



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

BOOK OF ABSTRACTS

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CONFERENCE THEME

Leveraging Science, Technology, Innovation and Entrepreneurship for Sustainable Development

CONFERENCE SUB-THEMES

1. AI, Machine Learning, IoT, and Data Science
2. Nanotechnology and Materials Science
3. Robotics, Automation, and Intelligent Systems
4. Sustainable Energy and Environmental Technologies
5. Biotechnology, Biomedical Engineering, and Health Sciences
6. Smart Cities, Urban Innovation, and Building Technologies
7. ICT and Emerging Technologies
8. Entrepreneurship, Innovation, and Startup Ecosystems
9. Education Technologies and STEM Education
10. Agricultural Sciences and Food Sustainability
11. GIS and Remote Sensing
12. Computational Methods, Modeling, and Simulations
13. Cryptography, Forensics, and Cybersecurity Systems
14. Tourism, Wildlife, and Hospitality Management

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STIE08-AMD-001

Quantum Intelligence in Biometrics: Integrating Ai and Matter Qubits for Advanced Fingerprint Security.

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Keywords: Quantum Intelligence, Biometrics, Matter Qubits, AI Integration, Fingerprint Security, Quantum Cryptography

Abstract

In the realm of digital security, the need for sophisticated and resilient biometric authentication systems is more critical than ever. Fingerprint recognition, a widely used biometric modality, faces ongoing challenges related to accuracy, susceptibility to spoofing, and scalability. As traditional methods struggle to keep pace with evolving threats, integrating Quantum Intelligence—specifically Artificial Intelligence (AI) and matter qubits—presents a promising solution to advance fingerprint security. This paper explores the innovative integration of AI and quantum computing technologies to enhance biometric fingerprint systems. AI, with its capabilities for learning and adaptation, offers significant improvements in the performance of fingerprint recognition algorithms. Through machine learning and advanced data analysis, AI systems can enhance accuracy, reduce false positives and negatives, and dynamically respond to emerging security threats. AI driven biometric systems are able to continuously refine their recognition processes and adapt to new patterns and anomalies, thus strengthening overall security. On the quantum side, matter qubits introduce a transformative approach to encryption and data protection. Unlike classical systems, quantum matter qubits utilize the principles of quantum mechanics to achieve unprecedented levels of security. By implementing quantum encryption methods, biometric data can be safeguarded against interception and tampering, making unauthorized access nearly impossible. This integration creates a dual-layered security framework that combines the adaptive intelligence of AI with the robust, quantum-based encryption capabilities of matter qubits. The study presents a comprehensive examination of how combining these advanced technologies can redefine biometric fingerprint systems. By leveraging AI for intelligent analysis and matter qubits for secure encryption, we propose a novel approach that addresses current limitations and anticipates future security challenges. This integration not only enhances the reliability and accuracy of fingerprint authentication but also establishes a new paradigm for biometric security in the digital age.

STIE08-AMD-002

Leveraging Intelligent Ai and Matter Qubits for Robust Biometric Fingerprint Authentication.

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Keywords: Intelligent AI, Matter Qubits, Biometric Authentication, Fingerprint Security, Quantum Computing, AI Integration, Quantum Cryptography, Advanced Security.

Abstract

The increasing reliance on biometric fingerprint authentication systems in various sectors, from financial institutions to government agencies, has underscored the need for more robust and secure methods to protect sensitive information. While effective, traditional biometric systems face security breaches, spoofing, and scalability challenges. As these challenges become more sophisticated, there is a pressing need to explore advanced technologies that can enhance the security and reliability of biometric authentication systems. This paper delves into integrating Intelligent AI and quantum matter qubits as a groundbreaking approach to fortifying biometric fingerprint systems. By leveraging the computational power of AI, we can significantly improve the accuracy, speed, and adaptability of fingerprint recognition algorithms. Intelligent AI enables the continuous learning and evolution of biometric systems, allowing them to detect and adapt to new threats in real time, thereby enhancing security measures. The introduction of matter qubits, a quantum computing concept, into the authentication process adds an unprecedented layer of security. Matter qubits allow for the encryption and decryption of biometric data at the quantum level, making it virtually impossible for unauthorized entities to intercept or manipulate the data. This quantum-based encryption, combined with AI's intelligent analysis capabilities, provides a dual-layered defense mechanism that is both highly secure and efficient. In this study, we explore the synergy between Intelligent AI and quantum matter qubits, demonstrating how their integration can lead to the development of biometric fingerprint systems that are not only more secure but also resilient to future technological threats. The findings suggest that this hybrid approach holds significant potential for transforming the landscape of biometric security, paving the way for the next generation of robust and reliable authentication systems.

STIE08-AMD-003

AI/ML (specially ANN) based controller for enhancing Power Quality and efficiency in Grid-Interactive EV charger

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Keywords: AI/ML, power quality, electric vehicle, CNISOGI, Harmonic distortion

Abstract

The use of Proportional-Integral (PI) controllers for DC link voltage regulation in electric vehicle (EV) charging systems are known for their simplicity and ease of implementation, but they struggle with dynamic and non-linear conditions, which are common in EV charging systems. For instance, the

performance of PI controllers is significantly affected by system parameter variations during load changes, leading to slow response times and inadequate handling of sudden changes in operating conditions [1]. The use of AI and machine learning (ML) techniques in DC link voltage control for electric vehicle (EV) charging applications is gaining traction as a more efficient alternative to traditional proportional-integral (PI) controllers. These advanced control strategies offer improved performance in terms of response time, adaptability, and efficiency, addressing the limitations of PI controllers in handling non-linear and dynamic systems. This work investigates about the application of artificial neural networks (ANN), namely, to replace conventional PI controllers using artificial intelligence/machine learning methods, hence lowering total harmonic distortion (THD) and raising grid stability. Furthermore, when comes to the integration of electric vehicle (EV) charging stations into power grid introduces significant power quality (PQ) issues, particularly concerning harmonic distortion and DC offset rejection. These issues arise primarily due to the nonlinear nature of power electronic converters used in EV chargers, which can lead to increased harmonic emissions and potential grid instability so to tackle these situations also the Cascaded non-identical second order generalized integrator (CNISOGI) technique is evolved with integration into EV chargers to solve power quality problems, therefore offering improved harmonic attenuation and DC-offset rejection. Lastly, Matlab/Simulink simulation of 1.1 kW is tested for the wide voltage scenarios like Sag, swell, etc. such that the control techniques help to confirm the suggested system's efficiency. Henceforth, THD of the grid current are satisfying the IEEE-519 standard (i.e.<5%). Future smart grids will be shaped by including sophisticated filtering methods and AI/ML-based controllers in EV chargers, thereby greatly improving power quality, grid stability, and operational efficiency.

STIE08-AMD-004

Harnessing IoT and Data Analytics for Sustainable Water Management: A Case Study of Pioneer University tapping system in Nairobi.

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Keywords: Internet of Things (IoT), Cloud based service, Data analytics, Water monitoring system, Water quality, Sustainable Development

Abstract

The problem of water pollution and quality degradation in the developing countries is increasingly becoming a threat to the natural water resources. This phenomenon is attributed to the increasing quest of these countries to attain industrialization status and diversification of the national development goals and Kenya is no exception to this phenomenon. Water pollution is a pressing global challenge hindering sustainable development. This paper presents a novel technologically based water quality monitoring system designed to address this issue. The system uses a network of sensors to collect real-time data on various water parameters, including pH, turbidity, and chemical composition. This data is then transmitted to a cloud-based platform for analysis and visualization. By leveraging advanced

data analytics techniques, the system provides valuable insights into water quality trends, enabling proactive measures to ensure clean and safe water access. The proposed solution aligns with Sustainable Development, which aims to ensure the availability and sustainable management of water and sanitation for all. This research demonstrates the potential of IoT and data analytics to revolutionize water management practices and contribute to a more sustainable future.

STIE08-AMD-005

University Education Data Management in the Advent of Artificial Intelligence (AI) – Focus on Nigerian National Public Universities

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Keywords: National Universities, artificial intelligence, machine learning, higher education institutions, data management

Abstract

What is clear in this age of fast digital transformation is that academic institutions must become more data-driven and integrate emerging technologies into higher education processes. To do this, sound data management must be implemented with solutions that can turn endless heaps of generated data and records into insights for the advancement of university education. With the rise of artificial intelligence (AI) and machine learning (ML) which are mechanisms that evolved from data management and developing processes, higher education will be faced with how to reap the benefits of AI to improve the education processes and prepare students for this new technology. In this research project, we assess the readiness of the National Public Universities in Nigeria to accept and incorporate AI into the processes involved in data management through a survey research approach. The survey was implemented among students and staff of Nigerian national public universities to generate data and information on how much knowledge of AI is held and deployed in these institutions to determine the understanding of the opportunities and challenges involved in AI within this ecosystem. Obtained data is analyzed using descriptive statistics with cross-tabulation of some of the variables as well as some data filtering. The study addresses critical issues, bothering on best practices regarding usage of AI in higher education in national public universities in Nigeria, to arrive at informed recommendations for the integration of AI in these universities' data management processes.

STIE08-AMD-006

Temperature and Pressure Distribution Analysis on Selected Geothermal Wells at Olkaria using Completion and Heat up Test Data

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Keywords: Temperature, pressure, completion, heat-up.

Abstract

Knowledge of the true temperature and pressure at a point within the formation and their variation across the field has many applications in resource definition, delineation, and power potential and how the resource is exploited. For electricity generation, the rule of thumb is a cut-out temperature of 230⁰ C. Resources at lower temperatures can be used for power generation from binary plants (below 180⁰C) or for direct use applications. Data is available in the newly drilled wells, but not much has been done to analyze and incorporate the model of the wells that were drilled earlier. The model would enable identification of the most appropriate targets for geothermal wells. The study conducted a temperature and pressure distribution analysis on selected geothermal wells at Olkaria using completion and heat up test data to model pressure and temperature behaviors of single-phase liquid-dominated geothermal systems for the reservoir characterization. The study also aimed to investigate the effect of thermal entry length, which is the axial distance needed to achieve a value of local Nusselt number $NU(x)$ when the entering fluid temperature profile is uniform, on the pressure and temperature behaviors. The literature revealed that most of the previous studies on temperature and pressure modelling in geothermal reservoirs relied heavily on analytical and semi-analytical models that assumed fluid and rock properties were independent of temperature and pressure. Hence, the studies failed to capture the complex interactions between thermal and hydraulic processes in single-phase liquid-dominated geothermal systems. The research used data from newly drilled adjacent wells in Olkaria 1 and systematic analysis of the database containing pressure and temperature data collected by KenGen staff during completion and heating-up tests. A conceptual model was developed from the formation temperatures and pressure based on this analysis. Temperature and pressure distributions at various depths in each well were correlated with nearby wells to provide a clear understanding of the feed zone locations. The results further indicated that the formation temperatures and pressure on geothermal wells were moderate with values ranging between 51.807-228.51 and 100.339-114.702, respectively, although slightly above the expected values of 115.95 and 71.38, respectively. The study revealed a significant effect of limited entry length on pressure ($p=0.000$) and temperature behaviors ($p=0.000$). The study highlighted a strong positive association between entry length and pressure ($r=0.970$), and moderate positive association between entry length and temperature ($r=0.599$). The study provided sufficient evidence of injection time's effect on pressure behaviors. The results imply that the wells at Olkaria have favorable thermal and pressure conditions for energy extraction. The study recommended alternative use of geothermal energy in Olkaria to tap the excess energy before re-injecting the water back to the ground. There is need to adjust the entry length to allow more controlled and efficient energy extraction.

STIE08-AMD-007

AI-Driven Soil Nutrient Analysis for Optimizing Maize Crop Yields: Enhancing Precision Agriculture through Machine Learning.

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Keywords: Agricultural, food security, soil nutrients, Artificial Intelligence, Machine learning, Algorithms, soil management.

Abstract

Agriculture, a cornerstone of global food security, faces significant challenges from pests, diseases, and soil nutrient deficiencies, leading to substantial crop losses and environmental degradation. In Kenya, where agriculture contributes 26% to GDP and supports over 40% of the population, maize is vital for food security and economic stability. Traditional soil nutrient testing methods, which are labor-intensive and time-consuming, often result in inefficiencies and reduced yields. This research proposes the development of an AI-driven soil nutrient analysis system aimed at reducing dependence on laboratory testing by equipping farmers with in-field sensors. These sensors, deployed across maize-growing regions in Kenya, will collect real time data on essential soil nutrients. AI algorithms will process this data to generate predictive models for optimal nutrient management, offering immediate, tailored fertilization recommendations. The effectiveness of this AI-driven approach will be evaluated against traditional practices in terms of yield improvement, cost reduction, and accessibility for smallholder farmers. The expected outcome is a significant enhancement in nutrient management efficiency, leading to higher maize yields, reduced costs, and improved accessibility for smallholder farmers. This study seeks to demonstrate that integrating AI and sensor technology in precision agriculture can play a crucial role in boosting food security, promoting sustainable farming, and supporting economic growth in Kenya.

STIE08-AMD-008

Lesion Detection and Classification Using Transfer Learning and Deep Learning Algorithms

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Keywords: Lesion detection, lesion classification, transfer learning, deep learning algorithms, medical imaging, Convolutional Neural Networks (CNNs), Residual Networks (ResNets), Inception Networks, automated diagnosis, machine learning, image pre-processing, AUROC, ensemble learning.

