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ABSTRACT BOOK

27-30 NOVEMBER 2025 KONYA

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THE PAST, PRESENT, AND FUTURE OF RADAR AND ELECTRONIC WARFARE TECHNOLOGY

Abdullah GÜÇLÜ[1], Nurettin DOĞAN[2*]

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Abstract – This study provides a comprehensive examination of the past, present, and future of radar technology by conceptualizing radar not as a single, independent sensing device but as an adaptive, multilayered electromagnetic system fundamentally shaped by its continuous interaction with electronic warfare. From its scientific origins in electromagnetic theory through its operational maturation during World War II and the signal-processing revolution of the Cold War, radar has evolved in direct response to increasingly sophisticated ECM threats; in parallel, advanced ECCM techniques emerged, ultimately forming the foundations of modern architectures such as AESA, MIMO, passive, and cognitive radar systems. The study demonstrates that DRFM-based deception, wideband noise jamming, low-observability technologies, and AI-enabled electronic warfare have collectively forced radar systems to develop capabilities such as frequency agility, adaptive beam shaping, waveform diversity, low-probability-of-intercept (LPI) strategies, environmental memory, and real-time optimization. Within this co-evolutionary dynamic, electronic warfare does not operate as an isolated domain but manifests as a set of mutually reinforcing disciplines that continuously reshape radar design across physical, signal-processing, system, and cognitive layers. The study also examines emerging technologies—including cognitive radar, quantum sensing, and AI-driven electronic attack and protection—revealing that future radar–EW competition will be governed not by raw spectral power but by algorithmic adaptability, cooperative sensing, and network-centric electromagnetic ecosystems. Overall, the findings indicate that the trajectory of radar technology cannot be understood independently of electronic warfare pressures and that radar's future will be defined by increasingly intelligent, autonomous, and integrated electromagnetic architectures.

Keywords: Radar, EW, ECM, ESM, ECCM, DRFM

SMART PLANT IRRIGATION SYSTEM

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Abstract - This study aims to meet the water needs of plants in home environments using an IoT-based smart irrigation system. The developed system performs irrigation at the lowest possible cost. Water consumption varies depending on the plant's needs. Temperature and humidity values in the plant's soil can be continuously monitored. Irrigation can be performed via internet communication based on the monitored values. When the humidity level falls below the reference values, the system automatically irrigates to maintain the soil moisture at an optimal level. For this purpose, a system has been designed that includes software and hardware to control the entire system via the internet.

Keywords: Internet of Things, Smart Irrigation, NodeMCU

REGULATION-BASED CHATBOT SYSTEMS: A REVIEW ON ARTIFICIAL INTELLIGENCE-SUPPORTED RELIABLE INFORMATION ACCESS FOR PUBLIC AND HIGHER EDUCATION INSTITUTIONS

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Abstract - This review article examines chatbot systems implemented in public institutions, private organizations, and especially higher education institutions such as universities, aiming to facilitate the understanding of complex regulations and administrative documents. With the rise of Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies, chatbots have fundamentally changed the nature of human-computer interaction. These systems offer the potential to reduce the repetitive workload on administrative staff and use resources efficiently by answering frequently asked questions (FAQs). However, regulation-based applications require much stricter accuracy and reliability standards than general-purpose chatbots (open-domain chatbots). For example, providing an incorrect answer about a UNIVERSITY exam regulation could negatively impact a student's academic career and lead to serious legal issues for the UNIVERSITY. Therefore, these systems must typically rely on closed-domain knowledge bases. This study discusses both the limitations of traditional rule-based (AIML, pattern matching) approaches and the text representation and semantic matching capabilities of modern deep learning models such as BERT and Sentence-BERT (SBERT). Specifically, it focuses on how generative AI models (GPT) can be safely used for legal texts, namely through API integration with Campus Management Systems (CMS) and a controlled AI architecture (RAG philosophy) based on the use of vectorized (embedded) legislation documents. Finally, ethical and TECHNICAL challenges such as transparency, data privacy (GDPR), and context understanding are addressed, and recommendations are made for future research.

Keywords - Chatbot, UNIVERSITY Administration, AI, NLP, API Integration, Campus Management System

DEEP LEARNİNG-BASED ANALYSİS and RECOMMENDATİON SYSTEM for MULTİ CHANNEL PERFUME REVİEWS

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Abstract - This study introduces a deep learning-based analysis and recommendation system designed to derive meaningful insights from the rapidly increasing volume of user reviews on digital platforms. In industries such as perfumery—where sensory perception and subjective judgment dominate—traditional data processing techniques often fail to capture linguistic nuances. The proposed system integrates textual, numerical, and categorical data within a unified, multi-channel architecture to generate personalized and accurate perfume recommendations. Textual data are analyzed through both classical and modern approaches to ensure a comprehensive comparison. In the classical setting, TF-IDF vectorization with (1–2) n-grams was applied to preserve compound terms such as “black pepper” and “blood orange,” followed by Logistic Regression and Multinomial Naive Bayes classifiers. The deep learning approach, on the other hand, employed a pre-trained RoBERTa model capable of understanding contextual and semantic relationships in language. Additionally, numerical features such as longevity and sillage were modeled using nonlinear ReLU activations and Dropout layers, while categorical attributes were encoded through trainable embeddings combined via a multi-head attention mechanism. Experimental findings validated that the roberta-base model achieved the highest accuracy of 73.40%, outperforming Logistic Regression (73.34%) and Naive Bayes (72.45%). These results clearly demonstrate that Transformer-based deep learning models are significantly more effective in extracting nuanced meaning and generating actionable insights from subjective, text-based consumer reviews in the perfumery industry.

Keywords - Cosine Similarity; Deep Learning; Multi-Channel Architecture; Natural Language Processing; Perfume Review; Recommendation System; ROBERTa; TF-IDF

COMPARATİVE STUDY on KAGGLE DRONE - DETECTİON

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Abstract - In this study, three different versions of the YOLO (You Only Look Once) architecture, namely YOLOv8, YOLOv9, and YOLOv11 models, were used for image-based drone detection. Experiments were conducted on the open-source Drone Detection dataset available on the Kaggle platform. The models were trained using an NVIDIA Tesla T4 GPU in the Google Colab environment. The dataset was divided into training, validation, and test sets; model performance was evaluated using the mean average precision (mAP), precision, and recall metrics. The results revealed that the YOLOv9 model demonstrated the highest detection success (mAP@50–95 ≈ 0.71, precision ≈ 0.92). The YOLOv8 model showed balanced performance and provided fast convergence, while the YOLOv11 model produced sharper bounding boxes but showed a slight decrease in overall accuracy. These findings indicate that the YOLOv9 model is the most suitable option for drone detection applications in terms of accuracy and generalization. The study serves as a practical reference for applications such as airspace security and surveillance systems.

Keywords - Drone detection, YOLOv8, YOLOv9, YOLOv11, Object recognition, Deep learning

RAINFALL PREDİCTİON USİNG NASA EARTH OBSERVATİON DATA and ENSEMBLE LEARNİNG

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Abstract – Outdoor event planning faces significant challenges due to weather uncertainties, with traditional forecasting methods often proving inadequate for location-specific, long-term predictions. This study presents a machine learning-powered rainfall prediction system leveraging 44 years (1981-2025) of NASA Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) Earth observation data. The system addresses the critical need for accurate, data-driven weather forecasting to support event planners in making informed decisions. An ensemble learning approach combining Random Forest and XGBoost algorithms was implemented to predict rain probability for specific dates and locations. The model processes 44+ meteorological features including temperature at 2 meters (T2M), relative humidity at 2 meters (RH2M), cloud coverage (CLOUD_AMT), surface pressure (PS), and wind parameters, with advanced feature engineering techniques such as moisture index and temperature range calculations. Experimental results demonstrate strong predictive performance with 86.0% accuracy, 83.4% precision, 77.9% recall, 80.5% F1-score, and 93.2% Receiver Operating Characteristic - Area Under the Curve (ROC AUC) score. The system was validated through retrospective testing and successfully predicted weather conditions for outdoor events in Konya, Turkey with high accuracy. Cross-regional validation across multiple cities confirmed the model's robustness and generalizability. The developed system provides three core functionalities: specific date prediction with confidence levels, optimal date recommendation within a given month, and comprehensive event planning reports. This work demonstrates that historical Earth observation data, when processed through ensemble machine learning techniques, can deliver superior performance compared to traditional statistical methods in weather prediction applications.

Keywords – Ensemble Learning; XGBoost / Random Forest; NASA MERRA-2 Earth Observation; Long-Term Rainfall Forecasting

AN EXAMINATION OF BIG DATA PRIVACY AND SECURITY APPROACHES

Sami Yusuf BULUT1, Havva Hazel ARAS1

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Abstract - Big data refers to massive data sets characterized by fundamental dimensions such as volume, velocity, and variety, which exceed the capabilities of traditional data processing methods. In recent years, the rapid proliferation of IoT (Internet of Things) and artificial intelligence (AI) applications has led to an exponential increase in big data production, elevating privacy breaches and cybersecurity risks to critical levels. This review examines the fundamental security and privacy challenges encountered throughout the big data analytics (BDA) lifecycle and systematically addresses the main approaches developed to counter these challenges. In particular, it focuses on results obtained from cryptographic mechanisms (Homomorphic Encryption and Attribute-Based Encryption) and non-cryptographic anonymization techniques (K-Anonymity, L-Diversity, and Differential Privacy). Furthermore, security requirements in distributed platforms such as the Hadoop ecosystem and ethical/legal challenges in smart city applications are discussed. The study emphasizes that ensuring the privacy and security of big data will be possible through the integration of emerging technologies such as artificial intelligence, machine learning, and quantum computing, and that these areas are critical for future research.

Keywords - Big Data Privacy, Hadoop Security, Differential Privacy, Homomorphic Encryption, Anonymization, Big Data Analytics (BDA).

CONTRİBUTİON to the ATTACK of SULFATE WATER on the ENVİRONMENT of the HAMMAM – DEBAGH DAM in ALGERİA

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Abstract - The study presented in this paper deals with the consequences of external sulphate attack on prefabricated concretes of Hamam Debagh Dam in Guelma (Algeria). Dams can still be the seat of concretes swelling. The sulphate reaction is part of the known chemical reactions that can cause the alteration of the mechanical characteristics of the hydraulic material (concrete) constituting the structure. Distinct markers of the reaction are then observed which are the appearances, in the more or less long term, of a network of cracking, swelling, dyes, but also corrosion or ruptures of reinforcement induced by the entry of water and oxygen into the structure. Sustainability is nowadays a determining factor in the new European normative context on concrete and requires effective control of all factors likely to affect its behavior over time. The results show that the impact of the age of the material on the environment and the degradation in contact with the sulfuric acid solution was highlighted, visual observations then rapid and sudden degradation on the surface then in depth towards the core then a loss of mass and cracking and finally the ruin of the material

Keywords - Hamam Debagh dam, prefabricated concrete, environment, sulphate attack, degradation.

ARTİFİCİAL INTELLIGENCE – BASED SOLUTIONS for DETECTING INTERNAL THREATS

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Abstract - Internal threat detection is one of the most costly and complex challenges in the cybersecurity world, with the average cost of a single incident estimated at $15.4 million in 2022. Therefore, there is a need for more sophisticated and adaptable solutions focused on User and Entity Behavior Analytics (UEBA) rather than existing static rule-based systems. Artificial intelligence, particularly machine learning and deep learning techniques, shows promise in this area due to its ability to automatically learn abnormal deviations in users' complex behavioral patterns over time. The study examines the most effective DL approaches for modeling behavioral sequences; these approaches include LSTM autoencoders that effectively process time series data and the Transformer Encoder architecture that captures long-range relationships. The Transformer model achieved superior performance scores, such as a 99.43% recall rate on CERT datasets. Furthermore, the addition of psychometric features (OCEAN model) and text-based features significantly improved detection accuracy beyond TECHNICAL logs alone. However, the “black box” nature of DL models and the non-public availability of real-world log data due to privacy concerns pose fundamental challenges to generalizability. Future work should focus on Explainable Artificial Intelligence (XAI) techniques and validation with real-world datasets to increase transparency.

Keywords - Insider Threat Detection, Artificial Intelligence, Deep Learning, Asset Behavior Analysis

ETHİCAL ISSUES IN ARTIFICIAL INTELLIGENCE SYSTEMS AND RESPONSIBLE AI APPROACHES : A CONCEPTUAL REVIEW

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Abstract - Artificial intelligence (AI) systems offer advantages such as productivity, cost efficiency, and security, but they also bring along issues such as bias, lack of transparency, and accountability problems. In this context, the "Responsible Artificial Intelligence" (RAI) approach offers a comprehensive ethical framework that aims to minimize these risks. In the literature, the four fundamental principles of RAI are defined as transparency, privacy, accountability, and fairness; these principles are supported by the values of human-centeredness, security, and sustainability. The main ethical issues arising from the proliferation of AI include data bias, the opacity caused by black box models, and new risks such as deepfakes, misinformation, copyright infringement, and data leaks caused by generative artificial intelligence (GAI). Governance frameworks developed to address these issues aim to bridge the "principle-practice gap." Tools such as ECCOLA, Z-Inspection®, AI Fairness 360, and Aequitas, along with human oversight approaches (HITL, HOTL, HIC), aim to integrate ethical principles into system design. RAI applications are critically important, especially in sensitive areas such as healthcare and academia. In healthcare, data privacy and explainability come to the fore, while in academia, transparency, error control, and accountability are paramount. The risks of false data production and plagiarism in AI-supported research necessitate the updating of ethics education. Consequently, ethical AI applications are not only a TECHNICAL but also a social responsibility. The systematic implementation of ethical principles is essential for building reliable, human-centered, and sustainable artificial intelligence ecosystems.

Keywords - Artificial intelligence, RAI, ethics, responsible, transparency.

ANALYSIS OF EMBEDDED IOT SYSTEMS FOCUSED ON ULTRA-LOW POWER CONSUMPTION: A CRITICAL REVIEW OF ARTIFICIAL INTELLIGENCE AND ARCHITECTURAL OPTIMIZATION IN ENERGY MANAGEMENT

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Abstract - This review study examines the challenge of simultaneously meeting energy efficiency and strong security requirements in modern embedded Internet of Things (IoT) systems. IoT devices necessitate ultra-low power consumption due to fundamental constraints such as compact structures, limited resources, restricted memory, and battery life. In this context, the integration of Artificial Intelligence and Machine Learning techniques into Energy Management Systems plays a vital role in managing large datasets and enabling dynamic optimization. At the architectural level, the use of lightweight communication protocols such as CoAP has been shown to reduce energy consumption by approximately 30.86% compared to other protocols. At the security layer, Speck encryption consumes 37% less CPU power and 5.2% less radio power compared to traditional AES encryption, demonstrating that it is the most suitable lightweight encryption for resource-constrained networks. These cross-layer optimizations enable a 30% reduction in total power consumption. In artificial intelligence applications, the use of AI for controlling HVAC systems in office buildings has been found to offer energy savings potential of up to 37%. However, the fact that most AIoT research is still in the Early Development Stages poses a challenge for practical adaptation.

Keywords - Embedded IoT Systems, Ultra-Low Power Consumption, Energy Management Systems, Artificial Intelligence, Machine Learning, Cross-Layered Architecture, Energy Efficiency.

PREDİCTİVE MAINTENANCE IN INDUSTRY

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Abstract - Increasing competition in the globalized production ecosystem makes the need for smart factories in industry more apparent every day. This situation puts the manufacturing sector under serious pressure to transform, directing it towards predictive approaches in production processes. It has become an inevitable necessity for businesses seeking to maintain and increase their competitive strength to improve their efficiency and productivity. In this regard, adopting advanced analytical methods provides a significant advantage. The Internet of Things (IoT) enables the systematic collection of data from industrial operations, the storage of this data, and its analysis to transform it into meaningful information. When processed with analytical techniques, IoT-based big data offers new perspectives on existing problems and contributes to the emergence of different research areas. Nevertheless, studies on how businesses can profitably integrate IoT into their strategic and operational processes are quite limited. In this context, the study examines how maintenance management can be made more effective through the use of big data generated in industrial environments and evaluates the potential offered by predictive maintenance. Predictive maintenance is based on monitoring the condition of equipment and components before a failure occurs, evaluating them using analytical methods, and thus estimating their lifespan and determining the probability of failure. Thanks to this approach, maintenance activities are planned and optimized more accurately using real-time data and machine learning-based prediction models in situations where equipment could cause unplanned downtime.

Keywords - Predictive Maintenance, Internet of Things (IoT), Big Data, Industry 4.0

THERMODYNAMIC ANALYSIS OF HEAT EXCHANGERS

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Abstract - In this study, thermodynamic analysis was performed for double-pipe heat exchangers, shell-and-tube heat exchangers, and plate heat exchangers. The performance of these three types of heat exchangers was tested experimentally. While the cold water flow rate in the heat exchanger test area was kept constant at 1.5 L/min, the hot water flow rate was changed to 0.8 L/min, 1.6 L/min, and 2.4 L/min. The hot water supply was selected as 50°C, 60°C, and 70°C. The experiments were conducted in both counter-flow and parallel-flow configurations. The experiments revealed that the power extracted from the heat exchanger increased with increasing temperature and flow rate. The shell-and-tube heat exchanger type exhibited the highest heat transfer rate per unit area, while the double-tube heat exchanger type showed the lowest performance.

Keywords - Double-tube heat exchanger, shell-and-tube heat exchanger, plate heat exchanger, thermodynamic analysis

A LITERATURE REVIEW ON ARTIFICIAL INTELLIGENCE TECHNOLOGIES USED IN THE STRUCTURES AND CONTROL OF EN-ROUTE SURVEILLANCE RADAR (RSR) AND TERMINAL APPROACH RADAR (TAR) IN AVIATION

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Abstract - This study systematically examines the integration of artificial intelligence (AI) techniques into radar systems (particularly En-Route Surveillance Radar - RSR and Terminal Approach Radar - TAR) used in air traffic control (ATC). The rapidly increasing volume of air traffic is pushing the limits of traditional surveillance systems and increasing the need for smarter, predictive systems. In this context, AI-supported approaches show promise in many critical areas, such as air traffic management, conflict detection and resolution, flight path prediction, and controller workload analysis. AI techniques such as machine learning, neural networks, and reinforcement learning have been shown to provide high accuracy rates, particularly in predicting the decisions of D-side controllers. Furthermore, the use of modern systems such as ADS-B in conjunction with radar-based surveillance increases surveillance accuracy and contributes to flight safety [1]. The examples presented in this study demonstrate the potential of AI-based solutions to enhance human-machine collaboration in air traffic control, improving both operational efficiency and safety.

Keywords – En Route Surveillance Radar, RSR, Terminal Approach Radar, TAR, PSR, SSR, ADS-B, MLAT

INVESTIGATION OF AIRCRAFT ACCIDENTS CANSED BY ELECTRICAL FAILURES

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Abstract - This study evaluates the electrical systems of military aircraft from a TECHNICAL perspective, based on case studies of actual accident reports. Flight control, avionics, weapons, and communication systems in modern defense platforms operate largely on integrated and redundant electrical infrastructures. However, factors such as electromagnetic pulses (EMP), short circuits, overloads, software errors, or cooling system failures can lead to serious consequences ranging from mission abortions to loss of flight control and vehicle loss.

In this context, the causes and effects of electrical failures have been systematically analyzed; fundamental weaknesses encountered in power generation and distribution, cable infrastructure, battery systems, and command-control interfaces have been identified. Supported by case reports, this assessment demonstrates that electrical system safety is not only a TECHNICAL design element but also an operational necessity.

Keywords – Military aircraft, Aircraft accidents, Unmanned aerial vehicles (UAVs), Drone crashes, Electrical safety

CNC MACHINE TOOLS: ROLE, CONTRIBUTIONS AND FUTURE IN MODERN MANUFACTURING

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Abstract – This study examines the evolving role of Computer Numerical Control (CNC) machine tools in modern production systems, focusing on their historical development, sectoral applications, and the impact of technologies such as digital twins, artificial intelligence, and Industry 4.0/5.0. It highlights the ongoing transformation of CNC machines from traditional tools to intelligent, autonomous production units. Additionally, the paper explores the synergy between CNC systems and digital manufacturing paradigms, emphasizing energy efficiency, sustainability, and real-time data processing.

Keywords –CNC Technology, Industry 4.0, Digital Twin, Smart Manufacturing, Artificial Intelligence

INSTRUMENT LANDING SYSTEM (ILS) AND STUDIES ON ITS COMPONENTS

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Abstract - The Instrument Landing System (ILS) is an important navigation aid that enables aircraft to land safely in low visibility conditions. Comprising the Localizer and Glideslope components, this system provides horizontal and vertical guidance, enabling pilots to achieve the correct landing angle during the final approach. Additionally, auxiliary components such as Marker Beacons and high-intensity runway lights enhance the system's effectiveness. This study presents the components of the ILS system and an interdisciplinary perspective; it addresses electromagnetic interference (EMI), CAT III automatic landing systems, system integration, and the use of ILS at airports in our country. The advantages, challenges, and operational factors of the system have been evaluated based on current theses, TECHNICAL reports, and peer-reviewed publications in the literature [1], [2], [3], [4].

