala, Kaudupalella and Ulpathaha deposits are suitable for the ceramic industry.

Keywords: Calcite, Dolomite, Mineralogy, Chemical composition

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Evaluation of antioxidant activities of two polyherbal formulations (Desadun Kalka and Buddharaja Kalka) found in Sri Lankan Ayurvedic treatments

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Polyherbal formulations are used in Ayurveda, to treat illnesses, in which various ratios of herbs and other solid and oil constituents are mixed in minute amounts. The two prominent polyherbal formulations utilized by locals for medical ailments are Buddharaja Kalka (BK) and Desadun Kalka (DK). Even though there are published studies analyzing the therapeutic effects of polyherbal formulations, no evidence has been reported regarding their bioactivities. Therefore, this study aims to evaluate the antioxidant activity of BK and DK compared to a positive standard. Both Kalka were purchased from a local Ayurvedic store, extracted with ethyl acetate and the solvent was evaporated using a rotary evaporator. The antioxidant activities were evaluated using phosphomolybdenum assay and DPPH free radical scavenging assay. In addition, total phenolic (TPC) and total flavonoid (TFC) contents were estimated. A higher TPC was observed for DK (34.84 ± 0.72 mg GAE/g extract) than that of the BK (10.22 ± 0.18 mg GAE/g extract), and the highest TFC was present in DK (159.77 ± 0.98 mg GAE/g extract). The total antioxidant capacity based on phosphomolybdenum assay displayed a higher value in DK (303.33 ± 2.07 mg AE/g extract) than in BK (210.00 ± 1.67 mg AE/g extract). Further, higher DPPH free radical scavenging activity was observed in DK. Interestingly, both BK and DK showed higher antioxidant activity than the positive control butylated hydroxytoluene (BHT) with IC_{50} values of 23.082 ± 1.547 mg/mL, 28.308 ± 1.102 mg/mL and 34.044 ± 1.557 mg/mL respectively. Hence, DK and BK could be used as potential free radical scavengers.

Keywords: Polyherbal formulation, Buddharaja Kalka, Dssadun Kalka, Antioxidant activity

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Mineralogical and chemical evaluation of five major feldspar mines in Sri Lanka

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The geochemistry of Sri Lankan feldspar has been investigated through several studies, but none of them have examined the chemical composition of major mining sites based on industrial needs. This study evaluates the chemical composition and impurity mineral incorporation of Sri Lanka's major feldspar mining sites. Five major mining sites at Mathele-Naula, Sewanagala, Weli-Oya, Owala-Kaikawela and Badalkubura were identified for the study. Ten samples were collected overall, with multiple samples taken from each site with varying compositions by preliminary mineralogical observations. Samples were powdered using a planetary ball mill and sieved below 125 μm and directed for the analysis. Crystallinity and mineral phase identification were completed by X-ray diffraction (XRD) analysis (Rigaku Ultima IV, $\text{CuK}\alpha 1 - \lambda = 1.5432 \text{ \AA}$) and X-ray fluorescence (XRF) analysis (Rigaku NEXCG, with 20mm diaphragm). Microcline feldspar is the major compound found in Mathale-Naula (59.68%), Sewanagala (41.36%), Welioya (54.06%), and Owala-Kaikawela (78.14%) mining sites. However, the mining site at Badalkubura is composed of albite (40.44%). In addition, quartz and muscovite mica are common in most mines as impurity incorporations. Further, the feldspar samples collected from the Weli-Oya mine have the maximum crystallinity compared with other samples. Hence, Owala-Kaikawela and Mathale-Naula mines are suitable for the ceramic and porcelain industry, while Badalkubura mine is suitable for the glass industry.

Keywords: Ceramic industry, Chemical composition, Feldspar, Glass industry, Mineralogy

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Banana stem as a waste-derived bio-sorbent to remove organics and nutrients from rice mill wastewater

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The discharge of organics and nutrients rich rice mill wastewater into an aquatic ecosystem ultimately affects ecosystem functioning. Bio-sorption is a viable technique for rice mills for onsite wastewater treatment. This study aimed to produce waste derived bio-sorbent from banana stem to treat rice mill wastewater. The banana stem was washed thoroughly, shade dried and ground using a kitchen blade grinder and sieved using 500 μ m sieve. The feed water was collected from a rice mill functioning in the Vavuniya town area and the initial COD, phosphates and nitrates were determined as 840.87 \pm 23.32 ppm, 12.32 \pm 0.11 ppm and 5.63 \pm 0.23 ppm respectively. Adsorption isotherm was conducted for varying dose of biosorbent(1- 6 g/L) and the adsorption kinetics was conducted for different contact times (30 -180 min). The bio-sorbent reduced 61.6 % COD, 52.1 % nitrates and 22.2 % phosphates at the dosage of 4 g/L biosorbent at 150 min. Based on the t-test, banana stem is effective in reducing organics, nitrate, and phosphate (p-value < 0.05). This study emphasizes that the banana stem has the potential to remove contaminants from wastewater.

Keywords: Bio-sorbent, banana, wastewater, rice mill, Vavuniya

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Evaluation of Anti-tyrosinase activity of leaf extracts of *Dialium ovoideum thwaites*

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Melanin protects human skin from ultraviolet radiation. However, abnormal melanin production leads to pigmentation problems. Since tyrosinase is the key enzyme that catalyzes melanin synthesis in humans, tyrosinase inhibitors could be a desirable therapy option for hyperpigmentation. Though several natural and synthetic regulators have been identified, the discovery of novel selective and potent plant-based tyrosinase inhibitors that are less hazardous to human health is still in development. Hence, this study investigated the tyrosinase inhibitory activity of the leaf extracts of *Dialium ovoideum thwaites*. Sequential extraction was conducted for leaves of *D. ovoideum thwaites* using hexane, ethyl acetate and methanol at room temperature for 24 hours for each solvent. The extracts were evaluated for their total phenolic content, antioxidant activity (DPPH radical scavenging assay) and tyrosinase inhibitory activity (dopachrome method). The methanol extract possessed the highest phenolic content of 80.59±1.88 mg GAE/g, antioxidant properties of IC₅₀ value of 300±1.04 µg/mL (compared to IC₅₀ value of ascorbic acid of 36±0.69 µg/mL), and 12%-44% tyrosinase inhibitory activity at a concentration range of 4.0-32.0 mg/mL (compared to kojic acid of 58%-61%). These results suggest that the methanol extract of leaves of *D. ovoideum thwaites* exhibits moderate tyrosinase inhibition which is positively correlated with its antioxidant properties and total phenolic content.

Keywords: *Dialium ovoideum thwaites*, Leaf extracts, Mushroom tyrosinase, Anti-tyrosinase activity

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Low-cost wearable non-invasive sensor coupled with Arduino Uno system to monitor hydration status during physical activity

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Dehydration is a common health challenge among athletes. Many attempts have been made to detect dehydration using the conductivity of perspiration as a biomarker. However, due to the poor reliability and portability of those devices, the requirement for an alternative detection method is required. Thus, a real-time human sweat conductivity-based portable non-invasive device combined with an interdigitated electrode sensor (IDE and DS18B20 sensor) and an Arduino Uno platform was developed. Sweat impedance was used to predict hydration status. An Android application was designed to provide alerts via Bluetooth connection to alarm the user regarding the hydration status. The device was calibrated with a 10 μ S KCl solution and cross-checked with the conductivity of known electrolytes. The sensor was tested for human sweat before and after consuming commercial electrolyte beverages in a controlled exercise environment. Results showed a noticeable 2.42 (\pm 0.26) times average conductivity increase compared to the initial conductivity with a 10.61% percentage deviation for each person before reaching a predefined dehydration level without consuming any electrolyte. After electrolyte consumption, this value was reduced to 2.03 (\pm 0.44) with a higher percentage deviation of 21.72%. Initial average conductivity and the increase in percentage sweat conductivity were used to programme the device to provide a warning signal to the user regarding potential dehydration.

Keywords: devices, non-invasive, dehydration, detection, low-cost

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Application of Ag/TiO₂ Composite for Wastewater Treatment

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Wastewater containing dyes is a significant polluter of the environment which also affects human health, as textile industries generate large amounts of highly colored wastewater containing a diverse range of persistent pollutants. Titanium dioxide (TiO₂) has been widely used in photocatalytic conversion reactions. Wide band gap (~ 3.2 eV) of TiO₂ allows the absorption of UV light only, hence lowering the efficiency of photocatalysis under solar irradiation. Reported herein is a novel green synthesis approach for Ag/TiO₂ composite which can act as an adsorbent and a photocatalyst in removal of MB. Incorporation of silver nanoparticles (AgNPs) to TiO₂ has been proven to be effective in enhancing visible light absorption. Tea extract was used as a reducing and stabilizing agent in AgNP synthesis. Adsorption capability and photocatalytic activity of Ag/TiO₂ composite was studied using MB and compared with TiO₂. Adsorption capability was studied by measuring the change in concentration of MB in a mixture of a MB solution and the catalyst kept in dark. Within the first few minutes, ~ 70 and 12 % of MB were adsorbed onto Ag/TiO₂ and TiO₂, respectively. Removal of ~ 90 and 35 % MB was observed by 1 h solar irradiation of the dye containing samples having Ag/TiO₂ and TiO₂, respectively. Ag/TiO₂ composite prepared by this method acts as a more efficient adsorbent and a photocatalysts than TiO₂ in removal of MB and it is a potential material for treatment of wastewater containing MB. The reported synthesis procedure is straightforward, economical, scalable, and effective.

