BOOK OF ABSTRACTS

XII SCIENTIFIC CONFERENCE
ENTREPRENEURSHIP, ENGINEERING AND MANAGEMENT

ENGINEERING ROLE IN SOCIETY 5.0

Zrenjanin, Serbia

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PLENARY SESSION

AI REGULATION AS A DRIVER OF CIRCULAR ENTREPRENEURSHIP IN SOCIETY 5.0: STRATEGIC AND ENGINEERING PERSPECTIVES

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Abstract:
This paper analyses the role of artificial intelligence (AI) regulation in shaping circular entrepreneurship within the framework of Society 5.0, with a specific focus on the comparative assessment of the European Union and Serbia. The study concentrates on regulatory frameworks as key determinants of innovation capacity, examining how differences in legal approaches influence the development and scalability of AI-driven circular economy solutions. The core contribution of the paper lies in a comparative analysis of the EU's comprehensive regulatory model, particularly the EU AI Act, and Serbia's partially harmonized, but still fragmented regulatory environment. The analysis identifies critical regulatory gaps that may hinder innovation, investment, and scale-up potential in Serbia, especially in the context of circular business models. Findings suggest that while the EU framework provides a structured and risk-based approach that enhances legal certainty and supports innovation, Serbia lacks a unified legal framework for AI, which creates uncertainty for entrepreneurs and limits the development of scalable solutions. The paper argues that targeted regulatory alignment and strategic legal reforms are necessary to enable circular entrepreneurship and foster sustainable innovation in Serbia.

Keywords: AI Regulation; Circular Economy; Comparative Analysis; EU AI Act; Serbia; Circular Entrepreneurship; Innovation Policy; Regulatory Framework.

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KEY ENABLING TECHNOLOGIES FOR SOCIETY 5.0

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Abstract:
Society 5.0 represents a human-centered paradigm that integrates cyberspace and physical space to address complex societal challenges through advanced digital technologies, with the aim of improving the quality of life. This paper explores the role of key enabling technologies, including Artificial Intelligence (AI), Internet of Things (IoT), Big Data, Cloud Computing, Edge Computing, 5G/6G and wireless communication technologies, Robotics, and Cyber-Physical Systems (CPS), in enabling the transition toward Society 5.0. The paper examines how these technologies contribute to key Society 5.0 domains, including smart cities, healthcare, industry, education, sustainability, and quality of life. In addition to technological opportunities, the paper addresses critical challenges related to data privacy, digital ownership, cybersecurity, ethical implications of AI, and digital inequality.
A conceptual framework is proposed to map enabling technologies to major Society 5.0 domains, highlighting their interdependencies and combined impact on human-centric and sustainable development. The findings suggest that the successful realization of Society 5.0 requires not only technological advancement but also interdisciplinary integration, governance frameworks, and a strong human-centric focus.

Keywords: Artificial Intelligence (AI), Internet of Things (IoT), Edge Computing, Society 5.0

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ADVANCED TECHNOLOGIES' ROLE IN SOCIETY 5.0

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Abstract:
This paper tries to investigate relation between advanced technologies and the countries development level. As a main premise within it is that inventing advanced technologies provides advantage on global level.
Society 5.0 where advanced technologies like AI, IoT, Robotics and others are vastly implemented in everyday life of majority of people seems like a dream that made through. R&D sector worldwide is busier than ever in history. Most of countries that intend to be dominant or at least competitive on global level have strategic approach on this issue and also have huge investments in it. Main "battle" in this field is still being fought "behind the curtain" distracting public awareness with more or less controlled local military conflicts, in order to indirectly weaken the "other side".
Finally, advanced technologies could be misused and instead of being the tool which help people on the road to Society 5.0 they could led humankind on the sideways with unforeseeable consequences.