Keywords – Instrument Landing System, Localizer, Glide Slope, Marker Beacons

METHODS FOR PROCESSING AND FILTERING IMAGES OBTAINED FROM VEHICLES USED IN THE DEFENSE INDUSTRY USING ARTIFICIAL INTELLIGENCE

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Abstract – Today, unmanned aerial vehicles (UAVs) offer revolutionary developments in data collection and analysis processes; they are used effectively in many areas, particularly defense, environment, agriculture, disaster management, and urban planning. This study comprehensively addresses the processing and filtering of images obtained from vehicles used in the defense industry using artificial intelligence. Application examples in many scenarios, such as fire detection, vehicle make and model recognition, and archaeological site analysis, were evaluated using image processing techniques, deep learning architectures, and UAV-supported data collection systems. The study highlights the contributions of UAV technologies in terms of cost, accuracy, and time advantages; it also emphasizes the potential of artificial intelligence-supported solutions in terms of decision support systems.

Keywords – Unmanned Aerial Vehicles (UAVs), Artificial Intelligence, Image Processing, Deep Learning, Defense Industry, Forest Fire Detection, Object Recognition, Digital Surface Model, Photogrammetry, UAV Applications

HYPERSONIC MISSILE SYSTEMS AND COUNTERMEASURES

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Abstract – This study examines hypersonic missile systems, which have fundamentally altered military and strategic balances in recent years, through a comprehensive literature review. Capable of traveling at speeds exceeding Mach 5, these systems stand out for their maneuverability and low detectability, which enable them to overcome defense architectures. The study provides a comparative analysis of the hypersonic missile strategies of major powers such as China, Russia, and the United States; it also evaluates Turkey's TECHNICAL capacity, national vision, and foreign policy reflexes in this field. Furthermore, the study details the impacts of hypersonic weapons on international law, ethics, digital warfare technologies, artificial intelligence integration, and engineering infrastructure. It reveals that hypersonic technologies have transformative effects not only on military systems but also on diplomatic, technological, and normative systems.

Keywords - Hypersonic Missile Systems, Defense Technology, Military Strategy, Deterrence, Geopolitical Competition, Artificial Intelligence, Turkish Defense Industry, International Law, US-China Competition, NATO

AI-POWERED STATE OF CHARGE (SOC) PREDICTION IN LITHIUM-ION BATTERIES

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Abstract – In this review, artificial intelligence and machine learning-based methods developed for the estimation of the state of charge (SoC) of lithium-ion batteries have been comprehensively examined. In addition to traditional algorithms such as support vector machines and decision trees, it has been observed that deep learning-based approaches such as LSTM, GRU, CNN and hybrid models can make SoC estimation with high accuracy. However, the need for large volumes of labeled data, lack of explainability and limitations in real-time applications of these models stand out as important challenges. In the future, hybrid models in which physics-based knowledge is integrated with artificial intelligence, systems with online learning capabilities and approaches using digital twin technology are expected to be effective in overcoming these problems. In this context, the study aims to shed light on future research by analyzing the current trends and challenges encountered in SoC estimation.

Keywords - Lithium-ion battery; SoC estimation; artificial intelligence; deep learning; machine learning; battery management system; time series analysis; explainable artificial intelligence; hybrid models

AIRCRAFT AND ADVANCES IN TRANSFORMER RECTIFIER UNIT (TRU) TECHNOLOGY: A REVIEW

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Abstract - The increasing demand for electricity in the aviation sector has led to fundamental changes in the structure of electrical power distribution systems in large passenger aircraft. The transition from traditional AC-based systems to DC or hybrid power distribution systems, which offer more efficient, lightweight, and reliable solutions, is rapidly continuing. This change has supported the development of new concepts such as More Electric Aircraft (MEA) and All Electric Aircraft (AEA). Power electronics components play a critical role in the transformation of electrical power distribution systems. Among these components, the Transformer Rectifier Unit (TRU) is positioned as a fundamental intermediate stage in converting AC power to DC. In particular, the development of multi-pulse TRU structures and regulated TRU designs has supported the systems in achieving their efficiency, weight, and power quality targets. This review discusses the types of electrical power distribution systems in large passenger aircraft, innovations in this field, and developments in TRU technology. It also evaluates current trends in aircraft electrical power systems.

Keywords – electrical power system

COMPARATIVE EVALUATION OF CLASSICAL AND FRACTIONAL MOMENT-BASED ESTIMATORS FOR COMPOUND GAUSSIAN RADAR CLUTTER WITH LOG-NORMAL TEXTURE

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Abstract - Reliable parameter estimation of non-Gaussian sea clutter is essential for modern high-resolution radar systems. This work compares four estimation methods for the Compound Gaussian with Log-Normal Texture (CG-LNT) model: Higher-Order Moment Estimator (HOME), Fractional Order Moment Estimator (FOME), [zlog(z)], and Fractional Negative Order Moment Estimator (FNOME). Special attention is given to the influence of the fractional order parameter on the performance of FOME and FNOME. Monte Carlo simulations are performed on synthetic CG-LNT clutter generated for various mean (δ) and standard deviation (σ) values. The Mean Squared Error (MSE) is used to assess accuracy for both δ and σ. Results show that small fractional orders improve estimation accuracy for FOME and FNOME, with FNOME providing the most accurate results in high-spikiness clutter conditions. This comparative analysis offers practical guidance for selecting estimators in statistical sea clutter modeling, demonstrating the advantages of fractional moment-based methods in challenging radar environments.

Keywords - Sea clutter, parameters estimation, CG-LNT distribution.

DETECTING EPILEPSY USING ARTIFICIAL INTELLIGENCE TECHNIQUES

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Abstract -Epilepsy is a chronic brain disorder that causes recurrent seizures and affects more than 50 million people worldwide. Early and accurate diagnosis is crucial for managing the disease. Recent rapid developments in artificial intelligence (AI) have made significant contributions, particularly in biomedical signal processing applications, and have opened new possibilities for epilepsy detection through the analysis of electroencephalography (EEG) signals. AI-based approaches have attracted attention with higher accuracy rates compared to traditional methods in classifying and predicting epileptic seizures. This review study examined various AI algorithms used for epilepsy detection and compared methods such as support vector machines (SVM), artificial neural networks (ANN), convolutional neural networks (CNN), and long short-term memory (LSTM). The findings indicate that AI models developed based on EEG signals offer effective tools for epilepsy diagnosis. Furthermore, it is emphasized that factors such as dataset selection, feature extraction, and model training are decisive for overall success. The study highlights the potential of AI-based systems in epilepsy diagnosis and aims to guide future research.

Keywords - Artificial intelligence, Machine learning, Epilepsy, EEG, CNN

A REVIEW ON BATTERY CHARGE ESTIMATION ALGORITHMS

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Abstract -Today, the limited nature of fossil fuels and the damage they cause to the environment have made it imperative to develop alternative solutions in the energy sector. Battery technologies are at the forefront of these solutions and are particularly important for electric vehicles. Studies on battery technologies have not yet achieved the desired level of performance and reliability. A review of the literature reveals that, in addition to studies based on traditional experimental methods, artificial intelligence-based approaches and methods based on new technological developments are also being used. In this review study, the aforementioned methods are discussed under subheadings; the advantages and disadvantages of each method are evaluated objectively.

Keywords - Battery State of Charge Estimation, Artificial Intelligence, Experimental Methods, Electric Vehicle

ARTIFICIAL NEURAL NETWORK (ANN) TECHNOLOGIES USED IN CANCER DIAGNOSIS

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Abstract – This review presents a comprehensive literature review on the use of artificial intelligence methods based on artificial neural networks (ANN) in cancer diagnosis. In recent years, deep learning techniques, particularly multilayer artificial neural networks, have achieved remarkable success in various types of medical data, especially image analysis. ANN-based models have been developed for the early diagnosis of breast, lung, prostate, brain, and many other types of cancer, achieving high accuracy and sensitivity rates in applications in fields such as radiology, pathology, and genomics. This study explains the basic principles of ANN technologies, presents specific application examples for different types of cancer, and examines commonly used deep learning models such as convolutional neural networks (CNN), recurrent neural networks (RNN), and generative adversarial networks (GAN).

Keywords - Artificial neural network, Cancer, Diagnosis, Imaging, Deep learning

ARTIFICIAL NEURAL NETWORK (ANN)- BASED EARLY DIAGNOSIS OF ALZHEIMER'S DISEASE

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Abstract – Alzheimer's disease (AD) is the most common form of neurodegenerative dementia affecting the aging population globally. Due to biological changes that begin before clinical symptoms appear, accurate diagnosis of the disease in its early stages is of great importance. In this context, the integration of artificial intelligence (AI) and, in particular, artificial neural network (ANN)-based models into diagnostic processes shows promise for early diagnosis and prediction of disease progression. This study examines developments in the literature on the use of ANNs for the early diagnosis of Alzheimer's disease in a multidimensional manner.

ANN models applied to different data modalities, such as structural and functional brain imaging (MRI, PET), electroencephalography (EEG), speech analysis, gait data, genetic profiles, and retinal images, were compared; the accuracy rates, generalizability, explainability levels, and clinical validity of these models were discussed. Deep learning approaches, particularly convolutional neural networks (CNNs) for image data and recurrent neural networks (RNNs) for speech and time series analysis, have been reported to perform well. Furthermore, multimodal models have been found to provide stronger diagnostic results by integrating multiple data types.

However, challenges such as overfitting due to limited datasets, model generalizability, lack of explainability, and ethical data sharing remain significant. The findings of this study indicate that ANN-based models have great potential for the early diagnosis of Alzheimer's disease; however, broader, balanced, and explainable models are needed for clinical integration.

Keywords - Artificial neural network, Alzheimer's, Early Diagnosis, Imaging, Deep Learning

COMPARATIVE ANALYSIS OF SOAP AND REST SERVICES

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Abstract – This review study comprehensively examines SOAP (Simple Object Access Protocol) and REST (Representational State Transfer) technologies, which are widely used in today's web service architectures. Through analysis of academic articles in the literature, the advantages and limitations of both approaches are evaluated in terms of architectural structures, data exchange methods, performance, security, and flexibility. SOAP's standardized structure and advanced security support make it stand out in enterprise applications, while REST's lightweight structure and implementation based on the HTTP protocol make it the preferred choice for mobile and web-based applications. The findings reveal that the choice of service type varies depending on the application domain and offer suggestions for future research.

Keywords – Web Services, SOAP, REST, Comparative Analysis, Software Architecture, Service-Oriented Architecture

COMPARATIVE ANALYSIS OF WCF AND WEB API SERVICES

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Abstract – This review article compares WCF (Windows Communication Foundation) and Web API technologies in terms of performance, security, scalability, and architectural compatibility. Based on academic studies in the literature, the advantages and disadvantages of both technologies are evaluated from various perspectives. Research shows that Web API stands out in modern software development processes due to its flexibility, lightness, and compatibility with microservice architectures, while WCF is still preferred in enterprise systems due to its deep integration with the SOAP protocol and advanced security capabilities. At the end of the study, recommendations are made to developers regarding service technology selection, and gaps in the literature are highlighted.

Keywords – WCF, Web API, REST, SOAP, Web Services, Comparative Analysis, Microservices, Security, Performance, Extensibility

CIRCUIT BOARD THAT READ CURRENT-VOLTAGE

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Abstract - Multimeters, which are also used to measure voltage and amperage in electrical and electronic circuits, provide information about whether the circuit is working properly by accurately measuring the voltage in the circuit and the electric current passing through it. This allows potential faults to be detected and checks whether the circuit elements are working at the desired values. Incorrect measurement of these values can lead to circuit component failure, energy loss, and safety risks, making the use of multimeters a necessity in TECHNICAL work. Knowing voltage and current values is important not only in laboratory environments, but also in home electrical installations, industrial and production facilities, automotive electronics, renewable energy systems (especially solar energy and wind turbine applications), communication systems, maintenance and repair operations, and educational experiment setups. This project aims to measure direct current (DC), current values in the 0–10A range, and voltage values in the 0–100V range, and to display the measured values in real time on a touch screen after processing them with a microcontroller.

Keywords – Current, voltage, measurement, circuit, shunt

MODERN IMAGE PROCESSING AND DEEP LEARNING ALGORITHMS USED FOR TARGET RECOGNITION, CLASSIFICATION AND TRACKING IN UAV SYSTEM

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Abstract – This study systematically examines current deep learning and image processing algorithms used in target recognition, classification, and tracking tasks in UAV systems. Fifty Turkish and English sources published between 2016 and 2024 were analyzed, comparing the performance of algorithms such as YOLO, SSD, R-CNN, RetinaNet, DeepSORT, EfficientNet, DETR, and Vision Transformer. Analyses based on metrics such as real-time performance, accuracy rate, hardware compatibility, and application area reveal the potential uses of each algorithm in UAV systems. Additionally, algorithm-task matching was performed based on task scenarios such as border security, search and rescue, and urban surveillance.

Keywords - Deep Learning, Image Processing, Unmanned Aerial Vehicle, Object Detection, Classification, Tracking.

YOLO ALGORITHMS

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Abstract – Deep learning-based object detection algorithms are among the most developed topics in the field of computer vision in the last decade. Among these algorithms, the YOLO (You Only Look Once) family is a remarkable architecture in terms of real-time inference speed, high accuracy rate and hardware efficiency. This study examines all versions of YOLO algorithms starting from YOLOv1 to YOLOv9 with a systematic literature review method. These articles in the literature reflect not only TECHNICAL achievements but also architectural evolution processes, areas of use, limitations and potential future developments. Each section comprehensively presents the general structure of the relevant YOLO version, the problems it encounters, the solutions it offers and comparisons with other models. The results obtained show that YOLO algorithms are continuously developed and each new version is optimized according to specific needs.

Keywords *- Classification, Embeddability, Deep Learning, Image Processing, Object Detection, Real-Time, Tracking*

MODERN IMAGE PROCESSING AND DEEP LEARNING ALGORITHMS USED FOR TARGET RECOGNITION, CLASSIFICATION AND TRACKING IN UAV SYSTEMS

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Abstract – This study systematically examines current deep learning and image processing algorithms used in target recognition, classification, and tracking tasks in UAV systems. Fifty Turkish and English sources published between 2016 and 2024 were analyzed, comparing the performance of algorithms such as YOLO, SSD, R-CNN, RetinaNet, DeepSORT, EfficientNet, DETR, and Vision Transformer. Analyses based on metrics such as real-time performance, accuracy rate, hardware compatibility, and application area reveal the potential uses of each algorithm in UAV systems. Additionally, algorithm-task matching was performed based on task scenarios such as border security, search and rescue, and urban surveillance.

Keywords - Deep Learning, Image Processing, Unmanned Aerial Vehicle, Object Detection, Classification, Tracking.

ALGORITHM FOR DAMAGE ASSESSMENT USING MAM C DETECTION TECHNOLOGY AGAINST CBRN ATTACKS

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Abstract: CBRN (Chemical, Biological, Radiological, Nuclear) threats pose serious risks in the field of contemporary security. The detection and damage assessment of these threats are of critical importance, especially regarding chemical warfare agents. The Chemical Warfare Agent Detection Device (KHMBC) developed by TÜBİTAK is a technology that can detect such threats quickly and reliably. However, the algorithms used to increase the effectiveness of this device play an important role in making more accurate damage predictions. This article highlights how the technology of the TÜBİTAK KHMBC device interacts with the algorithms it uses, particularly for damage detection, while also emphasizing the importance of machine learning.

Keywords - CBRN, TÜBİTAK, Chemical Warfare Agent Detection Device, damage detection, algorithm, machine learning

THE EFFECT OF ARTIFICIAL INTELLIGENCE

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Abstract - This article examines the changes in the academic success of secondary school students who use Artificial Intelligence (AI)-supported learning systems. In today's world, with the effective use of Artificial Intelligence (AI) technologies in many areas such as transportation, health, industry, entertainment, and especially education, individuals' quality of life has improved, and learning processes have been reshaped. The rise of AI in education enables the personalization of learning experiences; it makes learning more efficient and accessible by offering customized content based on students' learning styles, speeds, and individual needs. In this sense, AI is not only a technological tool but also serves as a pedagogical transformer. One of the most prominent advantages of AI in education is its ability to perform individual analysis. Systems can analyze students' previous achievements, behavioral patterns, and cognitive tendencies to suggest the most suitable methods for the learning process and approach each individual as if they were a personal teacher. This is an important development that supports equal opportunities in education. Furthermore, AI systems provide instant feedback, enabling students to identify their shortcomings in a timely manner and making learning more effective. In this context, AI contributes to the creation of a more strategic and guidance-based educational environment by reducing the workload not only for students but also for teachers.

Keywords - Artificial Intelligence, Secondary Education, Student Achievement, Intelligent Learning Systems, Educational Technology

USE OF BLOCKCHAIN TECHNOLOGY IN DATA SECURITY AND AUTHENTICATION

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Abstract - Today, social media, banking applications, and emerging technologies are causing devices to generate vast amounts of data. The control, management, and secure sharing of this data are becoming increasingly important. Under the leadership of the financial sector, new perspectives and technologies are constantly being introduced into the fields of data storage and data management. One of the most recent and popular examples of this is Blockchain technology. Although it gained its greatest popularity through the cryptocurrency Bitcoin, it is evident that blockchain is not merely a virtual currency technology. This article provides an in-depth examination of blockchain technology, exploring its types, architecture, working principles, and areas of application. The findings of the study suggest that rapid adaptation to this security-focused, decentralized technology is essential.

Keywords— Blockchain, authentication, security, database, Cryptography, Digital Identity Management

A COMPREHENSIVE REVIEW OF THE HARRIS HAWKS OPTIMIZATION ALGORITHM: STRUCTURE, APPLICATIONS AND ETHICAL PERSPECTIVES

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Abstract - The Harris Hawks Optimization (HHO) algorithm, inspired by the cooperative hunting strategy of Harris hawks, has garnered considerable attention for its effectiveness in addressing complex, nonlinear, and multidimensional optimization problems. Since its introduction in 2019, numerous enhanced variants have been proposed to overcome limitations such as premature convergence and entrapment in local optima. This comprehensive review systematically examines the theoretical foundations, dynamic mechanisms, and mathematical structure of the original HHO algorithm, alongside a wide array of its improved versions. It synthesizes findings from over 70 peer reviewed studies, highlighting applications in engineering design, machine learning, image processing, energy systems, and wireless sensor networks. Special attention is paid to multi-objective extensions and hybrid models, which demonstrate superior performance in real-world scenarios. Furthermore, the paper provides a critical ethical assessment of HHO related literature, evaluating transparency, citation integrity, methodological fairness, and reproducibility. The insights gained serve as a foundation for future research and cross disciplinary algorithmic development.

Keywords - Harris Hawks Optimization (HHO), Swarm Intelligence, Hybrid Optimization Models, Benchmarks, Engineering Design

THE USE OF DEEP LEARNING METHODS IN HEALTH AND BIOMEDICAL APPLICATIONS

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Abstract - Deep learning, a subfield of artificial intelligence, is a machine learning subfield based on artificial neural networks that automatically learns features from data. Inspired by the human brain, this method enables learning on large data sets thanks to its multi-layered structures. Today, deep learning models are effectively used in many applications in the healthcare field, such as disease diagnosis and medical image analysis. In particular, the diagnosis of some diseases is complex and time-consuming, requiring a high level of experience from physicians. Deep learning-trained models provide time savings and efficiency in the diagnosis process because they can analyze data obtained from different sources in real time without the need for human intervention. This study first addresses deep learning models and then examines deep learning models used in the diagnosis and detection processes of diseases. Pathological images and data obtained from medical devices are examined in articles and studies in terms of their use in various health and biomedical applications targeting systems such as the heart, lungs, liver, and brain.

Keywords - Artificial Intelligence, Deep Learning, Health, Biomedical, Image Processing

THE EVOLUTION OF NATURAL LANGUAGE PROCESSING (NLP) TECHNIQUES AND CURRENT APPLICATIONS

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Abstract - This study covers natural language processing techniques and the history of rule-based systems, statistical methods, machine learning, and deep learning methods, which are the most fundamental in natural language processing. It also provides information on which technologies are used today. Natural language processing aims to understand human language and interpret it correctly using machine learning, artificial intelligence, data science, deep learning, and algorithms. In short, natural language processing is the processing of language using machine learning in conjunction with grammar rules. It is used in many areas today to meet specific needs. More efficient results have been achieved using deep learning and artificial intelligence. It is frequently used in areas such as machine translation, text summarization, chatbots, sentiment analysis, and search engines. It is a technology that makes our lives easier in numerous applications, such as social media, email filtering, and voice response systems.

