2023 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT)

Abstracts of Accepted Papers

Contents

Biomedical Engineering Track

Paper Title: *The Impact of Flat Foot on the Clinical Measurement of Foot Posture and Dynamic Balance*

Authors: Mariam Ahmed A Muhsin (AL-Nahrain University, Iraq); Aseel Ghazwan (Al-Nahrain University, Iraq)

Abstract: Foot performance is greatly affected by shape. Biomechanical foot alterations impact dynamic stability. The medial longitudinal arch is the biggest of the foot's three arches: transverse, lateral, and medial. The medial longitudinal arch determines whether the foot is supinated, pronated, or normal. Mobility and stability are also met by these plantar arches. Thus, this research examined how clinical plantar feature assessments affect dynamic balance. 25 young adults with normal feet and 25 young adults with flat feet, ages 18 to 25, were participated in this cross-sectional research. Participants had two parameters measured: 1) Arch index (AI) was determined for both feet using footprints and Autocad 2015. 2) Star Excursion Balance Test (SEBT) to evaluate both feet's dynamic balance. The normal and case groups had substantial variations in dynamic balancing abilities according to foot shape. Dynamic balancing ability was significantly reduced in pronated foot groups. Posterolateral and lateral SEBT directions exhibited no significant differences, while anterior, anteromedial, anterolateral, posterior, and medial did. Due to a significant balance deterioration in people with different foot arches, clinical and practice-specific settings should include corrective foot arch workouts and balancing exercises in specific directions.

Paper Title: *Biomimetic Grasp Control of Robotic Hands Using Deep Learning*

Authors: Yazan Al Dweiri (Jordan University of Science and Technology, Jordan); Mohammad M. AlAjlouni (Jordan Design and Development Bureau (JODDB), Jordan); Alaa Yasin Al-Zeer (Jordan University for Science and Technology, Jordan); Jawdat R Ayoub and Ali H Hejazi (Jordan University of Science and Technology, Jordan)

Abstract: Gripping force modulation based on pressure feedback is an essential element for intuitive and natural-like control of powered limb prostheses. This paper aims to mimic human hand-gripping control in robotic arms by processing dynamic pressure maps with state-of-the-art artificial intelligence algorithms. A pressure-sensing glove was built with integrated data acquisition to learn human grip behavior when holding various objects, and then transfer the observed control pattern to control a robotic arm. The pressure readings are processed using a recurrent convolutional neural network and were able to predict the biological gripping termination with an accuracy of 84.5% for a single type of object and 77% for mixed object types. The proposed control system has proven to be a viable approach for biomimetic handling control for an intelligent robotic arm with pressure feedback.

Paper Title: *Features Selection for Force Myography Based Hand Gesture Recognition*

Authors: Malak Fora and Manar Jaradat (Binghamton University, USA); Bilel Atitallah (Technische Universität Chemnitz & National Engineering School of Sfax, Germany); Congyu Wu (Binghamton University, USA); Olfa Kanoun (Chemnitz University of Technology, Germany)

Abstract: Hand gesture recognition has a wide range of applications in robotics, game control, and in communication with the deaf and people with trouble hearing. Recognition of American sign language (ASL) hand gestures has been extensively studied in the literature. Multiple data sources and different features extracted from these data were used to classify ASL gestures. In this study, we examined the features used in previous research to determine the minimum number of features that can give an accurate classification of ASL hand gestures. Force myography (FMG) signals captured for ASL gestures of digits 0-9 were used in this analysis of the selected features. Extracted features from the raw FMG signals were applied to K-nearest neighbors (KNN) and Extreme Learning Machine (ELM) to evaluate their efficiency in identifying the corresponding hand
gesture. Results show that using only the mean value as input to classification algorithms yields the highest classification accuracy. The classification accuracy was 90% and 96.9% for KNN and ELM, respectively.

Paper Title: *Deepfake Image Generation for Improved Brain Tumor Segmentation*

Authors: Roa'a Mohammad Al-Emaryeen and Sara Al-Nahhas (University of Jordan, Jordan); Fatima Himour (Zarqa University, Jordan); Waleed Mahafza (Jordan University Hospital, Jordan); Omar Al-Kadi (University of Jordan, Jordan)

Abstract: As the world progresses in technology and health, awareness of disease by revealing asymptomatic signs improves. It is important to detect and treat tumors in early stage as it can be life-threatening. Computer-aided technologies are used to overcome lingering limitations facing disease diagnosis, while brain tumor segmentation remains a difficult process, especially when multi-modality data is involved. This is mainly attributed to ineffective training due to lack of data and corresponding labelling. This work investigates the feasibility of employing deepfake image generation for effective brain tumor segmentation. To this end, a Generative Adversarial Network was used for image-to-image translation for increasing dataset size, followed by image segmentation using a U-Net-based convolutional neural network trained with deepfake images. Performance of the proposed approach is compared with ground truth of four publicly available datasets. Results show improved performance in terms of image segmentation quality metrics, and could potentially assist when training with limited data.

Paper Title: *Diagnosis of Obstructive Sleep Apnea Using Machine Learning*

Authors: Alaa F. Sheta (Southern Connecticut State University, USA); Alaa Sheta (Southern CT State University, USA); Shyam Subramanian (Cheif, USA); Salim Surani (Clinical Professor of Medicine and Pharmacology, USA); Malik Braik (Al-Balqa Applied University, Jordan)

Abstract: Sleep apnea is a sleeping disorder affecting more than 20% of all American adults, associated with intermittent air passageway obstruction during sleep. This results in intermittent hypoxia, sympathetic activation, and an interruption of sleep with various health consequences. The diagnosis of sleep apnea traditionally involves the performance of overnight polysomnography, where oxygen, heart rate, and breathing, among other physiologic variables, are continuously monitored during sleep at a sleep center. However, these sleep studies are expensive and impose access issues, given the number of patients who need to be diagnosed. There is hence utility in having an effective triage system to screen for OSA to utilize polysomnography better. In this study, we plan to explore using several machine learning algorithms to utilize pre-screening symptoms to diagnose obstructive sleep apnea (OSA). Per our experimental results, it was found that Decision Tree Classifier (DTC) and Random Forest (RF) provided the highest classification accuracies compared to other algorithms such as Logistic Regression (LR), Support Vector Machines (SVM), Gradient Boosting Classifier (GBC), Gaussian Naive Bayes (GNB), K Neighbors Classifier (KNC), and Artificial Neural Networks (ANN).

Communications Track

Paper Title: *Design Wideband MIMO Antenna for UWB Applications*

Authors: Hussein Mohammed Naser, Mahmood Farhan Mosleh and Oras Ahmed Al-Ani (Middle Technical University, Iraq)

Abstract: The main challenges of designing an antenna for modern wireless communication represented size reduction and mutual coupling. In this paper, a four-element multiple-input-multiple-output (MIMO) ultra-wideband (UWB) antenna is proposed. Each element has two ports with dual-polarized patches to reduce the result of reciprocal coupling, increase the capacity, and keeps a proper size. Quasi-circular geometric shape containing slots has been placed in front of the patch of the proposed antenna to reduce the impact of mutual coupling. The four elements have been integrated with integrate eight ports with an area of 60.59×60.59 mm² with a rogers insulation layer where the single antenna element and MIMO antenna are simulated by the CST STUDIO 2019 program. The resulting operating frequency of the MIMO antenna is 6.18 GHz with a bandwidth of 4.79 GHz (4.93-9.72) GHz at -10 and a return loss of -45 dB at resonance while the operating frequency for the single antenna element is 6.37 GHz with a band of 4.72 GHz (4.93-9.65) GHz at -10 dB and return loss of -50 dB at resonance. The MIMO antennas achieved an envelope correlation coefficient (ECC) less than 0.0005 and an acceptable gain (around 9 dB) while diversity gain (DG) was equal to approx 10.