Abstract

The detection and classification of lesions in medical imaging are critical tasks that significantly impact diagnostic accuracy and patient outcomes. This dissertation investigates the efficacy of transfer learning and deep learning algorithms (DLAs) in enhancing the automated detection and classification of lesions in medical imaging modalities, such as MRI, CT scans, and X-rays. The study primarily focuses on the comparative analysis of different DLAs, including Convolutional Neural Networks (CNNs), Residual Networks (ResNets), and Inception Networks, augmented with transfer learning techniques to improve model performance, especially in cases where limited annotated data is available. A comprehensive dataset of medical images containing different types of lesions, including benign and malignant, will be curated and pre-processed for this study. The methodology will involve training several deep learning models with pre-trained weights from large-scale datasets such as ImageNet. Transfer learning will be employed to fine-tune these models on the medical imaging dataset to leverage the generalization capabilities of the pre-trained networks while adapting to the specific nuances of lesion characteristics in the target domain. The models will be evaluated using a stratified cross-validation approach to ensure robustness and mitigate overfitting. Performance metrics such as accuracy, sensitivity, F1-score, and Area Under the Receiver Operating Characteristic (AUROC) curve will be used to assess the effectiveness of each model. The expected end results should demonstrate that models employing transfer learning significantly outperform those trained from scratch, particularly in scenarios with sparse training data. Among the models to be tested, Inception Networks with transfer learning are expected to achieve high level of classification accuracy and sensitivity, indicating superior capability in identifying and categorizing lesions. Additionally, a novel ensemble approach combining predictions from multiple models will be used to further enhance the detection performance, to achieve state-of-the-art results. This study underscores the potential of leveraging transfer learning in conjunction with advanced deep learning architectures to improve lesion detection and classification in medical imaging, suggesting a viable pathway for enhancing diagnostic processes in clinical settings. Future work will explore the integration of multi-modal data and the application of these models to real-time diagnostic systems to further validate their clinical utility.

STIE08-AMD-009

AI-Orchestrated Multi-Sensory Learning Environments

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Keywords: Artificial Intelligence (AI), Multi-Sensory Learning, Educational Technology, Personalized Learning, Machine Learning, Natural Language Processing, Adaptive Instruction, Learning Environments

Abstract

In the rapidly evolving landscape of education, traditional teaching methods are being reimagined to harness the potential of artificial intelligence (AI) in creating more immersive and effective learning experiences. This paper explores the concept of AI-Orchestrated Multi-Sensory Learning Environments (AI-MSLE), where AI systems dynamically integrate various sensory inputs—visual, auditory, tactile, and kinesthetic—to create personalized, engaging, and adaptive educational experiences. By leveraging advanced AI techniques such as machine learning, natural language processing, and computer vision, AI-MSLE can tailor educational content to individual learning styles, optimize the pace and complexity of instruction, and enhance retention through multi-sensory stimulation. The study discusses the architecture of such environments, the role of AI in orchestrating seamless interaction between different sensory modalities, and the potential benefits and challenges of implementing AI-MSLE in diverse educational settings. Through case studies and experimental findings, this research aims to demonstrate the transformative potential of AI-MSLE in fostering deeper understanding, creativity, and critical thinking among learners across all ages and disciplines.

STIE08-AMD-010

Neural-Linked IoT for Direct Brain-to-Device Interaction

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Keywords: Neural-Linked IoT, Brain-to-Device Communication, Neural Interfaces, Thought-Controlled Devices, Neural Signal Processing, Machine Learning, IoT Connectivity, Brain-Computer Interface.

Abstract

The advent of Neural-Linked Internet of Things (IoT) technology represents a significant leap forward in human-device interaction, transcending traditional interfaces. This research explores the development of a novel system that enables direct brain-to-device communication, allowing users to control IoT devices through neural interfaces using thought alone. The objective is to create a seamless and intuitive interaction between the human brain and IoT ecosystems, enhancing accessibility, convenience, and efficiency in daily life. The system leverages advanced neural signal processing, machine learning, and IoT connectivity to interpret and execute user intentions with minimal latency. Potential applications range from home automation and healthcare to communication and environmental control. The study also discusses key challenges in neural signal decoding and security considerations. The findings demonstrate the feasibility of neural-linked IoT, paving the way for future innovations in brain-computer interface technology.

STIE08-AMD-011

Towards a Distributed Planned Economy: A Personal AI Agent Framework for Deep Decision Prediction, Conflict Resolution, and Social Optimization

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Abstract:

This paper introduces an innovative personal AI agent framework that could significantly contribute to realizing a distributed planned economy while optimizing individual and societal decision-making. The proposed system aims to resolve conflicts of interest and achieve social optimization through three key components: (1) a deep utility function model for precise prediction of future decisions and demand, (2) a multi-agent automated negotiation system for determining socially optimal yet individually satisfying goals, and (3) an interface AI agent that supports goal achievement while maintaining self-efficacy. This framework addresses fundamental challenges in distributed planned economies, including accurate demand forecasting, balancing individual preferences with collective benefits, and dynamic resource allocation. By facilitating win-win solutions in areas such as resource distribution, sustainability, and personalized services, the system offers a novel approach to economic planning that is both decentralized and highly responsive to individual needs. We outline the theoretical foundations, technical architecture, and proposed validation studies for the framework, including applications in food choice optimization and career matching. The paper also explores how this technology could bridge the gap between market mechanisms and planned economies, potentially creating a more efficient, transparent, and sustainable economic system. Additionally, we discuss the societal impacts, ethical considerations, and strategies for responsible development and deployment. This personal AI agent framework represents a significant step towards a more harmonious and efficient society, offering new possibilities for distributed economic planning in the age of artificial intelligence.

STIE08-AMD-012

Finite Element Mesh Refinement Using Genetic Algorithm

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Keywords: Finite Element Mesh (FEM), Genetic Algorithm (GA), Delaunay Triangulation, Mesh Refinement.

Abstract:

This paper presents a novel approach to finite element mesh refinement using a Genetic Algorithm (GA), with the initial mesh generated through Delaunay Triangulation (DTA). This research aims to

enhance the quality of finite element meshes, which play a critical role in the accuracy and efficiency of solving partial differential equations (PDEs) for complex domains, particularly in electromagnetic field solvers. Traditional mesh generation techniques like Delaunay Triangulation often have difficulty with highly irregular geometries or regions with multiple local extrema, resulting in suboptimal mesh quality. To address these challenges, we developed a GA-based mesh refinement method that iteratively optimizes the mesh by improving the aspect ratio of triangular elements and minimizing sharp angles at mesh nodes. The initial mesh is generated using Delaunay Triangulation to ensure a good starting point, while the Genetic Algorithm refines the mesh by evolving a population of candidate solutions over several generations. The fitness function is designed to reduce the aspect ratio and improve mesh uniformity, ensuring that the mesh adapts to the geometric constraints of the domain. Key results demonstrate that the GA-refined meshes exhibit superior quality compared to DTA only meshes, particularly in nonconvex regions and areas with complex boundary conditions. This leads to smoother field lines and improved convergence in the numerical solutions of Maxwell's equations for both electrostatic and magnetostatic problems. We validated our algorithm through convergence studies. Convergence was measured by comparing the number of triangles against their aspect ratios, and the GA consistently outperformed DTA in producing meshes with higher uniformity and fewer degenerate elements. The results confirm that GA-driven refinement improves mesh quality and enhances the accuracy of the numerical solutions in complex geometries, making it a valuable tool for mesh refinement in computational electromagnetics.

STIE08-AMD-013

Financial assets portfolio optimization using prediction-based GARCH-ANN ensemble models.

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Keywords: ANN, RNN, LSTM, BiLSTM, GARCH-ANN, ensemble models, portfolio optimization.

Abstract

In today's financial world, portfolio optimization remains crucial for financial industry players seeking high returns while minimizing risk and diversifying their investments. This study focuses on utilizing of prediction-based GARCH-ANN ensemble models to create optimal portfolios from a pool of financial assets, including four stock market indices (S&P 500, Dow Jones Industrial Average, Nasdaq Composite, and Nairobi Securities Exchange All Share Index), four commodities (WTI Crude Oil, Natural Gas, Silver, and Wheat), and two cryptocurrencies (Bitcoin and Ethereum). The study examines various GARCH models (IGARCH, EGARCH, ALLGARCH, and GJRGARCH) as well as neural network models (ANN, RNN, LSTM, and BiLSTM) to determine their predictive ability for the assets between 2016 and 2023. Ensemble models combining GARCH and different neural networks, including stacked neural networks, were also analyzed. The empirical results suggest that no single model consistently outperformed the rest in predicting asset prices. The neural network models

outperformed GARCH models in predicting asset prices, while the stacked neural network ensembles performed relatively close to the individual neural network models. The RNN-LSTM ensemble was identified as the best-performing ensemble across most assets, while the ANN-LSTM-BLSTM and RNN-LSTM-BLSTM models did not outperform non-ensemble neural networks, indicating over-prediction of asset values. In conclusion, generally, the optimal ensemble models outperformed the optimal neural network models in obtaining the optimal portfolio, as they produced the highest Sharpe ratio value. Overall, the study highlights the value of ensemble models in improving financial forecasting accuracy and optimizing short-term investment portfolios.

STIE08-AMD-014

IoT Based Surveillance Model for Monitoring School Children

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Keywords: *Child safety, School children, Surveillance, Internet of Things (IoT), Real-time tracking.*

Abstract

Due to their inherent vulnerability, reliance on caregivers and limited understanding of potential hazards and self-defense, children are naturally prone to accidents, exploitation, and various forms of abuse. Recent media coverage has shown an alarming increase in crimes targeting children, including abductions and murders, intensifying concerns about child safety. Because children spend a majority of their time in school, it is the joint duty of both the school and parents to ensure the continuous monitoring and care of children. The popular method of accounting for children in Kenyan schools is by performing a physical head count and checking of class lists. This process can be long, tiresome and hard to maintain for the those concerned. Furthermore, the process is not efficient enough for the school to know whether students are absent from classes during the course of the day. To improve the situation, surveillance of children has to be done properly and efficiently. In order to address the challenges related to monitoring and ensuring the attendance and safety of learners, it becomes imperative to embrace current technology. Technologies such as Global Positioning System, Radio-Frequency Identification, Ultra-Wide Band, Bluetooth Low Energy, Infrared, Wi-Fi and Zigbee and have been employed in object tracking scenarios. The general term given to these devices is Internet of Things (IoT). The utilization of IoT offers numerous possibilities for enhancing student, including the ability to track students' movements within the school premises. Consequently, this research will concentrate on the development of an IoT-based surveillance system for monitoring school children. weaknesses of IoT based surveillance models for monitoring children.

STIE08-NMS-001

Characterization of amorphous silicon nitride prepared from sand and coffee husk wastes by
carbothermal reduction-nitridation

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Key words: Extracted silica (ES), Silicon nitride (Si_3N_4), Bamburi Beach Sand (BBS), Coffee husk biochar (CHB), α - Si_3N_4 , β - Si_3N_4

Abstract

The continued coffee demand in Kenya has amplified the generation of its husk wastes causing disposal problems [1]. This has led to serious pollution to the environment [2]. Therefore, developing a greener and cost-effective ways to handle these wastes is necessary [3]. The current study entailed the use of extracted silica and coffee husk biochar as novel precursor materials for the synthesis of silicon nitride (Si_3N_4) composite in an ammonia environment. The silica was extracted from raw sand by alkali fusion route. The biochar was prepared by pyrolytic treatment of raw coffee husk biomass at 300 °C for 5 hours followed by acid leaching. The sand, extracted silica, raw and biochar samples and silicon nitride composites were characterized using X-Ray Fluorescence (XRF), Fourier Transform Infrared (FT-IR), X-Ray Diffractometer (XRD), Scanning Electron Microscope (SEM), Energy Dispersive X-Ray (EDX) and Thermogravimetric Analyzer (TGA). The results showed that the raw sand contain quartz, calcite, microcline and clinocllore. The results for the extracted silica showed a highly amorphous silica containing hydroxyl (-OH) and siloxane (Si-O-Si) functional groups. The alkali fusion process increased the silica content to > 92 % from 83 % with oxide impurities reduced to < 1 %. The characterization of biochar samples showed a highly amorphous, porous carbon structure with aromatic carbon bonds (C=C) and a negligible ash content. The characterization of Si_3N_4 powder showed thermally stable, porous and highly amorphous material with α - Si_3N_4 and β - Si_3N_4 phases. The FT-IR results showed Silicon-Nitrogen-Silicon (Si-N-Si), silanol (Si-OH), Silicon-Nitrogen (Si-N) and Silicon-Silicon (Si-Si) as important functional groups present in silicon nitride composite material. The results revealed a greener approach of Si_3N_4 synthesis for application in vast industrial fields.

STIE08-NMS-002

Recovery of Chromium (III) Sulphate from Aqueous Solution Using Limestone Rock Chippings and
re-use in Tanning of Goatskin

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Keywords: Limestone, Chromium, Aqueous solution, Removal, Recovery, Reuse, Tanning

Abstract

Chromium is a valuable element in human health and the manufacturing industry. However, any content greater than 0.1 mg/L in water has detrimental effects on the ecosystem. Its presence poses

severe health challenges for all living things and environmental risks. Different approaches have been applied to treat wastewater polluted with chromium before releasing it into the environment. The current practices face several challenges, including the complexity of their application and high running costs. This study investigated the potential of using limestone as an inexpensive and eco-friendly alternative to removing and recovering chromium from wastewater and recycling it into the leather tanning process. The locally available and naturally occurring limestone material was collected, cleaned, dried, crushed, and graded to the desired sizes. It was then subjected to chemical, SEM, and XRF analysis to determine its physical and chemical properties. The graded limestone chippings were used in batch experiments as filtration media to remove chromium from the freshly prepared chromium salt solutions. In batch studies, the ideal parameters for treating 100 mL of chromium solution were found to be a pH of 6.0, a contact duration of 90 minutes, a mass dosage of 110 g, and a starting concentration of 100 ppm. Our findings demonstrate that limestone has an outstanding filtration ability for chromium heavy metal removal, with maximum removal rates of 98.94% and 92.08% from fresh chromium solution and chrome tannery effluent, respectively. The results from the filtration experiments were then used to set up a relatively large experiment for the removal and recovery of chromium salt. The dried limestone filtering materials were treated with 0.5 M H₂SO₄ and successfully reclaimed 64.85% of the chromium (III) ions. To meet tanning concentration requirements, 10.04 g, equivalent to 24.37% of fresh basic chromium salt, was topped up to the recovered solution for it to induce tanning. A goatskin from the leather laboratory underwent pre-tanning processes and tanned with regenerated and fresh chrome solutions, respectively. Upon analyzing the physical properties, the wet-blue produced from regenerated chrome demonstrated favorable characteristics, including a shrinkage temperature of 114.7 °C, a tensile strength of 16.68 N/mm², tear strength of 32.66 N, 40.96% elongation at break, and a thickness of 1.32 mm. After 150,000 flex cycles, no cracking or damage was observed. These properties align with traditional tanning methods and meet international standards. Organoleptic properties were found to be comparable to the fresh tanned wet-blue leather. Further research is needed to optimize the recovery process to achieve higher chromium recovery rates suitable for tanning leather.