Keywords: Advanced technologies, Society 5.0, Industry 5.0, Artificial Intelligence (AI), Global innovation index

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SESSION #2

TRANSFORMATION OF THE ROLE OF ENERGY ENGINEERS IN THE REPUBLIC OF SERBIA – FROM A TRADITIONAL SYSTEM TO SOCIETY 5.0

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Abstract:
This paper analyzes the necessity of transforming the role of energy engineers in the Republic of Serbia within the context of the global energy transition and the shift towards the concept of Society 5.0. Starting from the chronic problems of the domestic energy sector, such as high dependence on low-calorie coal, high energy intensity, and an outdated centralized system, the paper points out the inadequacy of the traditional operational approach. A new paradigm is presented in which the energy engineer transforms from a technical executor into an entrepreneur, manager, and innovator, while the focus of development shifts to small and medium-sized enterprises and innovative technological ventures in the environmentally friendly and energy technology sectors (Cleantech and Energytech). Through the analysis of decentralization processes, the affirmation of the prosumer concept, and the implementation of smart grids and virtual power plants (VPP), it is concluded that the success of the transition requires a close synergy of advanced Industry 4.0 technologies and innovative business models. The ultimate goal of this transformation is the creation of a sustainable, human-centric energy system that will ensure long-term economic competitiveness and energy independence for the Republic of Serbia.

Keywords: energy transition, Society 5.0, engineer-entrepreneur, decentralization, smart grids, Cleantech, Serbia.

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INDUSTRY 5.0 IN BIOMEDICAL ENGINEERING: DEVELOPMENT OF PERSONALISED IMPLANTS USING ADDITIVE MANUFACTURING AND 3D SCANNING

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Abstract:
This paper examines additive manufacturing technologies in the context of personalised implants within Industry 5.0, with a focus on biomedical engineering. Additive manufacturing enables the production of complex, patient-specific implants directly from digital models. A key component is reverse engineering using 3D scanning, which provides accurate anatomical data for implant design. Industry 5.0 emphasises human–machine collaboration, personalisation, and sustainability, while additive technologies support flexible and efficient production of biocompatible implants. The paper outlines the main advantages, challenges, and future prospects of these technologies in medical applications. It concludes that the integration of additive manufacturing, reverse engineering, biomedical engineering, and Industry 5.0 principles has strong potential to enhance healthcare through innovation and personalised solutions.

Keywords: Additive manufacturing, 3D Scanning, Industry 5.0, Biomedical engineering, Personalised implants

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SMART SUPPLY CHAINS: USING DIGITAL TWINS TO PREDICT AND PREVENT DISRUPTIONS

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Abstract:
Modern supply chains are increasingly complex and vulnerable to disruptions. This paper examines the role of digital twins in enhancing supply chain resilience, with a focus on their predictive and preventive capabilities. By integrating Internet of Things (IoT), big data analytics, and artificial intelligence, digital twins enable real-time monitoring, simulation, and early risk detection. The analysis indicates that digital twins support proactive decision-making and improve supply chain transparency, flexibility, and reliability. However, challenges such as high implementation costs, data quality requirements, and integration complexity remain significant barriers.

Keywords: Digital Twins, Supply Chain Management, Predictive Analytics, Smart Supply Chains.

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USING MULTIMODAL AI TO ANALYZE VIDEO CONTENT

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Abstract:
In our paper, we present the basic characteristics of LLM as well as their division into Unimodal and Multimodal. Multimodal AI models today can analyze input data in different formats. We use Google Gemini to analyze video content. The model "Gemini 2.0. Flash" is used. The experiment is conducted on two samples, which are the presentations of work at the conference so that the structure of the samples is comparable. The content we analyze is video, but it contains audio of spoken words as well as text in the background. Questions are asked about each of these types of information. The potential of AI in extracting information from these media is examined. During the experiment, identical questions are asked about each of the samples. After receiving the answers, their analysis and results are tabularly and descriptively presented. The answers received were discussed in order to observe certain regularities in the view of the possibilities of artificial intelligence. At the end, conclusions and directions for further development are presented.

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Keywords: Artificial intelligence, Multimodal, Google Gemini, Information Technology

ENVIRONMENTAL IMPACT OF BIOGAS PLANT

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Abstract:
Biogas plants, through their work and energy production, contribute to reducing the emission of greenhouse gases, which is their biggest advantage. However, their benefit is also reflected in the disposal of waste from agricultural production and biodegradable municipal waste. But despite all the positive characteristics there are also negative ones. The negative impacts on the environment manifest in the emission of unpleasant odours and possible accident situations. Accidents are entirely related to improper management and maintenance of biogas plants with very low probability of occurrence. So, the risk of such situations cannot be ignored, but emphasis must be placed on the application of safety measures. In this paper will be analyzed the possible negative impact of the unpleasant odours, as well as the possible accident of an explosion at biogas plants.