Keywords: Silver nanoparticle, Titanium dioxide, Green synthesis, Adsorption, Photocatalysis.

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Indoor resting density of vector mosquitoes (Diptera: Culicidae) in selected sites in Galle district of Southern Sri Lanka

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Mosquitoes (Diptera: Culicidae) are the most important insect vectors of human diseases. The Galle district of Southern province in Sri Lanka is a high-risk area for mosquito vector-borne diseases. Since the past literature on the diversity of mosquito fauna in Galle District still remains much scattered, it is vital to update the knowledge on the diversity of vector mosquitoes in the area. Hence, the study aimed to estimate the density of indoor resting vector mosquitoes in selected sites in Galle District. The survey was carried out in eight (8) selected sites (urban, rural, coastal, natural inland, coastal inland mixed, rocky, mangrove and forest) from January 2017 to January 2020. Twenty-five (25) randomly selected houses in each site were sampled using the hand collection method once a month. Samples were collected from indoor and open areas within each house using standard mouth aspirators during the daytime (6.00 a.m. -12.00 a.m.) on each sampling day, while 10 min. were spent in one house. The density of mosquito species was calculated using Banaszak and Winiewski density index. Among the recorded densities of seven species (7) in five genera (5), *Culex quinquefasciatus* (36.06%), *Culex gelidus* (11.68%), *Aedes albopictus* (29.98%), *Aedes aegypti* (5.35%) and *Anophelese jamesii* (10.82%) belong to the 'dominant' density category, and *Armigerus subalbatus* (4.83%) and *Mansonia uniformis* (1.28%) belong to the 'subdominant' category of density index. Of the total collected 2338 adults, 48% of genus *Culex*, 35% of *Aedes*, 11% of *Anophelese*, 5% of *Armigerus* and 1% of *Mansonia* were represented. *Ae. albopictus* was dominant in urban and natural inland sites, and *Cx. quinquefasciatus* was dominant in rural, coastal inland mixed, coastal, rocky, mangrove and forest sites. *Ae. albopictus*, *Cx. quinquefasciatus*, *Cx. gelidus* and *Ar. subalbatus* were recorded from all sites. *Ae. aegypti* was reported only from urban, coastal and coastal inland mixed sites. *An. jamesii* and *M. uniformis* were recorded only from urban and mangrove sites respectively. The revealed information on indoor resting mosquito species is vital for the implementation of effective vector control programs in the district.

Keywords: Indoor resting density, hand-collection, vector mosquitoes

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Factors associated with knowledge of hypertension among hypertensive patients at the Teaching hospital, Jaffna, Sri Lanka

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Knowledge of hypertension among patients is crucial for its effective management. The objective of this study was to assess the factors associated with knowledge of hypertension among hypertensive patients attending the medical clinic at Teaching Hospital, Jaffna. It is a hospital-based cross-sectional analytical study conducted from November 2020 to October 2021. A systematic sampling method was used to select 427 hypertensive patients. The data were collected using a pre-tested and validated interviewer-administered questionnaire and data extraction form after obtaining ethical clearance. The total score on hypertension knowledge questionnaire was 25. Data were analyzed using SPSS software. Kruskal-Wallis test and Mann-Whitney U test were used to assess the association between HT knowledge on hypertension among patients and selected variables at α level of 0.05. The response rate of patients was 97.19% (n=415). The median age of patients was 55 years (IQR=13). The majority of the patients were female (65.5%). Most of the patients (72.3%) had uncontrolled blood pressure. The median of knowledge on hypertension score of patients was 11 (IQR=4). Knowledge of hypertension among patients was associated with gender, marital status, educational level, employment status, family history of hypertension, number of antihypertensive medications used and herbal usage. However, age, duration of hypertension, regular clinic attendance, presence of uncontrolled blood pressure, and presence of co-morbidities were not associated with knowledge of hypertension. Patients have inadequate knowledge of hypertension irrespective of controlled or uncontrolled blood pressure. Patients' knowledge needs to be improved for the effective management of hypertension.

Keywords: Hypertension management, blood pressure, patients' knowledge.

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Impacts of covid-19 pandemic on the fish harvest and the income of the marine fishers in the Chilaw area

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The marine fisheries industry plays an important role in the social and economic life of Sri Lanka. A sudden decline in the fish harvest in Chilaw was noticed in the years 2020-2021. This study evaluated the relationship between COVID-19 related changes such as lockdowns, mobility restrictions and quarantine periods, and fish harvest and the monthly income of fishers. A sample of 150 participants was selected randomly. Primary data were collected using a questionnaire and face-to-face interviews with the informed consent of the participants following the safety guidelines and regulations. Secondary data were collected from the official website of the Department of Fisheries and Aquatic Resources, Chilaw. Descriptive statistics, correlation, and regression analysis were obtained using SPSS software. Fish harvest was moderately, negatively related to the lockdown, while monthly income was low negatively related to the lockdown, and mobility restrictions with correlations of -0.412 and -0.293 respectively at $p < 0.01$. COVID-19 impact significantly predicts the fish harvest and the income with 10.329, 6.546 respectively at $p < 0.0005$ and $F(3, 146)$. This indicates the regression model is a good fit for the data. Findings revealed that a sudden decline in the demand of 92% for fish was noticed due to the lockdown. In the 3rd COVID-19 wave, fishers and sellers used to make dry fish as an adaptation strategy to minimize wastage. 75% of the increase in dry fish production in the third wave of COVID-19 was recorded whilst, 80% of fishers were able to distribute fish considering it as an essential service.

Keywords: COVID – 19, fisheries industry, fish harvest, monthly income

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Current Awareness of COVID-19 among the residents of Kandy district: An online questionnaire-based survey study

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Awareness and knowledge of the COVID-19 health guidelines (HGs) ascended when the death rates started to spike. Yet, the general public seems to have relaxed COVID-19 HGs with the reduction of daily deaths. This questionnaire was conducted to determine the knowledge, opinions, and current (October 2022) awareness of COVID-19 HGs among the residents of the Kandy district. The aim of this research is to minimize the health impact by keeping people aware. It was first piloted among a selected group to validate the questionnaire. The IBM statistics SPSS was used to conduct the Chi-square analysis. A total of 100 responses were received, and the analyzing process was done by using a scoring method. Sixteen were considered as incomplete responses. The collected data for the study indicated that more than half of the population (63.3%) were undergraduate students. Among the respondents 60%, 30% and 10% are still following, not following and occasionally following the government COVID-19 HGs, respectively. The majority of the respondents (31%) stay informed about COVID-19 HGs using social media while 24% of respondents relied on television. In our study, a significantly higher number of females were found to be more likely to follow HGs ($\chi^2 = 9.177$, $p = 0.01$). Yet, there was no significant difference between the male and female populations who were currently adhering to HGs ($\chi^2 = 5.88$, $p = 0.05$). Among the total population considered, 47.3% believed that the COVID-19 pandemic is over and ignored.

Keywords: COVID-19, SARS-CoV- 2 virus, pandemic, current awareness, survey

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Occurrence of gut acanthocephalans in Frigate tuna (*Auxis thazard*) and Mackerel tuna (*Euthynnus affinis*)

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Understanding the occurrence of parasites is important in the marine food fish trade. Acanthocephalans can perforate and damage fish tissues making them unsuitable for trade. This study focused on the identification of gut acanthocephalans in Frigate tuna (*Auxis thazard*) and Mackerel tuna (*Euthynnus affinis*) with a comparative analysis of the parasite occurrence between two fish species. Fifty specimens from each fish species were purchased from a retail store in Kandy, Sri Lanka, from June to September 2022. The fish were dissected and inspected for gut helminths. Recovered gut helminths were washed and microscopic morphometry of the head and other organs of the parasites was carried out for identification. The occurrence of parasites in the two fish species was statistically analyzed using Chi-square test. The microscopic examinations revealed two different acanthocephalan genera, namely *Rhadinorhynchus* and *Neorhadinorhynchus*. Juveniles of genus *Rhadinorhynchus* (Frigate tuna: 205 ± 0.84 , Mackerel tuna: 485 ± 1.47) and genus *Neorhadinorhynchus* (Frigate tuna: 61 ± 0.91 , Mackerel tuna: 28 ± 2.2) were recovered from the gut of the fish. The prevalence of *Rhadinorhynchus* was 82% and 74% in mackerel tuna and frigate tuna, respectively, whereas that of *Neorhadinorhynchus* was 4% and 20%, respectively. While the prevalence of *Neorhadinorhynchus* was lower in mackerel tuna compared to frigate tuna ($p < 0.05$), the co-occurrence of both parasitic genera in mackerel tuna was also low ($p < 0.05$). The parasite abundance for *Rhadinorhynchus* was 9.7 and 4.1 in mackerel and frigate tuna, respectively, and it was 0.56 and 1.22 for *Neorhadinorhynchus*. The present study marks the first attempt to explore acanthocephalans in Sri Lankan marine food fish.