STIE08-NMS-003

Motor Insurance Claim Frequency Prediction Using Extreme Gradient Boosting Trees (XGBoost)

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Keywords: Big data; Frequency; machine learning; ensemble learning; gradient boost; XGBoost

Abstract

Insurance claim frequency modelling is an important task for non-life insurers, this together with other variables forms an important part of product pricing and risk management. The traditional frequency models such as Poisson, Negative Binomial and Zero Inflated models have several weaknesses such as scalability issues, overdispersion and independence assumptions for large datasets and therefore not ideal to use when dealing with complex and unstructured data. Extreme gradient Boosting Algorithm (XGBoost) is an ensemble learning which has the capacity to effectively handle big complex and

unstructured insurance data. XGBoost creates tree-based models by iteratively fitting decision trees to the residuals of the previous predictions, effectively reducing the error in each iteration. This research utilized and explored the XGBoost algorithm to process motor insurance claims large dataset in-order to predict the frequencies of insurance claims, that is 0,1,2, and3. Using this algorithm, we aim to enhance the accuracy of predictions that will yield better estimates for improved risk assessment and pricing of insurance products. Cross validation was performed to assess the true performance of our model. Cross validation results showed that XGBoost models for the claim frequency had a RMSE estimate of 0.949, MAE of 0.7741 and RSQ 0.781. This demonstrated a strong predictive performance, with an RMSE of 0.949 and an MAE of 0.7741, indicating a low average error in the predictions. The RSQ of 0.781 suggests further that the model explained a significant proportion of variability of the insurance data. Our model was evaluated with a confusion matrix. The results of the confusion matrix showed that for the frequency 0 99.59% of cases were correctly predicted, frequency 1 94.01% were correctly predicted and frequency 2 84.80% and finally frequency 3 only 40.96% of the observations were correctly predicted. These results highlight the potential of XGBoost as a robust modeling technique for handling big data and accurately predicting insurance claim frequency. The results corroborate with other studies that XGBoost is an invaluable tool for insurance companies.

STIE08-NMS-004

91 Steel Chemical Composition Characteristics and Rejuvenation Heat Treatment

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Key Words: P91 steels, ferritic-martensitic steels, microstructure, heat treatment, rejuvenation heat treatment

Abstract

This article reviews the chemical composition characteristics and heat treatment of the P91 ferritic-martensitic steels. P91 steel is used extensively to manufacture high-temperature and pressure steam power plant components. This includes boilers, headers, main steam pipes and tubing for steam transmission and distribution. The thermal stability of the steel is obtained from its constitutive chemistry, microstructure and precipitation mechanisms which are highlighted. The steel has lath martensite microstructure which is the basis of its sound mechanical and creep properties. The microstructure is obtained by a careful heat treatment process which is discussed along with the effects of various constitutive elements, precipitations and secondary phases. During long-term service, the steel microstructure is evolved with subsequent loss of creep and structural properties. The restoration of the microstructure after creep by rejuvenation heat treatment is essential to extend the service life of steel components. These aspects are discussed along with challenges and prospects of the steel with a view to re-integration of creep exhaust steel components.

STIE08-NMS-005

Optoelectronic sensor for entomofauna study

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Keywords: entomofauna study, optoelectronics, real-time monitoring, environmental conservation.

Abstract

Monitoring insect population is important for applications in environmental conservation, agriculture, and public health. Traditional methods, such as pheromone traps and manual counting and identification, are labor-intensive and lack real-time capabilities. This paper presents the design and implementation of an advanced optoelectronic sensor system integrated with an existing camera system for real-time monitoring of insects. The system employs a Quarton Red Line Laser Module; a high-precision laser featuring a fan angle of 60 degrees at a wavelength of 638 nm, and a Hamamatsu S8543 Position Sensitive Detector (PSD); featuring a long, narrow active area, to detect insects crossing a 50 mm by 25 mm path. A mechanical support was designed and 3-D printed to hold the Laser Module, align the light towards the PSD across the enclosed insect path, and house the electronic circuit. In test with real flies, the sensor successfully detected 7 out of 10 captured flies-70% accuracy, demonstrating its effectiveness in detection. The system is aimed to be integrated with BeeGuard's Camera System for precise image capture, optimizing data collection for ecological studies. The system's low power consumption makes it suitable for long-term deployment in remote rainforests, addressing the need for non-invasive and real-time insect monitoring.

STIE08-NMS-006

Development of Sustainable Non-Toxic Polyurethane.

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Abstract

This study explores the sustainable and non-toxic production of polyurethane materials using an innovative non-isocyanate synthesis method. By reacting newly developed polycarbonate biscarbonates with polyamines in the presence of catalysts, a novel class of polymers is created, incorporating carbonate, urethane, and urea linkages within an aliphatic hydrocarbon backbone. These poly (carbonate urethane urea) materials can be processed into a wide range of forms, including semi-rigid foams, soft elastomers, adhesives, sealants, and anti-corrosive coatings, with specific applications in the electric and automotive industries. The mechanical properties of the resulting materials vary based on formulation and stabilizer usage. For instance, solid products range in Shore A hardness from

55 to Shore D hardness of 90, while elastic products fall within a Shore A hardness range of 55 to 75. Semi-rigid foams are produced with densities between 80 and 220 g/dm³, while rigid foams achieve densities between 75 and 135 g/dm³. Coatings exhibit Shore D hardness ranging from 35 to 95. In addition to flexibility in mechanical properties, the project demonstrated that foam density can be adjusted using stabilizers. A density of 125 g/dm³ was obtained without a stabilizer, while the use of a stabilizer reduced the density to 120 g/dm³. Incorporating CO₂ during synthesis proved sufficient to produce foams in the 100 g/dm³ range, making additional foaming agents unnecessary. Compared to traditional polyurethanes, these non-isocyanate polyurethanes (PHUs) offer distinct advantages, including superior UV and light stability, making them suitable for outdoor applications. PHUs also demonstrate improved resistance to hydrolytic degradation and mechanical wear, particularly in moisture-prone environments. Furthermore, the bio-based potential of PHUs is significant, as cyclic carbonates can be derived from renewable sources such as vegetable oils, enhancing the sustainability of the approach. This environmentally friendly process minimizes dependence on petroleum-based raw materials and reduces toxic exposure, aligning with industry trends toward greener chemistry solutions. The combination of sustainability, non-toxicity, adjustable mechanical properties, and enhanced durability makes poly(hydroxy-urethanes) highly promising for advanced applications in the automotive, electronics, and coatings industries. Their enhanced performance characteristics present a safer and more sustainable alternative to traditional polyurethanes for diverse industrial applications.

STIE08-NMS-007

Spiral Formation and Characterization for Protein Filament Driven by Biomolecular Motors

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Keywords: Protein filament, Biomolecular motors, Microtubule, Kinesins, Buckling, Spiral conformation.

Abstract

Cytoskeletal protein filaments act as tracks for biomolecular motors, such as kinesin and myosin, which harness chemical energy from adenosine triphosphate (ATP) hydrolysis to generate mechanical energy. In reconstituted systems like the *in vitro* motility assay, surface-bound motor proteins propel the filaments by taking stepwise movements along the filament toward the designated end. These actively driven filaments, functioning as active polymers, are of significant interest both as a form of active matter and as a means for material transport in biosensors and nanodevices. However, during their movement, filaments can buckle when the leading end is pinned by defective motor proteins, often leading to spiral conformations caused by uniform rotations around the pinned end. In such synthetic environments, this buckling can result in filament breakage [1] and loss of control during material transportation. Developing strategies to control active buckling presents a possibility to predict and stabilize filament shapes, improving their reliability for transporting materials in nanodevices.

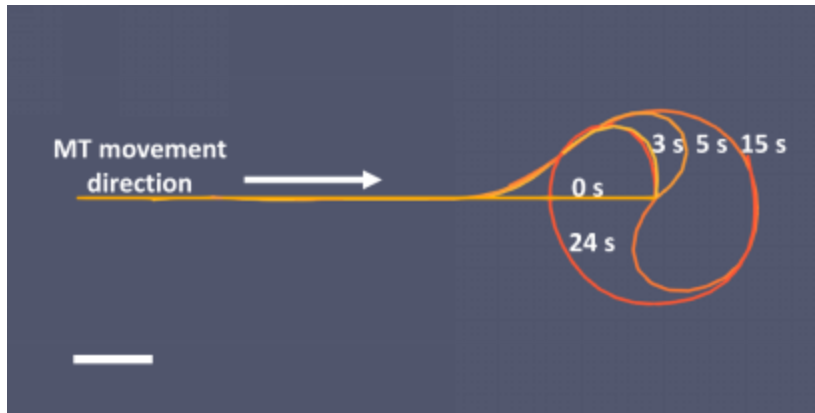


Figure 1: Time series of spiral formation of microtubule (MT) driven by kinesin motors. The length of the MT is $15\ \mu\text{m}$ and the surface motor density is $20\ \mu\text{m}^{-2}$. Scale bar = $2\ \mu\text{m}$.

buckling, initially taking a straight conformation (0 s). After buckling in the surface plane (3 s), MT started rotating uniformly around the pinned end (5 and 15 s), and then it adopted a spiral form and whirls around the pinned tip (24 s). We characterize the conformation by the spiral radius and obtain a scaling relation of the spiral radius as a function of the surface motor density. Our findings bring about improved understanding of buckling and spiraling mechanism of protein filament driven by biomolecular motors, which enhances their controllability and improves reliability in nanodevices.

Here, we report a simulation study on the spiral formation and the characterization of the spiral radius of microtubule (MT) cytoskeletal filament driven by kinesin motor proteins. Our simulation method is a build-up of our previous works [2,3], which we modify to induce buckling and spiraling of the microtubule. Fig. 1 shows the time series of the formation of spiral conformation during active

STIE08-NMS-008

Active materials by biomolecular motors

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Keywords: biomolecular motor, cytoskeleton, polymer, artificial muscle, actuator

Abstract

Biomolecular motors, such as kinesin and myosin, are molecular machines in living cells, involved in intracellular transport and force generation by consuming a fuel of adenosine tri-phosphate. These biomolecular motors and their associated cytoskeletal filaments, which serve as tracks for biomolecular motors, can be reconstituted outside of living cells and form active materials, such as active gels and active polymers. Due to activities of biomolecular motors, the active gels and active polymers are driven out of equilibrium and hence show distinct behaviors from their passive counterparts. We investigate these active gels and active polymers by biomolecular motors and utilize them for applications in robotics and biosensors. Active gel: We developed an active gel driven by an engineered kinesin biomolecular motor which can be efficiently integrated into and actuate millimeter scale mechanical components [1]. The force generated by the actuator reached the micronewton range, which is sufficient to actuate mechanical components on the millimeter scale. A computer simulation reproducing contractions of the active gel predicted that a homogeneous active gel would become more

resilient against rupture than a random active gel, which gives a physiological insight into structure of animal skeletal muscles. Active polymer: Cytoskeletal filaments propelled by motor proteins bound on substrates, can be viewed as active polymers. In particular, pinned at their leading ends, propelled microtubules or actin filaments form rotating spirals, arising from interplays between motor activity and mechanics of cytoskeletal filaments. By using a computer simulation, we investigated spiral formations of microtubules propelled by kinesin motors. Observations of simulated movements revealed that spiral formation was initiated by localized buckling near pinned ends, and that the length of localized buckling and the spiral radius were well correlated. This study showed that mechanical properties of kinesin motors played an important role in the spiral formations, giving an insight into efficient material transport on biosensors by molecular shuttles driven by biomolecular motors [2, 3].

STIE08-NMS-009

Ceramic Composites: Investigating SiC Particle Size and Self-Toughening Mechanisms

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Keywords: Nanoparticles, Flexural Strength, Thermal Conductivity

Abstract

This work investigated the effects of SiC particle size on the microstructure and physical, thermal, and mechanical properties of cordierite-mullite composites. SiC milled for 3 hours at 200 rpm (MPS~2.99 μm / microparticles), and 600 rpm (MPS~0.140 μm / nanoparticles) was incorporated in ceramic composites to investigate the size effect. XRD analysis of ceramic composites revealed cordierite, mullite, chamotte, and SiC peaks in ceramic composites. SEM results illustrated that the composites formed acicular microstructure attributed to mullite, with cordierite-mullite-chamotte-SiC nanoparticle ceramic composites exhibiting refined grains. At 7.5% SiC, nanoparticles reduced porosity by 24.15% and enhanced thermal conductivity and flexural strength by 40.72% and 12.12%, compared to microparticles at 23.11%, 34.20%, and 8.98%, respectively. SiC nanoparticles were observed to outperform SiC microparticles.

STIE08-RAI-001

Intelligent Reflecting Surfaces for Sustainable and Energy-Efficient Network Design

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Keywords: IRS, energy, sustainability, transmission.

Abstract

As wireless communication networks continue to grow to accommodate the requirements of 6G and IoT, energy efficiency is now an essential goal. Intelligent reflecting surfaces (IRS) are a great solution to attempt to mitigate energy problems since they have low power consumption compared to other active transmission approaches such as MIMO and relay technologies [1]. An Intelligent Reflecting Surface (IRS) is a 2D array of many subwavelength metamaterials that employs reflective elements to reflect and form wireless signals in a desired manner without having to erect more power-consuming equipment. In this way, through dynamic change of reflection angles according to real-time network traffic, IRS can facilitate signal radiation around the obstacles and thus minimize the transmission attenuation and the requirement for massive base stations [2]. This capability not only helps reduce power consumption but also fosters network densification as it can guarantee communication in highly dense areas where conventional transmission might fail. In addition, the IRS can make a contribution to environmental sustainability by decreasing the power consumption in communication systems and meeting the green network and carbon footprint objectives. MATLAB is used to simulate the performance of IRS systems in comparison to Half-duplex relays and MIMO systems. The power consumption, channel gain and power loss are used as the performance metrics where results indicate that the IRS outperforms these competing systems. Therefore, the IRS's possibilities of changing the network design for more efficient and energy-saving communication systems reveal the role of the IRS as an enabler of efficient and scalable solutions to future wireless communication needs. In summary, this paper illustrates how the IRS technology can shape the future advancement of communication systems towards an energy-efficient approach.