Paper Title: *Power Load Estimation in Smart Grids via k-Means Clustering Using Sensor Networks*

Authors: Sami A Aldalahmeh (Al-Zaytoonah University of Jordan & University, Jordan); Ali M Hayajneh (The Hashemite University, Jordan); Mahmoud Zeidan and Ashraf Al-Shawabkeh (Al-Zaytoonah University of Jordan, Jordan); Feras Alasali (The Hashemite University, Jordan)

Abstract: In this paper, estimating real and reactive power measurements provided in smart grids through wireless sensor networks is considered. The communication channel is assumed to suffer from additive white Gaussian noise (AWGN). k-means clustering is used to learn the underlying structure of the collected power measurements. Then, nearest-neighbour method is used to estimate the power measurements from the noisy received measurements. Two clustering approaches are proposed. First, clustering the real and reactive power measurements individually. Second, combining the power measurements and clustering jointly. Simulation results show very small estimation errors for both methods even if a small number of clusters is small, where, the individual clustering performs better. On the other hand, the joint clustering method performs better if the number of clusters increases.

Paper Title: *A Compact 2×1 MIMO Microstrip Patch Antenna With Enhancing Gain for UWB Applications*

Authors: Majed Dwairi (Al-Balqa Applea University, Jordan); Amjad Hindi (Al-Balqa Applied University, Jordan); Essam Trrad (Jadara University, Jordan)

Abstract: Proposed ultra-wideband UWB 2×1 MIMO antenna to enhance the realized peak gain, based on the reference single UWB antenna. A modified circular radiator constructed from a circular patch integrated with two circular shapes at 5mm from the main patch center with radius of 5.35mm. The modified patch is fastened on the top of a FR4-epoxy substrate dielectric material and fed by a microstrip type transmission line, and partial ground, while the proposed MIMO UWB antenna composed of two optimized patch antennas placed 180 degrees from each other, 2mm distance were inserted between the grounds. The simulation results using CST-EM software package prove that the realized peak gain enhanced about 1.5 dB more than the single UWB antenna without effecting on the operating UWB and a fractional BW of the MIMO antenna is about 131%. The radiation pattern of the investigated MIMO antenna also has been investigated for selected resonant frequencies. The proposed MIMO antenna covers the whole UWB range, while the antenna improves the narrow bands gain that lies within this band, such as narrow bands WLAN, WIMAX, and X-Band, that are suitable for different telecommunication applications.

Paper Title: *Narrowband IoT Network Self Localization*

Authors: Anas Alashqar (German Jordanian University, Jordan); Ala Khalifeh (German University of Jordan, Jordan); Raed Mesleh (Princess Sumaya University for Technology, Jordan)

Abstract: This article proposes a self-localization method for narrowband internet of thing (NB-IoT) networks. The proposed system uses the received signal strength indicator (RSSI) with a trilateration algorithm to determine the location of NB-IoT nodes within indoor environments. The adopted path loss model for the indoor environment is in accordance with the fifth-generation (5G) millimeter wave (mm-Wave) standard. The proposed method eliminates the need for additional infrastructure or external references, making it efficient and cost-effective. Simulation results are presented to corroborate the accuracy of the proposed technique, and to investigate the impact of different system and channel parameters on the overall performance. Reported results reveal the accuracy of the developed system where an average positioning error of less than 0.2 m is achieved.

Computing Sciences Trends Track

Paper Title: *Mobile Application Testing Strategies and Challenges: A Case Study in Jordan*

Authors: Diala Othman Qatanani (Independent Researcher, Jordan); Abdallah Qusef (Princess Sumaya University for Technology, Jordan)

Abstract: Mobile application testing is an activity that aims to evaluate and improve the quality of the released application by identifying all the defects and issues. The testing results should be consistent and also unbiased, and this comes with a set of challenges and barriers that could appear in different testing levels. In this situation, quality engineers might need to make a trade-off between the test strategy and test efficiency. This paper presents the results of a study that mainly focused on investigating the challenges of testing mobile applications that could affect the testing process in small and medium-sized enterprises in Jordan. This was achieved by conducting a questionnaire distributed to employees and managers in a number of Jordanian companies. The results show that the variety of mobile devices is the most common challenge for many firms. However, most of the firms agreed that battery life or consumption is not affecting the testing of mobile devices.

Paper Title: *Evaluation of Existing Virtual Tour Studies and Their Applicability to Jordanian Universities*

Authors: Mohammad Abdallah and Ayman M. Abdalla (Al-Zaytoonah University of Jordan, Jordan); Mosa Salah (Al-zaytoonah University of Jordan, Jordan)

Abstract: Several studies were conducted in the past for evaluating the benefits and shortcomings of virtual tours in various sites including university campuses. The previous studies addressed numerous issues such as providing initial perceptions, guiding visitors, etc. Most of these issues can be related, up to some extent, to Jordanian universities in general. However, there are issues specific to Jordan that need to be addressed such as the availability of fast internet connection and suitable data caps. Furthermore, new demands rose recently such as the need for social distancing under COVID-19 restrictions, thus limiting the sizes of physical tour groups. This paper reviews previous studies on virtual tours and evaluates their applicability to Jordanian university and their present practicality. Then, the paper outlines the motivations and limitations of virtual campus tours in Jordan.

Paper Title: *Multisource Indoor Positioning System Based on Edge Computing*

Authors: Umba Ilunga Jeannick and Hui Wang (Zhejiang Normal University, China); Maode Ma (Qatar University, Qatar)

Abstract: Due to its significance in numerous applications, indoor positioning has garnered increasing interest. The WiFi fingerprinting method and pedestrian dead reckoning approach are the most popular methods for indoor positioning. However, both methods have certain limitations in terms of accuracy and response time, rendering them ineffective for some applications. To overcome these problems, we propose a system based on edge computing that combines these two methods. The results of our experiments show that our proposed method outperforms stand-alone methods by giving an average positioning error of 0.75 m in just 0.7 seconds.

Paper Title: *The Role of Software Architecture in Business Model Transformability*

Authors: Tarek M.F. Kiblawi (Princess Sumaya University for Technology, Jordan); Muhanna Muhanna (Princess Sumaya University for Technology); Abdallah Qusef (Princess Sumaya University for Technology, Jordan)

Abstract: The lifespan of business models is continuously shrinking, and consequently, businesses are facing the need to renovate their business models much more frequently than ever before. With a "stale" business model, a business becomes at risk of being unable to sustain itself; let alone reap the benefits new opportunities may bring. This paper presents qualitative exploratory research that aims to identify what constitutes business model transformability and explore the effect of software architecture in this regard. The research uses a grounded theory approach to construct a substantive theory, particularly a code system that IT-based organizations can reference. The study uses theoretical sampling and the constant comparative method to identify required participants and analyze interview data. The resulting code system identifies thirteen main categories, one of which is Transformative Software Architecture, and delves further into its subcategories.