Keywords - Natural Language Processing, Machine Translation, Artificial Intelligence, Deep Learning

THE USE OF BLOCKCHAIN TECHNOLOGY IN HEALTHCARE APPLICATIONS

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Abstract - The healthcare sector has undergone a fundamental transformation in recent years due to the impact of digitalization. The increasing volume of data has made issues such as patient privacy, data security, and interoperability between systems more visible. This study focuses on the use of blockchain technology in healthcare and provides a comprehensive assessment based on studies in the literature. Key areas of application, such as the management of electronic health records, the traceability of drug supply chains, ensuring data integrity in clinical research, and patient-centered data control, are addressed. Furthermore, the contributions of blockchain-based solutions to patient privacy and data sharing processes are examined, and current challenges such as scalability, interoperability, and legal compliance are discussed. The review concludes that blockchain technology offers significant opportunities for security and transparency in the healthcare sector, but emphasizes that certain TECHNICAL and structural issues must be overcome for its widespread adoption.

Keywords - Blockchain, Health Informatics, Electronic Health Records, Data Security, Patient Privacy, Supply Chain, Clinical Research

AUGMENTED REALITY APPLICATIONS IN RETAIL STORES

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Abstract - Augmented reality (AR) has become one of the groundbreaking technologies that has transformed not only the entertainment world but also the very heart of commerce in recent years. Particularly in the retail sector, this technology is reshaping the relationship between customers and stores by blending the traditional shopping experience with the digital one. This study examines the role of augmented reality applications in retail stores from a multifaceted perspective, thoroughly exploring both the user experience and engineering dimensions. Applications developed using popular SDKs such as Unity, Vuforia, ARKit, and ARCore were evaluated using techniques like marker-based, markerless, and plane detection. Image processing and SLAM algorithms were also analyzed. Applications developed using popular SDKs such as Unity, Vuforia, ARKit, and ARCore are evaluated alongside techniques like marker-based, markerless, and plane detection; and systemic foundations such as image processing, SLAM algorithms, and sensor fusion are discussed. Furthermore, scenarios such as shelf placement optimization, in-store navigation, and virtual product trials are enriched with examples from real-world applications.

Keywords: Augmented Reality, Retail Sector, ARKit, ARCore, Vuforia, Unity, WebAR, SLAM, Marker-Based Tracking, Image Processing

A LITERATURE REVIEW ON BATTERY CHARGE PREDICTION USING ARTIFICIAL INTELLIGENCE ALGORITHMS

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Abstract **-** This compilation focuses on the increasing need for energy storage alongside the proliferation of electric vehicles, renewable energy systems, and portable electronic devices. It highlights that lithium-ion (Li-ion) batteries are the most widely preferred technology for energy storage, particularly due to their advantages such as long endurance, low maintenance costs, and high energy density. Battery Management Systems (BMS), used to ensure the safe and efficient operation of these batteries, perform critical functions such as state of charge (SoC) estimation and safety control. However, the complex, non-linear, and time-dependent behavior of batteries causes traditional physical modeling methods to fall short in SoC estimation. At this point, Artificial Intelligence (AI)-based approaches have come to the fore in recent years. In particular, data-driven models such as Artificial Neural Networks (ANN), Deep Learning (DL) methods (LSTM, RNN), and Radial Basis Function Networks (RBFNN) can predict battery behavior with high accuracy by learning from past data. Furthermore, hybrid models that integrate traditional methods such as Kalman filters and fuzzy logic with AI increase both prediction accuracy and system stability. Different approaches in the literature have been analyzed comparatively in terms of data type, learning algorithms, and model performance. This study aims to inform the selection of AI-based models in applications such as electric vehicles and energy storage systems, considering current trends.

Keywords - State of Charge (SoC); Artificial Intelligence; Artificial Neural Networks; Hybrid Methods; Energy Storage Systems (ESS)

STUDY ON BREAST CANCER DETECTION WITH ARTIFICIAL NEURAL NETWORK

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Abstract – In this study, the classification success of artificial neural networks (YSA) in the diagnosis of breast cancer was examined. Using the Wisconsin Breast Cancer data set, binary classification was performed on data consisting of 30 samples with 569 numerical characteristics. The model was developed with a forward-feeding artificial neural network architecture with an input layer of 8 neurons and an output layer of 1 neuron. During the training process, the ReLU activation function and the Adam optimization algorithm were used, while the Sigmoid activation function was preferred at the output layer. The success of the model was assessed by metrics such as accuracy (accuracy), accuracy (precision), precision (recall), F1 score and ROC AUC. The resulting accuracy rate of 93.8% and balanced classification performance suggest that YSA may be an effective tool for early detection of critical diseases such as breast cancer. In addition, with the confusion matrix and detailed classification report, it was analyzed how successfully the model was able to distinguish between benign and malignant classes. As a result of the study, it was revealed that a model that provides high accuracy with limited data can be developed and can be a reliable diagnostic tool that can be integrated into decision support systems in the health sector.

Keywords – Artificial Neural Network; Breast Cancer; Artificial Intelligence; Classification; Accuracy

IMPROVING THE UNDERSTANDABILITY AND USABILITY OF ARTIFICIAL INTELLIGENCE-SUPPORTED NAVIGATION SOFTWARE IN HUMAN-COMPUTER INTERACTION: NEW APPROACHES FOR HUMANS AND AUTONOMOUS VEHICLES

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Abstract- This article addresses the issue that current navigation software only reflects the current state of real-time traffic density and is insufficient in predicting future route load. It also highlights the lack of customized, understandable, and usable traffic and navigation information presentation formats for autonomous vehicles. The main objective of the study is to design a new AI-powered navigation system that enables both human users and autonomous vehicles to better understand current and future traffic conditions and use this information effectively. The proposed model aims to predict future traffic load using large-scale anonymized traffic GPS data and present this information with a richer visualization, different from the current yellow-red-green color coding. The article details the design principles of this system, the artificial intelligence approaches to be used, and the human-computer interaction (HCI) principles, discussing the potential effects of the developed solution on comprehensibility, usability, and cognitive load. The study aims to improve the user experience and provide optimized information flow for autonomous systems, particularly by presenting complex traffic data in a simple and intuitive manner.

Keywords - Artificial Intelligence-Assisted Navigation; Autonomous Vehicle Interfaces; Traffic Density Visualization; Human-Computer Interaction Navigation; Cognitive Load Navigation; User Experience Autonomous Driving

CLASSIFICATION APPLICATIONS WITH RADAR SYSTEMS A REVIEW ARTICLE

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Abstract- Recent advances in microwave, millimeter wave, and ultra-wideband (UWB) radar technologies have enabled significant progress in the remote detection of human presence and movement. Traditionally used in long-range and airborne systems, these techniques are now also widely used in closer-range and more sensitive applications such as health monitoring, search and rescue, security, and elderly care. Micro-Doppler signatures, in particular, have become an important tool for detecting micro-movements originating from various parts of the human body; vital signs such as respiration and heart rate, as well as walking patterns and human activities, can now be analyzed with high accuracy. This review comprehensively examines the fundamental techniques used in radar-based human detection systems, time-varying scattering analyses, the estimation of walking parameters used in fall risk assessment via radar, and the role of UWB radars in through-the-wall (TTW) applications. The integration of machine learning and artificial intelligence-supported signal processing approaches has increased classification accuracy in both defense and commercial applications and accelerated the development of next-generation radar applications. Additionally, methods such as multimodal image fusion, achieved by combining data from multiple sources (optical, radar, spectral), have further enhanced classification performance in complex environmental conditions. This study synthesizes the experimental systems and methods highlighted in the literature, providing a general assessment of the current state and revealing potential directions for future research.

Keywords - Equivalent Electric Circuit; Squirrel Cage Induction Motor; Induction Motor Modeling; Induction Motor Loading

STRUCTURES OF PRIMARY SURVEILLANCE RADAR (SSR), SECONDARY SURVEILLANCE RADAR (SSR), SURFACE MOVEMENT RADAR (SMR), AND AIRBORNE WEATHER RADAR (AWR) USED IN AVIATION AND THE ARTIFICIAL INTELLIGENCE TECHNOLOGIES USED IN THE CONTROL OF THESE RADARS ARTIFICIAL INTELLIGENCE TECHNOLOGIES USED IN THE CONTROL OF THESE RADARS

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Abstract- This compilation comprehensively analyzes current academic research on primary surveillance radar (PSR), secondary surveillance radar (SSR), surface movement radar (SMR), and airborne weather radar (AWR) systems. The ability of PSR systems to detect all targets without requiring transponders is contrasted with the high accuracy of SSR systems in target identification and positioning. Solutions for increased air traffic density using advanced SSR modes (Mode S, ADS-B) are evaluated. The effective monitoring of airport ground movements by SMR systems under low visibility conditions and their integration with multi-layer surveillance systems are discussed. AWR systems are examined in terms of convective weather event detection, compact radar design with sparse array antennas, the performance of different frequency bands, and integrated communication features. In radar technologies, numerous innovative approaches such as phased array antennas, sparse array optimization, signal processing algorithms, and artificial intelligence -supported solutions have been seen to enhance the performance of these systems. The review presents a comparative analysis of radar systems in the fields of civil aviation, security, and meteorological observation, providing a comprehensive perspective for future research.

Keywords - Intelligence-Assisted Navigation; Autonomous Vehicle Interfaces; Traffic Density Visualization; Human-Computer Interaction Navigation; Cognitive Load Navigation; User Experience Autonomous Driving

ADVANCED NEURAL NETWORK MODELS FOR AUTOMATED CLASSIFICATION IN AGRICULTURE: AN APPLICATION ANALYSIS ON THE DATE FRUIT DATASET

Ali ZIVLAK

Abstract- In the agricultural sector, the automatic determination of product diversity and quality levels has risen to a key position in the development of digitalization and sustainable production policies in the food industry. As an agricultural product that stands out for both its nutritional value and commercial volume, dates clearly demonstrate the need for reliable and rapid classification. In this study, based on various morphological and color-based characteristics of date fruits, Artificial Neural Network (ANN) and Deep Neural Network (DNN) based models were developed; the classification performance of these models was compared in detail according to scientific methodology. Each stage of the process, including missing data analysis, feature engineering, training and test set separation, hyperparameter selection, examination of the decision mechanism, and evaluation of processing times, was systematically addressed. The results obtained revealed that the DNN architecture demonstrated higher success in terms of both accuracy rate and generalizability compared to the classical ANN approach. Additionally, it was determined that the new features included in the data set provided meaningful contributions to increasing model accuracy. The findings obtained in the study were compared with current research published in international literature such as Dergipark, IEEE, and ResearchGate, emphasizing the added value of the proposed approach in both academic and industrial terms.

Keywords – Artificial neural network, Deep learning, Date classification, Missing data management, Feature engineering, Time-performance analysis, Agricultural automation

EXPLAINABLE ARTIFICIAL INTELLIGENCE (XAI): A COMPREHENSIVE REVIEW AND FUTURE PERSPECTIVES

Ali Zıvlak

Abstract- From credit applications to medical diagnoses, Artificial Intelligence (AI) systems are increasingly permeating our decision-making processes. However, we cannot fully see how these "black box" models work; this undermines user trust and obscures legal responsibilities [1], [2]. So, can a patient or customer truly understand the decision AI makes about them? Explainable AI (XAI) seeks to answer precisely this question.DARPA's XAI initiative, launched in 2015, did not just force models to produce correct predictions; it also sought to reveal the logic behind these predictions. DARPA's XAI initiative, launched in 2015, not only forced models to produce accurate predictions; it also aimed to reveal the logic behind these predictions [3], [4]. This study examined four popular XAI approaches: model-agnostic local explanations (LIME), coalition-based contribution methods (SHAP), counterfactual scenarios, and deep learning-based visual explanations [5], [6], [7]. The advantages and limitations of each method were examined through real-world case analyses in high-risk domains such as healthcare and finance. For example, LIME shows a physician the decision process for a specific patient example, while SHAP provides strategic insights by numerically summarizing the model's overall behavior [5], [6]. Furthermore, the ethical and regulatory dimensions of XAI were reviewed. Transparent explanations are not merely a TECHNICAL improvement; they are a necessity that protects user rights in light of regulations such as the GDPR and the EU AI Act [8], [9]. The results show that XAI methods bring not only performance but also trust and ethical responsibility.

Keywords – Explainable AI, LIME, SHAP, Counterfactual, Visual Explanation, Ethics, Regulatory Compliance.

AI-SUPPORTED PRODUCT REVIEW ANALYSIS AND E-COMMERCE SALES LOSS RISK PREDICTION

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Abstract- This study was conducted to identify the early-stage sales loss risk of products on e-commerce platforms and to systematically reveal the underlying factors contributing to this risk. User reviews, ratings, and timestamp data were successfully collected from relevant platforms using web scraping techniques, and the obtained dataset was thoroughly preprocessed through Python libraries and LLM-based text processing steps. The LLM was employed to convert the core satisfaction or dissatisfaction elements within user reviews into structured explanatory outputs, while time-based trend analyses performed in Python highlighted the emergence of recent negative sentiment patterns. The integration of these components enabled the classification of products in terms of both their "risk level" and the specific "reason for the risk." Consequently, the study offers a content-driven evaluation framework that provides sellers with early and well-grounded insights regarding which aspects of a product fail to meet user expectations

Keywords – E-commerce, Large Language Models (LLMs), Sales Loss Prediction, Sentiment Analysis, Web Scraping

FROM TEXT TO SCENT: A NATURAL LANGUAGE PROCESSING APPROACH TO PERFUME RECOMMENDATION

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Abstract- This study developed an intelligent perfume recommendation system that leverages natural language processing and API integration to match user preferences with suitable scents. The system analyzes user descriptions of desired perfume characteristics using advanced language models and performs similarity matching against a comprehensive perfume database. To ensure optimal performance and cost efficiency, a thorough comparative analysis of different large language models was conducted. Each model was evaluated based on note extraction accuracy, response time, and API costs, ultimately leading to the selection of the most suitable model with a superior price-to-performance ratio. The perfume database, which includes thousands of fragrances with detailed note compositions, was created using custom web scraping techniques rather than relying on preexisting datasets, ensuring comprehensive and up-to-date information. The system architecture consists of a Flask-based backend that processes user input through API integration, extracts perfume notes in English, and performs intelligent matching using normalized similarity algorithms. The frontend provides an intuitive interface where users describe their preferences in natural language, and the system returns ranked recommendations with similarity scores, highlighted matching notes, and detailed fragrance profiles. Future developments are planned to include dynamic database updates that automatically incorporate new scents and market trends. This real-world applicable system demonstrates the practical integration of AI APIs in e-commerce and shows significant potential for deployment in the fragrance industry by offering personalized shopping experiences and reducing decision fatigue for consumers.

Keywords –API Integration, Cost-Efficiency Analysis, E-commerce, Fragrance Note Extraction, Large Language Models (LLM), Natural Language Processing (NLP), Perfume Recommendation System, Personalized Shopping Experience, Web Scraping.

BIOMETRIC IDENTIFICATION USING EEG SIGNALS

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Abstract- This study reviews the current literature on the use of EEG (electroencephalography) signals in biometric identification. Due to the unique structure of brain signals for each individual, EEG offers a secure and difficult-to-replicate biometric data source (Paranjape et al., 20a01; Palaniappan, 2004). Deep learning-based models (such as CNN, RNN, LSTM) have been shown to automatically extract discriminative features directly from EEG data and to provide higher accuracy compared to traditional methods (Ma et al., 2015; Zhang et al., 2018; Wilaiprasitporn et al., 2020). In this study, these approaches are compared in terms of methodology, accuracy, dataset, and application domain. The findings indicate that even systems with a reduced number of channels can achieve accuracy rates above 99%; moreover, the delta and beta frequency bands appear to be particularly effective for individual identification (Sun et al., 2019; Hagras et al., 2021). This article systematically analyzes 50 academic studies in the field of EEG biometrics, revealing the wide range of potential applications from security systems to health informatics.

Keywords – CNN, RNN, LSTM, electroencephalography

BRAKING SYSTEM IN ELECTRIC AUTOMOBILES and THE EFFECTS OF BRAKING SYSTEM ON THE BATTERY

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Abstract – Today, environmental sustainability, the risk of fossil fuel depletion, and energy efficiency requirements are compelling the automotive industry to undergo a significant transformation. At the core of this transformation are electric vehicles; they are not only an alternative means of transportation but also a symbol of the transition from internal combustion engines to electric systems. In this transition, not only advances in battery technologies are crucial, but also the conversion of kinetic energy generated during braking into electrical energy plays a vital role. At this point, regenerative braking systems (RBS) have a critical role in both driving safety and energy recovery.

In this study, the structure and working principles of braking systems used in electric vehicles are discussed. Additionally, the effects on the battery during braking—such as energy recovery efficiency, thermal load, and cycle life—are examined. Findings in the literature indicate that RBS can extend battery life; however, in some cases, excessive heating and voltage imbalances may harm battery health. Furthermore, the study emphasizes the relationships between hybrid braking systems, supercapacitor-assisted energy solutions, and battery management systems (BMS). The results reveal that braking technologies do not serve only to slow down the vehicle but also constitute an important part of the overall energy management of electric vehicles.

Keywords – electric vehicles (EV), regenerative braking system (RBS), Battery Management Systems (BMS), energy recovery, thermal effects on batteries

RECYCLING OF ELECTRIC VEHICLE BATTERIES

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Abstract – The use of internal combustion engine vehicles is gradually decreasing due to the decrease in fossil fuel reserves and environmental impacts (climate change, air pollution, etc.) caused by high emission values. This situation has led the automotive sector towards electric vehicles and initiated a transformation supported by incentive policies in many countries. However, the demand for electric vehicles and the increase in their use bring new environmental problems, especially the management of end-of-life lithium-ion battery waste. In this context, battery recycling processes play a critical role in recovering precious metals, reducing the environmental impact of waste and developing circular economy models. In addition to supporting the sustainable use of resources, recycling activities also contribute to the cost-effectiveness of electric vehicles and increase green employment opportunities.

Keywords – Electric Vehicles, Battery Waste, Recycling, Waste Management, Green Employment

DEVELOPMENT OF AN AUTOMATIC LICENSE PLATE RECOGNITION SYSTEM USING SUPPORT VECTOR MACHINES AND LEAVE-ONE-OUT CROSS-VALIDATION

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Abstract – Automatic License Plate Recognition (ALPR) systems are essential components of intelligent transportation systems, facilitating traffic management and security enforcement. This study aims to develop a robust license plate recognition system using image processing and machine learning techniques within the Python environment. The Support Vector Machine (SVM) algorithm is employed for the classification and character recognition phases due to its high accuracy in high-dimensional spaces. Given the limited size of the specific experimental dataset (approximately 25-30 images), the Leave-One-Out Cross-Validation (LOO-CV) method is adopted instead of traditional K-Fold validation. This approach allows for the maximal utilization of available data for training and provides a deterministic, unbiased assessment of the model's generalization ability. The study evaluates the system's accuracy in detecting and reading license plates under varying conditions. The results demonstrate that the proposed SVM-based model, validated through LOO-CV, achieves high recognition rates, offering a reliable prototype for automated traffic monitoring and radar systems.

Keywords – Automatic License Plate Recognition (ALPR); Support Vector Machine (SVM); Leave-One-Out Cross-Validation (LOO-CV); Machine Learning; Image Processing

DEVELOPMENT OF A REAL-WORLD PLANT LEAF IMAGE DATASET AND DEEP LEARNING-BASED DISEASE DETECTION MODEL FOR SUSTAINABLE AGRICULTURE

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Abstract – The early detection of plant diseases, which directly affect agricultural productivity, is of critical importance for ensuring food sustainability. Existing image datasets in the literature are predominantly composed of images captured under controlled laboratory conditions or artificial lighting. To address this limitation, this study presents a new and comprehensive dataset consisting of leaf images captured in the plants' natural environment and under natural lighting conditions. The dataset includes a total of 20 classes—representing healthy and diseased samples from 18 different plant species—and comprises 20,985 images with a resolution of 512×512 pixels.

To validate the effectiveness of the dataset, models were developed on two different platforms. First, in the Orange data mining software, deep learning models such as SqueezeNet and DeepLoc were utilized for feature extraction; these features were then tested using classifiers including Logistic Regression, Artificial Neural Networks, and k-NN. Based on 10-fold cross-validation, the SqueezeNet model achieved 100% accuracy and an average F1-score of 99%. Second, a model trained on the Google Teachable Machine platform reached a 100% accuracy rate on the test data.