STIE08-SEE-001

Synthesis and Application of Coconut Oil Methyl Ester as Green and Sustainable Petro-Diesel Blend for Internal Combustion Engines

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Key words: cetane index, climate mitigation, coconut oil methyl ester, fuel blending, Petro-diesel additives

Abstract.

Petroleum products are essential economic drivers for nearly all countries in the world. Petrol and diesel are common petroleum products for transportation, agricultural and industrial applications. For automobiles utilizing internal combustion engines, additives are added to petrol and diesel to ensure smooth operation. Common additives such as tetra ethyl lead and methyl tert-butyl ether are toxic posing a threat to humans and the environment. Ethanol and vegetable oils are environmental benign but compete with other human needs. Coconut oil methyl ester (CME) is attractive as an alternative to ethanol and vegetable oil. CME benefits include local availability along the Kenyan Coast, cheaper and easily produced. CME from coconut oil contains medium chain saturated fatty acids giving the fuel unique characteristics lacking in the other biodiesel additives. In the current work, CME was

evaluated for potential use as petro-diesel blend. CME was synthesized through transesterification of native coconut oil. The synthesized CME had comparable quality standards to those specified for Automotive Gas Oil (AGO) by Kenya Bureau of Standards (KEBS). Blending CME with diesel was done by increasing its weight content from 5-20%. An optimum mixing ratio of 10:90 CME with diesel produced product complying with KEBS recommended AGO quality tests for density, acid number, flash point, distillation point, cloud point and cetane index. CME use as additives improves fuel efficiency, minimizes risks associated with release of greenhouse gases such as CO, CO₂ and NO_x and eliminate release of corrosive SO_x gases (x = 1, 2). Thus, greatly improving engine life, minimize fuel cost and mitigate climate change.

STIE08-SEE-002

Structural Controls Analysis and Its Correlation with Geothermal Occurrence at Barrier Volcanic Complex (BVC), Turkana, Kenya

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Keywords: Geothermal resource, Lineaments, Lineaments density, structural controls.

Abstract.

Geothermal is a clean energy source that occur in the subsurface. Its exploration and development require comprehensive scientific studies. Presence of heat source, fluids and fractures are the three main parameters that are considered when assessing the viability of a geothermal resource. The movement of fluids to and from the heat source is facilitated by geological features, which helps in the recharge of geothermal system and productivity. The Barrier Volcanic Complex (BVC) structures were mapped using remote sensing techniques employing the hill shading methodology, by making use of four sun illumination angles (azimuth): 45°, 90°, 150°, and 315°; a constant elevation of 45°; and an exaggeration factor of 10. SRTM satellite imagery was used. ArcGIS software was used for delineation of lineaments, PCI Geomatica for generation of major faults, while Georse and Rockworks 17 for generating the rose diagrams. A total of 260 lineaments were generated whereby at 45° there was a total of 60 lineaments, at 90° 95 lineaments, at 150° 61 lineaments, and at 315° 44 lineaments. Ground trothing was done to confirm the trend of the analyzed structures. The results show a NNE-SSW and N-S trends of structures. In conclusion, the study reveals that the area is highly fractured as indicated by numerous lineaments, hence, aiding the recharge and enhancement of the geothermal system at BVC.

STIE08-SEE-003

Determination of inertia support by HESS in reduced inertia microgrid

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Keywords: Inertia, optimization technique, frequency, RoCoF, HESS.

Abstract

The growing popularity of renewable energy sources (RES) results in frequency fluctuation in today's power system network. This phenomenon has been caused by reduction in fossil fuel and their hazardous nature in the environment. In addition, lifestyle improvement among the people has called for alternative sources of power. RES has been put forward to address this menace. However, these sources are intermittent in nature and lack inherent inertia. This article therefore is proposed to address inertia in microgrid. It quantified the amount of energy needed to act as virtual inertia support. HESS combines a battery and a supercapacitor, with the supercapacitor handling rapid power fluctuations by acting like inertia, while the battery manages long-term power changes. Additionally, for better power management of HESS, improve particle swarm optimization (MPSO) technique is applied to PID controller for tuning purpose. Both modified and conventional PSO performances were compared. Frequency nadir, zenith, RoCoF is measured at the PCC and used to calculate energy required for inertia support. Real time disturbances are introduced in multiple case studies, restoration time is also considered. Finally, the MATLAB/SIMLINK environment is used to simulate the proposed technique, and its advantages are verified in real-time using OPAL RT 04510.

STIE08-SEE-004

Enhanced Power Quality in Grid Connected EV Charging Systems using ML based Controller

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Keywords: Electric Vehicle (EV), Battery Bank (BB), Bidirectional AC-DC Converter (BADC), Bidirectional DC-DC Converter (BDDC).

Abstract: The field of electric vehicle (EV) technology is expanding quickly. Conventionally, two stage on-board charger is used for light electric vehicle (LEV) charging system. First stage comprises of Bidirectional AC-DC Converter (BADC) and second stage is a combination of the Bidirectional DC-DC Converter (BDDC) & Battery Bank (BB). In this paper, the Machine Learning (ML) based controller is applied to control the DC-Link voltage of Bidirectional AC-DC Converter (BADC). The recursive least squares (RLS) technique is used in the machine learning algorithm. The complete system is designed with the combination of Grid, non-linear (rectifier with RL) load, BADC, BDDC and BB. The notch filter is also used to control AC-DC converter. The problem of distorted source current (i_s) due to non-linear load is improved by the use of AC-DC converter (i.e sinusoidal waveforms are obtained). Battery Bank in an EV operating in Charging mode are charged by the grid. During the Discharging operation mode, the energy stored in the batteries may also be returned to the power grid, assisting in maximum demand savings, load balancing, voltage management, and enhanced system resilience. This paper reflects the extensive simulation work conducted in the MATLAB/Simulink system.

STIE08-SEE-005

Investigating potential ground infiltration and contamination risk by geothermal brine constituents due to geothermal reinjection

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Keywords: Geothermal, reinjection, environment

Abstract

In line with the SDG goals 2030 (item number 7, clean energy), Kenya has greatly pursued geothermal energy, which is widely regarded as one of the cleanest energy sources. While geothermal energy greatly reduces the carbon footprint, there are certain concerns with its level of environmental safety. Particularly, there are reasons to be concerned about the environmental safety of the geothermal brine reinjection processes. This paper presents a review of issues related to geothermal brine reinjection, with a focus on concerns of environmental contamination. Reinjection of used geothermal brine is preferred to surface disposal. The reinjection is done in specific reinjection wells in the field, not only as a safe disposal method but also to recharge the reservoirs. While standard practices such as deep reinjection have been practiced, the process can be delicate, causing early breakthroughs and leakage into the subsurface environment. If this happens, some brine constituents, including dissolved gases, inorganic salts, and trace metals, may leak into the subsurface environment. Indications are that leakage of geothermal brine into the subsurface environment is likely to cause serious water wastage and thermal and hydro chemical pollution of the surrounding environment. This can contaminate the local hydrology, altogether discrediting the “greenness” of geothermal energy. Detailed studies on the reinjection processes are important in identifying possible brine infiltration into the subsurface environment, which goes a long way in identifying gaps and informing the best practices and controls for safer and more environmentally friendly geothermal energy use in Kenya.

STIE08-SEE-006

The Effects of Climate Change on the Attraction Sites: A Case Study of Lake Olbolosat's Desiccation in Nyandarua County.

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Abstract

This research examined the effects of climate change on the tourism sector, case study drying up of Lake Olbolosat in Nyandarua County, Kenya. Lake Olbolosat, the only freshwater natural lake in central Kenya, plays a vital role in supporting the ecosystem and tourist activities of bird watching and nature tourism, which economically boosts the region. Recently, the lake has been experiencing environmental degradation from climate change factors such as high temperatures, fluctuating rainfall,

and dry spells. These climate changes, along with anthropogenic causes such as deforestation and inefficient land use, have further exacerbated the issue by drying out the lake, reducing the lake's capacity to maintain the requisite number of diverse species for tourist purposes. This study focused on the effect of climate change on the attraction sites and the practical solution in relation to that region's economy. For this reason, the research utilized qualitative interviews with local stakeholders. Several significant findings revealed a general decrease in the number of tourists that visited the area due to the extinction of bird species and other wildlife that served as significant tourist attractions. Consequently, affecting other industries dependent on tourism. This research suggests adequate and sustainable climate change adaptation measures to address the negative effects of climate change. This study recommends for incorporating measures such as climate resilience into tourist initiatives, suggested interventions include rewilding, water-saving measures, and afforestation and rewilding. Such findings will improve the existing knowledge base on climate change and tourism dynamics in coastal areas and inform policy approaches to tourism resilience in vulnerable environments.

STIE08-BBH-001

Dietary Practices and the Nutrition Status of Cancer outpatients at Nyeri County Referral Hospital, Kenya; A Cross-Sectional Survey

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Keywords

Dietary Practices, Nutrition Status, Food Frequency Questionnaire, 24-hour recall, Body Mass Index, Malnutrition risk

Abstract

The global burden of non-communicable diseases remains unacceptably high and Kenya is among the countries experiencing an epidemiological transition from the communicable to non-communicable diseases. In Kenya, cancer is the second leading cause of non-communicable disease related mortalities after the cardiovascular diseases and Nyeri County is among the counties that are leading in this burden of non-communicable diseases. This study sought to assess the dietary practices of the cancer patients on chemotherapy at Nyeri County and Referral Hospital in comparison with the recommended dietary practices. Analytical cross-sectional study design was employed and the dietary data was collected using a 24-hour recall and a Food Frequency Questionnaire (FFQ). Sixty one percent of the respondents were female while 39% were male. Sixty one percent had acquired primary school education and half of the respondents survive on a monthly income of between 0-10,000. Breast cancer was the most common cancer type in the population (39%), followed by esophageal and throat cancer at 14.5% and gastric cancer at 14%. Prostate cancer was the most prevalent among the male respondents at 11%. The mean energy intake of the respondents was 1068+- 520 Kcals which was not meeting the required requirements as per the ESPEN clinical guidelines on cancer. The dietary patterns identified from the

research were, excessive consumption of foods from the starchy foods and the fats category (65.1%) and less than half (41.9%) were not attaining the minimum daily requirements of the fruit's servings recommended by WHO. Using the Malnutrition Universal Screening Tool, more than half (51.7%) of the respondents were at a high risk of developing malnutrition, followed by low risk (32.6%) with only 15.7% respondents being at a medium risk of malnutrition. Using the BMI, half of the respondents, (50%) had a normal nutrition status and only 19.8% respondents were underweighted. There is a significant difference between classifying nutrition status of cancer patients using BMI and Malnutrition Universal Screening Tool ($P < 0.05$). Nutrition education and counselling is key in improving the dietary practices among the cancer patients, which in return improves the nutrition status. However, 44.19% had not received nutrition education and counselling regarding the appropriate diet to consume in the course of their treatment. Dietary practices of the cancer patients do not meet the recommended clinical guidelines on cancer nutrition. To improve the dietary practices of the cancer patients, nutrition education and counselling on the appropriate diet and the right proportions has to be enhanced. Social and behavior change is one of the possible strategies that could be adopted to improve the knowledge, attitude and dietary practices and the nutrition status of cancer patients in Kenya.

STIE08-BBH-002

Bionic Implementation for Enhancing Mobility in Crippled Patients a Case Study of Padua Hospital

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Keywords: Bionic Prosthetics, Neural-Controlled Exoskeletons, Neural Interfaces, Biomechanics, Neuroplasticity, Biocompatibility, Musculoskeletal Impairments, Padua Hospital

Abstract

This research delves into the integration of bionic technologies at Padua Hospital to enhance mobility in patients with severe musculoskeletal impairments. The study focuses on the application of bioengineered prosthetics, neural controlled exoskeletons, and advanced neural interface systems. These bionic solutions, which mimic biological functions, aim to restore motor capabilities and offer a significant improvement in the quality of life for patients suffering from limb deficiencies or paralysis. Bionic limbs and exoskeletons harness the principles of biomechanics, robotics, and neural engineering to create devices that interact seamlessly with the human nervous system. By using neural signals and advanced algorithms, these devices offer precise control and feedback, closely replicating natural movement. The study explores the biological integration of these devices, including the biocompatibility of materials, the efficacy of neural interfaces, and the potential for neuroplasticity to enhance device performance. This research also addresses the challenges associated with the implementation of these technologies, such as the complexity of neural signal processing, the need for customized fit and alignment, and the potential for long-term physiological effects. Ethical considerations, including patient consent, data privacy, and equitable access to these advanced treatments, are also discussed.

STIE08-BBH-003

An assessment of the antiproliferative properties of various Kenyan teas against the DU-145 prostate cancer cell line

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Abstract.

Phytotherapy is a promising solution to the challenges posed by cancer treatment. Black, green, and purple teas are renowned for their antioxidant properties, exhibit efficacy against various cancers, including prostate cancer. In this study, we performed Cytotoxic effect evaluation of black, green and purple teas against prostate cancer cell line DU-145. We quantified tea catechins (Epigallocatechin gallate (EGCG), Epigallocatechin EGC, Epicatechin gallate (ECG) and Epicatechin (EC) with high-liquid chromatography (HPLC). This was followed by cytotoxicity analysis of the crude tea extracts against DU-145 prostate cancer cell line at 24hr and 48hrs using Resazurin assay. EGCG appeared the most predominant catechin with 552.2 ± 10.61 (mg/g DW) while EC was the lowest detected with 118.08 ± 9.45 (mg/g DW). Purple tea extract exhibited high antiproliferative activity with IC₅₀ of 98.69 ± 1.99 μ g/ml at 24hr and 91.21 ± 6.91 μ g/ml at 48hr, green tea followed with 121 ± 5.97 μ g/ml at 24hr and 107.1 ± 2.03 μ g/ml at 48hr IC₅₀; black tea was the least effective tea at both 24hr and 48hr with IC₅₀ of 290.8 ± 2.46 μ g/ml and 237.8 ± 5.59 μ g/ml respectively. Our *In vitro* experiment detected a very significant antiproliferative activity of black, green and purple tea crude extracts against the DU-145 cell line. These results indicate that black and green teas exhibited significant levels of catechins purple tea a recent entrant into the Kenyan tea market had even higher levels of catechins makes it a promising potential herbal remedy for combating prostate cancer.

STIE08-BBH-004

Hydrological characterization of sand rivers: -A case study of Enguli ephemeral river in Makueni, Kenya.