Paper Title: *Applying Smart Contract in Blockchain Technology to Manage the Ticketing Issuance and Ticketing Traceability*

Authors: Quang Huu Nguyen (Industrial University of Hochiminh City, Vietnam); Nguyen Tuong Huynh and Thiet Thi Pham (Industrial University of Ho Chi Minh City, Vietnam)

Abstract: Every year, the Industrial University of Ho Chi Minh City presents a cultural program in conjunction with the start of the academic year. Students from the school are given free tickets to attend this event. However, there has been an occurrence problem with fake tickets or ticket sales appearing throughout the years. To assure the validity of the ticket issued, we suggest a ticketing issuance and ticketing traceability management system by applying smart contract technology on the blockchain platform to store, manage, and trace the origin of tickets. The system is designed on the Ethereum platform to implement smart contracts and blockchain technologies using the Solidity language. A blockchain is a decentralized database that holds data in encrypted chunks that grow over time. These information blocks function independently. The benefit of blockchain is that it offers great security by preventing information theft and manipulation. To evaluate the performance of the suggested system, it was carried out with real student data at the Faculty of Information Technology at the Industrial University of Ho Chi Minh City. The experimental results show that the proposed system carries out all functions well.

Paper Title: *A Hardware-Based Approach to Determine the Frequently Accessed DRAM Pages for Multi-Core*

Authors: Tareq Alawneh (Applied Balaqa University, Jordan); Ahmed Sharadqh (Al- Balqa Applied University, Jordan); Mutsam Jarajreh (Fahad Bin Sultan University, Jordan); Jawdat Alkasassbeh (Al- Balqa Applied University, Jordan)

Abstract: It is likely that processor performance improvements will continue to outpace the improvements in memory latency. As processor architectures have been evolved, memory latency has become increasingly an obstacle in achieving optimal application performance. In this paper, a new Hardware-based approach is introduced to determine at run-time the DRAM pages that are frequently accessed (hot DRAM pages). This approach would be an effective and low-cost solution designed primarily to be used with other DRAM memory latency reduction mechanisms. Our experimental results reveal that the prediction accuracy of the hot DRAM pages at run-time obtained by our proposed approach is 88.1% using a 256-entry history table.

Control, Robotics, and Mechatronics Track

Paper Title: *Intelligent Solution for Inverse Kinematic of Industrial Robotic Manipulator Based on RNN*

Authors: Areej Ahmad Shaar and Jasim Ghaeb (Philadelphia University, Jordan)

Abstract: The joint angles required for the robotic manipulator to execute a task in a preset location should be calculated using inverse kinematic equations. Finding these equations is important but it requires hard effort and a large time. In this work an Artificial Neural Network, more specifically, Recurrent Neural Network (RNN) is designed and trained using MATLAB such that the inverse kinematics for a robotic manipulator could be calculated. First, the Denavit-Hartenberg approach is used to derive the forward kinematics of a 6 Revolute (6R) robotic manipulator. Then, a dataset of 100000 samples is produced using the calculated homogeneous transformation matrices to train the RNN. The results are outstanding with MSE of 0.0013 and RF of 0.99 when compared to other techniques that are mentioned in the literature.

Paper Title: *SLAM Algorithm for Omni-Directional Robots Based on ANN and EKF*

Authors: Ahmad Derbas (Technology Strategy, Germany); Tarek A. Tutunji (Al Hussein Technical University, Jordan)

Abstract: This paper describes a Simultaneous Localization and Mapping (SLAM) algorithm that uses Infrared sensors, monocular camera, and motor shaft encoders to build a map of an unknown environment. The proposed algorithm is divided into three stages. First, Artificial Neural Networks (ANN) are used to analyze the sensors and camera image data to search for possible paths. Then, the camera image edges are detected using speeded up robust features (SURF) to find alternate paths. Finally, the paths from the previous two stages are compared and the best match path is found while Extended Kalman Filters (EKF) are used to estimate the robot position and orientation. The proposed algorithm is programmed using MATLAB software, interfaced with an omnidirectional robot by means of wireless communication, and validated experimentally using Robotino platform.

Paper Title: *Dynamical Modeling and Control of Motion System of the Gantry Crane to Minimize Swing Angle of the Payload*

Authors: Jehad Saleh Radaideh and Musa K. AlAjlouni (Al-Balqa Applied University, Jordan)

Abstract: This paper presents dynamical modeling and control of the payload swing of the gantry crane. The modeling is done in two dimensions using the Lumped Mass-Model. Two methods are used for the modeling, Newton's Mechanics and Lagrange's Mechanics, and both methods resulted in the same model. The model is linearized and converted to State-Space representation for the implementation of the Linear Quadratic Regulator (LQR). The objective of the controller is to move the payload from its initial position to its final position while minimizing the payload swing angle and vibrations during the movement. Simulation Results in MATLAB proved excellent regulation, fast and smooth convergence of the payload swing angle to a minimum value (close to zero) without causing a delay of the payload to reach its final position.

Paper Title: *Modeling and Simulating the Transition of an Old Vehicle From (ICE) to an Electric Vehicle (EV)*

Authors: Jamil Khalil Izraqi (Istanbul Okan University, Turkey)

Abstract: This research paper utilizes MATLAB/Simulink modeling and simulation to explore the transition of an old vehicle from an internal combustion engine (ICE) to an electric vehicle (EV). The study focuses on a 1970 Volkswagen beetle EV as a case study and evaluates its performance under different operational conditions, including standard and custom driving cycles in Turkey and Jordan (Amman). The results of this paper indicate that the transition is viable and that modeling and simulation can help in understanding the performance and efficiency of the electric drivetrain system including battery pack, power electronics, and brushless direct current (BLDC) Motor.

Paper Title: *Low-Cost Wireless Monitoring and Control: A Case Study for Industrial Implementation*

Authors: Amin Yousef (Quartz for Control Systems and Home Automation, Jordan); Osama Albayari (Ideal Concepts Company, Jordan); Ramzi Albawab (TAL group, Jordan); Bahaa Jibrini (The University of Jordan, Jordan); Mohammad H Salah (The Hashemite University, Jordan)

Abstract: In this study, a wireless industrial system is designed and implemented in a local pharmaceutical factory for monitoring and control. ESP8266 modules were utilized to establish wireless communication among various input and output devices in the factory. The master-slave (i.e., server-client) technology using ESP8266 modules was adopted for the communication topology where all clients can be connected to various types of sensors (e.g., to measure variables such as temperature, humidity, and pressure) and outputs (e.g., such as relays, lights, and output devices) for control purposes. It is in fact a simplified SCADA system implemented using low-cost WiFi microchips for monitoring and control. In addition, an HTML webpage was designed as a GUI for monitoring the sensors' measurements and manually controlling some output devices that are distributed in the factory. Moreover, a data logger was also designed and implemented using google sheets for mainly saving the data (i.e., real-time parameters variations measured) and for generating informative reports for the user and management.

Paper Title: *Genetic Algorithm-Based Path Planning for Autonomous Mobile Robots*

Authors: Areej Alabbadi and Awos Kanan (Princess Sumaya University for Technology, Jordan)

Abstract: In this paper, a Genetic Algorithm is used to solve the path planning problem for autonomous mobile robots in static environments. The goal of the path planning problem is to find a valid and practical path between two points while avoiding obstacles and optimizing a number of criteria including path length, safety, and distance from obstacles. A quality function is proposed to evaluate the optimization approach for different scenarios. Experimental results show that enhanced solutions can be achieved in less time using optimal values of the search algorithm parameters.