Keywords: Acanthocephalans, Frigate tuna, Mackerel tuna, *Neorhadinorhynchus*, *Rhadinorhynchus*

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Quantitative phytochemical analysis of eight plant materials of *Amurthashtaka kwatha*

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'*Amurthashtaka kwatha*' is an Ayurvedic polyherbal formulation widely used to treat fever associated with inflammation. It consists of eight ingredients, namely, the bark of *Azadirachta indica* (Neem), seeds of *Holarrhena antidysenterica* (Coneru), the heartwood of *Santalum album* (Sandalwood), stem of *Tinospora cordifolia* (Guduchi), whole plant of *Trichosanthes cucumerina* (Wild gourd) and rhizome of *Cyperus rotundus* (Nut grass), *Picrorhiza scrophulariiflora* (Kutki) and *Zingiber officinale* (Ginger). The study is aimed at the quantitative determination of phytochemicals of eight plant materials of '*Amurthashtaka kwatha*'. The plant materials were purchased from three Ayurvedic medicine shops in Sri Lanka and authenticated. Hot aqueous extracts were prepared according to Ayurvedic pharmacy. One part of the raw drugs was boiled with eight parts of water, and the final solution was reduced up to one-eighth. Total phenolic contents were determined by the Folin-Ciocalteu method against the gallic acid standard, and total flavonoid content was determined by aluminum chloride method against the quercetin standard. Alkaloids and saponins were determined using crushed powders. The highest total phenolic content was obtained in *Santalum album* (25.83 ± 0.43 mg gallic acid equivalents; GAE)/ g) while the lowest value 3.44 ± 0.29 GAE/ g was given by *Picrorhiza scrophulariiflora*. The highest total flavonoid content was identified in *Trichosanthes cucumerina* as 6.46 ± 0.18 (mg quercetin equivalents (QE)/ g) and the lowest value was found in *Zingiber officinale* as 1.06 ± 0.28 (mg QE/ g). The highest percentages of alkaloid and saponin contents were calculated as $11.84 \pm 0.91\%$ in *Holarrhena antidysenterica* and $8.80 \pm 0.20\%$ in *Picrorhiza scrophulariiflora* respectively. The lowest percentage of alkaloid and saponin contents were obtained as $1.48 \pm 0.22\%$ and $1.21 \pm 0.26\%$ in *Santalum album*. The results show that '*Amurthashtaka kwatha*' is a source of all the tested phytoconstituents which may be beneficial for its pharmacological activities.

Keywords: *Amurthashtaka kwatha*, total phenolic content, total flavonoid content, alkaloids, saponins

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Cross sectional study of Siddha diagnostic method of *Neikuri* in *Mathumega Noi* (Diabetic mellitus Type II) according to *Pirakiruti*

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The global prevalence of Diabetes mellitus has escalated over the last centenary due to changes in behaviour and lifestyle modifications practiced by humans. In the Siddha system of medicine, diabetes mellitus is known as '*Mathumega Noi*'. The objective of the study is the observation of Siddha diagnostic method of '*neikuri*' in '*Mathumega Noi*' (Diabetic Mellitus Type II). It is a cross-sectional descriptive observational single-centric study. This study was carried out on 50 patients at Government Ayurvedic Siddha Teaching Hospital Jaffna. The mean age of the study population was 59 ± 1.25 years with a range of 40-70 years. Urine samples were collected in the early morning and '*Neikuri*' was tested. The time duration between the collection of urine and performed as immediate and after one and a half an hour from the collection of urine. '*Neikuri*' is an antique method of urine examination based on the distribution of gingerly oil drops in urine. Data were collected by administering a questionnaire with the consent of the patients. Among the diabetic subjects, 35 and 15 respectively belonged to the '*Pitha*' and '*Vatha*' periods. There were more males (25) than females (10) in '*Pitha*' as well as '*Vatha*' (10 males and 5 Females) periods. According to the assessment of '*Pirakiruti*', there were 30 '*Pitha Pirakiruti*' subjects, 15 were '*Vatha Pirakiruti*' and 05 subjects were '*Kapha Pirakiruti*'. The highest incidence of diabetic Mellitus patients mostly '*Pitha Pirakiruti*' was predominantly seen in 30 patients (60%). '*Neikuri*' was assessed by spreading pattern and duration for spreading oil drop in urine significantly wherever applicable was found by Chi-square test at $p < 0.05$ significant level. Results of the study showed 60% of '*neikuri*' was '*Pitha*' nature, 30% was '*Vatha*' nature and 10% was '*Kapha*' nature. This study helps to determine the Siddha diagnostic method.

Keywords: Diabetic mellitus, Mathumega Noi, Neikuri, Pirakiruti, Siddha Medicine

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Anthropometric indices among *Mathumega* disease patients (Diabetic Type 11) in the Vadamarachy area according to Siddha perspective

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The objective of this study was to determine the anthropometric indices for Vadamarachy area among the *mathumega disease patients* (Diabetes Type II). In a study conducted recently with 193 type II diabetes mellitus patients aged 40-70 years. The occurrence of diabetes mellitus based on *Pirakruti* was assessed. The height and weight were measured using standardized equipment and body mass index (BMI) calculated. Asian cut of value for BMI was used to group the patients as overweight and obese. The study design was approved by the Ethical Review Committee, Faculty of Medicine, University of Jaffna. According to the different combinations of the features there were 68 *Vatha Pirakruti* patients, 74 patients with *Pitha Pirakruti*, and 51 patients with *Kapha Pirakruti*. According to *Pirakruti*, *Pitha Pirakruti* subjects were higher than other *Pirakruti*s with lowest number in *Kapha Pirakruti*. The mean height of 158.5 ± 11.2 cm in males was significantly (p value=0.001) higher than females (150.8 ± 7.5 cm), the mean height of total study sample was 155.36 ± 10.55 cm. 62.86Kg is the average weight of the subjects. Majority of the diabetic subjects were in Class 1 obesity (50.26 %) and 29 (15.03 %) patients were with Class 2 obesity, 12.44 % were overweight. Central obesity was present in 55.9% of the patients. The highest incidence of diabetic mellitus patients mostly over weight and obesity was predominantly seen in 150 patients (77.73%). Among the diabetic patients 161 and 32 belonged to the *Pitha* and *Vatha* Prakruti respectively. According to *Pirakruti*, *Pitha Pirakruti* (52 males and 22 females) subjects were higher than other *Pirakruti*s with lowest number in *Kapha Pirakruti* (29 males and 22 females).

Keywords: Anthropometric indices, Pirakruti, Dosha Mathumegam, Type 2 diabetes mellitus

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Strength enhancement of existing cement mortar using termite clay

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Cement mortar is a mixture of cement, sand and water with defined ratios. Portland cement manufacturing is very costly and energy-intensive process. Furthermore, it has a significant impact on environmental degradation and pollution, and may cause health hazards. Thus, the study aimed to investigate the performance of Portland cement that was partially replaced by termite mound clay to produced cement mortar in construction purposes. Termite clay is a widely available material in Sri Lanka and has been used in household work and the samples were obtained from Anuradhapura district Nachchaduwa area. Cement, sand, and termite clay were mixed with 10%, 25%, 50%, and 75% of replacement with termite clay and made two samples from each ratio to test for compressive strength. Tests were conducted for 50 mm cubic specimens and the compressive strength was measured at 7, 14, and 21 days of curing age. According to the results, the compressive strength of the mortar cubes remain the same as normal cement mortar up to 10% (by weight) of the termite clay replacement. Other samples showed significant declined in compressive strength. Thus, the study concluded that up to 10% of termite soil is suitable for the replacement of cement in mortar.

Keywords: Cement Mortar, Termite Clay, Eco-friendly Constructions, Strength Enhancement

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Design and development of a tire changing mechanism for heavy vehicles

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At present, nearly 500,000 lorries, trucks and buses are registered in Sri Lanka. Trucks are widely used for transportation of goods around Sri Lanka. The tires in these vehicles must be removed during a service, repair or for a tire replacement. High loads and awkward postures from manually lifting, lowering, and handling of tires in many instances are linked to Musculoskeletal Disorders in humans. This research project aims at developing a suitable mechanism to minimize the human effort and to overcome the awkward postures and time consumed when changing truck tires. A survey conducted showed that, 86% had difficulties in mounting the tire onto the wheel studs and 76% had difficulties in loosening lug nuts. Also, 60% experienced lower back pain due to the tire changing process. Levering, lug wrenches, impact guns and torque multipliers are the current methods used, to change truck tires. It was found that, 60% of the employees faced problems when using the current methods to change tires in heavy vehicles. The required torque for loosening and tightening of lug nuts was estimated at 600Nm to 800Nm respectively. The worm gearbox strength calculations of the proposed design were carried using a torque of 1000Nm. Total weight of a semi-truck tire was taken as 600N and the tire lifting equipment calculations were performed to withstand a load of 1000N using a factor of safety of three. Finally, the design was simulated and validated through ANSYS modeling software using properties of mild steel as for the strength calculations.

Keywords: musculoskeletal disorders, lower back, levering, mild steel

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Stability properties of a delayed HIV infection model with absorption and apoptosis

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The mathematical theory of viral infections has enhanced our knowledge of the dynamics of viral infections and allowed us to determine the efficiency of antiviral therapy. In this study, we formulated the stability properties of a modified HIV virus infection model by considering the absorption effect, which is distinguished from the existing HIV virus models. The apoptosis effect is incorporated into the model with absorption effect, which is the novel concept. To strengthen the biological realism of the processes, intracellular time delay was incorporated into this model by using system of delay differential equations. This study was conducted to illustrate the stability of the model and how the time delay affects it. Stability properties of feasible equilibriums were established by analyzing characteristic equations in the presence and absence of time delay. Furthermore, non-negativity and the boundedness of solutions of the model were also established. It is demonstrated that the infection-free equilibrium is locally asymptotically stable if the basic reproduction number is less than unity. Besides, it is proven that chronic infection equilibrium is locally asymptotically stable if the basic reproduction number is greater than unity. Moreover, numerical simulations were carried out in order to perform the validity of theoretical results obtained utilizing MATLAB, which indicate that intracellular time delay has a significant impact on disease eradication and that the basic reproduction number is solely responsible for the model's dynamics because the basic reproduction number totally depends on the delay term of the delay differential equations.