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Keywords: Ephemeral sand rivers, Hydrological modelling, HEC-HMS, Water supply potential.

Abstract.

Ephemeral sand rivers are seasonal rivers that flow during and after rainy seasons and, remain dry or with minimal flow during the dry seasons. Enguli sand river is an ephemeral river in Arid and Semi-Arid region (ASAL) part of Kenya. ASAL areas are characterized by relatively low rainfall and prolonged dry periods. Sand rivers have potential to store water in their alluvial aquifers for use during the dry seasons. This research focuses on hydrological characterization of Enguli ephemeral sand river using the HEC-HMS hydrological model to assess the river's potential to adequately supply water for riparian agriculture and domestic use throughout the dry season. This research aims to model event-

based streamflow patterns, infiltration rates and water storage potential of the alluvial aquifers. The research will develop a water balance of the alluvial aquifer in the Enguli river basin and evaluate water available for use during the dry season. HEC-HMS model will be used to analyze the streamflow pattern of the Enguli sand river. The SCS-UH and the Muskingum method within the HEC-HMS model will be used to transform excess rainfall into runoff and model channel flow respectively. Infiltration into the alluvial aquifers will be assessed using the Green and Ampt method available within the HEC-HMS hydrologic model. Data required for hydrological modelling of the Enguli sand river includes historical meteorological and streamflow data (2010 – 2024), geospatial data on digital elevation model and land use land cover data, and field measurement of infiltration and groundwater level (GWL) data. Meteorological and streamflow data from 2010 – 2017 will be used to calibrated the model and 2018 – 2024 will be used to validate the model. The HEC – HMS model performance will be evaluated using the Nash-Sutcliffe Efficiency (NSE), Percent Bias (PBIAS), and RSR ratio of root mean square error to standard deviation.

STIE08-BBH-005

Nutritional and Physico-Chemical properties of Ugali maize flour fortified with chia seeds (*Salvia hispanica L.*)

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Abstract

Fortification of staple foods with nutrient dense ingredients has gained traction as a strategy to improve dietary quality. This study investigated the effect of incorporating whole chia seeds (WCS) and defatted chia seed flour (DCF) into whole maize meal for ugali preparation. Both were incorporated at substitution levels of 3%, 6%, and 9% separately, and the resulting treatments subjected to laboratory analysis. In addition, ugali samples were prepared from all the resulting flour formulations and subjected to consumer acceptability assessment. Incorporation of both DCF and WCS resulted in increased water absorption capacity, swelling index, and swelling capacity. WCS decreased the bulk density and oil absorption capacity. DCF, however, resulted in an increase in bulk density and oil absorption capacity. Both DCF and WCS lowered the lightness (L^*) of the products. The obtained results show the potential of chia seeds as a good fortificant of maize flour since it resulted in nutritionally superior products (proximate composition, essential amino acids and of α -Linolenic acid compared to control). It also improved the water-soluble vitamins composition including: riboflavin, thiamin and niacin. The freshly prepared ugali samples were generally acceptable to the panelists up to 9% WCS and 6% DCF substitution levels.

STIE08-BBH-006

An Age-stratified Model for HIV and TB Co-infection with Optimal Control

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Keywords: Age-stratified, Co-infection; Optimal Control

Abstract

HIV has been identified as a significant risk factor estimated to contribute to TB burden in Kenya. Models formulated for the co-infection have treated the whole population homogeneously while it is evident that susceptibility and effects of treatment vary for different age groups. In this research, an age structured mathematical model for HIV and TB co-infection with optimal management is developed. HIV testing & treatment, tuberculosis prevention & treatment, and viral load suppression are the considered interventions. Runge Kutta method of order 4 & 5 is used to solve the system for its high accuracy and flexibility. Disease free equilibrium, endemic equilibrium and the reproduction number of the model are computed. This research can be used in the Ministry of Health (MOH) for emphasis on most effective interventions as well as a basis study tool that can be recreated for other co-infections.

STIE08-SUB-001

Smart Disaster Response System

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Keywords: Smart Disaster Response, IoT Sensors, Artificial Intelligence, Predictive Analytics, Blockchain Technology, Augmented Reality, Drones and Robotics, Emergency Response

Abstract

This exploration evaluates the potential impact of integrating advanced technologies into a "Smart Disaster Response System." The study investigates how the fusion of **IoT Sensors, AI and Machine Learning, Blockchain, Augmented Reality (AR), Drones and Robotics**, and a **Mobile Application** can transform disaster management. By deploying IoT Sensors to collect real-time data from vulnerable areas, and leveraging AI for predictive analytics and decision support, the system aims to enhance early warning and response capabilities. Blockchain technology would ensure the integrity and reliability of data while facilitating coordination among various agencies. AR could revolutionize emergency response by providing real-time visualizations and simulations for training. Drones and Robotics would offer critical support for damage assessment and search and rescue operations. A Mobile Application would improve communication and alert systems for users. This exploration assesses how these integrated technologies can significantly improve disaster response efficiency, resilience, and overall management, potentially leading to better outcomes and reduced impact in disaster situations

STIE08-SUB-002

Modeling Of Urban Water Demand for Present and Future Use, Using WEAP And SARIMA Models. A Case Study of Siaya Municipality.

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Keywords: Urbanization, Water Demand, Geospatial, Forecasting, Sustainability, Population Growth.

Abstract

Siaya Town, situated in western Kenya, has witnessed a significant surge in population and urbanization over the last three decades. This rapid growth has placed immense pressure on existing infrastructure, particularly water supply systems. To address this burgeoning demand and ensure sustainable water resource management, this study employs a comprehensive modeling and forecasting approach. Utilizing a combination of geospatial techniques, predictive models, and the Water Evaluation and Planning (WEAP) model, we analyzed historical water consumption patterns, identified key drivers of demand, and projected future needs. Satellite imagery, census data, and metered water usage were integrated to create detailed demand clusters and assess spatial variations. The Seasonal Autoregressive Integrated Moving Average (SARIMA) model was employed to forecast water demand up to the year 2030. The findings reveal a persistent upward trend in water demand driven by population growth, urbanization, and changing consumption habits. The town's existing water supply infrastructure is increasingly strained to meet these rising demands. The study highlights the urgent need for sustainable water resource management strategies, including infrastructure improvements, conservation measures, and efficient water allocation. By understanding the drivers of demand and projecting future needs, policymakers and planners can make informed decisions to ensure the long-term sustainability of water resources in Siaya Town.

STIE08-ICT-001

Moderating Effect of ICT Competence on the influence of Work-life Conflict on Job Performance: Evidence from Academic Staff in Public universities in Kenya

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Key words: Work-life conflict, ICT competence, job performance

Abstract

This study sought to determine the moderating effect of ICT competence on the influence of work-life conflict on job performance. The target population was the academic staff of public universities in Kenya on which stratified random sampling was applied on the professors, senior lecturers, lecturers and assistant lecturers to pick a sample of 389 respondents. A descriptive cross-sectional research

design was adopted with a positivist realist research philosophy. Data was collected using self-administered questionnaires which upon piloting was found to have a Cronbach's Alpha Coefficient (α) of $0.805 > 0.700$. The Systems theory was tested in the relationship between work-life conflict and job performance. Descriptive and inferential data analysis was done using SPSS version 26.0 with data being presented in tables and graphs. Hierarchical linear regression analysis was carried out to establish the moderation effect. It was established that work-life conflict had a statistically significant negative influence on job performance ($F(1, 297) = 3.753$), $\beta_1 = -.072$, $p\text{-value} = 0.054 \approx 0.05$). It was further established that the linear regression model which had work-life conflict and ICT competence as the predictors, and job performance as the response variable $F(3, 295) = 5.353$ ($p\text{-value} = 0.005 < 0.05$), $\beta_1 = -0.156$ ($p\text{-value} = 0.002 < 0.05$), $\beta_2 = 0.156$ ($p\text{-value} = 0.009 < 0.05$) was statistically significant. Also, the linear regression model which had work-life conflict, ICT competence and interaction term between work-life conflict and ICT competence as the predictors, and job performance as the response variable $F(3, 295) = 5.529$ ($p\text{-value} = 0.001 < 0.05$), $\beta_1 = -0.591$ ($p\text{-value} = 0.002 < 0.05$), $\beta_2 = -0.450$ ($p\text{-value} = 0.085 > 0.05$) and $\beta_3 = 0.142$ ($p\text{-value} = 0.017 < 0.05$) was statistically significant. Finally, it was established that ICT competence had a statistically significant moderating effect on the influence of work-life conflict on job performance ($\Delta R^2 = 0.018$, $\Delta F = 5.711$, $p\text{-value} = 0.017 < 0.05$). This study recommends that public universities invest in building ICT infrastructure, expose academic staff to knowledge of ICT, cultivate ICT skills in them as well as sensitize them on the need to have a positive attitude towards ICT use as they discharge their duties for improved job performance.

STIE08-ICT-002

Evaluating U-Net Variants for Medical Image Segmentation

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Keywords: Medica Image Segmentation, U-Net variants, Brain MRI, Breast Ultrasound, ResUNet.

Abstract

U-Net convolutional neural networks have become a cornerstone in medical image processing, particularly for complex segmentation tasks. However, with the proliferation of various U-Net variants, it is imperative to evaluate their performance across diverse medical datasets to determine the most suitable architecture for specific applications. This study presents a comprehensive comparative analysis of six U-Net variants namely; U-Net, U-Net++, ResUNet, TransUNet, V-Net, and U-Net 3+, focusing on their effectiveness in medical image segmentation. The research used two publicly available medical image datasets: the Breast Cancer Ultrasound dataset and the Brain MRI dataset. These datasets were selected to represent a range of challenges in medical imaging, including varying levels of noise, contrast, color channels, and lesion visibility. Each U-Net variant was trained and evaluated under consistent experimental conditions, with the Dice Similarity Coefficient (DSC), Jaccard Index also known as Intersection Over Union (IOU), and accuracy serving as the primary evaluation metrics. The findings reveal that while all U-Net variants exhibit strong performance,

ResUNet consistently outperformed other architectures across both datasets. Specifically, ResUNet achieved the highest Jaccard Index and DSC values, recording 0.5158 and 0.5930 for the Breast Cancer Ultrasound dataset and 0.7923 and 0.8730 for the Brain MRI dataset, respectively. Additionally, ResUNet demonstrated the highest accuracy of 96.20% in the Breast Ultrasound dataset and emerged as the first runner-up in the Brain MRI dataset with an accuracy of 99.70%, trailing slightly behind U-Net++, which achieved 97.72%. Conversely, U-Net 3+ registered the lowest performance in both datasets. ResUNet's superior performance suggests that its residual connections enhance feature propagation and mitigate the vanishing gradient problem, leading to better segmentation outcomes. U-Net++ excelled in capturing complex structures in the Brain MRI dataset, slightly outperforming ResUNet in accuracy. This can be attributed to the dense skip connections of the architecture. Conversely, U-Net 3+ showed lower performance, indicating that complexity doesn't always equate to better results. This study offers insights into the strengths and weaknesses of different U-Net variants, guiding practitioners in choosing the most suitable model for their specific applications especially in medical image processing domain.

STIE08-EIS-001

Assessing Technological Integration of National and Contextual Policies in Supporting Continuity of Start-Up Ecosystems in Kenya

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Keywords: entrepreneurial, start-up, investment, ecosystem, technology, policies, economic growth, harmonization innovation diffusion theory.

Abstract

Given the high levels of unemployment, entrepreneurial culture has been on an upward trend, which has led to a significant increase in new startup registrations, estimating a twenty-five percent (25%) rise since 2023. In the first half of 2024, Kenya start-up attracted a third of the total investment directed towards African start-ups, despite an overall decline in venture funding for the continent. According to data from Africa: The Big Deal, start-ups across Africa raised a total of \$780 million during this period. Further, investment rates have shown a considerable trajectory, reaching approximately \$250 million in 2024, an increase from the previous year's \$180 million. The incorporation of digital solutions by 75% of startups is attributed to the high adoption of technology within these ventures. Despite this technological recognition, it is important to acknowledge that the country's national policies are not tailored to specific contextual regions. The optimism surrounding growth projections in the startup ecosystem is continuously threatened by Kenya's dynamic and conflicting policy environment. The primary concern revolves around how we can leverage technology to develop a reliable policy harmonization system that encourages the continuity of startups within the promising ecosystem. The absence of a coherent system for aligning national and regional policies poses

challenges in addressing the distinctive needs of various regions and sectors, potentially hindering sustainable growth. This study aims to assess the technological integration of national and contextual policies in supporting start-up ecosystems in Kenya. To achieve this, the study will pursue specific objectives, including (a) examining the nature of the startup ecosystem in Kenya, (b) assessing the influence of technological integration on national and contextual policies in supporting the startup ecosystem in Kenya, and (c) evaluating the effectiveness of national and contextual policies in supporting the startup ecosystem in Kenya. This study will adopt a mixed-methods research design, integrating quantitative data that will be obtained from surveys and secondary data analysis on startup growth and technology adoption. On the other hand, qualitative data will be obtained through interview sessions with key stakeholders within the ecosystem, including successful entrepreneurs, technological experts, and government officials. The theoretical framework is based on the innovation diffusion theory, which will explain and contextualize how technological advancements spread and influence startup dynamics. The study reveals that while Kenya's regulatory environment supports technology-driven ventures, inconsistent regulations create obstacles for startups, especially in non-tech sectors. Access to capital remains a significant challenge, with many startups facing difficulties securing funding outside of Nairobi. Further, the study suggests that the government should streamline regulations through tech-driven policy harmonization systems to create a stable, predictable environment that fosters both tech and non-tech sectors

STIE08-EIS-002

Revolutionizing Last-Mile Delivery: A MaaS Approach with Electric Quad Bike cycles

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Keywords: sustainable delivery, Scalability, Mobility as a service (MaaS), Urban Logistics, Cargo Capacity, last mile delivery, micro-mobility solutions

Abstract

Traditional delivery vehicles contribute to traffic congestion and emissions in metropolitan areas. This study investigates the possibilities of electric quad bikes combined with a Mobility as a Service (MaaS) model to revolutionize last-mile delivery. The article delves into the challenges of last-mile logistics and the increased interest in MaaS and micro-mobility solutions. It investigates the potential of electric quad bikes for delivery, considering existing electric quad manufacturers and their specifications. The study looks at the potential benefits of a MaaS approach for electric quad bikes, including cost-effectiveness, scalability, and environmental sustainability. It then delves into the challenges of implementing MaaS on electric quad motorcycles, with an emphasis on regulations, infrastructure requirements, and battery swapping/charging. More study on optimizing electric quad MaaS for last-mile delivery. The paper contributes to the ongoing discussion of sustainable and effective urban logistics by offering an innovative approach that transforms last-mile delivery using electric quad bikes and MaaS.