Cybersecurity Track

Paper Title: *Android Stalkerware Detection Techniques: A Survey Study*

Authors: Ruba Taha EyalSalman (Princess Sumaya University for Technology, Jordan)

Abstract: Mobile stalkerware system refers to a type of software that is specifically designed to be installed on a person's mobile device without their knowledge or consent. Once installed, it allows someone else to track the device's location, monitor calls and text messages, and access other personal information. Mobile stalkerware poses several risks to individuals whose devices have been compromised. Most notably, the violation of user privacy. Several techniques proposed to detect stalkerware on a device. This research aims to provide a survey on the different mechanisms proposed to detect stalkerware applications on smartphones. This research includes a summary of the research that has been published about stalkerware applications, their capabilities, and the differences between them in terms of complexity and functionality. As a result, several classifications are used to detect these systems, the most prominent of which are Signature-based, Heuristic-based, Behavioral-based, Machine learning-based, and Sandboxing approaches. It was found that the efficiency of the different detection methods depends on the nature of the stalkerware design, and no particular method can be considered the most efficient. After reviewing the published research, it was found that the efficiency of these applications in terms of functionality is measured by several criteria, the most important of which is their ability to hide and the amount of information they leak about the victim's phone.

Paper Title: *VulDefend: A Novel Technique Based on Pattern-Exploiting Training for Detecting Software Vulnerabilities Using Language Models*

Authors: Marwan Omar (IIT, USA)

Abstract: The detection of vulnerabilities in source code is a critical task in software assurance. In this work, we propose a semi-supervised learning approach that leverages pattern-exploiting training and cloze-style questions. Our approach involves training a language model on the SARD and Devign datasets of code snippets with vulnerabilities, where the input is generated by masking parts of the code and asking the model to predict the masked tokens. Experimental results demonstrate that our approach can effectively detect vulnerabilities in source code, while leveraging the pattern information learned from the code snippets. This work highlights the feasibility of using pattern-exploiting training and cloze-style questions for improved performance in the detection of vulnerabilities in source code.

Paper Title: *Design and Implementation of a Malware Detection Tool Using Network Traffic Analysis in Android-Based Devices*

Authors: Areen Abdelwahab Eltaher (Princess Sumaya University of Technology, unknown); Dania Amer Abu-juma'a and Dania Raed Hashem (Princess Sumaya University of Technology, Jordan); Heba Alawneh (Al Hussein Technical University, Jordan)

Abstract: Smartphone use and dependability have increased substantially in recent years, as have malicious attempts to compromise mobile devices with various malware. Therefore, smartphones must have an active malware detection program to protect user privacy. We propose Android Malware Buster (AMB), a malware detection application for Android devices. AMB utilizes a machine learning classifier to identify ongoing malicious behavior through its network traffic analysis. The machine learning model was trained on a diverse set of Adware, Scareware, and Ransomware apps. The accuracy of the AMB classifier has reached 93%. Furthermore, AMB correctly classified the vast majority of applications during real-time testing.

Paper Title: *Vulnerability Exploitation Using Reinforcement Learning*

Authors: Anas AlMajali, Loiy Al-Abed, Ruba Mutleq, Zaid Samamah and Anas Abu Shhadeh (The Hashemite University, Jordan); Bassam Jamil Mohd and Khalil M. Ahmad Yousef (Hashemite University, Jordan)

Abstract: Our main goal is to create a reinforcement agent that is capable of exploiting a particular vulnerability. Hiring a penetration tester or doing manual exploitation can be expensive and time-consuming, thus such a process needs to be intelligent and automated. There are many tools out there that perform auto-exploitation, like Metasploit Pro. But the problem with such tools is that they require significant execution time and resources because they are based on trying every possible payload and checking if it works or not. In this work, we created a reinforcement agent and configured it to exploit a certain vulnerability. After the agent completes the training phase, it stores payloads with their corresponding reward values in a Q-Table. When the agent faces a state that is a combination of a target operating system and a certain vulnerability, it knows what options to set to perform exploitation by looking at its Q-Table. The proposed methodology was tested on remote code execution vulnerability in CouchDB version 3.1.0. After the training phase was completed, deployment was tested on three different systems in which the main goal of the attacker (establishing a reverse shell) was achieved using the payloads with the highest rank in the Q-Table in 8.26 seconds (average).

Data Science and Artificial Intelligence Track

Paper Title: *A Machine Learning Dataset for Enhancing Energy Efficiency in WSN*

Authors: Walaa Alshamalat (Al-Hussein Bin Talal University, Jordan); Moath Alsafasfeh (Al-Hussein Bin Talal University & College of Engineering, Jordan); Abdullah Alhasanat (Alhussien Bin Talal University, Jordan)

Abstract: WSNs are constructed of a large number of tiny energy-constrained nodes and have low capacity. Sensor nodes are skilled to carry the functioning of sense, aggregating, and transmitting information. In this paper, the use of machine learning is suggested in order to enhance the energy efficiency of WSNs. The proposed method aims at establishing a dataset that is used by a machine learning model to choose the best Cluster Head (CH) in WSN. Forming a sufficient dataset is primarily based on assuming several network parameters. For each combination of these parameters, the node which leads to the least energy consumption will be selected as CH. The system parameters used to build this dataset are inter-cluster distance, node residual energies, and how often each node is selected as a CH. As a result, a dataset for choosing the best cluster head in the WSN is created and would be trained by a machine learning model, where the dataset labels the best node to be chosen as a cluster head compared with the physical location of the node on the network.

Paper Title: *A Case Study of IoT-Based Water-Energy Nexus Monitoring Platform for Household Applications in Smart Cities*

Authors: Ashraf Ali and Mohammad H Salah (The Hashemite University, Jordan)

Abstract: with the lack of water and the increasing cost of imported fossil fuel in Jordan, the need for more efficient utilization of energy usage for pumping water in household applications is of top priority. Sudden power demands affect the stability of the entire power grid. There should be a balance between power generation and load consumption sides. IoT infrastructure helps in maintaining this balance via having a closed-loop control mechanism. This paper introduces a platform that can be implemented as part of a cloud solution that aggregates sensory data of water tank levels and displays real-time data for both energy and water consumption. The collected data is then analyzed to show the correlation and to give an indication of user water and energy consumption in household applications in smart cities. The correlation is minimized via adaptive and customized thresholds for each user according to the consumption pattern. Results show that there is a significant improvement in the water supply system by having less correlated user power demand in a certain time instant.

Paper Title: *A Neuro-Symbolic Approach for Marine Vessels Power Prediction Under Distribution Shifts*

Authors: Ahmad Hammoudeh (University of Mons, Belgium); Ibrahim Ghannam (RWTH Aachen University, Germany); Hamza Akram Musbah Mubarak (University of Malaya, Malaysia); Emmanuael Jean (Multitel, Belgium); Virginie Vandenbulcke and Stephane Dupont (University of Mons, Belgium)

Abstract: This paper proposes a neuro-symbolic approach to predict the power of marine cargo vessels. The neuro-symbolic approach combines two parts. The first is a neural networks part, and the second is a symbolic part that relies on physics-based formulae. The Shifts-power dataset was used for evaluation. The experimental results showed that a combination of a physics-based module (symbolic part) with a neural networks model (namely ensemble Monte Carlo dropout) superseded the state-of-the-art results by 2.3% in terms of uncertainty estimation measured using R-AUC, and by 3.4% in terms of power prediction for out-of-distribution (OOD) examples measured using RMSE. It also superseded the symbolic approach by 6.3% in terms of uncertainty and 17.7% in terms of OOD power prediction.