Key words: Absorption effect; Apoptosis; HIV infection; Mathematical modeling; Time delay

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Time series modelling and forecasting of electricity generation and consumption in Sri Lanka

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Electricity is the most versatile energy carrier in modern economics. There is a growing tendency in the demand for electricity over the past two decades in Sri Lanka. Ceylon Electricity Board is the only major utility in Sri Lanka where electricity is generated for the whole nation. None of the literatures have used the Auto-Regressive Integrated Moving Average (ARIMA) approach to model the electricity generation and consumption of Sri Lanka. This motivated us to study the monthly electricity generation and consumption of Sri Lanka using ARIMA approach. In this study, monthly data on electricity generation and consumption (Giga Watt hour) in Sri Lanka was obtained from the Data Library of Central bank Sri Lanka, during the period of 2000-2019, where the demand for electricity was dramatically increased in Sri Lanka. The Objectives of the study were to fit a suitable ARIMA model for monthly electricity generation and consumption in Sri Lanka and forecast the electricity demand in Sri Lanka for the near future. Further, three statistical criteria Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Mean Squared Error (MSE)) were considered in order to select the best fitting ARIMA model. Results revealed that $ARIMA(1,0,1) \times (2,1,1)_{12}$, and $ARIMA(1,1,1) \times (2,0,0)_{12}$ are the best fitting models for the monthly electricity generation and consumption respectively. Further, these chosen ARIMA models can be used to forecast the electricity generation and consumption in Sri Lanka in the near future.

Keywords: Auto Regressive Integrated Moving Average, Electricity consumption, MSE, Time series approach.

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Comparison of machine learning techniques used in type II diabetes risk prediction

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Native Americans living in Arizona called PIMA have several medical problems such as diabetes. Diabetes prediction of females in this population has been done using various machine learning techniques. The objective of this study is to compare eight supervised machine learning models to identify the best algorithm with a low bias-variance trade-off for the diagnosis of type II diabetes among female PIMA population. Eight prediction models namely logistic regression, decision tree, random forest, naïve bayes, k-nearest neighbor, support vector machine, gradient boosting, and artificial neural network (ANN) were developed for type II diabetes using the data published by the National Institute of Diabetes, Digestive and Kidney Diseases in the USA (PIMA Indian Diabetes Dataset). Among the 768 patient records, 430 (50% with diabetes and 50% without diabetes) were used to train the models to reduce data biasness, and the remaining 338 records were used for testing. The performance of each model was evaluated and compared using testing accuracy, mean squared error (MSE), sensitivity, precision, and F1-score. The results showed that the random forest model has the highest testing accuracy of 83.12% and the lowest MSE. This result shows that most significant predictor variables are number of pregnancies, insulin level, BMI level, and age. The ANN model achieved the highest MSE, due to the limited number of training data. Therefore, the random forest model with number of 50 subtrees is the most accurate machine learning model that can be used to diagnose type II diabetes in the PIMA Indian Diabetes Dataset.

Keywords: Machine Learning, Testing Accuracy, Types II Diabetes Prediction, PIMA Indian

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Identify the necessity of conducting a PCR test for COVID-19 by Random Forest Model

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The World Health Organization (WHO) declared the Coronavirus disease (COVID-19) as a pandemic in 2020, and it is still being dominated over the world. On that account, people tend to give their attention to the prevention and control of COVID-19. Although the Polymerase Chain Reaction (PCR) test was utilized to diagnose the virus in a person, it was a very difficult task for developing countries due to the cost. The purpose of this study was to create a model to identify the necessity of conducting PCR tests by using a Random Forest classifier in the Scikit-learn package. The data was collected from an online questionnaire survey provided to the university students who were living all over the country, in the Faculty of Science, University of Ruhuna, Sri Lanka during the period March-April 2021. Random Forest classifier of Scikit-learn in Python was used to construct the model using input factors—fever, sore throat, fatigue, first contact, loss of taste, headache, dry cough, and quarantine. The random trees were constructed using 100 bootstrap samples retrieved from data set of 70% of 81 complete responses. The accuracy of the developed random forest model was measured by the rest of the responses in the survey. As a result, the accuracy of the model which was 68.4% implies that the developed model can be used to identify the necessity of conducting PCR tests for any person using the relevant input factors. It will help to save the money of the country. In future, the developed model will be compared with other machine learning techniques to understand the precision of the current technique over others.

Keywords: COVID-19, PCR test, Random Forest

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A discrete dynamical model for gambler's ruin

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Gambler's ruin is a concept in Statistics. That is, regardless of their betting strategy, a gambler playing a game with negative anticipated value will eventually go bankrupt. A typical roulette wheel in the U.S. contains a loose ball and 38 slots: 18 for red numbers, 18 for black numbers, and 2 for green numbers. Assume we bet \$1 that a red number would appear on the next spin of the wheel. This indicates that if red appears, we earn \$1; if black or green appears, we lose \$1. In view of those investigations, we propose a dynamical system model which gives an idea of probability on eventual win or loss. In this task we developed a tree diagram to model this situation and obtained a second order dynamical system in the standard format. We considered the case in which we arrive at the casino with \$n and continue betting \$1 on red until we get a total of \$0 or \$m, $m > n$. A simple roulette scenario was studied and calculated $P_L(n)$ which is the probability of leaving the casino with no money. To find $P_L(n)$ we need $P_L(1)$ and made trial-and-error guesses for the correct value of $P_L(1)$. This study on a simpler roulette scenario is useful to study any kind of roulette. Dynamical system gives us an idea of probability of eventual win from which one can check whether it is possible to go home in a happy mode!

Keywords: Gambling, Roulette, probability, casino

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Qualitative behavior of HIV-1 delayed model with apoptosis and cure rate

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This study investigated the effects of apoptosis and cure rate delay on the qualitative behavior of a nonlinear functional response human immunodeficiency virus infection model. A novel feature is that both Apoptosis and Cure Rate are incorporated into the model. The basic reproduction number R_0 is used to make conclusions based on the model outcomes. We established that the infection free equilibrium and the chronic infection equilibrium are locally asymptotically stable if $R_0 < 1$ and $R_0 > 1$, respectively. This was done by using the characteristic equation of the model and Ruth Hurwitz criterion. We conclude by providing numerical simulations that demonstrate our findings.

Keywords: Basic reproduction number, HIV -1 infection, Cure Rate, Local stability, Mathematical delay.

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Predicting yellowfin tuna stock in offshore fisheries in Sri Lanka using sea surface temperature, sea surface salinity, and chlorophyll distribution

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Fisheries sector plays important role in addressing the national, regional, and global need for food security of human, and the sector supports nearly one million fishers, workers, and their family members in Sri Lanka. Yellowfin tuna is an important contributor to export revenue of Sri Lanka. The highly migratory and widely dispersed yellowfin tuna landings are influenced by seasonal and geographic fluctuations. Abrupt changes in climatic conditions disrupt the estimation of stocks. Thus, predicting spatial distribution of the species is important in reducing the fishing cost. The Sea Surface Temperature (SST), Sea Surface Salinity (SSS), and Sea Surface Chlorophyll (CHL), obtained from remote sensing satellites were used in predicting yellowfin tuna caught by longline vessels in the Indian Ocean near Sri Lanka. In this context, SST, SSS, CHL, and CPUE (Catch per unit effort), computed as the number of fish caught per hook per trip collected from the logbooks of the Department of Fisheries, Sri Lanka, were evaluated. The relationship between sea surface temperature, sea surface salinity, sea surface chlorophyll, and CPUE has been determined using the Generalized Additive Model (GAM). The present findings on the CPUE data throughout 2019 indicate that SST (28⁰C - 28.5⁰C), SSS (33.5ppt - 34 ppt), and CHL (0.15mg/dm⁻³ – 0.17mg/dm⁻³) have the optimum CPUE values. Results showed a good match between predicted and actual catch. The present study affirms that developed model could estimate yellowfin tuna stock at given SST, SSS, and CHL data.

Keywords: CPUE, GAM, Salinity, Temperature, Yellowfin tuna

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Modeling quality of life of final year students in university of ruhuna using multivariate statistical techniques

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Quality of Life (QoL) is defined by the World Health Organization (WHO) as a person's perception of their condition in life in relation to the way of life and value systems in which they live, as well as their goals, wants, standards, and worries. University students are a distinct demographic in that their issues, burdens, and concerns differ from those of other groups of people. They are subjected to a variety of stress, including academic pressure, social challenges, and financial difficulties, etc. This study tries to analyze factors affecting university students' QoL in terms of satisfaction with academic aspects, social aspects, and facilities. Data were obtained from the self-administrative questionnaire that was distributed randomly to 200 final year students from four faculties within the University of Ruhuna. The four faculties are chosen using simple random sampling technique. They are Faculty of Science, Medicine, Fisheries and Marine Sciences and Technology, and the Faculty of Humanities and Social Sciences. This study employed a stratified sampling technique to choose respondents from faculties. Data were analyzed using R statistical package for preliminary analysis, factor analysis, and Structural Equation Modeling. It was found that 62 % of the respondents are female and 38% male. According to this study, University of Ruhuna students' quality of life is highly impacted by their satisfaction with the level of facility satisfaction and academic, and social aspects respectively.