STIE08-EIS-003

Entrepreneurship, Innovation and Startup Eco-Systems for National Development in Kenya

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Key words: Entrepreneurship, Innovation, Startup Eco-Systems, National Development

Abstract

Rapid socio-economic development in history has often been driven by entrepreneurship, as evidenced in the Industrial Revolution in Europe. China strategically shifted towards a more market-driven economy in the late 20th century. The link between entrepreneurship and economic development is evident in increased output, income and societal transformation. Entrepreneurs drive innovation, rendering old ways obsolete and advancing development. A successful national start up ecosystem is vital for achieving national goals, requiring a shared vision and collaboration among stakeholders. Entrepreneurship provides employment opportunities to many people, thereby enhancing national development. At the same time, innovation supports entrepreneurs and promotes success in startup ecosystems. Entrepreneurship creates a central hub for stakeholders to exchange ideas, brainstorm innovate new products. Innovation hubs are facilitators of innovative projects and intentional communities, encouraging random linkages and collaborations. Enterprises are dynamically shifting towards sustainable practices, with hybrid organizations emerging to pursue diverse objectives including environmental, social and economic goals. Entrepreneurship, innovation and startup ecosystems are vital for national development due to their ability to create jobs, distribute income and develop technological capabilities in an enabling business environment. The Government of Kenya supports entrepreneurship through policies, infrastructure development and financial support. However, despite efforts to alleviate poverty and unemployment through entrepreneurship, many enterprises fail or stagnate. There is an urgent need to examine entrepreneurship, innovation, startup ecosystems and national development. This paper assesses how each of these elements contribute to national development. A theoretical underpinning of the study is highlighted and a conclusion made.

STIE08-EIS-004

Effect Of Diversification Strategies on The Market Performance of Small and Medium-Tier Deposit-Taking Saccos in Kenya

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Abstract

Purpose: The research aimed to evaluate the effect of diversification strategies on the market performance of small and medium-tier deposit-taking SACCOs in Kenya.

Design/ methodology/ approach: The study employed a positivist philosophy and acceded to descriptive research design. A census was conducted; data was collected using questionnaires physically or electronically allotted to the key respondents' CEOs. Data analysis employed descriptive and inferential statistics to deduce the characteristics and significance of the relationships among variables. The inferential analysis provided correlation and regression outputs showing the variables' relationships and predictions. The inferential analysis gave rise to simple regression models and multiple linear regression with models such as R-square (R²), Anova statistics (F-statistics and P-value), the regression coefficient of Beta statistics (β), t-value, and p-value. **Findings:** The study revealed a robust positive linear correlation between diversification strategies ($\beta = 0.179$, $p=0.000$) and market performance, signifying that these strategies account for a considerable portion of the market performance variance. Therefore, the study concluded that diversification strategies are crucial in enhancing the market performance of small and medium-tier deposit-taking SACCOs in Kenya.

STIE08-EIS-005

Effluence of Entrepreneurial Opportunities and Economic Sustainable Growth of the Boda-Boda Industry in Murang'a County, Kenya

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Keywords: Entrepreneurial Mindsets, Motorcycle Industry, Economic Development

Abstract

Motorcycle businesses play a key role in poverty alleviation when run on the basis of entrepreneurial opportunities. This research study was carried out in rural population of Murang'a county, Kenya. The study aims to provide relevant insights into how the boda-boda service business has influenced growth sustainability towards the economic development of Murang'a county. The research investigates the entrepreneurial opportunities and the growth sustainability of motorcycle industry for economic development in Murang'a County. The specific objective of the study was to examine the relationship between entrepreneurial mindsets and the economic sustainable growth of Boda-Boda industry in Murang'a County. The study was supported by dynamic capabilities theory. A cross-sectional survey methodology was utilized which incorporated qualitative and quantitative research methods. The descriptive research design was adopted to explain the interaction between the determinant variables and entrepreneurial opportunities on the economic sustainable growth. Questionnaires were used to collect the data and analyzed using descriptive statistics and regression analysis. During the selection of the sample, particular attention was paid to age, gender, education, income, household and

community. Stratified sampling technique was employed to obtain 359 motorcycle riders from 3500 licensed riders by the seven selected sub-counties in Murang'a county namely; Mathioya, Kangema, Kiharu, Kandara, Maragua, Gatanga and Kigumo sub-counties. The findings indicated that entrepreneurial mindsets had a positive and significant influence on the economic sustainable growth. This was supported by a significant level of ($\beta=.302, P <.000$). The study came to the conclusion that entrepreneurial mindset helps motorcycle industry to sustain growth for economic development in Murang'a, Kenya. The study suggested that motorcycle riders should focus more on creativity, entrepreneurial alertness and propensity in risk-taking respectively.

STIE08-EIS-006

Portfolio optimization and dependence modelling of financial assets using GARCH-EVT-Copula-CVaR Models

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Keywords: EVT, GARCH, GARCH-EVT-Copula, CVaR portfolio optimization.

Abstract

In today's volatile financial environment, creating an optimal investment portfolio requires advanced models that can effectively consider market fluctuations and extreme events. Conventional portfolio optimization models often struggle to fully capture the complex interactions and dependence structure of market volatility, extreme events, and the dynamic relationships between assets. This study utilizes an innovative approach to optimizing financial asset portfolios, with a focus on stock indices, exchange rates against the US dollar, and commodities. This approach uses Conditional Value-at-Risk (CVaR) as the primary risk measure, which is increasingly recognized as a superior metric for assessing the severity of losses beyond typical Value-at-Risk (VaR) measures, making it especially valuable for managing downside risk in uncertain environments. The study integrates three methodologies into a comprehensive risk management framework. First, it employs Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models to capture time-varying volatility, allowing for more accurate modelling of asset price dynamics. By incorporating Extreme Value Theory (EVT), the framework is further enhanced to focus on the tail behaviors of return distributions, which is essential for understanding extreme market movements. Copula functions are then used to model the complex, often non-linear dependencies between assets. These dependencies, particularly during periods of market turbulence, can significantly impact the overall risk of a portfolio, highlighting the importance of modelling correlations with precision. The integration of the three methodologies creates a robust system for assessing and managing financial risk. The empirical analysis is based on a dataset consisting of four stock indices, three exchange rates against the US dollar, and two commodities. Among the models tested, the EGARCH-EVT framework, in conjunction with the regular vine copula

approach, demonstrated superior performance in optimizing asset allocation. This approach was especially effective in capturing the tail risks while simultaneously modelling the dependencies between assets with greater accuracy than traditional linear correlation models. The empirical results demonstrate that the integration of GARCH, EVT, and Copulas within the CVaR framework significantly improves portfolio risk management. By capturing both the volatility clustering and extreme tails in financial returns, as well as the intricate dependencies between assets, the model offers a more resilient approach to portfolio optimization. The study demonstrates that the combined use of GARCH-EVT-Copula models, with CVaR as the guiding risk metric, offers a substantial improvement over traditional methods of portfolio optimization. By focusing on the accurate modelling of tail risks and asset dependencies, the framework provides a more comprehensive understanding of the risks inherent in financial markets. This is especially pertinent for financial analysts, portfolio managers, and investors looking to navigate increasingly uncertain market conditions. This approach also enhances the reliability of portfolio allocation decisions and equips investors with the tools needed to manage risk more effectively in times of market stress.

STIE08-ETS-001

Advancing Critical Thinking in STEM through Integrated Project-Based Learning and Technological Solutions

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Keywords: Project-Based Learning, Critical Thinking, STEM Education, Educational Technologies, Virtual Labs, Game-Based Learning, Reservoir simulation.

Abstract.

Project-Based Learning (PBL), when integrated with modern educational technologies, has emerged as a potent approach to enhancing critical thinking skills in STEM education. This paper investigates the effectiveness of technology-enhanced PBL across various engineering disciplines through four case studies. We analyze a robotics project in mechanical engineering, where students use CAD software and microcontroller programming to design and build functional robots. In chemical engineering, virtual labs enable students to simulate complex chemical processes, facilitating experimentation and deeper theoretical understanding. The third case study explores game-based learning in electrical engineering, employing interactive simulations and platforms like Circuit Lab and Arduino. Lastly, we include a case study on petroleum engineering using reservoir simulation software such as MATLAB, Eclipse, and OPM, focusing on pressure distribution simulation using Python. The results reveal that technology-supported PBL not only boosts engagement and comprehension of complex engineering concepts but also cultivates essential critical thinking skills. Despite its potential, challenges such as limited access to digital tools and the need for specialized faculty training persist. The paper proposes strategies for effective implementation of technology-enhanced PBL and advocates for further research into its long-term impacts on engineering education.

STIE08-ETS-002

Innovative Teacher Development Practices: Challenges and Opportunities.

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Key words: globalization, innovative, pedagogy, equity, adoptable

Abstract

As the world moves towards globalization, there is an increased demand for effective and adaptable educators who can fit into the current technological world. The article reviewed literature on the emerging approaches to teacher development practices that go beyond the traditional methods. The critical review aims to provide an understanding of the complex interplay between innovation, challenges and opportunities available in repackaging the teacher and his/her practice. The review delves into various innovative teacher development practices and how they influence teacher efficiency, instructional methods and overall job satisfaction. The article was guided by the technological pedagogical content knowledge (TRACK) framework, which emphasizes technology integration in the practice of teaching. The review established that teachers are resistant to change and that there were challenges of balancing innovation with established pedagogical principles. There were also disparities in access to innovative teacher development opportunities. Although there are opportunities presented by innovative teacher development practices, there is need to develop programs that can enhance student's outcomes and cultivate a dynamic and responsive teaching community. The review underscores the role of technology, collaboration and tailored professional learning experiences in fostering a culture of continuous improvement among the teaching profession. The article recommends that policymakers and education stakeholders should embrace innovative and sustainable ways of enhancing equitable access to education. Educators can be supported and prepared through effective strategies in the evolving educational landscape.

STIE08-ETS-003

Challenges And Opportunities of Virtual Learning in Higher Education Institutions in Kenya.

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Keywords: virtual learning, challenges, opportunities

Abstract

Virtual learning has received traction in the recent years especially with the advent of information technology. In addition, many institutions of higher education adopted online learning during and post the COVID 19 pandemic. It has emerged to be a very important means of delivering knowledge across borders at the touch of the button. However, with its advent, some challenges have been noted. This paper seeks to examine how virtual learning has been used in higher education in Kenya. It seeks to highlight the challenges faced in the virtual classroom, from the perspective of the lecturer and the

opportunities that exist to better the experience. The paper critically analyzed the various empirical literature that exist coupled with the experience gathered by the lecturers. It was established that among the main challenges include technological hitches, struggle to adjust pedagogically, difficulties with assessments, social isolation and difficulties in workload management. These challenges create an opportunity for distance learning that is well-designed and thought out. A hybrid way of teaching is recommended to utilize the advantages of virtual learning to solve some of these challenges.

STIE08-ETS-004

Developing a Predictive System for Student Success: Using Random Forests to Forecast Performance and Reduce Student Attrition

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Keywords: student performance, reduce attrition, predictive analytics, random forest algorithm

Abstract

Student performance in higher education is shaped by a complex interplay of psychological, personal, and environmental factors. This research aims to analyze student data collected over the course of a semester to predict academic success in future semesters using data science and machine learning techniques [1]. Data science provides the tools to extract insights from large datasets, while machine learning allows for predictive modelling and data-driven decision-making [2]. The study is motivated by the need to reduce attrition and underperformance, and to develop early intervention strategies that support struggling students. Considering the declining enrolment in bachelor's degree programs, this research seeks to provide institutions with a robust, data-driven approach to enhancing student retention and graduation rates [3]. By developing a predictive model based on relevant features, the study aims to optimize university resources, promote timely intervention, and foster a more inclusive and effective learning environment [4]. The goal is to improve student success while enhancing the quality and integrity of educational programs. Data collection and pre-processing, feature engineering, model selection, and predictive analytics form the backbone of this project, which strives to use data to drive both student and institutional success. Ethical considerations, such as fairness and privacy, are also integral to the model's design. Through these efforts, the research will contribute to improving educational outcomes in higher education.

STIE08-ASF-001

Influence of Rainfall Trends and Land Cover Change on Hydrological Response of a Watershed for Sustainable Food Security

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Key words: rainfall trends, land cover changes, hydrologic response, food security

Abstract

Globally, rainfed agriculture is the main economic activity that sustains human life. However, climate change and anthropogenic activities have resulted in rainfall variability and land cover changes that have threatened the sustainability of agricultural activities in many watersheds. The objectives of this study, conducted at Zaaba watershed in western Kenya, were to determine trends in rainfall for 1991 to 2020; to establish land cover changes for 2001 to 2020 and to determine hydrological response of the watershed to rainfall variability and changes in land cover. Rainfall data was sourced from Kenya Meteorological Department, Land cover data was downloaded from USGS website <https://www.earthexplorer.usgs.gov/> while qualitative interviews, Focus Group Discussions and questionnaires were used to determine factors influencing hydrologic response like encroachment into forested, riparian and the steep slope areas. Data analysis involved trend analysis of rainfall data and detection of change in land cover, computation of totals, percentages and drawing of tables, graphs and charts. Regression analysis determined the correlation between land cover changes and variability in quantity of water. Rainfall trends existed at $\alpha = 0.05$ in which MAM season had a declining trend with p -value = 0.043 and Kendall slope = - 0.030 while OND season had increasing trend with p -value = 0.046 and Kendall slope = 0.136. Annual rainfall had an increasing trend with p -value = 0.010 and Kendall slope = 0.503. The study found that agricultural area decreased from 50.05% in 2001 to 41.07% in 2011 and 32.8% in 2020 as buildup areas increased from 5.06% in 2001 to 9.29% in 2011 and 17.68% in 2020 while riparian area decreased from 5.18% in 2001 to 1.18% in 2011 and 0.87% in 2020. The changes were attributed to increased population, expansion of urban centers and encroachment into riparian and forested areas and eventually resulted in variation in quantities of water resources available and reduction in size of cultivable land. The study recommended for capacity building for citizens to protect riparian and forested areas for agricultural productivity and sustainable food security.