Keywords: biogas plant, negative impact, odour, explosion.

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PREDICTIVE MAINTENANCE IN SOCIETY 5.0: FROM REACTIVE REPAIRS TO AI-DRIVEN SYSTEM RELIABILITY

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Abstract:
The transition toward Society 5.0 introduces a human-centered paradigm in which advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), and big data analytics are integrated into industrial systems to enhance efficiency, sustainability, and reliability. This paper analyzes predictive maintenance as a key approach that replaces traditional reactive and preventive maintenance methods with intelligent, data-driven systems based on real-time monitoring and machine learning algorithms. Particular emphasis is placed on the application of IoT and AI technologies in industry, their impact on reducing downtime and operational costs, as well as the challenges of implementation, including data quality and cybersecurity. The results indicate that predictive maintenance represents a significant step toward the development of smart, sustainable, and human-centered industrial systems within the Society 5.0 framework.

Keywords: redictive maintenance, Artificial Intelligence, Digital Twin, Society 5.0.

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FACTORS INFLUENCING THE ACCEPTANCE OF GREEN TECHNOLOGIES IN THE CONTEXT OF SOCIETY 5.0: AN ANALYSIS OF PUBLIC ATTITUDES

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Abstract:
Modern technological development has led to significant changes in the functioning of society, while simultaneously contributing to the emergence of numerous environmental challenges such as environmental pollution, climate change, and the excessive use of natural resources. In this context, the concept of sustainable development has become one of the key principles of contemporary economic and technological policies. In recent years, increasing attention has been given to the concept of Society 5.0, which represents a vision of a future society based on the integration of advanced technologies and engineering innovations aimed at addressing modern social and environmental challenges. Within this framework, green technologies represent a key factor in reducing the negative environmental impacts of technological development. These technologies include solutions that enable more efficient use of natural resources, reduction of harmful emissions, and the development of sustainable energy systems.
Although the importance of green technologies is increasingly recognized at the global level, their successful implementation largely depends on the level of societal acceptance. Public perception, the level of awareness, economic factors, and institutional support represent important elements influencing their wider adoption. The aim of this paper is to analyze public attitudes toward green technologies and to examine the factors influencing their acceptance in the context of the development of Society 5.0. The research was conducted using a survey method through an online questionnaire, while the collected data were analyzed using descriptive statistical methods.

Keywords: green technologies, sustainable development, Society 5.0, environmental sustainability, acceptance of green technologies

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ANALYSIS OF TECHNICAL REQUIREMENTS FOR MICROSERVICE ARCHITECTURES IN THE CONTEXT OF SOCIETY 5.0

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Abstract:
In the era of Society 5.0 development, which we witness every day and which, through the use of digital systems, strives for prosperity based on the relationship between people and technology, the following important aspects have stood out: scalability, response time, stability, and efficiency of the system. Therefore, the need to implement software solutions that can effectively meet the stated requirements represents the motivation for analyzing microservice architectures as one of the effective approaches to the development of digital systems in the context of Society 5.0. The aim of the paper is to examine the role and application of performance requirements in the context of microservice architectures and technical requirements in the context of Society 5.0, in order to connect these two domains. The paper reviews the literature through 10 primary studies, according to predefined steps for the search and selection of scientific papers. The research results show that the common basis of microservice architecture and Society 5.0, through the analyzed studies, includes requirements such as scalability, response time, fault tolerance, system reliability, and efficient use of resources.

Keywords: Microservice architecture, Society 5.0, technical requirements, scalability, response time, system reliability, fault tolerance.