The model's performance was further evaluated using "real-world" images obtained from outside the dataset, and it demonstrated a high success rate in identifying plant diseases. The ultimate goal of this study is to export the trained model as a TFLite file and integrate it into a mobile application, enabling non-expert users to identify plant species and diseases directly in the field.

Keywords – Artificial Intelligence,Machine Learning, Deep Learning, Computer Vision, Image Processing

INVESTIGATION OF AUTONOMOUS ROUTE MONITORING PERFORMANCE OF UNMANNED MARINE VEHICLES (IDA) WITH GPS INTEGRATION

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Abstract – This study evaluates the autonomous route tracking performance of Unmanned Marine Vehicles (IDA) experimentally using GPS-based differential thrust control. The autonomy is based on the HERE4 GPS Module for Pixhawk Cube Orange+ flight controller, centimeter-level accuracy, and the NVIDIA Jetson Orin Nano central processing unit for artificial intelligence-based decision-making processes.With the control system, the MAVLink protocol and Python-based route-determined calculations, we work with the exact data; GPS data The differential PWM commands corresponding to this deviation are transmitted to the thrusters via VESC 6.0 75A ESC drives, providing precise directional control without rudder mechanism.As a result of field tests, the system has demonstrated a stable route tracking success with an average lateral deviation of 0.75 meters, despite environmental degradation. The findings prove that GPS and differential thrust integration offers a reliable and high-performance navigation solution for IDAs, even in difficult marine conditions.

Keywords – GPS Based Route Tracking, Unmanned Naval Vehicle Location Accuracy, Autonomous Navigation, Navigation

INTELLIGENT PATIENT MONITORING AND WARNING SYSTEM WITH ARTIFICIAL INTELLIGENCE SUPPORT

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Abstract – This project covers an artificial intelligence-powered monitoring and warning system developed to improve patient safety in hospital environments. The system analyzes the camera images, detects risky movements such as falls, sudden take-off in real time and sends instant notifications to health personnel. In the project, the YOLOv8 object detection algorithm was used, visual data was tagged with the Roboflow platform and model training was carried out in the Google Colab environment. In cases where classification methods are inadequate, more accurate results are obtained thanks to object detection. With the mobile application proposal, the portability of the system has been increased and its applicability in different health environments has been targeted. The project offers an innovative solution that contributes to digitalization in healthcare.

Keywords – Equivalent Electric Circuit; Squirrel Cage Induction Motor; Induction Motor Modelling; Loading of Induction Motor

SHARE OF RENEWABLE ENERGY SOURCES IN ELECTRICITY GENERATION: TURKEY EXAMPLE

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Abstract - Renewable energy sources are solar, wind, hydroelectric, geothermal and biomass. These resources, which have low carbon emissions, play an active role in combating climate change. It reduces the foreign dependence of countries due to the presence of local resources. In this study, the data from the TEIAS reports and the share of electricity generation value of Turkey from renewable energy sources between 2015-2024 in total electricity production was investigated.In 2015, renewable energy sources generated using 8h, 2 4l Renewable energy sources The total amount of energy produced between 2015-2024 is about 1190 TWh. As a result of this research, it was seen that in 2015, the rate of 32.16% was up to 2024, up to 46.35%'. In addition, the rate of production value obtained from solar and wind sources is 4.52%' to 19.06%'. As a result of the study, it was understood that Turkey's investment in renewable energy sources has increased and that investments in solar panels and wind turbines have been given weight. Although the orientation towards renewable energy is to a very large extent, it is still not enough. Compared to European countries, Turkey is still one of the largest coal consumers in electricity production and plans to gradually reduce coal use, and the orientation towards renewable energy needs to increase slightly.

Keywords - Renewable energy, Electricity generation, Climate change, Energy investment

POTENTIAL THREAT: MYCOTOXINS

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Abstract **–** Mycotoxins are toxic secondary metabolites produced by filamentous fungi such as *Aspergillus, Penicillium, Fusarium, Alternaria,* and *Claviceps*. They represent a major threat to both human and animal health due to their frequent presence in food and feed products. To date, over 300 types of mycotoxins have been identified, with aflatoxins, ochratoxins, fumonisins, trichothecenes (including T2, DON, DAS, HT2), ergot alkaloids, patulin, citrinin, alternaria toxins, and zearalenone considered the most relevant in terms of agricultural and public health importance. Although preventing mycotoxin contamination in food is a global priority, completely eliminating these compounds is not feasible due to their natural occurrence and environmental persistence. As a result, even small amounts can remain in crops and feed materials. Mycotoxin contamination leads to considerable economic losses worldwide, affecting human and animal health, agricultural productivity, and industrial sectors. Consequently, extensive research efforts continue to focus on developing improved detection methods and effective detoxification strategies to reduce mycotoxin exposure and mitigate associated risks. In this study, the main mycotoxins, the strategies to minimize their presence before, during, and after food production, as well as the methods used for their detection and detoxification, are introduced.

Keywords – Mycotoxins; Food; Filamentous Fungi; Detection; Detoxification

RECENT DEVELOPMENTS IN BIOETHANOL PRODUCTION AND USE

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Abstract – Bioethanol is one of the environmentally friendly fuels. Many socio-economic factors must be taken into account to establish ideal processes for the production of this fuel. Indeed, the production of bioethanol, especially from raw materials intended for human consumption, has led to serious problems such as the food/energy conflict. Therefore, over time, the production of bioethanol from raw materials which not consumed directly by humans has become a priority. These raw materials include examples such as agricultural wastes, algaes, and genetically modified plants. Raw materials for bioethanol production should have a high potential in terms of fermentable sugar. On the other hand, the total cost of the processes for fermentation of these sugars should not be high. Another critical factor regarding bioethanol is the percentage of bioethanol used in the fuel. This percentage must be kept at a level that does not cause corrosive effects on engines. It is also important to consider that if the percentage of bioethanol in the fuel exceeds a certain level, engines may need to be modified to minimize corrosive effects. This study aims to introduce the needs, socio-economic factors, critical points, environmental effects and future perspective about bioethanol production and use.

Keywords – Bioethanol; Environmentally Friendly; Fuel; Raw Materials; Engine Modification

HUNTINGTON'S DISEASE: GENETICS, MECHANISMS, NEUROPATHOLOGY, AND PSYCHOLOGICAL IMPACTS OF PREDICTIVE TESTING

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Abstract— An autosomal recessive neurological disorder, defining Huntington's disease (HD) includes chorea, cognitive loss, as well as mental symptoms like behavioral alterations and depression. These psychiatric features are associated with subcortical neurological alterations. Increased CAG repeat within that gene, known as HTT, causes Huntington's disease (HD), and the repeat size is related to the start and progression of the disease. This molecular switch raises additional ethical and psychological issues, particularly in the case of predictive testing. The disease has a preference for the striatum and underlying basal ganglia, and there are patterns of degeneration that can correlate with the range of symptoms seen in, even genetically identical, individuals. Similar to these disorders, many of the dysfunctional processes that lead to neurodegeneration in HD involve transcriptional dysregulation, protein aggregation, and defective clearance. These are key drivers of the disease. Emerging developments point to HD as a multisystem syndrome merging neuropsychiatric, genetic, and molecular aspects. Neurobiological impairment explains variation in symptom expression, bridging genetic risk markers and clinical outcome. Therapeutic strategies are aimed at these pathways, including increased protein clearance and stabilization of transcriptional pathways to ameliorate neurodegeneration. Here we summarize emerging information regarding the interaction of genetic, molecular and neuropsychiatric developments of HD that may inform future studies focused on treatment. Therapeutic targeting of these molecular networks is highly relevant to patients1–6 in both basic and clinical contexts.

Keywords—CAG Repeats, Huntington's Disease, Neurodegeneration, Neuropsychiatric, Therapeutic Strategies.

MULTIMODAL MRI-BASED DEEP LEARNING FRAMEWORK FOR PROSTATE CANCER CLASSIFICATION

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Abstract— Prostate cancer (PCa) is among the most prevalent malignancies worldwide, where early detection could have a significant impact on treatment effectiveness. An innovative deep-learning-based model for prostate cancer classification using multiparametric MRI, including ADC, HBV, and T2w images. The "Proposed Model" (a convolutional neural network, or CNN model) distinguishes between benign and cancerous prostate areas by combining three independent MRI modalities. The model was validated using various 1989 ADC, 2098 HBV, and 2189 T2w images dataset. Validation metrics available for the model, such as confusion matrix comparison, reports on classes and ROC curves, indicated a solid and consistent output across the involved classes. This model's performance illustrates that deep learning can enhance the diagnostic workflow for oncology by automating the detection and classification of prostate cancer. Compared to conventional manual techniques, which are labor-intensive and subjective, the Proposed Model gives a much more efficient and systematic manner of analyzing MRI data. One of the most important imaging and cancer advancements is the simultaneous incorporation of multiple types of MRI into a single model. Future work will continue to improve the model to generalize better to a wider patient population and more routine application in clinical practice. The proposed model exceeds the performance of traditional models such as ResNet-101, XmasNet, and the Interactive XAI Model with an accuracy of 93.67%.

Keywords — Convolutional Neural Network, Deep Learning, Automated Diagnosis, Medical Imaging, Multiparametric MRI, Prostate Cancer

COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF RADAR, IMAGE PROCESSING, AND SENSOR FUSION METHODS IN AIRBORNE TARGET DETECTION

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Abstract – The rapid proliferation of unmanned aerial vehicles (UAVs), the increase in small platforms with low radar cross-sections, and the effects of variable environmental conditions on detection systems have made the accurate and reliable detection of airborne targets a critical requirement. In this context, three main approaches stand out in the literature: radar-only systems, image processing-only methods, and sensor fusion approaches where data from these two sensors are evaluated together. In this study, current academic studies addressing radar, image processing, and sensor fusion techniques were examined through a comprehensive literature review. The strengths and weaknesses of each method were evaluated comparatively. Radar-based methods were found to offer advantages, particularly in adverse weather conditions, long range, and low visibility scenarios; however, they exhibited limited performance with targets having a low radar cross-section. Image processing methods offered high accuracy based on the target's shape and silhouette information, but experienced performance loss in various scenarios due to dependence on light and visibility conditions. Sensor fusion approaches, on the other hand, are widely supported in the literature as providing more balanced, robust, and highly accurate results by combining the physical advantages of radar with the geometric information of image-based methods.

This study highlights the existing gaps in the literature, demonstrating the increasing importance of radar-image fusion in airborne target detection and providing a comprehensive evaluation of which approach is more effective under which conditions. The findings reveal that sensor fusion exhibits stronger detection performance compared to single sensors, and that the use of multiple sensors is critical, especially in complex operational scenarios.

Keywords – Radar-based detection, Image processing, Sensor fusion, Unmanned aerial vehicles (UAVs), Target classification

WI-FI BASED REMOTE AIR CONDITIONER CONTROL SYSTEM (ESP32 + IR)

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Abstract - This study presents a remote air conditioner control system developed using Wi-Fi and infrared (IR) communication technologies. The system mimics the function of traditional air conditioner remotes via the ESP32 microcontroller, allowing the user to control the air conditioner through a smartphone or computer. The ESP32 manages both the Wi-Fi connection and transmits air conditioner-specific signals via the IR LED module. The device can perform basic commands such as turning on/off, temperature setting, mode switching, and fan speed control via a simple web interface. The system also offers easy setup and connection management with the WiFiManager library to provide a user-friendly structure. In the hardware structure, the GPIO current limitations of the ESP32 are overcome by using an NPN transistor to drive the IR LED. On the software side, brand-independent IR signals were generated using the IRremoteESP8266 library and implemented with the web server ESPAsyncWebServer. Tests of the developed system were carried out at different distances (1 m – 5 m) and under various lighting conditions, achieving an accuracy rate of over 95%. This project offers a viable solution for integrating traditional IR-based air conditioning systems into smart home automation with its low cost and high availability.

Keywords - ESP32, Infrared, Smart Home, Air Conditioning Control, IoT, Wireless System

SOLAR PANEL DATA MONITORING AND CONTROL SYSTEM

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Abstract – This project aims to monitor and analyze the basic parameters of a solar energy system, such as current, voltage, power, and temperature, in real time. In the system, the solar panel detects the position of the sun thanks to the integrated automatic light tracking mechanism and orients itself towards the maximum light intensity. All measured data is transferred to a local server via Wi-Fi through the ESP32 microcontroller and presented to the user via a graphical interface. Thus, energy production performance can be monitored instantly, long-term efficiency analyses can be performed, and necessary optimizations can be carried out. In addition, manual control is provided with the buttons on the board, and real-time data can be displayed on the LCD screen. This design ensures maximum efficiency from solar energy and allows for safer, faster, and more effective system management.

Keywords – Solar Panel, IoT, Data Monitoring, ESP32, Control, Wi-Fi

COLOR SEPARATOR CONVEYOR BELT SYSTEM

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Abstract – This study presents an approach to making conveyor belt systems, which play a critical role in industrial automation processes, intelligent. Today, the manufacturing and logistics sectors require faster, more flexible, and more reliable material handling solutions due to increasing product diversity and high processing volumes. The smart conveyor belt system developed in this context incorporates a sensor-based and programmable architecture for the automatic identification and routing of objects to target locations. The system can be used in a wide range of applications, such as product sorting in warehouse management and baggage classification at airports. The automatic sorting mechanism provides higher accuracy and speed compared to manual processes, thereby reducing the need for human labor and increasing operational efficiency. Furthermore, the system's reprogrammable features, compatible with the flexible production structures required by Industry 4.0, offer easy integration across different sectors. The smart conveyor belt approach offered by this project aims to reduce time losses in modern industrial processes, increase work safety, and achieve a more efficient material flow in high-volume operations.

Keywords – Smart conveyor belt system; Industry 4.0; Conveyor belt; Automation; Manufacturing industry

DESIGN AND SIMULATION OF A 2P3S LITHIUM-ION BATTERY CHARGING STATION WITH MP26123DR AND BQ77915 INTEGRATED CIRCUITS

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Abstract - In this study, a charging station design was implemented to ensure the safe and efficient charging of lithium-ion batteries, an indispensable energy source in today's technology. The designed system is configured to charge a 14500 type lithium-ion battery pack in a 2P3S (2 Parallel, 3 Series) configuration. The MP26123DR switched-mode charge controller is used for power management, while the BQ7791500 integrated circuit is chosen for battery protection and cell balancing. The system rectifies and filters the AC voltage received from the mains and transmits it to the battery management system (BMS), providing thermal protection against overheating through NTC sensors and relays. The designed circuit was tested in a simulation environment, the success of the CC/CV (Constant Current/Constant Voltage) charging algorithms was verified, and a physical PCB design and cost analysis were presented.

Keywords - DC-DC Converter, Lithium Ion Battery, BMS, MP26123DR, BQ77915, Battery Charging Station

PID CONTROLLED SINGLE-AXIS ANGULAR STABILIZATION SYSTEM

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Abstract –This study presents the design of a single-axis angular stabilization system using a PID control algorithm implemented on an STM32 microcontroller. The system aims to keep a platform balanced by reading real-time angular data from an MPU6050 sensor and controlling a servo motor accordingly. The system is powered through LM2596 and LM2576T voltage regulators, which provide stable power levels for both the logic and actuator sections. The proposed design outlines the control strategy, hardware structure, and signal flow required for achieving angular stabilization on a single axis.

Keywords: STM32; PID Control; MPU6050; Servo Motor; Stabilization System

CURRENT-PROTECTED POWER SUPPLY

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Abstract – This study presents the design and analysis of a current-protected DC power supply capable of limiting the output current and providing an adjustable output voltage. The system incorporates an automatic current limiting mechanism to protect the load and power supply in case of overcurrent or short-circuit conditions. The study details the historical development, design stages, calculations, circuit structure, simulation results, and cost analysis. The output current capacity was increased to 4.59A using LM317HV, BD139, and TIP3055 transistors. The proposed design offers a safe, stable, and low-cost solution for laboratory and educational environments.

Keywords-DC power supply, current protection, LM317HV, BD139, TIP3055

VEHICLE WITH AUTOMATIC PARKING FEATURE

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Abstract – Today's heavy city traffic and narrow parking spaces increase the difficulty of parking and raise the risk of accidents. This project aims to develop a low-cost and easy-to-implement solution prototype for these problems.

The designed system is an electronic control system designed for a small-scale vehicle that will automatically stop 10 cm away from an obstacle or wall in front. At the core of the system is a microcontroller board (Arduino Nano). This microcontroller continuously processes data from an ultrasonic sensor (HC-SR04) that measures the distance as the vehicle approaches an obstacle.

The software logic is simple: as long as the measured distance is greater than 10 cm, the vehicle moves forward; when the distance reaches or falls below this threshold value, the control system stops the motors via the motor driver board (TB6612FNG), completing the parking process. This approach creates a basic smart parking logic by ensuring safe stopping in driverless or remotely controlled small vehicles. Unlike costly and complex systems, the project stands out with its minimum sensors, simple software, low power consumption, and easy manufacturability.

Keywords – Ultrasonic Sensor, Automatic Parking, DC Motor Control, Arduino Nano.

ARTIFICIAL INTELLIGENCE BASED TILE QUALITY INSPECTION SYSTEM

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Abstract – In this study, an artificial intelligence-based quality inspection system was developed for the automatic detection and classification of surface defects in a tile production line. The dataset created to reduce human-induced errors in the production process and increase inspection accuracy consists of a total of 405 images, including 300 defective and 105 intact images. Data augmentation techniques were applied to expand the dataset to 550 images, consisting of 300 defective and 250 intact images. The images were collected to represent different surface textures and lighting conditions.

During the model development phase, CNN, MobileNetV2, ResNet50, and EfficientNetB0 architectures were used. All models were trained using the Transfer Learning approach with pre-trained weights on ImageNet to accelerate the training process and achieve higher accuracy. The performance of the models was evaluated using the 10-fold Cross-Validation method for an objective comparison.

The experimental results show that the EfficientNetB0 architecture achieved the highest performance with an accuracy rate of 96.73%. ResNet50 achieved 95.45%, CNN achieved 94.91%, and MobileNetV2 achieved 92.36% accuracy. EfficientNetB0's composite scaling structure distinguished defective and sound classes with lower error rates compared to other models. On the other hand, MobileNetV2 made more misclassifications, especially in sound classes, due to the limitations of its lightweight architecture. As a result, the EfficientNetB0 model was determined to be the most suitable deep learning architecture for automatic quality control applications in the tile industry due to its high accuracy rate, stable performance, and low error tendency. The developed system has the potential to improve product standards and reduce costs by providing fast, consistent, and reliable quality assessment on the production line.

Keywords – Deep Learning; Image Processing; Transfer Learning; Tile Defect Detection

ÇENGEL: AI-POWERED PLATFORM FOR WOMEN'S SAFETY AND SOLIDARITY

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Abstract – This report presents an integrated mobile application designed to deliver rapid intervention and structured support for women subjected to violence or harassment. The system incorporates emergency features such as instant alerts to law enforcement agencies and relevant civil society organizations, a deterrent siren mechanism, and a simulated (fake) call module. Additionally, a chatbot component provides users with structured information regarding legal rights and procedures, while psychosocial assistance is facilitated through volunteer psychologists.
The application has been developed using the Flutter framework for cross-platform compatibility on iOS and Android, supported by Firebase services for authentication, data management, and real-time notifications. The project aims to demonstrate the practical value of digital technologies in enhancing women's safety and to contribute to broader public awareness. The widespread adoption of the application and its inclusion in academic research are expected to underscore the potential of technology-driven solutions in addressing violence against women in Türkiye

Keywords – Violence Against Women, Mobile Application, Psychosocial Support, Chatbot, Emergency Notification Systems

A THEORETICAL INVESTIGATION OF THE DEVELOPMENT OF CARBON FIBER-LIKE COMPOSITE FIBERS FROM RECYCLED PET MATERIAL

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Abstract – This investigation aims to valorize polyethylene terephthalate (PET) waste, a primary source of environmental pollution, through advanced recycling methods. Within the scope of the project, recycled PET material will undergo a chemical sulfonation process using sulfuric acid. The resulting intermediate product will then be converted into carbon fiber-like composite fibers via the electrospinning method.

This methodology seeks not only to mitigate the environmental damage caused by plastic waste but also to establish an eco-friendly production approach, offering an alternative to the high-energy-consumption and costly processes inherent in conventional carbon fiber manufacturing.

The mechanical, thermal, and structural properties of the resultant fibers will be characterized using analytical techniques, including FTIR, TGA/DSC, SEM, and XRD. Consequently, the project is expected to enhance the engineering applicability of waste PET, contribute to environmental sustainability, and introduce a novel material development model. Furthermore, it is anticipated that this new material will constitute a domestic and economical alternative for high-technology sectors such as the defense industry, automotive, aerospace, and construction.