STIE08-ASF-002

Surface runoff and soil erosion from *Nitisols* and *Ferralsols* as influenced by different soil organic carbon levels under simulated rainfall conditions.

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Keywords; Rainfall simulator, Sediment concentration, Surface runoff, Agricultural productivity, Soil organic carbon

Abstract

Soil erosion poses a challenge to the environment and the sustainable use of natural resources, particularly in relation to agricultural production. The study aimed to assess the influence of different soil organic carbon (SOC) levels on runoff and soil erosion under varying levels of rainfall intensity. The study was conducted in pre-selected farmers' fields representing low, moderate and adequate SOC

levels in *Nitisols* and *Ferralsols*. Two parallel experiments were set up in each type of soil using a split-plot layout arranged in Randomized Complete Block Design. The main plots were the different soil organic carbon levels while the sub-plots were the different simulated rainfall intensities. Rainfall simulation was then conducted to determine runoff and sediment losses on each soil type. The simulation was done using a land type sprinkler nozzle rainfall simulator (460 788 type) in an experimental plot of 1 m², fenced with corrugated iron sheets with a small opening left for runoff collection. Runoff and sediment losses were determined from the volume collected in the jar. The data was subjected to analysis of variance and significant mean differences were determined using Tukey's Honest Test at a 95% confidence level. Pearson correlation was applied to assess the relationship between runoff volume and sediment loss. The results showed that *Ferralsols* recorded significantly higher runoff and sediment losses compared to *Nitisols*, by 60.27% and 53.14% respectively. However, adequate SOC level portrayed a significant effect in reducing erosion in both soil types, where it reduced runoff and sediment loss by 45.30% and 48.38% in *Ferralsols* and by 65.31% and 48.22% in *Nitisols*, respectively. In both soil types, runoff yield was positively correlated to rainfall intensity while sediment yield was inversely correlated with SOC levels. Therefore, the study recommends incorporation of organic matter to adequate levels in both soils, for reduced soil erosion

STIE08-ASF-003

Evaluation of the Mineral Composition of Chia (*Salvia hispanica* L.) Seeds from Selected Areas in Kenya

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Keywords: chia, elements, fortification, minerals, performance, seed

Abstract

Chia (*Salvia hispanica* L.) seeds are gaining popularity among consumers and food processors, particularly in food fortification. Consequently, there has been an increased need to determine the mineral composition of chia seeds cultivated in different regions to ascertain their potential in various food applications. In this study, 20 chia seeds samples obtained from farmers practicing commercial farming of chia seeds in selected areas in Kenya during the two main chia seed planting seasons (April-August 2019) and (September-December 2019) were analyzed for their mineral content using Atomic Absorption Spectrophotometry (AAS). Values of sodium and potassium were determined using a Flame photometer using sodium chloride (NaCl) and potassium chloride (KCl) as the standards, while phosphorus was determined using the Vanado-molybdate method. Chia seeds samples studied revealed the most predominant minerals as phosphorus (531 to 889 mg/100g), calcium (478 to 589mg/100g), potassium (343 to 526mg/100g) and, magnesium (322 to 440mg/100g). The general linear model (GLM) used to determine the coefficient of variation on all chia seed growing sites showed that calcium, iron,

and magnesium are the best-performing chia minerals in Kenya and hence should be the minerals of interest in food fortification using chia seeds.

STIE08-ASF-004

Quality Characteristics of Arabica Coffee Cherries and Beans from Farmers affiliated to Selected Coffee Cooperative Societies in Embu County, Kenya

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Keywords: coffee, arabica, cherry, bean, quality, cupping

Abstract

Coffee cup quality has a direct impact on farmers' income and livelihoods because of its critical role in the determination of pricing at the auction marketing system. Due to the aggregation of coffee during primary processing limited information is available on individual farmer coffee cherry and bean quality performance. This study aimed to evaluate the recovery of parchment, milling loss, premium grade distribution, defects, and cup quality profile of coffee cherry samples (n=158) obtained from selected coffee farmers affiliated with Kithungururu and Kagaari North farmers' cooperative societies in Embu County. From the results, the parchment recovery levels of most of the coffee samples (65.2%) were above the recommended 20% parchment recovery levels, whereas 34.8% of the coffee samples were slightly below the recommended levels. The milling losses of the majority of the coffee samples (84.2%) were below the recommended 20% of the milling loss limit, whereas 15.8% of the coffee samples were above the 20% limit. In terms of premium quality, 75.3% of coffee samples exhibited premium quality distribution 80% score. Half (50%) of the coffees showed minimal defects which accounted for 5% and below of the samples. The minimum defect count recorded in the samples was approximately 1% of the coffee samples as compared to the highest of 29% in another sample. In terms of cup quality, 62.7% of the samples exhibited best cups with 70% and above scores of the assessed attributes while the lower quality cups (<70%) were 37.3% of the total samples. In conclusion, most of the coffee samples were classified as premium grades mainly based on grade AA and AB distribution. The defects in the coffee samples were mainly linked to farm practices and had substantially affected the cup quality.

STIE08-ASF-005

Flooding Risk on Riparian Agriculture in Alluvial River System: A Case Study of Olkeriai River System in Kajiado County, Kenya

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Keywords: Flooding, HEC-RAS, socio-economic impacts, alluvial rivers

Abstract

Flooding in alluvial river systems presents significant risks to riparian agriculture, particularly in arid and semi-arid regions like Kajiado County, Kenya. These river systems are dynamic, with flood events caused by intense rainfall or changes in land use, leading to the deposition of sediments and widespread inundation of agricultural lands. The Olkeriai River, a key resource for local communities, experienced severe flooding in 2023, highlighting the need to understand and manage flood risks to protect agriculture and livelihoods in this water-scarce region. Given the reliance on riparian agriculture for both livelihood and economic stability, this study is vital for identifying flood drivers and developing effective mitigation strategies. The objectives of this study include: (1) to evaluate the environmental, climatic, and human factors influencing floods in the Olkeriai River system, (2) to model the flood extent of the 2023 event using HEC-RAS through steady and unsteady flow analysis, (3) to assess the socio-economic impacts of the 2023 flood on riparian agriculture, and (4) to predict the behavior of floods under various mitigation scenarios using HEC-RAS and recommend sustainable flood management solutions. In this study, we utilize hydraulic modelling through HEC-RAS to simulate the 2023 flooding, using rainfall, river discharge, and topographical data as model input data to generate flood extent maps. Field surveys and interviews will capture the socio-economic impacts of the flood on agriculture, infrastructure, and incomes. Various mitigation scenarios such as riparian buffer zones and retention basins will be modelled to predict their effect on flood behavior and propose the best mitigation strategies. The expected outcomes include identifying flood-prone areas, providing socio-economic impact assessments, and recommending flood management strategies that enhance agricultural resilience. This research will offer critical insights for local authorities, policymakers, and agricultural stakeholders in managing flood risks and supporting sustainable riparian agriculture in Kajiado and other similar regions.

STIE08-ASF-006

The Green Thumb Movement at the Centre for Food Safety and Naturopathy

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Abstract

The Green Thumb Movement promote nutrient dense agriculture through organic farming of indigenous and exotic fruits, vegetables and herbs that can be incorporated into existing diets to improve nutrition and health at household level. The team comprises persons enthusiastic with farming through sustainable methods that can fit in to local set up. Engaging youths to learn as they participate to promote productivity in agriculture is not just necessary, it is critical. Knowledge driven agricultural production needs to now be nurtured for local consumption and industry for agricultural transformation that is inspired through a formidable structure, strategy and systems. Empowerment of the youth uplifts the livelihood of majority resource poor persons living in Africa. The GTM has come up with noble ideas that promote the cultivation and consumption of healthy foods at household levels to boost food-nutrition security and the economic status of the youth. This project directly responds to the Big Four

Agenda of the President on food security, and, Sustainable Development (SDG) Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Conversely, despite the expansion of the education systems, youth unemployment in Kenya has reached alarming proportions, creating a dire need to develop personnel with technical skills thus promoting small business enterprises. Majority of the youth lack knowledge on how to utilize the locally available resources to earn a living and therefore spend plenty of their time idling. The empowerment of these youth is therefore paramount to uplift their livelihood through profitable agriculture enterprises

STIE08-ASF-007

The Physico-Chemical, Functional and Sensory Properties of Rice-Base Complementary Porridge Flour Fortified with Dried Yacon Root and Oyster Mushroom Powder.

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Abstract

Malnutrition remains a pressing issue in child health, particularly in developing regions where dietary diversity may be limited. This study aimed at developing a nutrient-rich complementary flour by fortifying rice flour with dried yacon root and oyster mushroom powder. The inclusion of yacon root, a source of prebiotic fructooligosaccharides, and oyster mushroom, known for its high protein, fiber and bioactive compound content, was hypothesized to enhance the nutritional and functional profile of traditional porridge flours. The primary objective of the research was to analyze the physico-chemical, functional and sensory properties of rice-based porridge flour fortified with dried yacon root and varying levels of oyster mushroom powder. The study aimed to determine the potential of this fortified porridge flour as a nutritious and sensory acceptable complementary food for young children. Physico-chemical analysis including proximate composition, color, and water-holding capacity, were conducted on the fortified flour. Functional properties, such as solubility and gelation were evaluated to understand the flours suitability for children consumption, sensory evaluation was performed to determine consumer acceptability, focusing on parameters such as taste, texture, aroma and overall preference. Fortification with yacon root and oyster mushroom powder significantly improved the protein and fiber content of the porridge flour, while also enhancing its prebiotic potential. The functional properties were notably impacted with increases in water holding and swelling capacities, which may improve digestibility and satiety. Color changes were observed due to fortification, with a slightly darker hue from oyster mushroom addition but this had a minimal effect on consumer perception. Sensory evaluation indicated that the porridge was generally acceptable with the 70:30 formulation balancing nutrition with taste, texture and preference. The rice-based complementary porridge fortified with dried yacon root and oyster mushroom powder offers a promising, nutrient-dense option for young child feeding. The study findings suggest that such a fortified product can potentially address nutritional deficiencies with a favorable balance between sensory qualities and nutritional value. Further studies could expand on long-term storage stability to confirm its suitability for large-scale production and distribution in areas with high rates of child malnutrition.

STIE08-ASF-008

Nutritional And Physicochemical Properties of Oyster Mushroom (*Pleurotus Ostreatus*) And Sorghum-Pearl Millet Based Composite Flour.

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Abstract

Due to over-reliance on starchy staple foods in Kenya, Micronutrient deficiency (MD) and Protein Energy Malnutrition (PEM) are the major nutritional concerns. Despite these foods being characterized by low nutrient densities, they are still used as main food ingredient especially in making porridges. The government has targeted use of chemical fortificants in flours in order to combat this problem, although it has been found to be a short-term strategy because its expensive. Therefore, the need for a sustainable and long-term strategy like food-to-food fortification. This research aimed at a more sustainable and better approach by fortifying sorghum- millet flour with oyster mushroom. The study intended to formulate sorghum-pearl millet composite flour fortified with oyster mushroom and further evaluate its physicochemical, nutritional, rheological, pasting properties, shelf-life stability and consumer acceptability. First, sorghum and pearl millet were soaked then solar dried followed by milling into flour. Oyster mushrooms were also solar dried and milled. Subsequently, oyster mushroom was added at 10%,20%,30%,40% and 50% to form the composite flours. Proximates: crude protein, moisture content, crude fat, crude fiber, ash, carbohydrate was determined using standards methods; EC 152/2009. Inductively Coupled Plasma Optical Emission Spectroscopy and Ultra Performance Liquid Chromatography Ultraviolet Spectroscopy/Mass Spectrometry were used for mineral and vitamin analyses, respectively, fatty acid content using gas chromatography, amino acid: UPLC, color: chroma meter, RVA and rotational rheometer was used in pasting and rheological tests respectively. Protein content of the composite flours increased from 11.15% - 19.74%, and there were significant increases in fiber (2.68%-10.66%) and ash (1.38%-5-79%). Lysine, mineral content as well as vitamins content (B1, B2, B3, B6 and B9) improvement was also observed. Oil absorption capacity, water absorption capacity, swelling index and swelling capacity, L*, b*, chroma, hue increased while bulk density and a* decreased with increase in oyster mushroom substitution. Pasting parameters decreased while the pasting temperature increased. Dynamic rheological tests showed a distinctive gel like character (storage modulus) $G' > G''$ (loss modulus) meaning the elastic behavior dominated over the viscous behavior. Sensory analysis showed relatively moderate overall acceptance of thin porridges, although the acceptability decreased with the increase in oyster mushroom; composite flour with 50% oyster mushroom was rich in most of nutrients but it had the lowest scores for the sensory attributes.

In conclusion, addition of oyster mushroom increased the overall nutritional composition of local cereal based staple foods an indication of potential solution to PEM and MD.

STIE08-ASF-009

Yacon (*Smallanthus sonchifolius*): a source of fructooligosaccharides, phenolic compounds with antioxidant activity and low glycemic index.

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Keywords: Yacon, glycemic index, fructooligosaccharides, antioxidants

Abstract

Yacon (*Smallanthus sonchifolius*) is an Andean crop that grows at altitudes of 1000 – 3200m above sea level. It is sweet tasting tuber belonging to the botanical family of Asteraceae, it originates from the Quechua language meaning 'water without taste'. It is grown in South American countries such as Colombia, Peru, Ecuador, Bolivia, Argentina and Brazil. The roots of the fruit can be white, cream, white with purple striations, purple, pink, yellow and its skin can be brown, pink, violet, cream or ivory white. This present review aims to broaden discussions on the functional properties of yacon, *Smallanthus sonchifolius*. It contains bioactive compounds such as fructooligosaccharides (FOS) and is therefore considered prebiotic with a favorable effect on consumer health. The FOS content can amount to 40-70% of dry matter and within this FOS; inulin is important which can reach the value of 20%. The fructooligosaccharide in yacon is not digestible by the human enzymes thus after consumption it is selectively fermented in the colon by a group of bacteria mostly, *Bifidobacterium*, thus a prebiotic. It modulates the intestinal microbiota thus facilitating the exclusion of potential pathogens by competition and modulating the immune system increasing defenses of the host. Phenolic compounds, mainly chlorogenic acid (caffeine-kinase) and other caffeic acid derivatives, are responsible for yacon's antioxidant properties. Chlorogenic acid are chemical compounds with antioxidant properties since they prevent the oxidation of biomolecules by reacting with unstable atoms or molecular structures, such as free radicals. These antioxidant properties are related to the prevention of degenerative diseases for example cancer. Snack formulations with higher fractions of yacon flour showed higher amounts of slowly digestible starch and resistant starch, these are beneficial because they are linked to the ability to promote satiety, minimize postprandial insulin secretion and minimize the risk of cardiovascular diseases and diabetes. However, yacon has two disadvantages, its high aqueous content >80% and the high activity of the polyphenol oxidases which makes it a highly perishable product with difficulties in preserving its properties during drying and storage processes, which has limited its application.