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SESSION #3

LEARNING-BASED VISUAL TRACKING FOR MOBILE ROBOT LOCALIZATION USING RADIAL BASIS FUNCTION NETWORKS

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Abstract:
Mobile robot localization is a fundamental challenge, and the use of the global positioning system (GPS) offers a solution. However, in GPS-denied environments, these methodologies are not applicable. The present work proposes a calibration-free visual tracking method for mobile robots, with an overhead camera, in which radial basis function (RBF) neural networks are used to generate a direct mapping between image coordinates and spatial coordinates. It is compared with a traditional method based on fiducial markers, which requires camera calibration, and the results show improved position prediction, with a root mean squared error (RMSE) approximately 66% lower, reduced Euclidean error, greater robustness under fixed-overhead camera configurations, and reduced system complexity.

Keywords: visual tracking, overhead camera, mobile robot, radial basis function networks

STUDY OF AN IMPEDANCE-BASED SENSOR FOR MICRO- AND NANOPLASTICS

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Abstract:
This research investigates the suitability of a custom-developed electrical impedance spectroscopy sensor for the in vitro detection of micro- and nanoplastics, aiming to determine the specific measurement conditions that yield distinct impedance variations. The impedance behavior of polystyrene-based micro- and nanoparticles was studied in physiological saline across various concentrations and particle sizes. Measurements were conducted using custom-fabricated four-electrode measurement plates by recording frequency-dependent impedance spectra. This study included the fabrication and validation of measurement plates, the development of a reproducible protocol, and the execution of experiments. The evaluated results address the initial research questions and provide essential insights to refine this measurement technique, facilitating its future application in the development of micro- and nanoplastic sensors.

Keywords: Engineering, Impedance Sensor, Microplastics and nanoplastics, Impedance spectra.

PREPARATION OF IN VITRO BIOIMPEDANCE TECHNOLOGY FOR MICRO- AND NANOPLASTIC TOXICITY STUDIES

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Abstract:
This work investigates the suitability of a custom-developed Bioimpedance Spectroscopy (BIS) sensor for the in vitro detection of micro- and nanoplastics, as well as the measurement conditions required to obtain reliable signal changes. The behavior of polystyrene-based particles across different concentrations, sizes, and surface coatings was explored. Experiments were conducted using in-house developed sensing plates and suspensions containing plastic fractions of various size ranges. The methodology included fabrication of the plates, validation with saline solutions, preparation of surface coatings, and repeated BIS measurements. Based on the results, particle detectability was characterized, and the effects of surface coatings on adhesion and washability were assessed. These findings provide a foundation for the development of standardized in vitro platforms and for future toxicological applications.

Keywords: Engineering, In vitro assay, Toxicity Studies, Micro- and nanoplastic

BIOIMPEDANCE SPECTROSCOPY-BASED STUDIES OF ZEBRAFISH EMBRYO DEVELOPMENT

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Abstract:
Accurate and non-invasive monitoring of early embryonic development is of key importance for both, basic research and applied biomedical fields. Since the success rate of human in vitro fertilization remains limited, an early, objective assessment of embryos' developmental potential can help identify the embryos best suited for implantation, thereby increasing clinical success. The aim of this study was to characterize zebrafish (Danio rerio) embryos using bioimpedance spectroscopy (BIS) during the early (1-, 2-, and 4-cell) stages of development. During the measurements, a highly sensitive BIS sensor was used, which allowed the electrical properties of a single embryo to be monitored over time without adversely affecting its development. The results show that the individual stages of cell division are characterized by distinct impedance curves. The characteristic changes observed in the impedance curves correlate with cell division and changes in cell morphology. Significant differences between the various stages were most evident at frequency values above 10 Hz, which made it possible to clearly differentiate between them. The significance of this method extends beyond the current model organism, as non-invasive, real-time monitoring of conditions could also be crucial in the development of human in vitro fertilization procedures.

Keywords: Bioimpedance spectroscopy, Biocompatibility, Embryo development monitoring, Zebrafish embryo

DESIGNING TWO-WAY ELECTROSTATIC TRANSDUCERS WITHOUT ADDED LC CROSSOVER COMPONENTS

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Abstract:
A novel design framework for two-way electrostatic transducers is proposed, targeting ultra-low distortion and time-coherent sound reproduction without LC crossover networks. The method aims to reduce distortion by up to two orders of magnitude relative to state-of-the-art dynamic loudspeakers. Unlike conventional designs that prioritize frequency response, the proposed approach jointly optimizes frequency, phase, impulse, and polar characteristics by controlling transducer physics and its coupling to the driving electronics and acoustic radiation field. The framework enables linear frequency response with preserved fast transient behavior and near-linear phase, while eliminating time-dependent nonlinearities introduced by inductive and capacitive components. The results suggest a viable pathway toward full-range, high-fidelity electrostatic systems with improved temporal accuracy.