Keywords – Recycled PET, Carbon Fiber, Sulfonation, Electrospinning, Composite Fiber

ELECTRONIC DIGITAL PERIODONTAL PROBE SYSTEM

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Abstract – This article describes the design of a digital periodontal probe developed in the field of health technologies and its necessity in the industry. The designed probe is still in the conceptual stage, and a prototype will be developed once the necessary components are selected. The accuracy of clinical probe measurements is critical for the early diagnosis of periodontal diseases. However, manual periodontal probing makes standardization of measurements difficult due to practitioner-dependent variations, inadequate pressure control, and errors in the recording process. In this study, a new digital periodontal probe prototype was designed to enable more accurate, repeatable, and digitally recordable measurement of periodontal pocket depth and related clinical parameters. The designed system incorporates micro-linear actuator-based controlled probe movement, high-precision pressure and distance sensors, an angle measurement module, and an STM32-based embedded control unit. This aims to standardize the force applied during measurement, digitally track the probe tip's position, and instantly convert all obtained data into a digital format. The study also discusses the clinical importance of periodontal pocket measurement, the impact of measurement errors on the periodontal diagnosis process, and the advantages offered by the designed device compared to existing manual and semi-digital probe systems.

Keywords – Digital Probe, Periodontal Probe, Pocket Measurement, Periodontology, Dental Pocket, Digitalization in Dentistry, Health Technologies, Gingivitis, Periodontitis, Bleeding on Probing

MARKETING BUDGET OPTIMIZATION AND TARGET AUDIENCE MANAGEMENT VIA UPLIFT MODELING

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Abstract **–** This paper is concerned with the efficient marketing budget allocation and maximizing incremental profit at the individual customer level in response to the inability of traditional response models in their current form to capture the incremental profit potential of a campaign. In order to fully analyze the financial return of a marketing campaign, an Uplift Modeling framework, Uplift-Learn, based on Causal Inference principles is developed. The aim of the study is to realize a cheaper and more efficient budget allocation by avoiding the wasted budget and unnecessary customer inconvenience caused by targeting customers who would convert regardless of the campaign. In addition, despite the limitations of simple conversion models, the proposed Uplift-Learn model, leveraging Machine Learning techniques, is developed to capture the Conditional Average Treatment Effect (CATE) at the individual level, incorporating heterogeneous customer expenditure (monetary value). With this model, the importance of an alternative marketing strategy is demonstrated by revealing the potential to generate the highest incremental profit (ROI) through the ranking of customers and identifying four distinct segments.

Keywords – Marketing Budget Allocation, Incremental Profit Optimization, Uplift Modeling, Causal Inference, Conditional Average Treatment Effect (CATE), Machine Learning, Customer Segmentation, Return on Investment (ROI)

0-50V 0-10A ADJUSTABLE POWER SUPPLY DESIGN

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Abstract – This paper covers the design and implementation of an adjustable DC power supply capable of providing output up to 10 A in the 0–50 V range, with the aim of reliably and stably supplying the direct current required by electronic circuits used in laboratory environments. The design utilizes a linear regulation structure with an LM317 adjustable regulator and TIP3055 power transistors, output stability is enhanced with an LC filter, and current-voltage measurements are digitally monitored via an INA219 sensor. The circuit will be simulated in the Proteus environment before being implemented as a prototype and tested under various voltage-load conditions. The results obtained will demonstrate that the system can provide a low-ripple and stable DC output, operates safely under high current, and is supported by protection elements (fuse, cooling, current limiting). In this respect, the work contributes to linear power supply designs by presenting a low-cost power supply prototype suitable for laboratory applications.

Keywords – Adjustable power supply, linear power supply, regulator, transistor, LC filter.

PWM-BASED SPEED CONTROL OF 24V/200-240W BRUSHED DC MOTOR: ARDUINO–HALL FEEDBACK AND LCD SPEED DISPLAY

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Abstract – In this study, a low-cost system has been designed that controls the speed of a 200-240W brushed DC motor and displays the speed in real-time on an LCD screen. The control system is based on a 20 kHz PWM (Pulse Width Modulation) signal generated by an Arduino UNO microcontroller. This generated signal switches a power stage, which includes an IR2101 MOSFET driver IC and an IRLZ44N N-MOSFET, to provide sufficient voltage and current to drive the motor. The motor's speed is measured via an A3144 Hall effect sensor that detects a magnetic part placed on the motor shaft. The Arduino processes the pulses from the sensor, calculates the speed in RPM (revolutions per minute), and presents this information to the user on an I2C-module 2x16 LCD screen. The design includes a Schottky diode to suppress the back EMF (Back Electromotive Force) generated by the inductive load and voltage regulators for stable supplies. This work presents a practical reference design for high-power DC motor control with a focus on education and prototyping.

Keywords – Brushed DC motor, PWM, Arduino, Hall effect sensor, MOSFET, MOSFET driver

DESIGN AND IMPLEMENTATION OF A HIGH-PERFORMANCE SENSOR-BASED FIELD ORIENTED CONTROL DRIVER FOR BLDC/PMSM MOTORS USING STM32F411

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Abstract Brushless motors (BLDC/PMSM), unlike conventional motors, have a symmetrical structure where the permanent magnets are on the rotor and the windings are on the stator. The "brushless" design contributes to the motor's high efficiency and extended lifespan by eliminating mechanical wear and friction. To enable the motor to rotate continuously and smoothly, three-phase windings (U, V, W) are arranged around the stator at 120-degree intervals. Computing is the process whereby the motor driver, using information obtained via a sensor about the rotor position, drives the motor windings in sequence and time to create a rotating magnetic field in the stator. The magnets on the rotor attempt to capture the rotating field and turn the motor. This process, which is performed mechanically in brushed motors, is performed electronically in brushless motors, and the aim of the project is to design the card that performs this electronic process. The card that performs this electronic process is designed.

Keywords: Field Oriented Control (FOC), BLDC Motor Driver, PMSM FOC, STM32 FOC

HYDROGEN-POWERED VEHICLES SENSOR-BASED VEHICLE CONTROL BOARD

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Abstract – This study presents the design and prototype implementation of a sensor-based intelligent vehicle control board developed to ensure safety and data management in hydrogen fuel cell and electric vehicles. In hydrogen-powered vehicles, real-time monitoring of critical parameters such as hydrogen gas leakage, battery temperature, and motor speed is vital for driving safety. In this work, a modular, low-cost hardware architecture based on the STM32 microcontroller has been developed. The designed system continuously monitors hydrogen gas leaks using the MQ-8 sensor, battery temperature via MAX6675 thermocouples, and motor speed through an optocoupler-based circuit. In case critical threshold values are exceeded, the system automatically cuts off the power line by activating a relay-based safety mechanism. Additionally, all collected data is wirelessly transmitted to the ground control station using LoRa technology and simultaneously recorded on an SD card with timestamps. This developed control board offers a domestically designed, original, and highly effective hardware solution aimed at enhancing the safety standards of hydrogen-powered vehicles.

Keywords- Hydrogen, STM32, Vehicle Control Board, LoRa Telemetry, Sensor

DESIGN OF A PWM-CONTROLLED BUCK CONVERTER BASED ON TL494

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Abstract **–** This study examines the role of the buck converter topology, which is widely used in electronic systems, in power distribution and its importance in modern applications. Buck converters, which supply low and stable voltage from high-voltage lines to various sub-modules, hold a critical position in the industry due to their simple structure and high efficiency. Understanding the stable operating characteristics of buck converters is of great importance to reliably power multiple loads found in server motherboards, communication cards, and embedded systems.

Keywords- TL494; Buck Converter; PWM Control; DC-DC Conversion; Switched-Mode Power Supply; Duty Cycle Control; Power Electronics

DC-DC STEP-DOWN (BUCK) CONVERTER CIRCUIT DESIGN

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Abstract – This paper presents the design and analysis of a high-efficiency Step-Down Buck Converter circuit engineered to produce a stable and regulated low-voltage output from a wide DC input voltage range 10V to 40V. The primary goal of this project is to supply a critical 5V output voltage, essential for many electronic systems, with a maximum load current capability of 3A. At the core of the design is the LT1074 Monolithic Switching Regulator integrated circuit, which possesses high current handling capability. Thanks to the IC's 100kHz fixed switching frequency and current-mode control architecture, the design aims for fast transient response and superior regulation, particularly under varying input voltage conditions.

Keywords- Step-Down Buck Converter; LT1074; Switching Regulator; 5V output voltage

STUDIES ON ARTIFICIAL INTELLIGENCE METHODS USED IN THE CONTROL OF DIRECT CURRENT MOTORS

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Abstract- Direct current (DC) motors are widely used in industrial systems, automation, electric vehicles, and robotics due to their simple structure, ease of control, and low cost. However, classical control methods often fall short when faced with variations in system parameters and external disturbances, highlighting the need for more flexible and advanced control approaches. This review paper examines recent studies on the application of artificial intelligence (AI)-based control strategies in DC motor control. Methods such as artificial neural networks, fuzzy logic systems, genetic algorithms, deep learning, ANFIS, and multiobjective optimization algorithms are discussed in terms of their advantages, limitations, and practical implementations. The performance of these methods is evaluated through selected applications in literature, with a particular emphasis on their success in modeling nonlinear system behaviors. The study concludes with suggestions for future research directions aimed at improving AI-based controllers. Keywords - DC motor, artificial intelligence, control systems, artificial neural network, fuzzy logic, deep learning, optimization algorithms.

Keywords- DC motor, artificial intelligence, control systems, artificial neural network, fuzzy logic, deep learning, optimization algorithms.

AUTOMATION IN HYBRID CLOUD ENVIRONMENTS: ORCHESTRATION APPROACHES BETWEEN PRIVATE AND PUBLIC CLOUDS

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Abstract **–** Increasing demands for flexibility, scalability, and high availability in today's IT infrastructures are driving organizations toward hybrid cloud architectures. Hybrid cloud offers a structure where private (on-premises) and public cloud resources operate together, providing businesses with advantages in both cost and performance. However, successful management of this structure requires automatic provisioning, monitoring, and governance of resources. For this reason, automation has become one of the fundamental building blocks of hybrid cloud systems. In this study, automation tools, methods, and challenges used in hybrid cloud environments are compiled in the light of academic and industry sources, and different orchestration approaches are comparatively examined. Within the scope of the study, leading automation tools such as Terraform, Ansible, Crossplane, Kubernetes, and VMware vRealize Automation are discussed; event-driven automation, GitOps methodologies, and Infrastructure as Code (IaC) approaches are detailed. Additionally, critical topics such as security, compliance, and cost management are discussed in light of current studies in the literature.

Keywords- Hybrid Cloud, Automation, Orchestration, Infrastructure as Code, Kubernetes, Terraform, GitOps

ARTIFICIAL INTELLIGENCE-POWERED NEXT-GENERATION CHATBOTS: STUDIES ON RETRIEVAL-AUGMENTED GENERATION (RAG) AND LARGE LANGUAGE MODELS (LLM)

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Abstract **–** Natural Language Processing (NLP) is one of the most prominent fields of artificial intelligence. In recent years, significant advancements have been achieved in this domain with Large Language Models (LLMs), particularly models such as the GPT and Gemini series.[1] LLMs have revolutionized applications like chatbots through their superior language understanding and generation capabilities. However, these models face limitations in accessing up-to-date and reliable information. To address this issue, the Retrieval-Augmented Generation (RAG) approach has been developed. RAG enhances the accuracy of LLMs by retrieving information from external sources. Extensive research on RAG systems demonstrates the rapid progress in this field.[2] The limited context window of LLMs and their difficulty in accessing information not present in their training data create challenges in domains requiring real-time knowledge. RAG overcomes these limitations by enabling language models to access external databases, knowledge bases, and current sources. This innovative approach has expanded the application areas of AI-powered chatbots and significantly improved the reliability and accuracy of their responses.

Keywords- Large Language Models, Retrieval-Augmented Generation, Chatbot, LangChain, Natural Language Processing, Vector Database, Query Optimization, Embedding, LLM Security, Prompt Engineering

MACHINE LEARNING APPROACH TO THE CLASSIFICATION OF RAISIN VARIETIES

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Abstract **–** This study presents a comparative analysis of machine learning algorithms for the classification of Keçimen and Besni raisin varieties, which are widely cultivated in Turkey. Logistic Regression (LR) and K-Nearest Neighbor (KNN) algorithms were applied to a dataset based on morphological features obtained from the Kaggle platform. In the study, systematic steps such as data preprocessing, feature scaling, and 10-fold cross-validation were followed; model performance was evaluated using metrics including accuracy, precision, recall, F1-score, and ROC-AUC. The results demonstrate that the LR algorithm outperformed the KNN algorithm, achieving an accuracy of 89% and an ROC-AUC value of 92%. By highlighting the potential of artificial intelligence-supported decision support systems in the classification of traditional agricultural products, this thesis aims to contribute to digital agriculture applications at both academic and industrial levels.

Keywords- Machine Learning, Raisin Classification, Logistic Regression, K-Nearest Neighbor (KNN), Cross-Validation.

THE IMPACT OF DATA QUALITY IN INTELLIGENT SYSTEMS: REVIEW AND COMPARISON

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Abstract – This article comprehensively examines the critical and decisive role of data quality in the success of today's transformative technologies, intelligent systems (artificial intelligence, machine learning, etc.). The fundamental data quality dimensions (accuracy, completeness, consistency, timeliness, validity, uniqueness, and relevance) are discussed in detail regarding their effects on the operation and decision-making efficiency of various types of intelligent systems. Significant negative impacts caused by low data quality—such as performance degradation, erroneous decisions, loss of trust, increased costs, and ethical issues—are substantiated with various examples. Furthermore, the article systematically reviews data quality improvement methods, including data cleaning, integration, transformation, enrichment, and data governance, while emphasizing their strategic importance in different intelligent system applications. In conclusion, it is argued that high-quality data forms the bedrock of intelligent systems that produce accurate, reliable, and ethical results; therefore, continuous investment in data quality is presented as a necessity. This study aims to provide a framework for fully [leveraging]* the potential of intelligent systems.

Keywords- Accuracy, Reliability, Machine Learning, Data Quality, Artificial Intelligence

THE TRANSFORMATIVE ROLE OF SUPERCAPACITORS IN ENERGY STORAGE SYSTEMS

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Abstract- This comprehensive review examines the position and future of supercapacitors within the energy storage ecosystem through a multidisciplinary lens. The analysis spans a broad spectrum of materials, ranging from electrochemical double-layer capacitance (EDLC) and pseudocapacitance mechanisms to graphene-based nanocomposites, ionic liquid electrolytes, and biomass-derived carbons. Bridging theory and application, nanotechnology and global energy policies, this study investigates the unique characteristics of supercapacitors, including their 100,000+ cycle life, operational temperature range of -100°C to 200°C, and power density exceeding 10,000 W/kg. Research findings demonstrate that supercapacitors, by addressing critical limitations of conventional lithium-ion batteries—such as fire hazards, low power density, and ethical supply chain concerns—will play a pivotal role in the global energy transition. Their integration into renewable energy systems, electric transportation, and advanced electronics underscores their potential to redefine energy storage paradigms while aligning with sustainability goals.

Keywords- Supercapacitor, Energy Storage, Nanomaterials, Electrolyte Technology, Sustainable Energy

COMPARISON OF THE TURKISH DEFENSE INDUSTRY WITH ISRAEL, SOUTH KOREA, AND INDIA

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Abstract- This study aims to evaluate the Turkish defense industry from a comparative perspective with Israel, South Korea, and India. The defense industry holds critical importance in terms of national security, economic growth, and technological advancement, directly impacting countries' global competitiveness. Within this context, the defense industry policies, domestic production capacities, R&D investments, export rates, economic and employment impacts, as well as geopolitical and strategic positions of the four countries have been analyzed in detail. The development process, historical background, and current status of Turkey's defense industry have been examined comparatively with the other three countries, identifying strengths, weaknesses, and potential areas for future development. Based on academic literature and existing sources, this study seeks to provide a comprehensive reference for policymakers and researchers in the field of defense industry.

Keywords- Turkish Defense Industry, Comparative Analysis, National Security Defense Economics, R&D Investments, Defense Exports, Geopolitics

HARDWARE AND SOFTWARE DESİGN OF A 13S LİTHİUM-ION BATTERY MANAGEMENT SYSTEM

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Abstract – This paper focuses on designing a reliable and low-cost Battery Management System (BMS) for lithium-ion battery packs consisting of 13 series cells (13S). In this study, a control structure based on passive balancing has been developed to monitor cell voltages and ensure effective protection against abnormal operating conditions such as overcharge, over-discharge, and short circuits. In the designed system, balancing operations are performed entirely via hardware and passively through an integrated circuit, preserving both the simplicity of the circuit architecture and cost-effectiveness. Furthermore, the proposed BMS structure aims to ensure that lithium-ion cells are kept within the safe operating range and to create a stable, reliable control layer for energy storage systems. It is evaluated that this design will offer significant contributions in terms of safety, performance, and economic sustainability, particularly in medium-scale battery applications.

Keywords- Lithium-ion battery, Battery Management System (BMS), Passive Balancing, Cell Monitoring, Energy Storage Systems, Cell Protection Circuit, 13S Battery Pack.

DEVELOPMENT OF AN EMBEDDED AVIONICS SYSTEM FOR MODEL ROCKETS

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Abstract – This paper focuses on the development and modeling of an avionics system designed for model rockets, addressing the limitations of existing low-cost flight control and data acquisition units that fail to accurately capture the dynamic behavior of rockets during flight. To fully analyze the responses to aerodynamic, mechanical, and environmental conditions encountered during ascent and descent, a compact avionics architecture containing barometric, inertial, and satellite-based sensors has been developed. The aim of the study is to realize a low-cost yet reliable avionics design by integrating lightweight sensor units and an efficient microcontroller-based processing system, avoiding the high cost and complexity of commercially available flight computers. Furthermore, unlike traditional hobby-grade avionics systems, the proposed architecture consistently ensures apogee detection, real-time telemetry transmission, and autonomous parachute deployment via a custom flight algorithm. The suitability of the proposed avionics system for analyzing transient and steady-state flight behaviors has been evaluated, and the importance of flight data analysis is demonstrated by presenting the variations in altitude, acceleration, and attitude parameters throughout the mission profile. This study emphasizes the practicality of the developed system for education, competition, and research-oriented rocketry applications.

Keywords- Rocket Avionics, Avionics System Design, Apogee Detection, Real-Time Telemetry, Autonomous Recovery System.

DC MOTOR DRİVER DESİGN

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Abstract – In this study, an Arduino-based motor driver system for Brushed DC Motors has been designed and practically implemented. The implemented driver system utilizes an IR2104 Gate Driver to control the motor via PWM signals generated by an Arduino Uno. Common and cost-effective components have been used in the circuit, aiming for a design that is both easy to implement and low-cost.

Keywords- Brushed DC Motor, Arduino Uno, Motor Driver, IR2104.

INTEGRATION OF ROS, ROS 2, AND ROS-M INTO THE DEFENSE INDUSTRY: CURRENT STATUS, CHALLENGES, AND FUTURE PERSPECTIVES

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Abstract - This article examines the TECHNICAL foundations, architectural structures, and current development status of ROS, ROS 2, and ROS-M. It then examines the integration of ROS into the defense industry, the necessity and importance of such integration. The article evaluates the current status of ROS-defense industry integration in Turkey and the world, as well as potential scenarios that could arise if Turkey were to utilize this technology in the defense industry.

First, the general architecture of ROS, ROS 2, and ROS-M is introduced, and recent developments are presented. After defining the technological framework, the potential applications of these systems in the defense industry, integration paths, and existing applications are examined. The contributions of ROS-based architectures to military platforms (land, air, sea, and multi-domain autonomous systems) are comprehensively evaluated. The article will also discuss why ROS is a fundamental technology for the defense industry, the operational and technological advantages it offers, and whether it can be considered an indispensable infrastructure in this context. Global examples will be explored, the current state of global integration will be explained, and Turkey's current status within this framework will be assessed. Finally, if Turkey fully utilizes ROS in its defense industry vehicles, possible future scenarios and potential outcomes will be analyzed, along with their impact on the defense industry. This article begins by focusing on the technology's latest developments, explores its military implications, addresses its critical importance and national position, and ultimately aims to present future perspectives in a comprehensive and scholarly manner.

Keywords **–** ROS, ROS 2, ROS-M

WIRELESS POWER TRANSMISSION PROJECT

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Abstract - This study covers the design, theoretical framework, and efficiency analysis of a wireless power transfer system based on magnetic resonance coupling (MRC WPT). Increasing energy demand and the proliferation of portable devices have made contactless energy transfer a critical technology. The project examined inductive and resonant coupling principles and analyzed the effects of coupling coefficient (k), quality factor (Q), coil geometry, ferrite materials, and impedance matching on system performance. Resonant LC circuits were modeled for the transmitter and receiver coils, and performance was evaluated through efficiency calculations and experimental measurements. Optimization methods, long-range transmission techniques, multi mode resonator structures, and electromagnetic safety criteria were discussed. The results show that proper resonance tuning, high Q values, and optimized coil design significantly increase efficiency and achieve up to 86.2% transmission efficiency. This work provides a comprehensive foundation for electric vehicle charging, biomedical implants, IoT systems, and room-scale wireless energy solutions.