Paper Title: *Analyzing and Forecasting the Weather Conditions in Jordan Using Machine Learning Techniques*

Authors: Laith O. Bani Khaled and Gheith A. Abandah (The University of Jordan, Jordan)

Abstract: Weather forecasting is an important research field due to its impact on a wide variety of life aspects. The traditional way of weather forecasting is based on complex physical models that describe the hydrodynamic behavior of the atmosphere. This way is costly, time consuming, often inaccurate and requires supercomputers to make predictions. In this paper, we investigated the performance of machine learning algorithms in predicting the weather conditions in Jordan for a short period. We start by analyzing the used dataset of the weather conditions of the 12 Jordanian governorates over past 13 years, where the long-term trend shows 0.3-°C rise in the average temperature and 10-mm decrease in the average annual precipitation. We propose a prediction model based on encoder-decoder architecture and bidirectional long short-term memory cells (ED-BiLSTM). We carefully tune and train this model and show the importance of integrating the data of nearby locations to the target location's data to improve the model accuracy. Also, we show that the model accuracy improves significantly when adding training instances of other locations. The proposed tuned model trained on the train data of 16 locations and accepting regional weather conditions at the input has very low mean squared error of 1.78×10-6 in predicting Amman's weather for the next 24 hours.

Paper Title: *Sentiment Analysis of Tweets: A Machine Learning Approach*

Authors: Wael Qassas (AABU & Infomation Technology Faculty, Jordan); Ammar Badarneh and Omar AlZoubi (Jordan University of Science and Technology, Jordan); Mohammad AlBasheer (Al Albayt, Jordan); Suhaib Al-Darwesh (Jordan University of Science and Technology, Jordan)

Abstract: The growth and advancement in social network platforms increase the number of users noticeably. Social network platforms, like Twitter, grant users the ability to interact and express their emotions about events. Since Twitter platform involves all ages with a fair representation of gender, the sentiment analysis of Twitter data reflects the general feelings of people about a particular event. The sentiment analysis is a natural language processing (NLP) method that mainly focuses on deciding whether the sentiment is positive, negative, or neutral. Additionally, it is referred to as material polarity or mining of opinions. In the context of sentiment analysis, various approaches can be applied such as the Lexicon and machine learning (ML) approaches. Compared with lexicon approach, ML approach is considered simple and more efficient. In this study aims at Performing sentiment analysis of Twitter data related to COVID19 using the ML approach. Four ML models are used in this study namely, linear support vector classification (Linear SVC), logistic regression (LR), decision tree (DT), and random forest (RF). The performance of the above-mentioned models is tested using various metrics such as accuracy, recall, precision, and F1 score. The results released that the Linear SVC model has superior performance among the other models.

Paper Title: *Diagnosis of Polycystic Ovary Syndrome Using Random Forest With Bagging Technique*

Authors: Amjed Al-Mousa (Princess Sumaya University of Technology, Jordan); Badr Mansour, Hamsa Al-Dabbagh and Mohammad Radi (PSUT, Jordan)

Abstract: The goal of this research is to aid doctors in the diagnosis of PCOS in female patients. Diagnosing the condition in question depends on many factors making it complex to diagnose. The model developed would help confirm a doctor's diagnosis to further its reliability. The model tested several classifiers, including Extreme Gradient Boosting (XGBoost), Linear Discriminant Analysis (LDA), and Adaptive Boosting (Ada-Boost). The highest accuracy was 94.4% using the Random Forest classifier with the Bagging method. This accuracy surpasses any previously achieved results using the same dataset, which were 91% and 92%. The results achieved were using a 10-Fold cross-validation.

Paper Title: *Tuning the Parameters of Cutting Machines Using Particle Swarm Optimization: A Comparison Study*

Authors: Alaa F. Sheta (Southern Connecticut State University, USA); Malik Braik and Abdelkarim Baareh (Al-Balqa Applied University, Jordan)

Abstract: In this study, we conducted experiments to model the temperature of two manufacturing processes using various metaheuristic search algorithms. The two processes adopted were the P05 horny steel tool and the AISI304 stainless steel castings machines. Our approach involves building a data-driven model, as traditional search methods for modeling manufacturing problems often need help finding the global optimum when faced with a complex objective function and numerous decision variables. Bio-inspired metaheuristic search algorithms have shown promising performance in handling multi-model optimization functions, and efficiently exploring the search space to attain more global results. We applied several metaheuristic search algorithms to find the optimal tuning parameters of a temperature-based model. The results from the case studies demonstrate that Particle Swarm Optimization (PSO) provided the best performance in tuning model parameters, resulting in minimum modeling error.

Paper Title: *Explainable Machine Learning-Based Cybersecurity Detection Using LIME and Secml*

Authors: Sawsan Alodibat (Princess Sumaya University, Jordan); Ashraf Qaddomi (Graphics Animations, Jordan); Mohammad Azzeh (Princess Sumaya University for Technology, Jordan)

Abstract: The field of Explainable Artificial Intelligence (XAI) has gained significant momentum in recent years. This discipline is focused on developing novel approaches to explain and interpret the functioning of machine learning algorithms. As machine learning techniques increasingly adopt "black box" methods, there is growing confusion about how these algorithms work and make decisions. This uncertainty has made it challenging to implement machine learning in sensitive and critical fields. To address this issue, research in machine learning interpretability has become crucial. One particular area that requires attention is the detection process and classification of malware. Handling and preparing data for malware detection poses significant difficulties for machine learning algorithms. Thus, explainability is a critical requirement in current research. Our research leverages XAI, a novel design of explainable artificial intelligence that uses cybersecurity data to gain knowledge about the composition of malware from the Microsoft large benchmark dataset-Microsoft Malware Classification Challenge (BIG 2015). We use the LIME explainability technique and the Secml python library to develop explainable prediction results about the class of malware. We achieved 94% accuracy using Decision Tree classifier.

Paper Title: *Using Context Specific Generative Adversarial Networks for Audio Data Completion*

Authors: Marina Maayah (Computer Science and Engineering, Qatar); Abdulaziz Al-Ali (KINDI Center for Computing Research & Qatar University, Qatar); Abdelhak Belhi (Joaan Bin Jassim Academy for Defence Studies, Qatar)

Abstract: Audio quality plays an essential role in several applications ranging from music to voice conversations. Sound information is subject to quality loss caused by reasons such as intermittent network connections, or storage corruption. Recent approaches resorted to using GANs for audio reconstruction due to their successful deployment in visual applications. However, audio datasets often include sounds from different contexts which increase the complexity of the patterns to be learned, leading to sub-optimal quality reconstruction. We propose a novel audio completion pipeline that clusters audio based on similarity of features extracted by a pre-trained CNN model and then trains a dedicated specialized GAN for each context separately. The proposed technique is compared with the traditional method of training one general GAN in completing 200ms missing segments of 1-second audio samples. Experimental results on a public benchmark dataset show that using specialized GANs led to a clear improvement in the completion quality as measured by a higher PSNR and a lower MSE. Qualitative evaluation also supported these results.