Keywords: Factor analysis, Quality of life, Structural equation model, University students

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Effective gas gain and uniformity measurement test for Triple-GEM detectors for the GE1/1 muon upgrade of the CMS experiment at CERN

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The Gas Electron Multiplier (GEM), an ionizing radiation detector, contains chemically pierced thin copper-coated polyimide layers sandwiched between a drift cathode and a charge collective readout anode immersed in a closed gas mixture. An optimized electric potential is applied between the electrodes to achieve amplified signals in the readout when ionized electrons are released from the drift. This technology is utilized in the muon system upgrade of the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) to achieve high performance, precision tracking, fast triggering, and the missing redundancy in the high- η region. Altogether, there are 144 triple-GEM chambers installed in both endcaps of the CMS experiment during the second long shutdown (LS2) of the LHC. To validate the chambers for the proposed upgrade, detectors are undergoing several levels of pre- and post-assembly quality control (QC) tests. The effective gas gain measurement test (QC5) is crucial in indicating the chamber's overall uniformity of gas gain. By irradiating the gas-filled GEM chamber using X-rays, secondary electrons are generated, which are then collected as an electronic signal on the readout board. All tested chambers clearly manifest gain variations of less than 30% which is well below the threshold of 37%. Consequently, all the detectors passed the QC5 phase. Depending on the QC5 test results, two chambers with nearly equal gas gain and high uniformity in all sectors are coupled to form a "Superchamber" and are grouped for high-voltage power supply.

Keywords: Gas Electron Multiplier; Muon System; CMS Upgrade; Gas Gain Uniformity

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Measurement and reduction of noise of the front-end electronics of GE1/1 chambers for the CMS muon upgrade during mass production

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Gas Electron Multiplier (GEM) based chambers are used in the most forward and inner most layers of the Compact Muon Solenoid (CMS) detector to enhance the trigger performance during the High Luminosity phase of the Large Hadron Collider (HL-LHC). This phase of the experiment will be used to collect data for the physics program beyond the discovery of the Higgs Boson. The new GEM system has been designed to improve the triggering and tracking capability of CMS in this particularly harsh region during HL-LHC. To reach those objectives, each detector must be operated at acceptable electronics thresholds to ensure high detection efficiency of minimum ionizing particles (MIPs) ($> 97\%$), while limiting the noise to maintain the Level-1 muon trigger rate at acceptable levels. This work aimed to study the noise at different stages of the final assembly of the chambers and to come up with a proper grounding scheme to keep the noise rates at a minimum level. The noise rates were measured against the threshold in each of the readout sectors using an Application Specific Integrated Circuit (ASIC). The measurement was repeated after the introduction of additional components, or whenever a variation was done on the grounding scheme with the intention of bringing down the already observed noise levels. The developed methods and techniques through this study, allowed the chambers with the final grounding scheme to be operated at thresholds of a maximum of $8fC$, which is favorable for data collection at CMS.

Keywords: CMS, GEM, Noise, Electronics

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A preliminary study on sound transmission characteristics of wood chips in the application of noise insulation

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Organic material in sound insulation offers additional environmental and human health benefits. This study deals with an experimental investigation of the Sound Transmission Coefficient (STC) of loosely packed wood chips for introduction as sound insulation applications. STC is calculated by measuring the Transmission Loss (TL) through wood chips between the walls of the cubical-shaped box. The material is packed securely between the walls of 5 cm thickness of a meshed cube of outer measurements 60×60×60 cm³. The sound source is placed at the center of the cube. Packing uniformity is ensured by stuffing the material evenly in known mass in a unit volume. The sound source consists of a B&K type 4292, Omni directional speaker and a type 2734 amplifier. B&K type 2250 class 1 handheld Sound Level meter is used for Sound Pressure Level measurements. SPL, inside and outside the cube, was measured for four sides, and the average value was taken. Measurements were taken in a reverberation room with 25 Hz ambient noise or less. Pink noise (12.5 Hz –20,000 Hz) in one-third of octave bands is used for the study. TL and STC were calculated, and variations were analyzed for different sound frequencies. The results imply the TL of the material is significantly dependent on the sound frequency. Sounds of frequencies less than 400 Hz are transmitted with minimum attenuation, while higher-frequency sounds significantly attenuate. These loosely packed wood chips efficiently weaken the susceptible sound frequencies (2 to 4 kHz) to the human ear. The average sound absorption coefficient in commercially available solid wood panels is much less, with a higher reflection. Because of their flexibility, the loosely packed sound insulation panels are not very attractive in the construction industry. However, loosely packed, durable organic materials could be used in the acoustic insulation industry in an creative manner, providing an esthetic appearance to the room while maintaining good health.

Keywords: Sound insulation, Wood chips, Transmission loss, Sound transmission coefficient

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Efficient distortion removal in electrocardiograms by multichannel filter banks

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Electrocardiograms (ECG) are extensively used to monitor the electrical activities of the heart. It is a valuable tool, especially for the initial medical diagnosis of different heart diseases. However, because of the weak nature of signals, ECGs easily get adulterated with distortions such as noise and baseline fluctuations. Although Savitzky-Golay (SG) filters are often used to remove such distortions from ECGs, they have limited distortion filtering efficiencies. This is because in SG filters a polynomial curve fitting process is employed, and it is not possible to directly specify the distortion removal frequency bands. In contrast to SG filters, Multichannel Filter Banks (MFB) realized by stable digital impulse responses would have higher distortion filtering efficiencies due to the ability to remove only the undesirable distortions based on the frequency sub-band characteristics, while preserving the valuable features of the ECG signals. Thus, to remove the distortions in ECGs more efficiently, in this paper we have proposed and developed a new band-pass MFB filter, using a two-band filter bank as the building block. Using experimental techniques, the ECG signal distortion removal efficiencies for the proposed MFB and SG filters were estimated and compared by evaluating the output Signal to Noise Ratios (SNR) for different input signal SNR levels. Adulterated ECGs were cleaned using the MFB and SG filters. While having the ability to simultaneously remove different kinds of ECG signal distortions, significantly improved distortion removal efficiencies indicated by an average SNR increase of 3.2 dB in the filtered ECG signals were observed by the proposed MFB filter when compared with the SG filter.

Keywords: Electrocardiograms, Distortion, Multichannel Filter Banks

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A study of pendulum bob oscillations of an undamped simple pendulum with large-angle motion

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An undamped simple pendulum motion was studied for large-angle oscillations. The motion was captured using video-capturing techniques, and the trajectory of the pendulum bob was also determined. Using Tracker and Kinovea Video Analysis software, the experimental time periods of oscillations of a simple pendulum with various angular displacements were determined. The analytic approximation formula for the solution to the differential equation representing the oscillations of a simple pendulum at large angles, which was previously reported, was used in this study to obtain analytical solutions. A comparison between theoretical and experimental values was carried out. The first three terms of the approximation formula for the time period were used to determine theoretical values. The findings show that both measures are statistically related, but this relationship is far from ideal in theory. This study also shows that this approach is feasible and interactive for analyzing the motion of a simple pendulum.

Keywords: Simple pendulum, Time period, Large angle oscillations

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A preliminary study of an electronic model to analyze the current-voltage characteristics of semiconductor nanowires

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The current-voltage (I–V) characteristics of single nanowire (NW) Field Effect Transistors are found to be depended on the device geometry and contact resistances. The proposed electronic model for the metal-semiconductor-metal structure of the device, which has two back-to-back Schottky diodes connected in series with the NW resistor, is shown to be able to extract Schottky barrier heights, mobility, conductivity and carrier density using only a few fitting variables. The thermionic emission and thermionic field emission theories were used to model the current transport through the metal-semiconductor junctions. The model was applied to fit a couple of experimental I–V curves of Zincblende n-type InP NWs using Mathematica. These InP NWs were ~100 nm in diameter and ~8 μm in length. The source and drain electrodes of the fabricated device were defined by photolithography followed by metal evaporation of Ti/Al. The normality of the data was verified graphically and analytically using standard tests. The model fitting was validated by graphical residual analysis and chi square test. The extracted average carrier density and mobility of these NWs were $\sim 2.00 \times 10^{16} \text{ cm}^{-3}$ and $\sim 8471 \text{ cm}^2/(\text{Vs})$ respectively. They are in good agreement with the mobilities of doped III-V semiconductor NWs with similar carrier densities. It is observed that the extracted barrier heights of the NW devices are (0.07 – 0.25) eV in range which are in good agreement with their I-V curves. The conductivity estimated for these NWs was $\sim 2.70 \times 10^3 \text{ Sm}^{-1}$ and it agrees with the conductivities of semiconductor NWs.

Keywords: MSM Modelling, Nanowires, Semiconductor

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Investigation of charging and discharging characteristics of lead-acid batteries

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Rechargeable batteries are often used in off-grid power systems to enhance uninterrupted power requirements. They have become popular in Sri Lankan households in the recent past due to continuous power failures and many people tried to move to off-grid solar power systems via rechargeable batteries instead of popular on-grid solar power systems. Various batteries exhibit different voltage and current characteristics during charging and discharging. Secondary batteries can be charged using various battery charging techniques depending on the application. Furthermore, charging characteristics of a battery significantly enhances the performance as well as the durability. A rechargeable battery has specific conditions for charging. When the charging voltage and current are not in the recommended range, the battery performance may be reduced, and sometimes the battery may be seriously damaged. Due to the lack of centralized power networks, some on-grid energy sources have been replaced with lead-acid batteries. The main objective of the proposed study is to investigate the charging and discharging characteristics of lead-acid batteries, experimentally as well as analytically using different charging techniques. Three types of fundamental charging methods; (i) constant voltage method, (ii) constant current method, and (iii) constant current/voltage method, were carried out and analyzed in this study. Based on experimental and analytical results, the constant current/voltage method is found to be more appropriate for the battery charging process because it charges a battery quickly while maintaining its health.