Keywords — Wireless Power Transfer, Magnetic Resonance Coupling, Resonant LC Circuit, Coupling Coefficient, Q Factor, Wireless Charging Systems

ESP32 BASED DC MOTOR SPEED CONTROL AND MONITORING SYSTEM

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Abstract – The main objective of our project is to design a system to precisely control the speed of a DC motor and at the same time remotely monitor the speed operating data (speed, current) of the motor wirelessly. With the proliferation of Industry 4.0 and cyber-physical systems, remote monitoring and real-time performance of DC motor drives form the basis of predictive maintenance strategies [1]. In our project, embedded systems, power electronics and wireless communication are brought together. The main axis of the project is the dynamic speed control and real-time monitoring of a 140W 24V DC motor. It offers both precise and dynamic control of the rotational speed (RPM) of the DC motor according to a command from the user and real-time monitoring (telemetry) by transferring the instantaneous operating status of the motor (e.g. speed parameter) to a remote point (computer screen or phone screen) via wireless communication [5].

Keywords – ESP32, DC Motor Speed Control, PWM, PID Control, Telemetry, IoT, BTS7960B, Hall Effect Sensor

DC MOTOR SPEED CONTROL WITH PIC

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Abstract - In this study, the speed control of a Direct Current (DC) motor using the Pulse Width Modulation (PWM) technique is considered. PWM is based on the principle of controlling the width of the generated pulses, thus allowing the adjustment of the average voltage applied to the motors. This is accomplished by varying the time the signal remains at high voltage, known as the duty cycle. The system is designed using a PIC microcontroller (e.g. PIC12F675 or PIC16F877A) as the main control unit. The PIC is software programmed to adjust the motor speed according to an external analog signal input (e.g. a potentiometer). This analog signal dynamically changes the width of the PWM pulses that determine the speed of the motor. This control unit allows the speed of DC motors to be adjusted with high precision and under user control. In this paper, the details and performance of the DC motor speed controller with the developed hardware and software architecture will be discussed.

Keywords - DC Motor Speed Control, PWM, PIC Microcontroller, Duty Cycle, Motor Drive

DC MOTOR SPEED CONTROL WITH PIC

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Abstract – In this study, the speed control of a Direct Current (DC) motor is discussed using Pulse Width Modulation (PWM) technique. PWM is based on the principle of controlling the widths of the generated pals, thereby adjusting the average voltage applied to the motors. This method is carried out by changing the duration of the signal at high voltage, known as the duty cycle (Duty Cycle).

The system is designed using a PIC microcontroller (for example PIC12F675 or PIC16F877A) as the main control unit. PIC is programmed to program the motor speed according to an external analog signal input (for example, a potentiometer). This analog signal dynamically changes the width of the PWM pals that determine the speed of the engine. This control unit enables the speed of DC motors to be adjusted with high precision and in user control. This statement will discuss the details and performance of the DC motor speed controller with the hardware and software architecture developed.

Keywords – DC Motor Speed Control, PWM, PIC Microcontroller, Duty Cycle, Motor Driver

MOBILE APP CONTROLLED, SMART, CAT FEEDING SYSTEM

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Abstract - This paper is about the development of an IoT-based solution to reliably automate the pet grooming process, taking into account the health of pets and the comfort of pet caregivers. The proposed solution monitors the vital data of the pets in real time through various sensors and the necessary interventions are made at specified times. Likewise, by transferring this data to the cloud environment via wireless network and informing the user of the situation, it enables the user to intervene manually remotely when necessary. As a result of the simulations, automatic feeding with the help of the motor used and water withdrawal with the help of the pump by seeing the status of the water with the help of the sensor were realized by writing the necessary codes. With this IoT-supported approach, it is envisaged that the reliability of pet care can be increased, the workload of caregivers can be reduced and continuous monitoring can be provided.

Keywords - Internet of Things (IoT); Pet Smart Care System; Real Time Data Collection; Cloud Based Monitoring

AGV (AUTONOMOUS GUIDED VEHICLE)

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Abstract - This study covers the design and implementation of a versatile Autonomous Guided Vehicle (AGV) prototype developed to automate material handling processes in industrial logistics and production facilities. The main objective of the project is to reduce labor and increase system efficiency in logistics and production lines. The developed AGV aims to demonstrate that a basic level of autonomous navigation can be realized with a low-cost control architecture based on Arduino and Raspberry Pi without the use of expensive sensor systems (e.g. LIDAR). The system uses camera based AprilTag recognition for orientation and utilizes ultrasonic and infrared sensors for environmental awareness. Based on the Robot Operating System (ROS) infrastructure, this prototype offers a functional solution for education, research and low-cost industrial applications thanks to its modular structure.

Keywords - Autonomous Guided Vehicle (AGV), AprilTag, Image Processing, Robot Operating System (ROS), Modular Architecture, Low Cost Prototype.

DRIVING STEPPER MOTOR ON MOBILE APPLICATION WITH ESP32, DESIGNING STEPPER MOTOR DRIVER

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Abstract - In this study, a drive system has been designed for the wireless control of stepper motors used for precise positioning in industrial automation and Internet of Things (IoT) applications via mobile devices. Within the scope of the project, an ESP32 microcontroller based control unit and a power stage consisting of IR2110 integration and IRF630N MOSFETs were developed to drive a bipolar hybrid stepper motor in NEMA23 standard. The designed driver circuit has current sensing with LM358 operational amplifier and hardware overcurrent protection with LM293 comparator. For remote control of the system, a platform independent mobile application has been developed using the Flutter framework; data transmission between the ESP32 and the mobile interface is provided by the WebSocket protocol, which offers lower latency compared to MQTT and HTTP protocols . The circuit designs are schematically and PCB prepared in KiCad environment, and the stability of the system is verified with Proteus simulations. This paper presents the integrated design process of a low cost and high performance motor drive system with hardware and software components.

Keywords - Stepper Motor; ESP32; Motor Drive Design; PCB Design; WebSocket; Flutter

IOT CLOUD TABANLI SMARTLED DRIVER

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Abstract - The IoT Cloud Based SmartLED Driver project is about the development of an ESP8266 based smart LED driver circuit that aims to make traditional LED lighting systems controllable over the internet. By combining low-cost hardware solutions with cloud-based IoT platforms, the project enables users to remotely manage LED systems with advanced features such as brightness and color control. The aim of the project is to develop a small, modular, flexible driver that can make any LED strip smart. In this respect, the project differs from the brand-dependent "disposable type" smart bulbs on the market and offers a unique value. In the hardware design, the ESP8266 module was used as the "brain" of the system and the device was enabled to access the internet through the IoT Cloud platform thanks to Wi-Fi connection. The MOSFET switching layer is designed to meet the high current requirement of the LEDs due to the low voltage signals generated by the ESP8266. MOSFETs safely deliver the required current to the LED strips For the circuit supply, a Buck Converter power circuit that obtains 3.3V output from 12 24V input is designed. A stable 3.3V output is provided using the MC34063A integration and the supply circuit provides a reliable energy infrastructure for the entire system. In software and IoT integration, the ESP8266 is connected to the cloud platform over the internet to transfer user commands to the LED driver circuit. With the web or mobile based user interface, LED brightness and color settings can be controlled in real time. The developed interface is aimed to be user friendly and provide instant feedback.

Keywords - IoT, ESP8266, Wi-Fi, Smart Lighting, Remote control

WIND TURBINE ENERGY MONITORING CONTROL SYSTEM

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Abstract - Within the scope of the project, the mechanical energy of the wind is converted into electrical energy by using a motor with 230V DC output as a generator. The energy obtained is safely transferred to a 12V 9Ah battery through the designed charge regulator circuit. The charge controller prevents overcharging or discharging of the battery, extending the life of the system and increasing energy efficiency. The energy received from the battery is reduced through the LM2596 adjustable DC/DC voltage regulator and converted to the operating voltage suitable for the STM32F103C8T6 microcontroller. In this way, stable and reliable operation of the system was ensured. The STM32 microcontroller undertakes all measurement and control tasks of the system. The rotational speed of the wind turbine was measured by means of the US1881 Hall Effect sensor placed on the shaft to obtain instantaneous RPM information. The current of the generated electricity was measured with the ACS712 current sensor and the voltage was measured through the designed voltage divider circuit. All these data are processed by STM32 and displayed to the user instantly on the 0.96" I2C OLED screen. Thus, the operating status of the system, the amount of energy produced and the turbine performance can be monitored in real time.

Keywords - Wind Turbine; Energy Monitoring System; LM317; Pre-Regulator; STM32; Hall Sensor; DC Motor Generator; Battery Charging

LINEAR ACTUATOR SYSTEM WITH REMOTE POSITION CONTROL

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Abstract - In this study, a remotely controllable automation system is developed by integrating linear actuators with modern IoT technologies. Linear actuators are mechanical-electronic system components that convert rotational motion into linear motion and are widely used in industrial automation systems. In the developed system, a Wi-Fi based web server was created using ESP32 microcontroller and real-time position control was provided to the user. The system controls a 12V DC linear actuator via L298N motor driver board and provides a feedback mechanism with potentiometer/encoder. Through the web-based interface, the user can control the forward-reverse movement of the actuator and monitor the instantaneous position information. The system design, circuit diagram, PCB design and software algorithms are presented in detail at . As a result of the study, precise position control with remote access has been successfully realized and the usability of the system in industrial automation, smart home systems and IoT applications has been demonstrated.

Keywords - linear actuator, remote control system, ESP32 microcontroller, IoT integration, web-based control interface, motor driver.

AUTONOMOUS AND MANUAL SHUTTER CONSTRUCTION FOR SMART BUILDING SYSTEMS

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Abstract - This paper is about how smart building systems make life comfort, security and energy savings and how the systems are installed. In this paper, autonomous roller shutters and security are only a part of smart building systems. The aim of the study is to control the roller shutter system with ESP32S both manually and through the mobile application, as well as to open and close it autonomously according to the situation thanks to the sensors, which are the security elements added to the system.

Keywords - SMART BUILDING;ESP32S

SIGNAL GENERATOR WITH AD9833

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Abstract - Generators that produce signals in different waveforms are of great importance in the test and analysis of electronic systems. In this project, a DDS (Direct Digital Synthesis) based signal generator is designed that offers high frequency stability and ease of digital control. Thanks to the DDS method, frequency, phase and amplitude can be precisely adjusted digitally and more stable signals are obtained compared to analog methods.

Keywords - Equivalent Electric Circuit; Squirrel Cage Induction Motor; Induction Motor Modeling; Loading of Induction Motor

DC-DC BUCK CONVERTER

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Abstract - This study presents the design of a digitally controlled, high-efficiency DC DC buck converter intended for industrial applications requiring high current. The developed converter is optimized to step down an input range of 12-24 volts to a regulated 5 volts output capable of delivering 10 amperes. The hardware design incorporates high-current-capacity MOSFETs, low-ESR filter components, and a PCB architecture optimized for electromagnetic interference (EMI), while the control structure employs an STM-based digital feedback system. This approach yields a reliable power converter that offers high efficiency, dynamic stability, and suitability for industrial use. The study aims to contribute to the literature by providing a practical design methodology for high-current, digitally controlled buck converters.

Keywords – DC-DC Buck Converter, Closed-Loop Control, PWM Control (Pulse Width Modulation), High Current Output

13S MICROCONTROLLER-BASED PROTECTION SYSTEM DESIGN FOR LITHIUM-ION BATTERIES

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Abstract - The aim of this project is to monitor the voltage, current and temperature parameters of a 13S lithiumion battery pack in real time and to automatically disconnect the battery from the load via a relay when defined limits are exceeded, thus ensuring pack integrity and safety of connected loads. Architecturally, the core flow (measure-compare-disconnect) and pack-level hardware stability principles recommended by the electric vehicle-scale BMS literature are followed; the high voltage line is decoupled from the control electronics with two-stage power conversion (buck → 12 V, followed by a clean 5 V measurement rail) [1,3]. Hall-effect sensors were chosen for current sensing due to galvanic isolation and EMI immunity, thus minimizing the transfer of fast transients in the power line to the measurement floor [5]. In the temperature interface, RC filtering and local decoupling were applied to reduce the effect of high frequency components caused by switching power supply and relay commutation on ADC readings, and in the decision layer, threshold/hysteresis and "time over threshold" (i.e. ≥200 ms) condition were used together to prevent false triggers [2,4]. Clearly reporting conditions such as high/low voltage, over/low current and high temperature with 6 LEDs on the user interface is a practical diagnostic method reported in low-cost MCU-based prototypes [2]. From a thermal point of view, cooling the load block with a fan is intended to reduce the surface temperature and ensure stable operation in long driving/testing scenarios as recommended in the BTMS literature [6]. Thus, the miniBMS prototype combines secure threshold detection, fast and selective load cut-off, visual status notification and thermal management on a single board, offering a low-cost and modular infrastructure suitable for laboratory/test use.

Keywords - Lithium-Ion Battery; Battery Protection System; Microcontroller; Arduino; Voltage Monitoring; Current Sensing; ACS758.

DC-DC BUCK CONVERTER CİRCUİT

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Abstract - This article presents the design and analysis of a high-power DC-DC buck converter that converts a variable input voltage ranging from 36V to 54V into a fixed 36V output voltage at a maximum load current of 10A (360W). To achieve high efficiency (95% target) and minimize losses associated with standard diode usage, a synchronous topology with N-channel MOSFETs operating at a 150 kHz switching frequency was selected. The study details the duty cycle (66.7% - 100%) and critical inductor (48 µH) calculations that guarantee stable operation of the system in Continuous Current Mode (CCM). Furthermore, a component selection methodology incorporating the hybrid use of MOSFETs with ceramic (MLCC) and polymer capacitors to manage high RMS current ripple (4.71A at input) and voltage stresses (100V class) is explained. This work includes the complete circuit schematic and PCB (Printed Circuit Board) design developed based on theoretical calculations and presents a comprehensive synchronous converter design methodology for industrial applications.

Keywords: Synchronous Buck Converter; DC-DC Converter Design; High Power; Continuous Conduction Mode (CCM); Power Electronics.

SYNCHRONOUS BUCK-BOOST CONVERTER DESING AND SIMULATION PROVIDING A FİXED 36V 10A OUTPUT IN THE 36-54V INPUT RANGE

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Abstract -In this study, a DC-DC Buck-Boost converter design capable of maintaining a constant output voltage of 36V and a current capacity of 10A for industrial systems and power supplies with input voltages ranging from 36V to 54V has been developed. Considering the importance of efficiency, thermal stability, and voltage regulation in power electronics applications, the LT8390 integrated circuit, which has a wide input voltage range and high efficiency, was preferred for the control stage of the system. The designed circuit was simulated in the LTSpice environment under different input voltage scenarios, and the dynamic responses and stability of the system were analyzed. The simulation results obtained show that the designed topology can regulate the output voltage to the desired level even under variable input conditions and operates stably under high current loads. In addition, PCB design and cost analysis in terms of the physical feasibility of the system are also presented within the scope of the study.

Keywords -DC-DC Converter, Buck-Boost, LT8390, Power Electronics, Voltage Regulation.

ELECTROMAGNETIC WEAPON PROJECT

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Abstract – Electromagnetic weapons stand out in modern warfare technology for their ability to directly utilize energy and disable electronic systems without causing physical damage. The theoretical basis behind these weapons is the electromagnetic field created around charged particles. Stationary charges create only an electric field, while moving charges create both electric and magnetic field effects. The functioning of the electromagnetic field is based on fundamental laws of physics such as Coulomb's Law, which defines the force between charges; Ampere's Law, which determines the magnetic field around a current-carrying conductor; Faraday's Law, which explains the induction of electric current by changes in magnetic flux; and Lorentz's Law, which defines the force created by both electric and magnetic fields together. The direction of the magnetic field is determined by the Right-Hand Rule, and the direction of motion affecting the conductor is determined by the Left-Hand Rule.

Keywords - Electric Field, Magnetic Field, Electromagnetism, Coil Gun, Charged Particles

SMART ROBOT VACUUM CLEANER

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Abstract – This project study comprehensively examines the theoretical basis, design principles, and operational algorithm of a highly efficient Smart Robot Vacuum System, stemming from the need to automate cleaning processes in modern living spaces. Aiming to minimize the human labor dependency, time, and resource losses associated with traditional cleaning methods, this robotic solution focuses on electronic circuit design and the practical integration of embedded systems.

Within the scope of this study, an environmental perception architecture has been developed to enable the robot to accurately perceive its surroundings and dynamically cope with obstacles. The navigation capability, which is the most critical function of an autonomous robot, is supported by a reliable decision-making algorithm based on the continuous processing of sensor data. This architecture incorporates effective route planning principles that not only avoid stationary obstacles but also enable the robot to systematically cover the area to complete its cleaning task.

The robot's motion system is designed to optimize cleaning performance. The drive mechanism, which meets high torque requirements, provides stable and controlled movement on both flat surfaces and small elevation differences. All these physical and software components are synchronized under a microcontroller-based control system, enabling the robot to perform its autonomous cleaning task with minimal energy consumption.

This project, with the development of the Smart Robot Vacuum System, demonstrates not only the functionality of a prototype but also the methodology for overcoming fundamental design challenges in modern robotic systems. The results obtained confirm that the developed system exhibits high coverage efficiency and autonomous obstacle avoidance success in the specified area. This work establishes a scalable and reliable foundation for future home automation and mobile robotic applications.

Keywords – Smart Robot Vacuum Cleaner; Robotic Algorithm; Obstacle Avoidance; Automation

ELECTRICAL AND MECHANICAL LOAD DESING FOR INDUCTION MOTORS

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Abstract – It offers a wide range of door and access control systems, from security and aesthetics to durability and functionality. Designed to meet the needs of modern living spaces and businesses at the highest level, it offers multiple opening actions and operates quickly and practically with its powerful processor. The first method is facial recognition, a way to identify or verify someone's identity using their face. The second method is RFID technology, the identification of objects using radio waves, a widely used system today. And finally, the encryption system is a method of scrambling data so that it cannot be read by anyone other than authorized parties.

Keywords - door entry system; esp32-s3; keypad; camera; rfc525.

TECHNIGUES USED IN COMMUNICATION IN AUTONOMOUS SWARM SYSTEMS

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Abstract – This study aims to conduct a comprehensive review of the literature examining the communication networks of autonomous swarm systems. Autonomous swarm systems have recently become widely used in many areas such as reconnaissance, military missions, factories where autonomous vehicles are prominent, and many more. What enables these swarm systems to operate in a coordinated manner is the communication established among them. This communication takes place through various channels. However, as the distance between the vehicles forming the swarm increases, disruptions occur in this communication, leading to negative outcomes such as data loss and vehicle loss.

Cognitive radio is a type of radio that can be dynamically programmed and configured to use the best available channels in its environment in order to prevent user intervention and congestion. In this context, current studies in the literature that employ cognitive radio techniques as a solution to communication disruptions in the communication process of autonomous swarm systems, and how these disruptions are resolved with such techniques, will be analyzed.

The study aims to present and compare different approaches in terms of communication speed, accuracy in channel selection, and availability, as well as to summarize the existing works in the literature. In this way, it is intended to reveal the advantages and limitations of using cognitive radio in communication within autonomous swarm systems and to provide a guiding perspective for future research.

Keywords – Communication in Autonomous Swarm Systems, Cognitive Radio

MULTIMODAL DEEP LEARNING AND MACHINE LEARNING-BASED ARTIFICIAL INTELLIGENCE SYSTEM FOR EARLY BREAST CANCER DIAGNOSIS

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Abstract – This study presents a multimodal artificial intelligence-based desktop application designed to assist in the early diagnosis of breast cancer by integrating both clinical and mammographic data. The system combines classical machine learning and deep learning methods through a dual-stage pipeline. Clinical parameters—including tumor size, lymph node involvement, nuclear grade, hormonal receptor status, and age—are processed using a Random Forest classifier, achieving high specificity and robust overall performance. Mammography images are analyzed through a fine-tuned ResNet-50 model for binary classification and a U-Net–based segmentation module for precise localization of tumor regions. The integration of segmentation outputs enables visual interpretability and supports explainable AI principles by highlighting suspicious areas on the breast tissue. A user-friendly Tkinter-based interface unifies all components, allowing clinicians or users to upload images, enter clinical parameters, view probability-based predictions, and examine segmented tumor regions. Experimental results indicate that the multimodal approach enhances diagnostic reliability compared to single-modality systems, demonstrating the potential of AI-supported decision tools to reduce diagnostic delays and improve early detection outcomes.