Keywords: Electroacoustic reproduction, Time coherence, Phase linearity, Impulse response, Acoustic measurement

WINTER INDOOR AIR QUALITY MEASUREMENTS AND DIFFERENT AI TOOLS SUPPORT

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Abstract:
In Serbia, the winter season is generally the period with the worst air quality. The reason for this is very low temperatures and consequently very intense indoor heating. During winter 2026, at Technical College of Applied Studies in Zrenjanin air quality measurements were performed with uHoo smart air quality monitor. Obtained results were then submitted to Artificial Intelligence tools, GPT and Gemini, for comments and estimations. The results of this analysis are presented and discussed.

Keywords: Indoor Air Quality, uHoo smart air quality monitor, Artificial Intelligence, GPT, Gemini

CALCULATION OF THE VOLUME OF TUBULAR REACTOR ON THE EXAMPLE OF CIS-TRANS CATALYTIC ISOMERISATION OF 2-BUTENE

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Abstract:
This paper presents an example of reactor volume calculation for a system used in the cis–trans isomerization of 2-butene in catalytic processes in the petrochemical industry. The aim of this example is to demonstrate the application of tubular reactor design equations to calculate the required reactor volume as a fundamental design parameter. This parameter enables the achievement of the desired conversion of the reactant into the target product under the specified reaction conditions. Determining reactor volume as a key design variable facilitates effective control of catalyzed chemical reactions, which represents one of the primary objectives of chemical reaction engineering.

Keywords: Tubular reactor, Catalytic processes, Chemical reaction engineering.

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PRESERVATION OF VEGETABLES WITH INDIVIDUALLY QUICK FROZEN (IQF) TECHNOLOGY

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Abstract:
Vegetables spoil quickly because they contain a lot of water and have active enzymes. This makes effective preservation methods necessary. Individually Quick Frozen (IQF) technology allows for fast freezing and creates small ice crystals. This helps maintain the structure, texture, and nutritional value of vegetables. This method also boosts food safety by slowing down the growth of bacteria and enzyme reactions, which extends shelf life. While IQF requires special equipment and costs more than regular freezing, it offers better product quality and is commonly used in the modern food industry.

Keywords: IQF technology, frozen vegetables, preservation, quality, food safety

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POSTER SESSION

AI SUPPORTED SOLUTIONS FOR IMPROVEMENT OF AIR QUALITY AND FURTHER HEALTH RISK EVALUATIONS

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Abstract:
At Technical College of Applied Studies in Zrenjanin indoor air-quality was monitored using View Plus Radon Detector. Measured results were transferred via API to the Web application, which after send these results to the Artificial intelligence for evaluation. Artificial intelligence then estimates health risks and also propose methods for indoor air quality improvement.

Keywords: Air Quality, Artificial Intelligence, View Plus Radon Detector.

SOME OF THE MODERN TECHNOLOGIES IN THE FUNCTION OF MACHINE MAINTENANCE IN INDUSTRY 5.0

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Abstract:
Industry 5.0 brings us a new paradigm based on a human-centric approach, resilience and sustainability. Unlike Industry 4.0, where the aspiration was to perform the maximum possible automation and digitization of work and replace human work with the same, the new industrial revolution focuses on man who needs to use smart technologies to perform work. The paper analyzes some of the modern technologies that represent an important factor in the transformation of the machine maintenance function. Their integration allows us to collect data in real time, fluidly implement predictive maintenance, simulate various desired scenarios, human-robot collaboration, and soon, resilient machine maintenance is to be expected. It is to be expected that these technologies will enable the creation of smart maintenance systems, by means of which the maintenance function should become a strategic element of Industry 5.0, important for resilience, sustainability and human-centric development of industrial systems.