Keywords: Charging and discharging, Lead-Acid, Rechargeable Characteristics

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Development of a portable and low-cost haptic communication device for visually impaired people

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Despite communication advances, visually impaired people have limited access to these technologies. The objective of this research is to develop a wearable, cost-effective, and user-friendly haptic communication device for visually impaired people. Through Wi-Fi, a smartphone and a haptic communication device are connected. The haptic device receives text messages from the smartphone and turns the English text into braille. This system includes vibration motors that vibrate in a predetermined pattern. By using the vibration motors, they can easily read the message by sensing the vibration. Those who have knowledge of English Braille can use it after a simple training session. Also, blind people can type and send text messages on a smart device using a special Braille keypad. This device has been tested on 10 people. Each participant was presented with 10 random words on two occasions, with a time delay of 500 ms and 1000 ms between two letters. According to the test results, the average success rate for character recognition is 82%. Further, the ideal time delay between two words was identified as 1000 ms. The Braille Oriented Message System (B-Chat) is a device similar to a haptic communication device. Compared to B-Chat, the haptic communication device is portable and offers the ability to exchange messages with ordinary people. This can be offered in the market for less than 10,000 rupees. This haptic communication device for visually impaired people has been designed and developed, and its use enables text message conversations.

Keywords: Haptic communication, Braille language, Vibration motors, Wi-Fi module

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Correlation analysis and gradient boosting for music genre prediction

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Music has been influenced by technology; hence data is the fundamental building block. Through the concepts of Music Information Retrieval (MIR), data immersed in music can be retrieved and effectively used for data mining and machine learning aspects. This study aimed to utilize correlation and gradient boosting technique to increase the accuracy of the music genre prediction. MIR techniques were used to retrieve data from 200 music tracks and conducted preprocessing followed by a correlation analysis. With correlation analysis, the most correlated set of music features were identified to be roll off, beats, zero crossing rate, spectral centroid, tempo, spectral bandwidth and Mel-frequency cepstral coefficients (mfcc2). Then experiment was designed to measure the accuracy in using correlation and gradient boosting technique. Hence, as the first experiment a Random Forest Classifier (RFC) and XGBoost Classifier (XGBC) were developed to predict the genres using all the extracted feature set as the output. Here f-score of 60.5% and 63% were yielded respectively for RFC and XGBC. Then, for the second experiment, with the use of identified set of correlated features a RFC and an XGBC were developed with as accuracy of 93.5% and 100% respectively. In both the experiments, models were trained to classify 10 music genres and 80:20 training to testing data split was used. Considering above results, it can be concluded that utilization of gradient boosting technique with correlation analysis has increased the accuracy level in music genre prediction using music data.

Keywords: Correlation Analysis, Gradient Boosting, Music Genre, Random Forest Classifier, XGBoost Classifier

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Liver disease detection using CT images and R2U-NET algorithm

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The Computed Tomography (CT) scan pictures are one of the most helpful tools for diagnosing unusual regions in the liver. These pictures can be used to identify abnormal areas of the liver and width of these areas in numerous clinical applications. Manual and customary clinical testing needs a lot of experienced pathologists and tedious interaction. Computer helps in distinguishing pieces of proof which will further create and develop clinical testing proficiency by identifying low accuracy and deficient determination calculations. This paper proposes a Recurrent Residual U-Net (R2U-Net) algorithm to classify the segmented liver. The experiments were led in CT liver pictures that are available in clinic's picture chronicling and kaggle datasets. Experiments have been carried out with a dataset of 400 liver CT pictures. This dataset contains 200 liver CT pictures of patients with healthy liver and 200 liver CT pictures showing unhealthy liver. Finally, the proposed method accomplished average accuracy, precision, sensitivity, specificity, and F1-score values of 85.83%, 86.46%, 81.66%, 88.67%, and 95.23%, respectively.

Keywords: Deep learning, liver detection, R2U-Net, morphology, Kaggle.

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Automatic extraction and recognition of Sinhala text from images with complex backgrounds

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Sinhala is a unique and national language spoken only in Sri Lanka. Sinhala characters are difficult to recognize in images with complex backgrounds, and some visually impaired people cannot read/write properly due to their eye problems. This study is mainly focused on extracting and recognizing Sinhala text from images with complex backgrounds using a Convolutional neural network. Different 33 Sinhala characters (10 images per each character) are used as a training dataset. 400 images of bus destination name boards with Sinhala characters are collected as a testing dataset. The character recognition model is trained using CNN with the collected training dataset. The model is trained 10 times until an accuracy of 81% is achieved. The collected dataset of bus destination name board images is used to extract and recognize Sinhala characters and pre-processing is performed on them to check the availability of text in the images. After the recognition process, the non-text regions are removed. Three types of segmentation such as line, word, and character are performed on preprocessed images to segment each character on the image. The segmented characters are used as input for the recognition model, and it is successfully identified as Sinhala characters. Furthermore, there are numerous types of Sinhala optical character recognition and Sinhala handwritten character recognition research, however, there is no research on recognizing Sinhala text on images with complex backgrounds. Moreover, people with eye problems/issues can easily read Sinhala characters in images with a complex background as an important benefit of this proposed methodology.

Keywords: Convolutional Neural Network, Sinhala text, Text Extraction, Text recognition, Complex background

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Automated Lip-Reading Recognition Using EfficientNet Architectures

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Lip-reading recognition focuses on recognizing words spoken by a talking face by only utilizing a video without audio. Lip-reading recognition can help people with difficulties such as communication difficulties caused by removing the larynx in the total laryngectomy. It is hard to recognize the lip reads manually from humans. Therefore, it is necessary to build lip-reading recognition models with good accuracy and efficiency that results in the development of good practical applications. Lip-reading recognition involves preprocessing steps such as face recognition, facial landmark detection and image preprocessing, followed by mouth Region of Interest (ROI) extraction. Currently, these preprocessing techniques are much improved in efficiency and accuracy. Therefore, most recent works are focused on improving the performance by developing the optimal architecture. In this paper, we propose new lip-reading recognition model using Temporal Convolutional Networks (TCN) for classification and utilizing different EfficientNet architectures for feature extraction. First, we developed our base model for lip-reading recognition with EfficientNet-B0 and TCN. Secondly, we obtained the performance of the developed lip-reading recognition models by replacing EfficientNet-B0 with the scaled versions of the family of EfficientNets, EfficientNet-B1 to B6. All the models were trained for 80 epochs and Adam optimizer was used with a batch size of 32. We compared the performance of models when using different variants of EfficientNets. The results demonstrate that lip-reading recognition can be improved when TCN is combined with EfficientNet-B1, B2 and B3 architectures where the accuracies are 83.8%, 81.8%, and 84.32%, respectively.

Keywords: Temporal Convolutional Networks (TCN), Neural Networks, Deep Learning, Visual Speech recognition

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Public opinion on political changes during Covid-19: A comparison of machine learning algorithms using Twitter messages

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Covid-19 has caused havoc in people's lives in all nations and communities and had a detrimental effect on the expansion of the world economy. Due to the pandemic, political factors are also changed and it was urgent to examine public opinion on political changes during Covid-19. Those opinions will help to stabilize the countries in the future during these kind of pandemic situations. The posts and comments on Twitter related to political opinions had posted frequently. The study used Twitter to examine user opinions regarding the political changes that occurred during the pandemic period. A sample of 10658 English tweets from the whole world was used during the period of Covid-19 from 2020 to 2022 and these tweets were gathered using the Twitter API. After the tweets had been pre-processed, the feature vectors were produced using the Term Frequency-Inverse Document Frequency (TF-IDF). To build a forecast paradigm for sentiment analysis, the dataset was then put into machine learning and deep learning algorithms such as Support Vector Machine (SVM), Multilayer Perceptron (MLP), and Long Short-Term Memory (LSTM). The results indicate, MLP performed better than SVM and LSTM and had greater accuracy with 95.32% and also better recall, precision, f-measure values, and lower error values. A training dataset of 77% was used for the experiments. These algorithms classify tweets into four categories such as positive, negative, neutral, and suggestions to the government. Based on the results, we can estimate human opinions about political changes and can address pertinent concerns as soon as possible.

Keywords: Covid-19, Machine learning, Political changes, Sentiment analysis, Twitter

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Simulation of automated traffic light system for cross junctions of six-lane roads using Fuzzy logic

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The number of vehicles today has increased dramatically, which causes traffic jams, accidents and other important problems such as increased fuel consumption, vehicle emissions and noises. The proposed system monitors the factors of traffic in a particular junction and makes decisions according to the current situation using Fuzzy logic. Here, priority values are calculated using a Mamdani type fuzzy module using linguistic variables such as zero, small, Medium, large and very large. The Next State Module (NSM), Extending Current State Module (ECSM) and the Decision-Making Module (DMM) are proposed in this design of the fuzzy traffic lights controller. NSM reads the input queue, output queue, and waiting time in order to provide the most suitable values for the next state of traffic lights configuration and the priority level to DMM. The ECSM reads input and output queues and provides the value of priority level for the extension of the current state to the next time lap to DMM. Finally, the DMM decides the most priority from the outputs of NSM and ECSM. This simulation of automated traffic light system was designed by MATLAB fuzzy toolbox for six-lanes roads in a cross junction. Here six different states are considered to enable green lights for straight through and right turn lanes while keeping all left turn lanes in green signal. This model chooses the best time lap to open the lanes which is effective than other methods.