Keywords – Breast cancer; Multimodal artificial intelligence; Deep learning; Machine learning; ResNet-50; U-Net; Mammography; Segmentation; Early diagnosis; Clinical decision support; Random Forest; Explainable

COMPARATIVE ANALYSIS

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Abstract - This study aims to comprehensively examine the literature focusing on feature selection algorithms, which are a fundamental factor determining model success in artificial intelligence applications. In the context of large and complex datasets, removing data that is unnecessary, misleading, or does not contribute to the analysis not only alleviates the computational burden but also enhances the reliability of the resulting outputs. Identifying the most relevant data attributes is considered a critical step for achieving high accuracy rates, particularly in data-intensive processes such as machine learning and deep learning.

Within the scope of this research, fundamental techniques such as filter, wrapper, and embedded methods will be addressed, and their strengths, limitations, and computational resource usage will be analyzed comparatively. Furthermore, the relative advantages and performance differences of various methodologies—including decision trees, genetic algorithms, regression-based models, and increasingly prevalent hybrid approaches—will be evaluated in detail.

As a result of this literature review, the effectiveness of the examined algorithms across different data types and application domains will be demonstrated, and the limitations of existing methods along with areas requiring further development will be discussed. This study serves as a resource for both researchers and practitioners, aiming to assist in the development of more effective models by optimizing feature selection processes.

Keywords **-** *Feature Selection; Machine Learning; Artificial Intelligence; Dimensionality Reduction; Hybrid Algorithms; Data Preprocessing.*

DEEP LEARNING MODEL SECURITY: ADVERSARIAL ATTACK DETECTION AND DEFENSE MECHANISMS

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Abstract **–** Deep learning models demonstrate high performance in computer vision tasks, yet vulnerability to adversarial attacks remains a significant challenge [1]. In this study, the impact of visually imperceptible pixel-level manipulations on model performance is investigated, and a security evaluation is presented. A ResNet-50 [2] architecture was trained on the CIFAR-10 dataset, achieving a baseline accuracy exceeding 90% through transfer learning with ImageNet weights and fine-tuning over 50 epochs.

Three fundamental attack methods were systematically analyzed: FGSM (single-step gradient-based), PGD (iterative optimization), and C&W (optimization-based) [3]. It was observed that undefended models experienced drastic performance degradation, with accuracy dropping significantly under FGSM and PGD attacks.

To mitigate these vulnerabilities, four defense mechanisms were implemented and evaluated: Adversarial Training, Input Transformation, Defensive Distillation, and Feature Squeezing [4]. Evaluation results indicated that Input Transformation demonstrated the highest overall effectiveness, maintaining robust accuracy against FGSM and PGD, with minimal loss in clean data performance. While Adversarial Training provided a balanced protection profile, Defensive Distillation was found to best preserve clean data performance. These findings highlight the necessity of integrating robust defense mechanisms into security-critical AI applications, as emphasized in recent comprehensive studies [5].

Keywords – *Adversarial Machine Learning; Deep Learning Security; FGSM; PGD; C&W; Adversarial Training; Input Transformation; Model Robustness*

POST-DISASTER SAFE ROUTE DETERMINATION SYSTEM

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Abstract – Current static map systems remain insufficient in reflecting dynamic damage data after disasters. Although damage detection studies using YOLOv8 exist in the literature, these studies have been limited to damage detection alone and have not been integrated with safe route determination. In this study, a YOLOv8m-OSRM integration that combines damage detection and route optimization in a single system has been realized. The system detects seven classes of infrastructure damage from user-sourced photos and geo-tagged social media images. Transfer learning was applied via COCO pre-trained weights, and fine-tuning was performed with data from the February 6, 2023, Kahramanmaraş earthquake. The model performs damage detection with an 85% accuracy rate on test data. The detected damage data is processed in a PostGIS-based 500m×500m grid system, converted into dynamic heat maps, and integrated with the OSRM (Open Source Routing Machine) engine. An optimization algorithm weighted for safety (70%) and time (30%) suggests alternative safe routes by excluding damaged road segments. The system was retrospectively tested with data from the February 6, 2023, Kahramanmaraş earthquake and provided improvement in route safety compared to traditional shortest path algorithms.

Keywords - *Depo Learning; YOLOv8; Damage Detection; Route Optimization; Geographic Information Systems; Disaster Management*

STOCK MARKET ROBOT AND THEIR BENEFITS

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Abstract – With the rapid advancement of technology, significant developments are also occurring in the financial sector, with one of the best examples being automated trading systems (trading robots). Trading robots are computer programs that automatically execute buy and sell orders in stock, forex, or cryptocurrency markets. These robots save investors time, reduce impulsive decisions caused by human psychology, and monitor the market 24/7 to avoid missing trading opportunities. Additionally, by analyzing historical price and transaction data, they help investors make more informed decisions. Their ability to execute trades quickly allows them to react instantly to sudden market changes. However, although they operate based on predefined strategies, they do not completely eliminate investment risks and do not guarantee profits. In this study, previous research conducted on trading robots is examined, and the relevant findings are presented.

***Keywords*:** Financial markets, algorithmic trading, risk management, automated trading, trading robots

EXPLAINABILITY IN DEEP LEARNING MODELS: EXPLAINABLE AI (XAI) TECHNIQUES AND APPLICATIONS

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Abstract – Deep Learning (DL) models achieve remarkable performance, yet their opaque decision-making processes raise critical concerns regarding ethics, trust, and legal compliance. This study focuses on Explainable Artificial Intelligence (XAI), which aims to improve the transparency and interpretability of AI systems by providing insight into how predictions are made. The research centers on Local Explainability methods, particularly LIME (Local Interpretable Model-agnostic Explanations) and SHAP (SHapley Additive exPlanations). LIME approximates the local behavior of complex models with simple interpretable models to reveal the most influential decision factors, while SHAP uses Game Theory to quantify the exact contribution of each input feature to the final output. The project evaluates these techniques through real-world case studies in high-stakes domains such as healthcare and finance, highlighting their strengths, limitations, and computational trade-offs. The results emphasize the growing importance of XAI for building trustworthy AI systems and outline future research directions to improve explanation fidelity and scalability.

Keywords –Deep Learning (DL), Explainable AI (XAI), LIME (Local Interpretable Model-agnostic Explanations), SHAP (SHapley Additive exPlanations), Model Interpretability

DEVELOPMENT OF AN INTELLIGENT DATA GENERATOR AND AI-BASED ANALYSIS TOOL SIMULATING ALZHEIMER'S DISEASE LANGUAGE IMPAIRMENTS IN TURKISH TEXTS

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Abstract – This study examines the linguistic biomarkers of Alzheimer's disease (AD) in Turkish and develops both a synthetic data generator that simulates semantic, syntactic, and morphological impairments servet in patients, and an AI-based analysis tool. Due to the limited availability of labeled datasets and analytical tools for Turkish, this project addresses a critical gap by modeling language impairments within the agglutinative structure of Turkish, with particular emphasis on suffix errors, reduced morphological complexity, and simplified sentence structures characteristic of AD in morphologically rich languages.

English AD datasets, including DementiaBank and the ADReSS Challenge, are analyzed to identify impairment patterns, which are then adapted to Turkish morphology in collaboration with neurology and linguistics experts. A control dataset of healthy Turkish texts is created, and the extracted impairments are integrated into these texts through a rule-based perturbation model to generate synthetic data. The generator specifically targets Turkish-specific markers such as incorrect suffix usage, reduced agglutination depth, and simplified clause structures. The resulting data is processed using a BERTurk-based classifier to detect impairment types and severity levels.

This project provides the first comprehensive synthetic data generator and analytical infrastructure for Turkish AD research, offering a scalable solution for academic studies, early screening processes, and domestic health-tech development. The open-source tool will be made available to researchers and universities.

Keywords – Alzheimer's Disease, Natural Language Processing, Linguistic Biomarkers, Synthetic Data Generation

ARTIFICIAL INTELLIGENCE APPROACHES USED IN SOLVING DIFFERENTIAL EQUATIONS

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***Abstract*—** This study aims to review the literature examining the use of artificial intelligence methods in solving differential equations. Differential equations are equations that relate the rate of change of a quantity with respect to time or another variable and are used to model dynamic systems in physics (motion, electrical circuits), engineering (control systems, vibrations), economics (growth models), biology (population growth, epidemic spread), and many other dynamic systems. However, solving these equations using numerical and analytical methods can be challenging, especially in high-dimensional and nonlinear cases.

Artificial intelligence methods are attracting interest because they can provide fast and effective results, unlike traditional solution approaches. For this reason, the study will analyze current research in the literature on how methods such as artificial neural networks, evolutionary algorithms, support vector machines, deep learning, and hybrid approaches are used to solve differential equations.

The study aims to compare existing methods in terms of accuracy, computational cost, and usability, and to present the studies in the literature. In this way, it aims to provide a perspective that will guide future research by revealing the advantages and limitations of artificial intelligence-based approaches in solving differential equations.

Keywords – Differential Equations, Artificial Intelligence, Numerical Solution Techniques

WHEN HYBRID IS NOT BETTER: A COMPARATIVE ANALYSIS OF MFCC-BASED CNN, LSTM, AND CNN-LSTM ARCHITECTURES FOR ENVIRONMENTAL SOUND CLASSIFICATION

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Abstract – Three deep learning architectures based on Mel-Frequency Cepstral Coefficients (MFCCs)—CNN, LSTM, and hybrid CNN-LSTM—were compared for environmental sound classification using the UrbanSound8K dataset (8,732 records, 10 classes).

Model 1 (MFCC+CNN) achieved 89.81% accuracy, Model 2 (MFCC+LSTM) achieved 11.45% accuracy, and Model 3 (MFCC+CNN-LSTM) achieved 87.98% accuracy. The study's original contribution is the experimental demonstration that the widely suggested hybrid CNN-LSTM architecture did not provide the highest performance for environmental sound classification, as might be expected in the literature. The hybrid model showed 1.83% lower accuracy than the standalone CNN and revealed that the added computational complexity was not commensurate with the performance gain. The findings indicate that spatial feature learning (CNN) is more critical than temporal modelling (LSTM) in short-duration environmental sounds. These results emphasize the importance of careful architectural selection based on the specific characteristics of the dataset

Keywords – *Environmental Sound Classification, MFCC(Mel-Frequency Cepstral Coefficients), CNN(Convolutional Neural Network), LSTM (Long Short-Term Memory), Hybrid Architecture, UrbanSound8K*

DIGITIZING THE ANALOG CLASSROOM: MULTIMODAL LLM AND RAG ANALYSIS FOR UNSTRUCTURED EDUCATIONAL DATA

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Abstract **–** Abstract Recent advancements in artificial intelligence technologies present new opportunities for digitizing the analog classroom and supporting personalized learning processes. However, a significant portion of educational data, such as lecture notes, exam papers, and blackboard images, still exists in unstructured formats. This study investigates the effectiveness of Multimodal Large Language Models (MLLMs) and Vision-Language Models (VLMs) in converting such visual data—specifically containing printed text, handwriting, mathematical graphs, and complex layouts—into machine-readable, searchable, and analyzable structured data formats.

Unlike traditional Optical Character Recognition (OCR) methods, these models possess contextual learning capabilities, allowing them not only to transcribe visual data into text but also to interpret it semantically. To evaluate these capabilities, the study conducts an analysis of closed-source (GPT-5, Gemini 3) and open-source (LLaVA, Qwen-VL) models in terms of accuracy rates, Turkish language support, hallucination tendencies, and cost-effectiveness. Furthermore, integration methods with Retrieval-Augmented Generation (RAG) architecture are discussed to enhance information accuracy specific to the educational curriculum and ensure the reliability of generated outputs.

The findings indicate that hybrid model approaches and fine-tuning techniques yield the highest success in processing visual data. This system enables students to receive instant feedback on visual materials, while simultaneously facilitating the creation of a sustainable and personalized progress tracking system through the analytics of data accumulated in the background

Keywords *– Vision-Language Models (VLM), Multimodal Large Language Models (MLLM), Retrieval-Augmented Generation (RAG), Educational Technology (EdTech), Personalized Learning, Intelligent Tutoring Systems*

MOBILE APPLICATION TO STRENGTHEN AND MAKE SOCIAL-ACADEMIC INTERACTION IN UNIVERSITIES SUSTAINABLE: UNICONNECT

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Abstarct - Today, UNIVERSITY students face significant information disarray and communication gaps when accessing community activities, project teams, and campus events, which are critical to their academic and social development. This situation, in particular, prevents students from different disciplines from coming together to develop innovative collaborations and limits on-campus interaction. As a solution to this problem, the UniConnect mobile application will be developed, a user-centered and sustainable digital communication platform specifically designed for the Selçuk UNIVERSITY ecosystem. Unlike existing general social networks, UniConnect, which focuses solely on the dynamics of a single UNIVERSITY, will operate through three interconnected main modules: Communities, Projects, and Events. The platform's technological infrastructure will be strengthened by a rule-based Smart Recommendation System that delivers personalized content based on users' interests and competencies, ensuring the right student is matched with the right project or community. Furthermore, to overcome the "user engagement" problem frequently emphasized in the literature, gamification dynamics will be integrated into the system to encourage active and continuous use of the application. The project will conclude with a functional software prototype that has completed pilot testing and enhances both social and academic interaction. This process will equip the undergraduate students involved with the project with advanced TECHNICAL competencies in full-stack application development, API documentation, and system design, while also providing the UNIVERSITY with a permanent digital campus infrastructure that renews itself annually with new enrollments and supports an interdisciplinary work culture.

Keywords : *UNIVERSITY Mobile Application, Social Development, Academic Development, Gamification, Innovative Communication*

DEVELOPMENT OF A TRACKING APPLICATION USING LUETOOTHB LOW ENERGY (BLE) TAGS TO PREVENT LOSS AND FORGETFULNESS OF ITEMS

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Abstract – Core Problem and Objective: The widespread issues of misplacing and forgetting items in daily life cannot be fully resolved due to the high energy consumption, cost, and closed ecosystem dependency of existing commercial tracking solutions. The primary objective of this project is to develop an innovative mobile tracking system that overcomes these limitations, featuring low energy consumption and high positioning accuracy. Originality and TECHNICAL Solution: The project utilises advanced signal processing algorithms, such as the Kalman Filter, to minimise environmental noise and fluctuations in the RSSI (Received Signal Strength Indicator) data obtained from BLE tags. Thanks to this algorithm, it aims for competitive accuracy, such as $\mathbf{\text{RMSE} < 2 \text{ metres}}$, with low-cost BLE hardware. The mobile application, to be developed with Flutter/Dart, will include a geofencing-based instant alert mechanism that aims to proactively prevent items from being forgotten. Industry/Sector Contribution: The project will contribute to the development of local IoT solutions by offering an economical and accessible alternative to expensive and brand-dependent solutions on the market. The developed stable RSSI processing infrastructure will form a sustainable technological foundation that can be scaled to future industrial asset management and indoor positioning (Indoor LBS) applications.

Keywords *– Bluetooth Low Energy, Internet of Things, Asset Tracking, Signal Strength Indicator, Mobile Application Development*

MIND SUPPORT APPLICATION

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Abstract **–** Attention Deficit Hyperactivity Disorder (ADHD) is a common neuropsychological disorder characterized by impulsivity and attention problems, affecting a significant proportion of school-age children worldwide and in Turkey. The high cost of current treatments has accelerated the search for alternatives; as seen in FDA-approved examples, video game-based digital support systems have been proven to provide meaningful improvements in attention and executive functions. The aim of this study is to introduce ZII-DES, an accessible and personalized mobile learning platform developed for children aged 7-10 diagnosed with ADHD.

The proposed system is built on a Dynamic Difficulty Adjustment (DDA) algorithm that analyzes user behavior (response time, incorrect presses) on the touch screen instead of complex sensors. ZII-DES moves away from the classic test structure and integrates educational content into story-based game modules. In this context, mathematical operations (addition/subtraction) are associated with the task of "collecting the correct energy sphere," while verbal skills (synonyms/antonyms) are linked to decisions about "choosing the correct word tunnel" within the story. Furthermore, to help children control their impulses, microphone-interactive breathing exercises have been designed as a "motor cooling task."

This article details the multi-layered TECHNICAL architecture of the ZII-DES platform, the pedagogical foundations of gamification scenarios, and the working principles of the developed adaptive algorithm.

Keywords *– ADHD, Digital Therapeutics, Dynamic Difficulty Adjustment, Gamification, ZII-DES, Mobile Learning.*

CASE ANALYSIS OF RANSOMWARE ATTACKS AND SECTORAL IMPACT IN TÜRKIYE

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Abstract – Over the last couple of years, ransomware cases in Türkiye have been showing up more often, especially in sectors that depend heavily on connected industrial systems. WatchGuard Türkiye's 2024 report lists roughly 1.27 million detected cyber incidents, and what really catches the eye is the jump in network-based intrusions, which passed the one-million mark after an unusual year-to-year spike of more than 2,300%. At the same time, malware detections fell to around 235,000, a drop of 76.53%, which suggests attackers are favoring direct exploitation rather than the old "spread malware and hope it works" approach. Several 2024 assessments, including SOCRadar's ransomware overview, highlight that manufacturing has quietly become the most targeted area, followed by professional services and healthcare. This fits the general feeling that OT-heavy environments still have gaps that attackers can take advantage of. On the global side, the 2024 Zscaler ThreatLabz Report mentions a USD 75 million ransom payment linked to the Dark Angels group, which puts into perspective how large these incidents can become. The purpose of this study is to outline how these trends appear in Türkiye, compare which sectors face the most trouble, and get a sense of what factors make certain incidents more damaging than others. Overall, the data paints a picture of a threat that isn't going away anytime soon, and whose impact varies depending on how prepared each sector actually is.

Keywords – *Ransomware; Cybersecurity; Threat Landscape; Türkiye; Sectoral Impact; BTK; WatchGuard; Malware Trends*

MULTI-FEATURE INTEGRATED DEEP LEARNING FRAMEWORK FOR DETECTION OF AUDIO MANIPULATIONS

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Abstract – Advances in text-to-speech (TTS), voice conversion (VC), and neural audio generation have significantly intensified audio-based security threats, particularly deepfake voice attacks. The increasing realism of LLM-driven voice synthesizers has made distinguishing authentic human speech from manipulated audio increasingly difficult. This study proposes a Multi-Channel Convolutional Neural Network (MC-CNN) architecture that integrates heterogeneous acoustic features—time–frequency spectral representations, MFCC-derived cepstral characteristics, and pitch/formant-based vocal tract cues—to enhance manipulation detection across diverse attack scenarios.

The architecture incorporates an Attention-Based Feature Fusion (ABFF) mechanism, dynamically recalibrating the contributions of spectral, cepstral, and prosodic–resonance features. This fusion strategy enables the system to capture subtle generative artifacts that persist even in highly naturalistic synthetic speech. To rigorously evaluate generalization performance, the model is trained on the ASVspoof 2019 LA partitions and evaluated on both the ASVspoof 2019 LA evaluation set and the more challenging ASVspoof 2021 LA/DF benchmarks, which reflect unseen and complex real-world deepfake conditions.

Across these benchmarks, the integrated feature approach demonstrates substantial improvements over single-feature baselines. Preliminary evaluations indicate a measurable reduction in Equal Error Rates (EER) and detection accuracies exceeding 90% against modern neural cloning attacks. Overall, the study introduces a scalable and explainable detection framework that strengthens the robustness of voice-based systems against rapidly evolving generative audio technologies.

Keywords – Deepfake Speech Detection, Multi-Channel CNN, Acoustic Feature Fusion, MFCC, Spectrogram Analysis, Voice Security

ARDUINO-BASED DATALOGGER DESIGN

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Abstract – In this study, an Arduino-based data logger system capable of monitoring and recording analog sensor data in real time was designed and implemented. The developed system reads signals ranging from 0-5 V from two analog inputs using the Arduino Uno's 10-bit ADC module and records them to an SD card with time stamps using the DS3231 real-time clock (RTC) module. At the same time, a C#-based interface software enables graphical monitoring of the data on a computer and dynamic modification of user-defined threshold values. When the measured value exceeds the specified threshold, the system generates visual (LED) and audible (buzzer) alerts and can also activate an external control mechanism via a relay output. The hardware design utilizes a BC337 transistor to create LED and relay driver circuits. Composed of low-cost, readily available components, this system offers a flexible data collection solution suitable for various applications, ranging from laboratory experiments to industrial and environmental monitoring.