Paper Title: *Arabic Sentiment Analysis of Food Delivery Services Reviews*

Authors: Dheya Mustafa (Hashemite University, Jordan); Safaa M. Khabour (Yarmouk University, Jordan); Ahmed Shatnawi (Jordan University of Science & Technology, Jordan); Eyad Taqieddin (Jordan University of Science and Technology, Jordan)

Abstract: Customer reviews on online platforms have grown to become an important source of insight into a company's performance. Food delivery services (FDS) companies aim to effectively use customers' feedback to identify areas for improvement of customer satisfaction. Although Arabic is becoming one of the most widely used languages on the Internet, only a few studies have focused on Arabic sentiment analysis to date. The present study conducts an extensive emotion mining and sentiment analysis on FDS-related reviews in Arabic, exploiting natural language processing, and machine learning techniques to extract subjective information, determine polarity and recognize customers' feelings in the FDS domain. This work begins with collecting the FDS dataset (Talabat), and then extracting and creating a dialects lexicon for Arabic dialects, followed by walking the reader through detailed steps of cleaning and pre-processing a manually annotated dataset. Finally, we examined classification algorithms including Decision Tree (DT), and Support Vector Machine (SVM). We achieved a maximum accuracy of about 82% using the SVM classifier.

Paper Title: *Fine-Tashkeel: Fine-Tuning Byte-Level Models for Accurate Arabic Text Diacritization*

Authors: Bashar Eid Al-Rfooh (University of Jordan, Jordan); Gheith A. Abandah (The University of Jordan, Jordan); Rami Eid Al-Rfou (Google, Jordan)

Abstract: Most of previous work on learning diacritization of the Arabic language relied on trainingmodels from scratch. In this paper, we investigate how to leverage pre-trained language models to learn diacritization. We fine-tune token-free pre-trained multilingual models (ByT5) to learn to predict and insert missing diacritics in Arabic text, a complex task that requires understanding the sentence semantics and the morphological structure of the tokens. We achieve state-of-the-art accuracy on the diacritization task with minimal amount of training and no feature engineering, reducing WER (word error rate) by 40%. We release our fine-tuned models for the greater benefit of the researchers in the community.

Paper Title: *Multiclass Diabetes Detection Using Random Forest Classification*

Authors: Amjed Al-Mousa (Princess Sumaya University of Technology, Jordan); Laith AlKhdour, Hatem Bishawi and Fares AlShubeliat (PSUT, Jordan)

Abstract: Detecting diabetes at an early stage can help save lives and improve the patients' quality of life significantly. Diabetes can be detected with the assistance of information regarding the patient's lifestyle and health. This work aims to predict diabetic patients using different machine-learning classification algorithms and a dataset about diabetic and healthy patients. The work employs a data balancing technique to handle the data imbalance issue, as well as using cross-validation. In addition, it compares these machine-learning algorithms according to several performance indicators like accuracy, precision, recall, and F1-score. Accordingly, the Random Forest classifier proved to produce the best results with accuracy, precision, recall, and an F1-score, all equal to 89%.

Electric Power Systems Track

Paper Title: *A Comparison of GWO and PSO for MPPT in Solar Photovoltaic Stand Alone System*

Authors: Ali Haider Fawzi, AHF and Naseer Yasin (Middle Technical University, Iraq); Zuhair Sameen Shuker (Middle Technical University & Baquba Technical Institute, Iraq)

Abstract: Electricity production from solar energy gained a lot of recognition on a global scale as because of its copious availability and also environmentally beneficial quality. The availability of the electricity created from the sun may fluctuate depending on a number of circumstances, including shifts in irradiation, temperature, and shade, amongst others, Therefore, in recent, research has been focused on the Maximum Power Point Tracking (MPPT) approach with the purpose of extracting the most power possible from photovoltaic solar panels. The Hill-Climbing and Incremental Conductance MPPT techniques popular choices among the several ways that were developed for achieving Maximum Power while being exposed to continual irradiation. However, when exposed to changes in environmental circumstances, these approaches display poor dynamic performance, and substantial steady-state oscillations near MPP. bio-inspired algorithms demonstrated outstanding performance when confronted with non-linear, non-differentiable, and stochastic optimization problems, all while avoiding the need an excessive amount of mathematical calculations, in this paper utilizing the Grey Wolf Optimization technique (GWO) and the Particle Swarm Optimization technique (PSO), with a focus on starting value selection. The capacity to measure the global peak power precisely under changing environmental circumstances with practically minimal steady-state oscillations, quicker dynamic reaction and straightforward implementation are some of important aspects of this technology. A methodical examination was carried out under various settings, including varying degrees of solar irradiation, and lastly, the findings produced were compared between the two established methodologies. In addition, the accuracy of this suggested technique was validated by utilizing MATLAB/Simulink as the simulation software.

Paper Title: *The Impact of Using STATCOM for PV Farms Connected With Grid*

Authors: Tasneem T Al-Daboubi and Hussein AL-Majali (Mutah University, Jordan)

Abstract: Solar energy is now playing a vital role in electrical distribution networks due to its strong financial benefits. However, the integration of photovoltaic systems can cause issues such as power losses by altering the way power flows through the network. To study the impact of PV penetration, an IEEE 14 bus system is used as a distribution network model. In this study, an IEEE 14 bus Simulink model was created and the reactive power was compensated using STATCOM to minimize overall network losses. Two optimization methods were evaluated, with the AGWO algorithm suggested as the best STATCOM control method. The suggested method first determined the optimal allocation and number of STATCOMs to add, then calculated the appropriate reactive power for each STATCOM using power flow analysis in the MATLAB-Simulink environment. Ultimately, the results showed that using the AGWO algorithm in combination with STATCOMs produced better results than the other technique.

Paper Title: *Disturbances Identification by Using Machine Learning Algorithms*

Authors: Mohammad Al-Amaryeen (Mutah University & EDCO, Jordan); Hussein AL-Majali (Mutah University, Jordan)

Abstract: The quality of power and power interruptions are issues that users and power distributors are becoming more concerned about. The degradation in the quality of power comes from any disturbing phenomena that cause the mains voltage (or current) wave to depart from its nominal characteristics and are called disturbances. Identification of Power Quality Disturbances (PQD) and reliable PQD categorization are therefore particularly desirable. Additionally, identifying and categorizing PQD in distribution networks are important tasks for protecting power distribution networks. The most of disturbances are non-stationary and transient in nature, necessitating the use of advanced methods and tools for PQD analysis. The proposed method builds up to find the best model from Machine Learning (ML) classification techniques. Real three-phase voltages and frequency values are used to train ML, and according to the measured three-phase parameters, ML can identify and classify the disturbances event and find the best technique for that.

Paper Title: *ANN-Based Fault Location in 11 kV Power Distribution Line Using MATLAB*

Authors: Hamza Abdulkhaleq Naji (Middle Technical University & Iraqi Ministry of Education, Iraq); Rashid Ali Fayadh (Middle Technical University, Iraq & College of Electrical Engineering Techniques, Malaysia); Ammar Hussein Mutlag (University Kebangsaan Malaysia, Malaysia)

Abstract: Artificial Neural Networks (ANN) have been making a significant impact in the field of electrical engineering, particularly in the realm of power systems. This study explores the use of ANN for fault detection and location in a power distribution line, providing valuable insights into the potential of this technology for power systems management. This research is important to investigate the use of ANN to detect and locate faults in power distribution lines to improve the efficiency and accuracy of fault detection in power systems. The problem this work aims to address is finding a more accurate and faster method for detecting and locating faults in power distribution lines. The study uses MATLAB and the Levenberg-Marquardt algorithm to design and train an ANN model using preprocessed data. The ANN model was configured with various hidden layers and neuron configurations. The study's results showed that the ANN model had a high accuracy in identifying and locating faults in the power distribution line, outperforming traditional fault detection methods in terms of accuracy and speed. The findings of this study demonstrate the potential of ANN for fault detection and location in power systems. The results suggest that further research in this area could lead to even more efficient and accurate fault detection methods, improving the management and maintenance of power systems.