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Keywords: Industry 5.0, machine maintenance, industrial internet of things, edge computing, digital twins, artificial intelligence, collaborative robots

APPLICATION OF LARGE LANGUAGE MODELS IN DECISION-MAKING THEORY: ACCURACY, INTERPRETABILITY, AND LIMITATIONS

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Abstract:
The development of large language models (LLMs), such as ChatGPT, has opened new possibilities for supporting decision-making across various domains. This paper examines the potential application of ChatGPT version 5.3 in solving problems from the field of decision-making theory, with a focus on accuracy, interpretability, and limitations. Through case studies and the analysis of common problem types, the paper shows that LLMs can be a significant aid in solving formal tasks, but also exhibit systematic errors and biases. It is concluded that ChatGPT represents a useful support tool, but not a substitute for expert decision-making.

Keywords: LLM, ChatGPT 5.3, decision-making theory

CYBERSECURITY AND DATA PROTECTION IN SOCIETY 5.0

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Abstract:
Cybersecurity and data protection represent one of the key challenges of modern digital society due to the increasing dependence on information and communication technologies. This paper analyzes the fundamental principles of cybersecurity, the most common forms of cyber threats, and data protection mechanisms, with particular emphasis on technical, organizational, and legal aspects. Special attention is given to the protection of personal data, the role of users in maintaining security, and the importance of regulations in this area. The paper also examines contemporary challenges and future trends, including the application of new technologies in information protection. It concludes that effective cybersecurity requires an integrated approach that combines technology, legislation, and user education.

Keywords: cybersecurity, data protection, information security, cyber threats, privacy, digital society, regulations

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AI, IOT AND INTELLIGENT ROBOTICS: ENGINEERING THE FUTURE FOR SOCIETY 5.0

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Abstract:
Artificial intelligence, the Internet of Things, and intelligent robotics represent key technologies of the Fourth Industrial Revolution that are significantly transforming modern society. This paper analyzes their fundamental characteristics, applications, and interconnections, with particular emphasis on their role in the development of smart systems and process automation. The impacts on industry, the economy, and quality of life are examined, as well as challenges in the areas of security, ethics, and regulation. Special attention is given to the synergy of these technologies as the foundation of future engineering. It is concluded that their integration has the potential to improve efficiency, sustainability, and social development, with the need for responsible and controlled implementation.

Keywords: artificial intelligence, Internet of Things, intelligent robotics, digital transformation, Industry 4.0, automation, smart systems

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ENVIRONMENTAL IMPACT OF UNTREATED SEWAGE ON GROUNDWATER IN LIBYA: A COMPREHENSIVE REVIEW

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Abstract:
With an arid climate and very little available surface water, Libya depends almost entirely on groundwater as its primary source of fresh water. That resource, however, has been severely compromised by decades of rapid urbanization, inadequate sanitation, and the lack of centralized wastewater treatment. This paper brings together evidence on the environmental impact of untreated sewage discharge on groundwater quality across several Libyan regions, including Misurata, Zliten, Tajoura, Jadu, and Sabha. The results are troubling. Up to 38.5% of sampled wells show fecal coliform contamination, with E. coli detected across multiple sites, while nitrates, chlorides, and total dissolved solids all exceed World Health Organization recommended levels. The effects ripple outward: household incomes fall, healthcare costs rise, and agricultural productivity declines. Against this backdrop, the paper examines the full complexity of the crisis, reviews current mitigation efforts and recent infrastructure developments in Tripoli, and puts forward a comprehensive water management framework built on technological, regulatory, and community-based solutions.

Keywords: Libya, Groundwater contamination, untreated sewage, environmental impact, integrated water resources management

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LANE DETECTION FOR AUTONOMOUS DRIVING

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Abstract:
This paper presents a system for lane detection in the context of autonomous vehicle driving, based on image processing methods. The implementation includes the Canny edge detection algorithm and the Hough transform for extracting straight lines on the road. The system was evaluated using video data of varying image quality, including high-resolution recordings and footage captured with a web camera. The results show that the system reliably detects lanes under favorable conditions, while its performance degrades with lower image quality. In conclusion, the presented approach represents an efficient solution with potential for further improvements, particularly in more complex driving environments.