STIE08-GRS-001

Assessment and Prediction of the Effects of Soil Degradation on Agricultural Land Using Multi-Models Approach

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Keywords: Soil degradation, Agricultural land, Soil nutrients, Economic decline, Food security, Environment.

Abstract

A significant environmental problem that threatens many nations is soil degradation, which puts global food security and ecosystem sustainability in jeopardy. Soil degradation is a component of the land degradation process that describes a reduction in soil productivity and quality which can occur through the displacement of top soil through wind and water erosion and tillage. The most common form of environmental destruction is soil deterioration, which poses a constant menace to the natural equilibrium of the soil hence reducing agricultural productivity, food scarcity, malnutrition and economic decline in countries that rely on agricultural support. This research focuses on assessing and predicting the effects of soil degradation on agricultural land using multi-model approach within Enkare Narok watershed whose major rivers are the Narok river and Ewaso Ng'iro. The datasets used include the satellite images for the years 1986,2002,2012 and 2022. The satellite images were used to determine the land use and land cover within the watershed, determine the cover management (Cfactor), calculate normalized difference vegetation index (NDVI), land surface temperature, soil moisture index and soil organic carbons. The digital elevation model (DEM) that was used to generate streams and delineate the watershed, calculate the slope and flow accumulation within the watershed and to determine the slope length and steepness (LS factor). The soil data that was used to determine soil erodibility (K factor) and soil types. The soil samples collected within the watershed and tested in the labs to determine soil salinity, potential of hydrogen (pH), soil organic carbons and soil moisture content. The weather data for the years 1986,2002,2012 and 2022 used to determine the rainfall erosivity (R factor) and calculation of the aridity index. Models used include the modified universal soil loss equation (MUSLE) to estimate surface runoff, agent-based model (ABM) to determine how the soil degradation agents interact under different conditions and the cellular automata MARKOV chain analysis to predict soil degradation for the year 2030. The results after the research showed that land surface temperatures increased from 39.5 degrees in 1986 to 47.2 degrees in 2022 while normalized difference vegetation index reduced from 0.7 in 1986 to 0.56 in 2022 over the span of 36 years. The size of the agricultural land also increased from 94493ha in 1986 to 211518ha in 2022, while the forest reduced from 95509ha in 1986 to 52426ha in 2022 due to encroachment while searching for fertile land suitable for farming. Measures to prevent further soil degradation should be put in place and the community be sensitized on how they can preserve the soil since problem affects them the most.

STIE08-GRS-002

Climate-Induced Wood Rot Hazard Mapping of Exposed Timber Structures Across Different Regions in Kenya

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Keywords: Scheffer Climate Index, Wood rot, Service life, Construction, Durability

Abstract.

Use of wood in construction can lower greenhouse effect and increase stored carbon. However, persistent exposure of wood to high humidity and moisture content poses a high risk of deterioration to unprotected timber. Rotting being a major threat reduces strength and durability of wooden structures. Because wood rot requires optimum temperature and moisture to occur, it is likely that rise in temperature and precipitation will increase the severity of attack on exposed timber buildings and construction (Chemeli *et al*, 2021; Lisø *et al*.2006). For purpose of assessing and visualizing potential wood rot vulnerability, a hazard risk map for different regions of Kenya in the context of climate change was created using Scheffer Climate index. Scheffer Climate Index (SCI) determines regional wood rot risk based on mean annual temperature and number of days when rainfall is greater than 0.25mm/day. The goal of this study was to map out spatio-temporal variation in wood rot vulnerability across the 47 counties in Kenya. The results showed a rise in average SCI index for the 30-year period. The Scheffer Climate Index varied from 135.2 in 1991 to 156.5 in 2020. This was due to elongated wetness from 110.3 days of rainfall in 1991 to 125.2 days in 2020 respectively. This implies that spatio-temporal rot of exposed timber structures increased significantly across the regions during the reviewed period. Conclusively, a significant change in SCI results as observed were associated with increased geographic coverage in wood rot hazard. Therefore, localized conditions of different regions in Kenya influence the severity of wood rot hazard disproportionately. Notably, high humid and wet areas experienced increased risks of wood rot compared to warmer regions. To ensure extended service life of untreated wooden structures, proper drying and treatment of timbers should be considered. There is need to develop a wood hand book for the Kenya to complement the 2024 building code.

STIE08-GRS-003

Mapping potential geothermal resources through integrating hydrothermal alteration minerals and geological structures in the Songwe region, SW Tanzania.

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Keywords: Remote sensing, Geothermal targets, Mineral alterations, Geological structures

Abstract.

Geothermal energy is one of the most valuable and preferable renewable energy sources, given that it produces sustainable, dependable, and clean energy [1]. Understanding the geothermal systems, parameters such as heat, fluids, and structures help to identify potential geothermal systems. These parameters are manifested as hot springs, fumaroles, and alteration minerals. Hydrothermal alteration minerals are often used in geothermal system exploration to evaluate factors such as temperature, fluid, and structures [2]. This study employed GIS and remote sensing in the identification of hydrothermal mineral alterations and delineating geological structures which provided invaluable information for identifying prospective geothermal resource sites in the Songwe geothermal field, SW Tanzania. The study utilised ASTER remote sensing data in the visible near-infrared and shortwave infrared bands to

identify, discriminate, and map hydrothermal alteration assemblage minerals including phyllic, argillic, and propylitic minerals using Selective Principal Component Analysis (SPCA), whereas ISO cluster classification was used to detect individual minerals such as kaolinite, smectite, calcite, chlorite, and muscovite/illite-rich areas. ASTER Digital Elevation Model (DEM) data was used to map geological structures (faults). The DEM-Flow direction approach was used to extract and map geological lineaments that termed as geological structures. Results have revealed that the regions that were mapped with indicator hydrothermal alteration minerals were also associated with geological structures (faults) as well as coincided with existing hot springs, thus indicating potential geothermal resources. The results obtained from remote sensing data were validated through comprehensive field work and laboratory analysis. The field work, X-ray diffraction (XRD), and Analytical spectral devices (ASD) laboratory analysis results indicated a good match with the findings from the remote sensing data. The approach applied in this study may be used along with other techniques during the early phases of geothermal exploration to define geothermal potential targets.

STIE08-GRS-004

Modelling and Predicting Pluvial Flood Events in Response to Changing Environment Using Multimodal Machine Learning Approach: A Case Study of Mtopanga River Basin, Mombasa

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Keywords: pluvial flooding, land use change, drainage infrastructure, machine learning, Coastal urbanization.

Abstract

Pluvial flooding, caused by intense rainfall overwhelming local drainage systems, poses a significant risk to urban areas, particularly in coastal cities like Mombasa. As land use and land cover change with rapid urbanization, existing drainage systems in regions like the Mtopanga River Basin become increasingly strained, leading to frequent flooding. This study focuses on modeling and predicting pluvial flood events in response to these environmental changes using a multimodal machine learning approach. The research is essential in helping urban planners and policymakers assess the adequacy of current drainage systems, predict future infrastructure needs, and propose solutions for mitigating flood risks, especially in the years 2030 and 2050. The study objectives include: Evaluating the hydrological and hydraulic response of the Mtopanga River Basin to LULC changes, modeling pluvial flood events using machine learning techniques, and predicting future flood susceptibility under various scenarios. Methodologically, the research combines hydrological modeling through the HEC-RAS model with machine learning algorithms such as Random Forest and logistic regression to simulate flood events and drainage system performance. The expected results include an accurate prediction of flood-prone areas, identification of critical zones requiring drainage upgrades, and a proposal for new drainage infrastructure based on future urban development trends. In conclusion, this study contributes to the growing field of AI-driven environmental modeling, offering a practical and innovative framework for

flood risk management in rapidly urbanizing coastal areas like Mombasa, ensuring the sustainability and safety of future developments.

STIE08-CFC-001

Ransomware-As-A-Service (Raas): Analyzing the Impact of a New Cybercrime Business Model on Organizational Security.

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Keywords: business: ransom ware, cybercrime, small and medium-sized enterprises, RaaS, framework, cyber security.

Abstract

The rise of Ransomware-as-a-Service (RaaS) has changed the world of cybercrime, making it easier for people with little technical knowledge to launch complicated attacks on organizations, especially small and medium sized enterprises (SMEs). Ransom ware attacks are expected to happen everywhere, and SMEs are often targeted because they usually have weaker security measures. This paper looks at how RaaS affects the security of organizations, focusing on the specific weaknesses that SMEs face and how they respond to these threats. The research uses a descriptive approach based on the ideas of vulnerability and resilience in organizational security. It aims to understand the structure and business model of RaaS used against SMEs, explore how vulnerable these businesses are to RaaS attacks, and evaluate the strategies they use to improve their cyber security. The study focuses on around 200 SMEs from different sectors, using qualitative data from expert interviews and quantitative data from structured surveys. Statistical analysis will help identify trends and common vulnerabilities. The findings are expected to provide useful insights and recommendations for creating strong cyber security policies that can protect organizations, promote a security-focused culture, and build resilience against ransom ware threats. Overall, this study aims to significantly enhance our understanding of how RaaS impacts organizational security and offer practical strategies for SMEs to reduce the risks associated with this growing threat.

STIE08-TWH-001

Augmented Reality: A Cultural Bridge to Tourism, Wildlife, and Hospitality in Kenya

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Keywords: Augmented Reality, Heritage, Culture, Immersive experience

Abstract

The concept of augmented reality has emerged in recent times as an influential tool that carries immense potential for transformation in many industries: tourism, wildlife, and hospitality. Augmented reality overlays digital information onto the real world, improving visitor experiences, education, and engagement. Tourism, wildlife, and hospitality industries are literally looking for novel ways to make people visit them and take part in the events at the same time without losing their cultural heritage. Augmented reality does this by seamlessly connecting the physical and digital worlds, opening up new possibilities. This technology will be of importance in enhancing the experience of visitors and building up educational opportunities that further create a spark to comprehend culture. This paper explores how AR can preserve and promote cultural heritage by offering immersive experiences, digital storytelling, and even language translation. Visualize a world where ancient ruins come alive and cultural experiences are crafted for one's imagination. AR is making this imagination a reality and changing the way we experience tourism, wildlife, and hospitality. Augmented reality can be one of the most powerful tools to preserve and promote cultural heritage in tourism, wildlife, and hospitality industries. The industries can use AR not only to enhance visitor experiences but also for educating people and building cultural awareness that permits growth and development. This research into AR for cultural preservation makes it clear that technology has the capability to enhance our knowledge of the past, promulgate cultural heritage, and even spur economic growth. It is a contribution to a more connected, culturally rich world that pushes the boundaries of technological innovation and creates immersive experiences.

STIE08-TWH-002

Balancing Coexistence: Addressing Human-Wildlife Interactions in Kenya's Changing Landscapes

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Key Words: Human-wildlife interactions, Conflict resolution, Encroachment, Crop raiding,

Wildlife corridors, Compensation mechanisms.

Abstract

The study examined the dynamics of human-wildlife interactions in Laikipia County, Kenya. The study aimed at (i) assessing the driving forces behind the interactions, (ii) Examining the associated costs and (iii) documenting the existing conflict resolution mechanisms. Humanwildlife interactions are defined as both positive and negative impacts between humans and wildlife, shaped by the context of each situation. Key driving forces identified include climate change, destruction of natural wildlife corridors, encroachment due to land scarcity, and land-use changes, which have collectively contributed to wildlife invading farmlands, particularly elephants, seeking food due to shrinking habitats. The costs incurred from these interactions include livestock depredation, crop raiding, and the mortality of both humans and wildlife. Elephants, hyenas, leopards, and smaller animals such as porcupines and moles were cited as the main culprits of destruction, leading to human-wildlife conflicts.

Cultural factors also play a role, as perceptions of wildlife vary across the communities. While some view animals, particularly elephants, as enemies that threaten their livelihood, others acknowledge the economic benefits wildlife brings through tourism. Education and awareness initiatives have been instrumental in changing attitudes towards wildlife conservation, though challenges remain. Conflict resolution strategies highlighted in the study include preventive measures such as electric fencing, use of dogs, and scaring tactics like fire and loud noises. Trapping and payment systems to control smaller wildlife, particularly moles, were also noted. However, mitigating strategies like government compensation for losses caused by wildlife have been inconsistent and insufficient, leading to dissatisfaction among farmers. Overall, the study underscores the complex interplay of ecological, economic, and cultural factors in human-wildlife interactions and the need for more effective conflict resolution mechanisms in these regions.

STIE08-TWH-003

Strategic Initiatives for the Sustainability of Hotel Sector During and Post Covid-19 Pandemic: A Kenyan Perspective

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Key words: Covid-19 Pandemic, Hospitality Industry, Hotel Sector, Business Sustainability

Abstract

Covid-19 pandemic has adversely disrupted business operations across the world with the hospitality industry and the hotel sector in particular being among the worst affected. Although there has been a number of governmental activities put in place to mitigate against the economic meltdown in the hospitality industry occasioned by the pandemic, it is essential for the management of the hotel sector to put in place robust strategic initiatives for the sustainability of their businesses during and even after the Covid-19 pandemic. This paper contextualizes the delicate nature of the hospitality sector amidst pandemics with particular emphasis on the effects of the Covid-19 pandemic on the operations of the hotel sector. The paper presents a comprehensive set of strategic initiatives that would greatly assist the management of hotels safeguard the sustainability of their businesses and even prosper their institutions during and post Covid-19 pandemic.

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