Keywords: Fuzzy logic, Intelligent Transportation Systems, Traffic lights controller

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A Comparative study of predicting the award-winning books using machine learning algorithms

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Most people around the world are very fond of reading books offline and online. Different people have different preferences when it comes to choosing books and it has become important to find better books for readers. The awards are one of the main criteria to select the best books. There are no existing studies relevant to the same idea. Therefore, the purpose of this study is to predict the best books such as award(s) winning books based on different ten attributes such as author, average ratings, date, genre, language, pages, publisher, ratings, reviews, and title. For this, a data set has been obtained through online community platform called Kaggle. The dataset contains information about books obtained from the 'Goodread' website. Those books are related to the period between years 2000 and 2021. The dataset is pre-processed by removing duplicate data, removing unnecessary special characters and removing missing values etc. The Waikato Environment for Knowledge Analysis (WEKA) data mining tool is used to rank the preprocessed data, and hyper-parameter tuning was applied to enhance the outcomes. Six machine learning methods at the classification level including Random Forest, Support Vector Machine, Decision Trees, Multilayer Perceptron, Logistic Regression, and Naive Bayes have been used to generate prediction models. Using a Naive Bayes algorithm, we achieved 86.32% higher accuracy with higher precision, recall, and f-measure values, as well as the lowest error rates. The proposed method can predict the best books for readers using the above attributes by the Naive Bayes algorithm successfully.

Keywords: Award, Books, Classification, Machine Learning, Prediction

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Prediction model for assessing the Sri Lankan employees' perception on remote working in post-covid-19 pandemic

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It is important to protect all employees from contacting COVID-19 since they want to continue their careers. Therefore, the remote working process has been sped up for continuing the work without any interruptions during this Covid-19 pandemic. Many organizations have been persuaded by the pandemic that remote work has benefits for a successful organization. The objective of the study is to identify the employees' ideas and assess their sense for continuing the remote working concept in the post-COVID-19 pandemic. The study used a random sample of 325 workers in private and public sectors who did remote work during the pandemic and collected data via questionnaires through Google form. Information gain ranking was applied to the ranking of attributes and removed unnecessary data. After the pre-processing, the prediction models were generated using the WEKA tool, and 66% of the percentage split used with six different classification algorithms such as Support Vector Machine, Naive Bayes, Logistic Regression, Decision Tree, Multi-Layer Perceptron, and Random Forest and ensemble learning algorithm that combined above six algorithms using an average of probabilities through vote algorithm. Based on the evaluation results of accuracy, recall, precision, f-measure, and error values, the ensemble learning algorithm outperforms the other six algorithms by 90%. According to the data set, the majority of employees prefer the remote working concept. Using this prediction model, we can also assess the employee's sense and compatibility for the remote working concept. In the future, we plan to expand the data set and conduct more evaluations using deep learning.

Keywords: COVID-19 pandemic, Machine learning, Prediction, Remote working

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Profanity word detection for Sinhala language using deep learning

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In the present world, content censorship is an important concept. When it comes to the Sinhala language, several studies have been conducted on text-based content censorship methods, but not for audio content. The Sri Lankan government prohibits the use of profanity in public media. Therefore, Sri Lankan media companies must check their videos for profanity before telecasting. Till now, this process has been done manually, and it is extremely difficult with long videos and audio clips. This study suggests developing a deep learning model that can automatically find profanity words in Sinhala audio files. The ten profanity words were selected and audio samples from 100 people were gathered. The data was preprocessed, transformed into spectrogram images, and applied to a convolutional neural network (CNN) to develop the profanity filter model. By converting audio files to spectrograms and applying image processing to extract the features from the dataset, the model predicts the profanity words. This paper addresses the procedure of the mentioned process and its capabilities with upcoming updated versions of the final product.

Keywords: profanity detection, Sinhala language, deep learning, audio processing.

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Automated prediction of computer specification for university students

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Undergraduates need a laptop computer for their academic program. Most of the students tend to buy a laptop/computer for their higher studies as it becomes an essential device for the education. However, when buying these devices, they do not have a good knowledge of its specifications and then the students have to upgrade the devices in the middle of their academic programs as these devices do not fit with their needs. The present study attempts to investigate the specification of a computer for students who await university entrance according to their department. It is expected that this will help the student to buy a computer which can be used throughout their university life. This is because, the specifications and performances of laptops/computers change according to the academic stream the students get selected. The most suitable model for this research is random forest classifier as it shows the highest accuracy level (84%) among other supervised learning techniques and a dataset with more than 800 samples was separated into two-parts called test set and training set. 20% of data was taken as test data set and other data was considered as the training set because then performance of the model can be enhanced. This research is to predict the specification of a computer for university selected students according to their degree in technology stream.

Keywords: Machine Learning

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Assessment of ICT competence for Effective Learning Process of Undergraduates at Gampaha Wickramarachchi University of Indigenous Medicine Sri Lanka

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The broad purpose of this study is to assess information and communication technology skills relevant to effective learning possessed by undergraduate students. The study made use of a descriptive survey research design. We used a cluster sampling method. Sample size included 117 undergraduates from the department of technology, Gampaha Wickramarachchi Indigenous Medicine, Sri Lanka. A questionnaire was used for data collection. The reliability of the questions was determined using Cronbach-Alpha method and a reliability coefficient of 0.927 was obtained which indicates a high consistency among the set of questions. 10 research questions groups with subcategories and two hypotheses guided the study. The mean and standard deviation were used to answer the research questions by assigning numbers for each category while the hypotheses were tested using t-test and ANOVA at 0.05 level of significance. The findings revealed that gender and A/L Stream of undergraduate's effect for ICT skill knowledge, while district does not affect ICT skill knowledge of undergraduate students. It was recommended that students need to be encouraged to continue to improve their ICT skills as it will enable them to strive well academically. Further, authorities should ensure adequate and ICT facilities are put in place within the university environment. The literature showed the influence of different variables on ICT skill knowledge of students in different contexts. However, there was little evidence concerning the influence of variables on ICT skill level specially for undergraduates in Sri Lanka. Thus, it is worthwhile to understand the variables that affect the ICT skill level of undergraduates.

Keywords: Information & Communication Technology, ICT skills, undergraduate

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Identifying factors affecting the ICT literacy of the school teachers: A case study of Nuwaragampalatha East educational division

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The rapid development of Information, Communication and Technologies (ICT) has initiated an unparalleled transformation in schools all over the world. The general purpose of the study is to determine the influence of factors on the Information and Communication Technology (ICT) literacy of teachers in schools in the Nuwaragampalatha East educational division of Sri Lanka. The study covers the entire population of 70 teachers in the Nuwaragampalatha East educational division of Sri Lanka. 57 copies of the questionnaire were completed and returned for analysis representing 81.43%. The purpose of the questionnaire was to assess each teacher's level of self-knowledge regarding the apps they use, with one denoting a lack of knowledge and five denoting a high level of expertise. In this study, the tools that teachers use to take advantage of teaching and learning methodologies such as Microsoft Office, Google Applications, Educational Tools, Operating Systems, Social Media, and Multimedia Editors have been taken into consideration. The t-test and the One-Way Analysis of Variance were used to analyze the data in this study. The age category (p-value=0.363), teaching experience (p-value=0.862), and subject category (p-value=0.546) do not affect the ICT literacy of the teachers. However, the male teachers (mean=2.0125, SE=0.0689) have significantly higher ICT literacy level than the female (mean=1.7323, SE=0.0868) teachers (p-value=0.014, t-test). In conclusion, gender, but not age, subject area, or experience, has an impact on school teachers' ICT literacy. The study may also help the strategic level decision makers to plan teacher education programs effectively.

Keywords: ICT Literacy, School Teachers, Education

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Classification of Sri Lankan Coconut Types Using CNN

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This research develops an efficient and accurate methodology for classifying the types of coconut in Sri Lanka. At present, coconut-type identification can only be done by the best professionals and those who are well-trained in the particular section. Normal people find it difficult to identify the coconut type accurately before farming. So, as proposed in this research, a simple application is developed to identify the type of a coconut. CNNs have an effective architecture compared to other Deep Learning algorithms since they can detect patterns with high accuracy. Therefore, in this study, a CNN architecture has been used to identify the shape as a pattern along with its color. Also, the convolutional layer reduces the high dimensionality of coconut images without losing its information. CNN automatically recognizes significant features of coconut images. The coconut images are grouped into five according to their type, “Typica”, “Navasi”, “Bodiri”, “Eburnea”, and “Regia”. Here 80% of the images are used for training while 20% of the images are used for validation. Each group has 1000 images in the dataset. In building the CNN sequential model, the layers transform one activation to another through a differentiable function. Here, three main layers are used to build CNN architecture: the convolution layer, the non-linearity layer, and the pooling layer. This proposed research announces that the CNN algorithm reached 85% accuracy perfectly. The future work of this research is to implement this methodology to develop a mobile application to scan and identify all types of coconuts in Sri Lanka.