Paper Title: *Optimal Location of PMUs to Enhance State Estimation of Power Systems*

Authors: Atallah Ahmad Al Qaralleh (Faculty Of Engineering Mutah University Karak Jordan, Jordan); Khaled Mohammad Alawasa (Sultan Qaboos University); Abdullah Al-Odienat (Amman Arab University)

Abstract: The Wide Area Monitoring Systems (WAMs) has brought several advantages for the power system monitoring, operation, control. Recently, the introduction of Phasor Measurement Units (PMUs) to power grids played a significant role in transforming them into smart grids. However, PMUs are costly and installing PMU at each bus is feasible. Therefore, the formulation of optimal placement of PMUs (OPP) in power systems is very important to minimize the total number, while preserving the observability of the system. Newton Raphson load flow method is applied to obtain load flow results of the system. Weighted least squares WLS with PMUs approaches for the state estimation of IEEE 14 bus test case is presented. The results show more accurate state estimation process.

Paper Title: *High Impedance Fault Detection in Distribution Feeder Based on Frequency Spectrum and ANN*

Authors: Mohammed Naisan Allawi and Ali Hussain (Middle Technical University, Iraq); Mousa Wali (College of Technical Electrical Engineering, Iraq)

Abstract: High impedance fault (HIF) is among the common faults in distribution networks. This type of fault creates peculiar characteristics in the current signal as a result of the electric arc during the fault, such as irregularity, non-linearity, and asymmetry, and because this fault occurs when the power line touching with high resistance surfaces, the magnitude of the current drawn during the fault is relatively small compared to the rated load current; therefore, it is difficult for the traditional protection devices to capture it. This paper presents a fault detection method based on the frequency spectrum analysis for the current signal at the substation bus. Fast Fourier Transform (FFT) is proposed in this work as an efficient technique for current signal analysis and extracting harmonics content during HIF and other non-fault events in the distribution system while employing an Artificial Neural Network (ANN) as a features classifier. The ANN is regarded as a vital tool in power system-related applications. It has demonstrated its ability to detect and classify HIF from other normal events such as capacitor bank switching, load switching, and inrush current due to saturation transformer. The results demonstrate that this method has high accuracy (99.34%) for HIF detection with no false positive rate (dependability 100%). MATLAB software (R2021a) is used in this study to perform the simulation.

Paper Title: *The Application of Synchronverter for the Enhancement of Power System Stability*

Authors: Basel T Alkhamis (College of Engineering, Jordan); Abdullah Al-Odienat (Mutah University, Jordan)

Abstract: This paper is aimed at investigating the impact of the virtual synchronous generator in the enhancement of power system stability. The virtual synchronous generator is built and applied to enhance the transient stability margins for the power system whenever a photo-voltaic panels are added to the system. IEEE 9-bus system is chosen for investigating the effectiveness of the proposed synchronverter control scheme. The synchronverter has been connected to a single machine infinite bus system through a 208V/ 13.8kV step up transformer. The proposed scheme is verified using MATLAB® Simulink software which is used for the simulations in this study. The results demonstrates that the synchronverter enhances the behavior of the power system in transient and steady state operation.

Paper Title: *Solar Photovoltaic Forecasting Using ANN Network for Central and Southern Regions of Jordan*

Authors: Rafi Al-Rawashdeh (Mutah University, Jordan); Mohammad Alsarayreh (Princess Sumaya University for Technology & Samra Electric Power Company, Jordan); Abdallah Al-Odienat (Mutah University, Jordan)

Abstract: The use of renewable energy has increased during the last several decades. The most popular renewable energy source is photovoltaic (PV) technology, which uses solar radiation to create electricity. However, a number of variables, such as position, weather, etc., have an impact on the production of PV electricity. It is crucial to control the inherent changeability of PV plants as they expand and contribute significantly to the production of grid power. Predicting solar PV is therefore essential for ensuring efficient and dependable grid functioning. The forecasting model's inputs were historic PV power output data from two solar power installations in Jordan's central and southern regions. The prediction of PV power production in this research takes into account a stacked long short-term memory network (LSTM), a crucial part of the deep recurrent neural network. This model and Nonlinear Autoregressive NARX have been contrasted (Dynamic Neural Network). The outcomes demonstrated equivalent, admirable performance for both the dynamic NARX ANN and the LSTM, with NARX being better. The dynamic ANN can be claimed to be superior to the deep neural network (DNN) for time-based performance modeling of PV systems with varying data.

Paper Title: *Study of Power Factor Corrector Operating at Multiple Switching Frequencies*

Authors: Deniss Stepins, Janis Zakis, Annamneni Subbarao and Alexander Suzdalenko (Riga Technical University, Latvia); Kamal Khandakji (Tafila Technical University, Jordan & Bonn University of Applied Sciences, Germany); Jaroslavs Zarembo (Riga Technical University, Latvia)

Abstract: This paper deals with the use of multi-switching-frequency approach for reduction of conducted electromagnetic emissions (EME) from power factor correctors (PFC) operating in discontinuous conduction mode (DCM). The effect of multi-switching-frequency operation on the total harmonic distortion (THD) of PFC input current, power factor, conducted EME levels and efficiency is studied in details in the paper. The PFC in DCM is studied by using simulation in PSIM software and analytically. Performance of the DCM PFC with the multi-switching-frequency approach is compared to that of classical switching-frequency modulation. Some advices for more effective use of the multi-switching-frequency approach in DCM PFC are proposed.

Paper Title: *Integration of Helix Wind and Archimedes Screw Turbines for Renewable Energy Generation From Wind and Rainwater*

Authors: Hiba Jamal Altatar, Noura Azzam Almaghareez, Raed Abed and Joud Alsarayra (AL Hussain Technical University, Jordan); Hassan Qandil (University of North Texas, USA); Emad AbdelSalam (Al Hussein Technical University, Jordan)

Abstract: The use of wind energy has grown drastically over recent years. As wind can occasionally be accompanied by rainfall and storms, the combined harvesting of wind energy and rainwater can be a viable and efficient solution. This work proposes a novel design to collect wind and water flow energy to supply an elementary school building in the Al Zaatari refugee camp in Jordan with electricity. The design integrates a helix vertical axis wind turbine (VAWT) and an Archimedes screw turbine. This work showed how to utilize the helix wind turbine to generate energy from the wind movement and how the rainwater is collected via gutters to pour into the integrated Archimedes screw water turbine and further generate more power. Results showed that the total average wind energy production per year was 12.96 MWh, and the total average energy production from rainwater was 16.35 kWh, using a 30-unit system at the school.

Sustainable Energy Systems and Smart Grids Track

Paper Title: *Community Energy Storage System for Cost Benefits*

Authors: Augustine Ikpehai and Sunkanmi Olajide (Sheffield Hallam University, United Kingdom (Great Britain)); Kelvin Anoh (University of Chichester, United Kingdom (Great Britain))

Abstract: Future low-carbon energy systems will be people-centred. However, optimal utilisation of renewable-based distributed generation in neighbourhood energy market (NEM) remains a limiting factor. This paper investigates a NEM and evaluates the benefits of central energy storage system (ESS) in maximising collective self-consumption and savings, using Sheffield city centre, UK as a case study. The results show that the central ESS has a significant impact on utilization of renewable resources, reduces cost of energy and offers flexibility of the grid through peak reduction. In particular, use of central ESS reduces peak demand by up to 55% while the community's self-consumption and self-sufficiency increased by 28.8% and 32% respectively.