Keywords: Lane detection, Autonomous driving, Image processing, Canny edge detection, Hough transform, Computer vision, Real-time processing.

NOAA SIGNAL ANALYSIS

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Abstract:
This paper presents a system for receiving and processing National Oceanic and Atmospheric Administration (NOAA) Automatic Picture Transmission (APT) satellite signals, with an emphasis on signal analysis and automated visualization. Audio signals acquired using a crossed Yagi antenna, a low-noise preamplifier, and a Software-Defined Radio (SDR) receiver are processed using the Hilbert transform to extract amplitude envelopes. The system detects synchronization and telemetry signals, segments the data into scan lines, and reconstructs images by mapping amplitudes to pixel intensities. A custom Python-based graphical user interface enables loading recordings, visualizing signal segments, and applying processing steps such as channel selection, downsampling, normalization, and matrix reshaping. The reconstructed images reveal cloud formations and land–sea contrasts, demonstrating the effectiveness of the approach. The proposed system provides a cost-effective and automated platform for satellite-based weather observation, signal analysis, and educational applications, while highlighting the importance of accurate synchronization and amplitude mapping.

Keywords: NOAA satellites, APT signal processing, Hilbert transform, Python visualization, Satellite image reconstruction, Telemetry and synchronization.

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THE IMPACT OF PACKAGING ON THE PRESERVATION OF FRUIT FRESHNESS

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Abstract:
Fruit spoils quickly because it has a lot of water and continues to change after being picked. The packaging serves as a vital element which protects freshness. It also extends product shelf life and decreases product waste. The packaging serves three main functions which protect products from physical harm while it controls moisture levels and gas exchange, and preserves product quality. Different materials, like plastic, cardboard, and wood, affect fruit preservation in various ways. The packaging material controls two main environmental elements which include temperature and humidity levels, together with gas exposure to oxygen and ethylene that affects fruit ripening. The selection of appropriate packaging materials stands as a vital step because it protects fruit quality from degradation while preventing product waste during storage and transportation.

Keywords: fruit packaging, freshness preservation, shelf life extension, post-harvest losses, storage conditions, ethylene control, quality maintenance

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DEVELOPMENT OF A CROSS-PLATFORM CASHLESS PAYMENT SYSTEM WITH QR CODE INTEGRATION FOR REAL-TIME TRANSACTION PROCESSING

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Abstract:
The topic of the article is the development of a software system consisting of a Windows-based application written in the C# programming language and a user application developed for Android mobile devices. Together, these applications form a cashless payment system whose purpose is to speed up the purchasing process. To enable fast data processing, the widely used QR code technology was applied. In order to achieve the previously mentioned goals, it was necessary to use free external libraries to implement the required functionality. Thanks to the digitalization of operations, all financial transactions can be tracked on an event-by-event basis, which significantly increases security. The goal was to create modern, user-friendly interfaces so that the system can be widely adopted. Large-scale events such as festivals and concerts involve high transaction volumes within limited time frames. Traditional cash-based systems often lead to long queues, accounting errors, and security risks. This proposal outlines the implementation of a QR code–based cashless payment system to enhance operational efficiency, security, and user experience. The adoption of a QR code–based cashless payment system at festivals and concerts significantly improves efficiency, security, and user satisfaction. The proposed solution is scalable, cost-effective, and aligned with modern digital transaction trends, making it highly suitable for large-scale events.

Keywords: Cashless Payment System, QR Code Technology, C#, Digital wallet

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THE ROLE OF ORGANIZATIONAL CULTURE IN SHAPING EMPLOYEE CYBERSECURITY BEHAVIOR

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Abstract:
Despite the intensive development of cybersecurity research, existing approaches still dominantly view cybersecurity culture through formal policies, training, and technical controls, ignoring the deeper organizational determinants of employee behavior.
The paper starts from the thesis that cybersecurity culture is an emergent property of a wider organizational (work) culture, which shapes risk perception, norms, and decision-making patterns in everyday practice.
The aim of the paper is the theoretical clarification of the mechanisms of the influence of organizational culture on the safety behavior of employees, with a focus on leadership, communication, trust, and norms. Through a critical synthesis of the literature, it is shown that formal compliance without the internalization of security values remains limited.
The paper introduces an integrative framework that links organizational and cybersecurity culture, emphasizing the behavioral dimension as a key mediator. The findings indicate that organizations with a developed security-oriented culture achieve a higher level of compliance, reduce the human factor of risk, and increase resilience to cyber incidents.