Keywords *–Data Logger; Arduino; C#; Real-Time Monitoring; PCB Design; KiCad*

MATERIAL SELECTION FOR HEAVY-DUTY SEMI-TRAILERS

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Abstract – Heavy load transportation necessitates durable and reliable vehicle design. Semi-trailers need to exhibit high structural performance due to the weight of the transported loads and operating conditions. To achieve this performance, the correct material selection is of great importance. Factors such as strength, weight, cost, and durability are considered in the material selection process. Steel and aluminium, in particular, are among the most commonly preferred materials in semi-trailer manufacturing. In addition, with the advancement of production technologies, high-strength composite materials have also started to be considered as alternatives. Since material choice directly affects not only the load-carrying capacity but also fuel efficiency and vehicle's lifespan, it is essential to establish the right balance between material properties and application requirements in engineering designs. In this study, the types of materials used in semi-trailers for heavy load transportation and the criteria for their selection were examined.

Keywords – Semi-Trailer; Trailer; Material; Strength of Material; S235 (ST-37); S355 (ST 52); Strenx; Hardox

A LITERATURE REVIEW ON SEMI-TRAILER ANALYSIS

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Abstract **-** Semi-trailers are heavy-duty vehicles with a wide range of applications in the land transportation sector due to their high load-carrying capacity. Owing to the weight of the transported loads and operational conditions, they must exhibit high structural performance and are therefore, subjected to necessary analyses, tests, and experiments. In this study, the structural and dynamic characteristics of semi-trailers are examined through various modeling techniques, simulations, and experimental analyses found in the literature. The current approaches are compared, and the resulting data is used to provide suggestions aimed at improving transportation safety and vehicle efficiency.

Keywords *– Semi-trailer; Analysis; Safety; Modeling; Simulation;FEM*

CUSTOMER LOSS PREDICTION MODEL

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Abstract – With increasing competition in the telecommunications sector, retaining existing customers and predicting customer churn has become critically important for businesses. In this study, Logistic Regression, K-Nearest Neighbor, and Random Forest machine learning algorithms were comparatively examined to analyze customer churn behavior. The "Telco-Customer-Churn" dataset was used in this study, which contains 7043 examples, including 8 noisy and corrupted data points. The corrupted data points were analyzed and removed from the dataset. Eighty percent of the samples were used for training, and 20% were used for testing. As a result of the experimental analyses performed on the "Telco-Customer-Churn" dataset, the Logistic Regression algorithm was determined to be the most successful model with an overall accuracy rate of 81%, while the K-Nearest Neighbor algorithm had the lowest overall accuracy rate at 76.4%. The Random Forest algorithm stood out with high precision values of 62.95%.

As an original contribution of the study, an "Artificial Intelligence Customer Advisor" module was developed that integrates the prediction probabilities generated by the algorithms into business processes. This system segments customers according to their risk levels and recommends retention strategies for high-risk groups and cross-selling strategies for low-risk loyal groups. The findings reveal that data mining and machine learning techniques are not only effective for risk detection but also serve as an effective tool for businesses to develop proactive and data-driven strategies.

Keywords **–** KNN Algorithm, Logistic Regression Algorithm, Random Forest Algorithm

THYROID DISEASE CLASSIFICATION WITH MACHINE LEARNING

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Abstract – This study addresses a binary classification problem on the Thyroid Disease dataset. During the data preprocessing phase, the original multiclass problem was converted into a binary classification (0: healthy, 1: diseased). Missing values were imputed using the median for numerical variables and the most frequent value for categorical variables. Numerical features were normalized using MinMaxScaler, and categorical variables were transformed using one-hot encoding. After preprocessing, the cleaned dataset consisted of 9,172 samples with 54 features. Examination of the target variable distribution revealed that the dataset contained 6,771 healthy (Class 0) and 2,401 diseased (Class 1) samples. Using the prepared features, K-Nearest Neighbors (KNN), Logistic Regression, Naive Bayes, Support Vector Machines (SVM), Random Forest, and Artificial Neural Network (ANN) models were trained with various variants and hyperparameter tuning, and their performances were compared. According to the comparison results, the Random Forest model achieved the highest accuracy (0.9504) and F1 score (0.9084), demonstrating the best performance. SVM and ANN models also showed strong performance but had slightly lower F1 scores compared to Random Forest. The study highlights the applicability and performance differences of various machine learning algorithms, emphasizing the importance of model selection, particularly in healthcare data.

Keywords – Machine Learning; Binary Classification; Thyroid Disease; Random Forest; Data Preprocessing

ARTIFICIAL INTELLIGENCE IN HEALTHCARE: AN ANALYSIS OF APPLICATIONS, ADVANTAGES, AND CORE LIMITATIONS

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Abstract-This study focuses on the analysis of current Artificial Intelligence (AI) applications in the healthcare sector, the advantages they offer, and the fundamental limitations they face. Data incompatibility and complexity issues arising from the inadequacies of existing General Health Data Models (GHDM) have been examined, with the aim of increasing the effectiveness of AI systems in diagnostic processes, treatment personalization, and clinical decision support mechanisms.Current achievements and challenges requiring solutions are being evaluated within the context of AI's potential benefit to gain a deep understanding of disease dynamics in light of large health data sets. The main objective of the research is to provide more cost-effective, accessible, and faster healthcare services through AI-based solutions, in the face of growing patient populations and complex health demands.The main advantages provided by AI are identified as the ability to rapidly analyze high-volume data, precisely detect critical patterns, and develop individualized treatment protocols. In contrast, the primary limitations of AI applications include; potential ethical and bias risks stemming from training data sources, lack of transparency in algorithms, and difficulties in integration with existing health information technology infrastructure.In conclusion, this analysis demonstrates the strategic importance of AI in healthcare by showcasing its capacity to enhance patient data evaluation and dynamically reveal the speed of parameter changes in treatment processes.

Keywords – Artificial Intelligence; Health Informatics; Clinical Decision Support Systems; Medical Image Processing; Bioethics; Personalized Medicine

COMPREHENSIVE PERFORMANCE ANALYSIS OF MACHINE LEARNING ALGORITHMS FOR PREDICTIVE MAINTENANCE IN INDUSTRY 4.0 APPLICATIONS USING IMBALANCED DATASETS

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Abstract – With the advent of the Industry 4.0 paradigm, the digitization of production lines has made predictive maintenance applications critical, enabling the monitoring of machine health and the early detection of potential failures. This study aims to predict machine failures using the AI4I 2020 dataset, which simulates an industrial milling machine. Unlike many studies in the literature, this research adopts a holistic performance analysis to eliminate evaluation biases caused by class imbalance. The study compares the performance of four different machine learning algorithms: Logistic Regression, Support Vector Machines, Decision Tree, and Random Forest. Due to the severe class imbalance in the dataset (96.6% Healthy, 3.4% Faulty), the success of the models was analyzed not only using the Accuracy metric but also using discriminative metrics such as Sensitivity (Recall), F1-Score, and ROC-AUC. Experimental results showed that all algorithms achieved an overall accuracy rate above 97%; however, linear models (Logistic Regression) were insufficient in fault detection (Recall: 0.14). In contrast, the Random Forest algorithm, based on ensemble learning, demonstrated the best performance in both overall accuracy and detection of rare faults, with an accuracy rate of 98.30% and an ROC-AUC value of 0.97. The study addresses industrial maintenance problems with imbalanced datasets.

Keywords *– Predictive Maintenance, Machine Learning, Imbalanced Dataset, Random Forest, Industry 4.0.*

CHARGING YOUR PHONE WITH SOLAR ENERGY

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Abstract – In this project, a power system has been designed that utilizes solar energy to provide stable phone charging for mobile devices. The system consists of a solar panel, a battery for energy storage, and charging sockets that provide a 5 V output. The energy obtained from the solar panel is managed through an MPPT-based charge control circuit to ensure efficient and safe battery charging. The MPPT algorithm increases system efficiency by ensuring the panel operates at its maximum power point under variable light conditions. The designed structure offers a low-cost and environmentally friendly alternative charging solution in line with the goals of portability, energy continuity, and high efficiency.

Keywords- MPPT, solar energy, phone

IOT BASED SMART IRRIGATION SYSTEM DESIGN

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Abstract - This paper presents the design and development of an advanced IoT-based multi-zone smart irrigation system utilizing ESP32 microcontroller technology, capacitive soil moisture sensors, SG90 servo-driven valve mechanisms, and a Wi-Fi-enabled mobile application developed via MIT App Inventor. The proposed system is engineered to minimize water waste in agricultural environments by enabling precise, demand-based irrigation through real-time data acquisition and automated decision-making.

The system architecture is composed of four independently controlled irrigation zones, allowing tailored watering strategies for different soil or crop types. Each zone is continuously monitored through capacitive soil moisture sensors, which provide high-accuracy moisture data resistant to corrosion and long-term degradation. The ESP32 microcontroller processes these readings using an embedded control algorithm that dynamically regulates the servo-operated valves. Through this mechanism, water flow is adjusted according to the soil's instantaneous water requirement, ensuring optimal moisture balance while preventing over-irrigation and water loss.

In addition to hardware implementation, the study covers detailed system modeling, electronic circuit design, algorithm development, and the communication framework. The Wi-Fibased integration enables seamless interaction between the mobile application and the irrigation controller, granting users the ability to monitor moisture levels, adjust irrigation modes, and track system performance remotely. The system supports both manual and automated irrigation modes, enhancing user flexibility and overall usability.

Simulation and prototype testing were conducted to evaluate system efficiency, response time, water-saving performance, and operational stability under various soil moisture scenarios. Experimental results demonstrate that the proposed design significantly reduces water consumption while maintaining consistent soil hydration, making it suitable for both small-scale household gardening and larger agricultural fields.

Overall, the system provides a low-cost, scalable, and sustainable technological solution aligned with modern precision agriculture requirements. Its modular structure allows future enhancements such as solar-powered operation, cloud-based data logging, and integration of AIdriven predictive irrigation models.

Keywords - IoT, Smart Irrigation, ESP32, Soil Moisture Sensors, Automation, MIT App Inventor, Agriculture

MAZE-SOLVING ROBOT

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Abstract – The primary objective of this study is to design and implement a Maze-Solving Robot prototype to experimentally demonstrate autonomous decision-making and navigation capabilities within an embedded systems architecture. To this end, the project involves the integration and programming of basic electronic components such as the Arduino Uno microcontroller, HC-SR04 ultrasonic distance sensors to detect the maze environment, and the L298N DC Motor Driver module to precisely control the robot's movement.

Keywords *– Arduino Uno, HCSR04/Distance Sensor, L298N/DC Motor Driver, DC Motor*

MULTI-LAYERED ARTIFICIAL INTELLIGENCE ARCHITECTURE AND INTEGRATED CYBERSECURITY APPROACH IN MOBILE FRAUD DETECTION: THE "GÜVEN CEPTE" MODEL

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***Abstract**:* With the rapid increase in digitalization today, mobile devices have become the primary target of cybercriminals. Social engineering attacks, particularly those carried out via SMS (smishing) and voice calls (vishing), can bypass traditional security measures by targeting users' emotional vulnerabilities. Current "blacklist"-based protection methods are insufficient to detect these constantly evolving and increasingly complex attack types. This study presents the Güven Cepte project, which aims to detect and block these dynamic threats targeting mobile users in real time.

This study proposes a hybrid artificial intelligence architecture named "Güven Cepte" (Safety in Your Pocket) that aims to proactively detect and prevent cyber threats targeting mobile users. The proposed system consists of three main defense layers: A Deep Learning-based Natural Language Processing (NLP) module that analyzes fraudulent intent in SMS texts by considering morphological features specific to the Turkish language structure ,Unsupervised machine learning (K-Means/DBSCAN) algorithms that detect abnormal traffic patterns and Wangiri fraud via Call Detail Records (CDR) without listening to call content; and A URL classification engine that detects newly created phishing sites in real time through lexical feature analysis.

The aim of the study is to design a scalable and user-friendly security layer that can be integrated into the existing applications (Super-App) of telecommunications operators by combining cybersecurity with artificial intelligence technologies. The findings and literature reviews reveal that the proposed multi-model approach reduces false positive rates and increases fraud detection success compared to single protection methods. This study aims to contribute to providing a secure experience in the mobile ecosystem, regardless of the end user's level of digital literacy.

Keywords – Cybersecurity, Artificial Intelligence, Mobile Fraud, Innovative Methods

INTERNET OF THINGS (IOT) MULTI-SENSOR FUSION AND TINYML-BASED SMART ENVIRONMENT CONTROL SYSTEM IN EDGE DEVICES

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Abstract– Traditional home automation systems typically rely on cloud-based voice processing services. This situation brings with it problems such as data security, high bandwidth requirements, and network latency. In this study, an autonomous environment control system based on edge AI (Edge AI / TinyML) has been developed that eliminates cloud dependency. The designed system integrates real-time voice command processing and sensor fusion algorithms using the ESP32 microcontroller. The system processes audio data received via the INMP441 I2S microphone using the Mel-Frequency Cepstral Coefficients (MFCC) feature extraction method and a Convolutional Neural Network (CNN)-based model. Furthermore, data obtained from the DHT11 temperature/humidity sensor and LDR light sensor are combined with voice commands to create a hybrid decision mechanism. Experimental results show that the developed TinyML model has a classification accuracy of over 95% and that the system responds in real time with an average processing time of 50-100ms.

Keywords – Edge AI, TinyML, Sensor Fusion, ESP32, Smart Home, Deep Learning

SENSORLESS ESC DESIGN FOR BLDC DRONE MOTOR CONTROL

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Abstarct – In this project, a sensorless BLDC motor driver (ESC) will be designed using the BEMF method, drawing on researched sources. This motor driver will be divided into two parts: a three-phase inverter and a control circuit.

The three-phase inverter circuit is a circuit switched by MOSFETs. It consists of the combination of three half-bridge circuits. This circuit will be the circuit that transfers power to the phase inputs of the motor.

The control section will have two main tasks: First, it will detect BEMF and start the motor with the phase it determines accordingly, and then it will switch between phases to enable the motor's rotation with the other phases. Its other task will be to control the motor's speed by controlling the on-time of the MOSFETs with PWM signals. These two sections will be examined in more detail in the following sections.

Keywords – BLDC Motor; Motor Driver; Electronic Speed Controller

DESIGN OF A BRUSHED DC MOTOR DRIVER CIRCUIT WITH VOLTAGE AND CURRENT MONITORING VIA BLUETOOTH COMMUNICATION

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Abstract **–**This study presents the design and implementation of a brushed DC motor driver capable of monitoring both voltage and current in real time and transmitting the measured data to the user via Bluetooth communication. The system is built around an STM32 microcontroller, which controls the motor through PWM signals and simultaneously acquires feedback from a current and voltage sensing module (INA226). The driver stage employs a TC4420 MOSFET gate driver and low-side configuration to achieve efficient and reliable operation. Power is supplied through independent buck converters, providing stable and isolated voltage levels for both logic and power sections of the circuit. The collected data are transmitted to a smartphone using an HC- 05 Bluetooth module.

The PCB was designed using Altium Designer, and its layout was optimized for signal integrity, grounding, and noise reduction. The developed system provides a low-cost, modular, and scalable platform for motor control applications requiring wireless telemetry, such as robotics, laboratory automation, and mechatronic experiments.

Keywords – STM32; Brushed DC motor driver; Low-Side configuration; Bluetooth Communication; PWM control; INA226 current sensor

INDUSTRIAL SYMBIOSIS DIGITAL SYNERGY PLATFORM FOR KONYA NEW MOTORIZED INDUSTRIAL SITE

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Abstract **–** Industrial symbiosis is an approach of critical importance in terms of efficient resource use and waste minimization, and its significance is growing day by day. The idea of one industrial facility's waste being used as raw material input for another is important for sustainability. The development of the Industrial Symbiosis Digital Synergy Platform for the New Motor Industry Site established in Konya is the unique value proposed by the project, whereby industry site stakeholders share their waste to turn it into benefit by establishing a symbiotic relationship with each other through a digital platform.This platform will offer innovative solutions for the reuse and recycling of waste by creating industrial symbiosis models, thereby contributing to the minimization of environmental impacts. Flutter will be used for the front-end processes of the automation to be developed within the scope of the project, while Python and FastAPI will be used for the back-end processes. PostgreSQL has been chosen as the database. All software technologies to be used are open source and free. The Konya New Motor Industry Site has been selected as the project's implementation area. Training programs will be organized for industrial workers and business owners to facilitate the adoption of the platform. The training will increase the competence of workers and managers by raising their awareness of new technologies and applications. The training and implementation processes will be organized and monitored by the project management team. The project's promotion of sustainable industrial practices and its implementation by UNIVERSITY students will also facilitate the strengthening of academic and industrial collaborations. The project aims to strengthen cooperation among industrial site stakeholders and promote more efficient use of resources in the context of sustainability and digitalization objectives. Through the development of a digital synergy platform, businesses will have the opportunity to reduce costs while enhancing environmental sustainability. The outcomes achieved within the scope of the project also hold the potential to contribute to the development of new national and international projects.

Keywords – Smart City Planning, Industrial Symbiosis, Sustainability, Digital Platform

PERFORMANCE ANALYSIS OF DEEP LEARNING MODELS FOR LIVER AND LESION SEGMENTATION

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Abstract – In medical image analysis, the segmentation of data obtained from imaging techniques, such as computed tomography (CT), is a critical step for diagnosis and treatment planning. However, manual segmentation of the liver and, especially, tumorous lesions is a time-consuming and subjective process that can vary among experts. This study compares two different deep learning models, which have demonstrated high performance in the medical segmentation literature, capable of automatically detecting the boundaries of the liver and tumors using 3D CT images from the LiTS 2017 (Liver Tumor Segmentation) dataset. Within the scope of the study, 3D medical data was converted into 2D slices suitable for model training, taking into account inter-slice contextual information. The performance of the utilized models was quantitatively compared using standard segmentation metrics, and the results obtained were reported. The main objective of this study is to present a potential automatic segmentation tool that can assist in medical diagnostic processes by reducing the challenges of manual segmentation.

Keywords – Deep Learning, Medical Image Segmentation, Liver Segmentation, Lesion Segmentatio

DEVELOPMENT OF A REAL-WORLD PLANT LEAF IMAGE DATASET AND DEEP LEARNING-BASED DISEASE DETECTION MODEL FOR SUSTAINABLE AGRICULTURE

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Abstract – The early detection of plant diseases, which directly affect agricultural productivity, is of critical importance for ensuring food sustainability. Existing image datasets in the literature are predominantly composed of images captured under controlled laboratory conditions or artificial lighting. To address this limitation, this study presents a new and comprehensive dataset consisting of leaf images captured in the plants' natural environment and under natural lighting conditions. The dataset includes a total of 20 classes—representing healthy and diseased samples from 18 different plant species—and comprises 20,985 images with a resolution of 512×512 pixels.

To validate the effectiveness of the dataset, models were developed on two different platforms. First, in the Orange data mining software, deep learning models such as SqueezeNet and DeepLoc were utilized for feature extraction; these features were then tested using classifiers including Logistic Regression, Artificial Neural Networks, and k-NN. Based on 10-fold cross-validation, the SqueezeNet model achieved 100% accuracy and an average F1-score of 99%. Second, a model trained on the Google Teachable Machine platform reached a 100% accuracy rate on the test data.

The model's performance was further evaluated using "real-world" images obtained from outside the dataset, and it demonstrated a high success rate in identifying plant diseases. The ultimate goal of this study is to export the trained model as a TFLite file and integrate it into a mobile application, enabling non-expert users to identify plant species and diseases directly in the field.

Keywords – Artificial Intelligence, Machine Learning, Deep Learning, Computer Vision, Image Processing

WHEN HYBRID IS NOT BETTER: A COMPARATIVE ANALYSIS OF MFCC-BASED CNN, LSTM, AND CNN-LSTM ARCHITECTURES FOR ENVIRONMENTAL SOUND CLASSIFICATION

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ABSTRACT - Three deep learning architectures based on Mel-Frequency Cepstral Coefficients (MFCCs)—CNN, LSTM, and hybrid CNN-LSTM—were compared for environmental sound classification using the UrbanSound8K dataset (8,732 records, 10 classes).
Model 1 (MFCC+CNN) achieved 89.81% accuracy, Model 2 (MFCC+LSTM) achieved 11.45% accuracy, and Model 3 (MFCC+CNN-LSTM) achieved 87.98% accuracy. The study's original contribution is the experimental demonstration that the widely suggested hybrid CNN-LSTM architecture did not provide the highest performance for environmental sound classification, as might be expected in the literature. The hybrid model showed 1.83% lower accuracy than the standalone CNN and revealed that the added computational complexity was not commensurate with the performance gain. The findings indicate that spatial feature learning (CNN) is more critical than temporal modelling (LSTM) in short-duration environmental sounds. These results emphasize the importance of careful architectural selection based on the specific characteristics of the dataset.

Keywords *– Environmental Sound Classification, MFCC(Mel-Frequency Cepstral Coefficients), CNN(Convolutional Neural Network), LSTM (Long Short-Term Memory), Hybrid Architecture, UrbanSound8K*