Paper Title: *A New Five-Level Transformerless Boost Inverter for Renewable Energy Applications*

Authors: Aseel K. Rashid (Middle Technical University & MTU, Iraq); Nabil Kadhim Al-Shamaa (Middle Technical University, Iraq); Mousa Wali (College of Technical Electrical Engineering, Iraq)

Abstract: This paper introduces a new five-level boost inverter based on a single capacitor to be fit for transformerless renewable energy systems. The proposed single-phase topology consists of a single dc source, six switches, a single diode, and a single capacitor. Compared to the latest publishing of five levels of boost inverters, it has fewer components and a simple structure. The inverter's operation is based on charge-pump theory, which utilizes parallel charging and series discharging of the capacitor to increase the output voltage. Due to the suggested configuration's need for a specific control technique, a level-shift pulse width modulation approach is designed to drive the switches and create the necessary pulse pattern by comparing the reference signal with four carriers. The designed inverter is unique in several respects, including using a single dc-source and a single capacitor, small size, specific control needs, and boosting capacity. To test the efficacy of the proposed five-stage setup, a simulation MATLAB/Simulink is used. The constructed five-level multilevel inverter performs as intended, as the findings show.

Paper Title: *Single-Axis Solar Tracker System for Maintaining Southward Orientation of Solar Cells in Solar Cars*

Authors: Ziyad Almajali and Sana Aldmour (Mutah University, Jordan)

Abstract: Generating enough power in a solar car can be challenging due to the limited surface area available for solar cells. To maximize energy output, designers strive to use the latest, most advanced solar cell technology. Additionally, research has shown that using a solar tracker can increase energy absorption in various systems. This study presents the idea of implementing a solar tracker in a solar-powered vehicle, which was developed and simulated using MATLAB/Simulink. To evaluate the proposed tracking system, the study simulated its performance on a hypothetical track with changing directions. The paper outlines the operational steps of the tracker, which involves tracking the southern direction consistently, regardless of the vehicle's orientation. Additionally, the paper presents a comparative analysis of the initial outcomes obtained from the proposed system and those of other existing systems.

Paper Title: *Potentials of Utilizing Berkeley-Bioreactor Pile Composting as Heat Recovery System in Domestic and Small-Scale Applications*

Authors: Talal Tareq Enaya, Jamila Husan and Ghazi Tareq Sharqawi (Al Hussein Technical University, Jordan); Malek Alkasrawi (Associate Professor, Jordan); Yousef Okour (Al Hussein Technical University, Jordan)

Abstract: This paper presents an assessment of the potential of utilizing the Berkeley-Bioreactor pile composting method as a heat recovery system for domestic heating applications with a focus on Jordanian farms. The study compares the economic feasibility of this system with existing thermal heating systems in the market. The results show that the proposed system is the most economically viable, cost-effective, and profitable option for domestic heating. The study highlights the potential of composting systems as a source of renewable energy for domestic heating applications and provides a useful guide for further research in this area.

Paper Title: *Battery Energy Storage Planning in Distribution Network With Renewable Resources*

Authors: Ahmed Ali Alguhi (King Saud University, Saudi Arabia); Majed A. Alotaibi (King Saud University & University of Waterloo, Saudi Arabia); Essam A. Al-Ammar and Ahmed A. AL Katheri (King Saud University, Saudi Arabia)

Abstract: The vital role of power system planning and operation is to provide secure, reliable, and high-quality energy services for the consumers in cost-effective manner and friendly environmental framework. This can be achieved by introducing innovative applications and technologies and integrating them into the system infrastructure. Battery Energy Storage Systems (BESS) are one of these technologies that are expected to play a key role in the energy sector in the near future. In this paper, a probabilistic planning model is introduced to optimize the location, size, and operation of BESSs that takes into consideration the intermittent nature of wind speed and solar irradiance as well as system demand uncertainty. BESSs investment and operation costs as well as upgrade costs of substation and distribution feeders and energy losses were considered in this study. The objective of this planning is to minimize the total expenditure and operation costs over planning period, and the problem was solved using Particle Swarm Optimization (PSO). The results have shown that integration of BESSs in the distribution system, in the presence of renewable resources will have a significant impact on reducing the total expenditure and operation costs in distribution systems.

Paper Title: *Impact of Grid-Connected Photovoltaic Systems on Low Voltage Distribution Network*

Authors: Dareen Habash (Al Hussein Technical University, Jordan); Ahmad Ra'ed Azzam (The University of Jordan & Htu, Jordan); Reda Issa (The University of Jordan, Jordan); Emad AbdelSalam (Al Hussein Technical University, Jordan); Hassan Qandil (University of North Texas, USA)

Abstract: This work presents and analyzes the penetration impact of grid-connected photovoltaic systems on the voltage, power factor, and current harmonics of low-voltage distribution feeders. A typical low-voltage distribution feeder is simulated with installed solar photovoltaics. The electrical parameters data of the feeder are obtained from the Jordanian Electric Power Company, responsible for distributing electrical energy to nearly 66% of the total consumers in Jordan. The analysis was carried out via power system analysis software on a distributed system model using recorded data for consumer load and photovoltaic system generation. The simulation was focused on the change in the levels of voltage, current harmonics, and power factor on the feeder related to integrating photovoltaic panels into the distribution system. Results showed that the integration of solar photovoltaic panels reduces the power factor and increases the current harmonics of the low-voltage distribution feeder. Although some minor overvoltage problems can be expected, particularly in urban areas, in most cases, the overvoltage did not go above the statutory limit of 1.1 p.u.

Paper Title: *Management Framework for Energy Crisis & Shaping Future Energy Outlook in Pakistan*

Authors: Jamshaid Iqbal Janjua (Al-Khawarizimi Institute of Computer Science & University of Engineering & Technology, Lahore, Pakistan); Osman Anwer (University of Central Punjab, Pakistan); Atique Saber (University of Engineering & Technology, Lahore, Pakistan & Al Khawarizmi Institute of Computer Science University of Engineering & Technology, Lahore, Pakistan)

Abstract: The energy crisis in Pakistan has been exacerbated by several factors, including aging infrastructure, rapidly growing population, circular debt, subsidies, tariffs, and power plant profits. The regulatory to address these issues in order to improve the energy sector with the establishment of a competitive market for electricity generation and supply, and the development of independent power projects are critical to the country. The article provides a proposed framework with options for crisis management for addressing the issues facing the energy sector and improves its overall efficiency, with the ultimate goal of reducing the gap between demand and supply and ensuring a stable and reliable supply of energy to consumers.

Paper Title: *Use of Convolutional Neural Networks and Long Short-Term Memory for Accurate Residential Energy Prediction*

Authors: Hani Jamleh (University of Jordan, Jordan); Hafiz Mohd Al-Alami (The University of Jordan, Jordan)

Abstract: With the deployment of smart meters on the residential level, consumers now possess more options for controlling the electrical consumption of their electrical appliances. So, consumers can better plan for and control how much electricity they use if they know how much electricity they use every day. Today's electrical systems must properly estimate consumer energy use, which can lead to a better understanding of the actual power consumption patterns that consumers experience. This paper addresses methodologies based on machine learning tools used to improve electrical system load forecasting by applying Long Short-Term Memory and Convolutional Neural Networks on a dataset containing 2 months, (i.e. from 1-1-2022 to 1-3-2022), of six-second regularly spaced measurement samples obtained from a lab designed smart meter placed in a residential house. This study also looks at how well the proposed LSTM-CNN model can predict home consumption based on data from two months.