Key words: Convolutional Neural Network, Coconut, Segmentation

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Protein structure predictions for coronavirus non-structural protein 1 (nsp1)

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The recently discovered SARS-CoV2 virus provoked a severe coronavirus pandemic (COVID-19). Understanding the structure and function of viral proteins is essential for comprehending viral infection and pathogenesis and developing treatment and prevention techniques. The coronavirus non-structural protein 1 (nsp1) is a crucial feature with a wide range of involvement in virus-host interactions and various sequence, structure, and functional mode characteristics. This research aims to reveal the structural conformational changes of nsp1 to aid in prediction by developing a homology model utilising SWISS-Model and I-Tasser and evaluating the best model. PROCHECK, PROSA, Errat, and Verify3D investigated and validated all predicted models corresponding to the nsp1 homologs of SARS-CoV1, SARS-CoV2, and MERS-CoV. SWISS-Model homology modeling for SARS-CoV2 resulted in 94.6% of builds being in the most favorable region, 5.7% in the authorised region, 0% in the liberally permitted zone, and 0% in the denied region. The i-Tasser model had a significantly lower percentage of builds in the most favourable region (61.1%), higher percentages in the authorised region (28.9%), a relatively higher percentage in the liberally permitted zone (6.0%), and a relatively higher percentage in the denied region (4.0%). It was observed that SARS-CoV1 nsp1 and MERS-CoV nsp1 in SWISS-Model showed higher PROCHECK values than I-Tasser. The PROCHECK, ProSA Z-score, Errat, and Verify3D results demonstrated that the SWISS-Model is reliable and solid enough to be utilised in future research.

Keywords: Protein modeling, Bioinformatics, Structure and function analysis, Immunoinformatic, COVID-19.

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CNN-LSTM based approach to predict the Sinhala alphabet letters based on the lip-movement of mute students

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School-age children with speech disorders have difficulties in communicating with others. They use sign language for communication purposes, but it takes time to understand, learn and provide the appropriate response. As a solution, teachers are using sign language along with lip reading to make interaction with speech-impaired students. The discussions with teachers revealed that it was very challenging and a tedious task to understand lip reading accurately. This research is carried out to understand and develop a solution to overcome a part of this communication challenge. During this study, a framework was developed by the researchers to assist the speech-impaired students using the lip-reading. It uses 60 Sinhala alphabet letters, for each letter 50 pronouncing lip-reading videos of speech-impaired students as input. The input video is then sent to a well-trained Sinhala alphabet recognition video classification model which use motions of lips, nose, chin, and cheeks. Then the model will predict the Sinhala alphabet letters based on the input. Convolutional Neural Network and Long Short-term Memory techniques have been used to build the framework. The framework provides 70% accuracy for the vowels in the Sinhala alphabet recognition. However, the accuracy decreases up to 60% with Velar and Retroflex alphabets. As an overall, this framework will support both teachers and students who are speech-impaired to communicate effectively and understand each other. Furthermore, the improved outcomes of the research will lead to fulfilling the communication gaps and it will become a great initiative for the community to connect with each other.

Keywords: CNN, Lip-Movement, LSTM, Mute Students, Video Processing

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Identification and classification of Coryza infected chickens in poultry using machine learning

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Chicken is the most famous meat in society and the apparently the most salable meat in the markets. The most of the farmers are raising chickens to get eggs and meat for commercial purposes. There is a disease called Coryza which is infected to the chicken's eyes hardly. As a result, the chicken must be blind as well as they cannot eat well, and finally Coryza can destroy their lives. Therefore, the production of meat and eggs must be decreased. This study is mainly focused on the identification of Coryza-infected chickens using image processing techniques. 800 images of Coryza infected and well-being chickens are captured as the training dataset and 200 images of chickens as the testing dataset. Then image preprocessing and feature extraction are performed. Mutated eyes, which are extracted as features, are difficult to identify from images with complex backgrounds. The image preprocessing techniques are used to overcome that issue. A classification model is developed using MobilenetV2 in a convolutional neural network and the developed model is trained using training dataset with accuracy of 91%. The model is able to predict any given image as infected or well-being chicken with the average testing accuracy of 76%. After the identification process, if it is an infected chicken, relevant medicines are suggested to the farmers as the final outcome of this research. It will be more helpful to maintain sustainable eggs and meat production for a commercial purpose.

Keywords: Coryza, CNN, Image Processing, Poultry, Chicken

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Real-time model to recognize Sinhala sign language based on CNN-LSTM approach

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Around the world, hearing-impaired and speech-impaired people are using different kinds of sign languages to communicate with each other and others. In Sri Lanka, they use Sinhala Sign Language (SSL) to communicate. SSL consists with more than 2000 sign-based words which cover the basic three parts of sign language which are isolated signs (Static signs), continuous signs, and annotations. Apart from the people who are using, others find it difficult to understand SSL. Due to the fact, the impaired people are facing difficulties in day-to-day communication. To address this difficulty in communication, a prototype model was proposed to translate the SSL signs to words in real-time by capturing the hand gestures of SSL with the aid of video processing, MediaPipe and Long Short-term Memory (LSTM) techniques. As a starting point, the proposed model was developed to recognize selected static SSL signs. Mobile phone captured 250 videos of the selected signs from impaired persons were used as inputs to the model. 30 extracted frames from each input video are then used to extract right hand, left hand, and face landmarks. Finally, the extracted landmarks are fed into a well-trained Convolutional Neural Network model. This development reached an overall accuracy of over 65% for the selected static SSL gestures. The model will be further developed to a simple and efficient mobile application to convert isolated signs (Static signs), continuous signs, and annotations made by an impaired person.

Keywords: Sinhala Sign Language, Real time translator, Neural Network, Video Processing.

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Identify of rubber leaf diseases using convolutional neural network

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The rubber tree, or *Hevea brasiliensis* (*H. brasiliensis*), is one of the most important commercial crops in the world. It belongs to the family Euphorbiaceae. The Rubber trees are also a major plantation crop in Sri Lanka. The Rubber tree is affected by several severe diseases, categorized into rubber leaf, stem and branch, panel and root diseases. By identifying the real causes of rubber leaf diseases, the shortcomings of rubber leaf diseases, and the implications of the existing technology, solutions are provided to identify three specific diseases that are currently having a great impact on the economy of Sri Lanka. In most cases, these diseases are diagnosed by humans in Sri Lanka. When farmers are trying to identify these diseases, it is challenging to identify. If they make a mistake, the right remedies or treatments will not be able to give to the infected plant. From this issue, the country will lose a considerable amount of income. This study offers a machine learning method to automatically identify the diseases of rubber leaves without the need for human effort and subjective errors. The Convolutional Neural Network (CNN) was used to automatically identify and predict rubber leaf diseases. The experimental results indicated that the CNN model's accuracy is 93%, which will help more accurately and effectively identify the rubber leaf diseases than existing methods and technologies. This research provides a solution for reducing rubber leaf disease diagnosis in Sri Lanka.

Keywords: Convolutional Neural Network, *Hevea brasiliensis*, Rubber leaf diseases

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MRI-ADC image texture feature analysis to differentiate benign and malignant brain tumors

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Apparent Diffusion Coefficient (ADC) is one of the most common magnetic resonance imaging (MRI) techniques that are frequently used in the brain tumor diagnosis process. This study is based on extracting statistical texture features from MRI-ADC images of human brain tumors to observe correlations of feature values between malignant and benign brain tumors. This study was carried out using 980-malignant, 813-benign labeled MRI brain ADC image slices acquired from 253 subjects presented to the National Hospital of Sri Lanka. The pathological condition of each subject was identified by the radiological reports and confirmed it using histopathological reports. Pixel values within the tumor region of the selected ADC images were delineated by drawing region of interest (ROI) surrounding the tumor area. The features; mean pixel value, higher-order moments of ADC, Grey Level Co-occurrence Matrix (GLCM) texture features; mean, variance, energy, entropy, contrast, homogeneity, correlation, prominence and shade, and patients' age were extracted from each ROI. The extracted features were tested with a one-tailed P-value test with a 95% confidence level. The values for kurtosis of ADC, mean pixel value of ADC, patient age, and the GLCM texture features; mean1, mean2, variance1, variance2, energy, and contrast showed significantly ($P\text{-value} < 0.05$) higher feature values for benign tumors while the entropy, homogeneity correlation, prominence, and shade showing significantly high values for malignant tumors. The facts for the skewness of ADC were not enough ($P\text{-value } 0.05 < 0.0734$) to reject the null hypothesis. The study concludes the feasibility of utilizing the above features except for skewness, as potential biomarkers to differentiate benign and malignant brain tumors.

Keywords: MRI, Malignant, Benign, GLCM texture features

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Sales forecasting using improved LSTM deep learning model

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Time series Analysis (TSA) is used to explore, analyze and predict time series data, and its ultimate goal is to predict future values based on historical data. Sales forecasting plays a vital role in business management; it is one of the most common research areas in time series data analysis. Revenue prediction based on sales forecasting is a critical processes in a business because so many areas of business are integrated into it. Most companies forecast their future sales revenue in the coming season/yearly wise to take financial decisions, expand/minimize their business and supply chains, employee hiring process, advertising & marketing, and many more. Accurate forecasting is crucial for a sales company for decision-making; inaccurate forecasting negatively impacts the company in the short or long term. Sales forecasts help to achieve target sales/revenue by identifying early warnings in their sales pipeline and mitigating the loss of revenue and its risk. According to the literature, sales forecasting performs based on the regional, country, and seasonal-wise. In this paper has used different algorithms (RNN, Random Forest, XGBoost, LSTM and proposed CNN-LSTM model) to compare weekly, monthly and quarterly sales prediction accuracies. For the implementation, Tensorflow has used with the computational support of GPU. Minimum MSE observed in proposed model for weekly sales; i.e mse = 19.18. By applying the CNN layer to the existing LSTM model focused to identify the hidden patterns in multivariate time series data. So compared to the above mentioned models, the CNN- LSTM model performed well and minimizes the MSE value.

Keywords: Sales forecasting, LSTM, Time series data modelling, deep learning.

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