Keywords: cybersecurity culture; organizational culture; employee cybersecurity behavior; human factors; cyber risk; organizational resilience

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INTEGRATION OF DIGITAL TECHNOLOGIES, BUSINESS PROCESSES AND HUMAN RESOURCE MANAGEMENT IN THE CONCEPT OF SOCIETY 5.0

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Abstract:
The concept of Society 5.0 represents a contemporary development framework based on the integration of digital technologies, business processes, and human resources, with the aim of improving organizational efficiency and competitiveness in modern business conditions. Digital transformation leads to significant changes in business processes, organizational structure, and human resource management, requiring organizations to adapt their management models to the digital environment. The aim of this paper is to analyze the relationship between the digital transformation of business processes and human resource management in the context of Society 5.0. The methodological approach of the paper is based on theoretical analysis and conceptual consideration of the relationship between digital transformation, business processes, and human resource management. The results indicate that the integration of digital technologies, business processes, and human resources represents a key factor in improving organizational performance and achieving sustainable competitive advantage in Society 5.0.

Keywords: Society 5.0, digital transformation, business processes, human resource management, digital competences, organizational performance

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MODERN APPROACHES TO THE APPLICATION OF ESSENTIAL OILS AS NATURAL ANTIOXIDANTS IN OIL STABILIZATION

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Abstract:
Oil oxidation is one of the main causes of quality deterioration in lipid-containing products in both the food and cosmetic industries. This process leads to changes in odor, taste, color, and nutritional value, as well as a reduction in product shelf life. Synthetic antioxidants such as butylhydroxytoluene (BHT) and butylhydroxyanisole (BHA) are commonly used to prevent oxidation; however, due to the increasing demand for natural additives, research has been focused on natural antioxidants. Essential oils, rich in phenolic compounds, exhibit significant antioxidant activity and can contribute to improving the oxidative stability of vegetable oils. Their application is limited due to volatility and their impact on the sensory properties of products, which is why modern delivery systems such as microencapsulation and nanoemulsions are being developed. Based on the literature review, it can be concluded that essential oils represent a potential natural alternative to synthetic antioxidants in the stabilization of vegetable oils in the food and cosmetic industries.

Keywords: essential oils, lipid oxidation, natural antioxidants, microencapsulation, nanoemulsions, oil stability

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APPLICATION OF MICROCONTROLLER SYSTEMS IN THE DESIGN AND CONTROL OF ENERGY-EFFICIENT SYSTEMS IN THE CONTEXT OF THE GREEN AGENDA

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Abstract:
Contemporary challenges related to the green agenda increasingly highlight the need for simple, accessible, and efficient solutions for resource management. In this context, microcontroller systems play an important role in the design and control of energy-efficient systems, particularly in the fields of water management and heating. This paper examines their application in real-time data acquisition and processing, supported by sensor systems for monitoring key parameters. Special emphasis is placed on mathematical modeling and predictive approaches, which enable improved system control and reduction of losses. The results indicate that such solutions can be sustainable, flexible, and economically viable, while significantly contributing to the rational use of energy and water resources.

Keywords: microcontroller systems, design, control, green agenda, water, heating, mathematical modeling

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INTERNATIONAL COMPARISON OF STUDENTS' TRUST IN INFORMATION SOURCES

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Abstract:
The aim of this study is to explore how higher education students perceive the reliability of different information sources. The research is based on two samples: a smaller group of international students and a larger group of Hungarian students. Data were collected using a five-point Likert scale, where respondents evaluated both online and offline sources.
The results demonstrate that in both samples, scientific sources—especially printed and online books, as well as academic journals—are considered the most reliable. In contrast, social media, online forums, and certain traditional media channels received lower reliability ratings. Hungarian students tend to be more critical towards media content and show greater trust in formal, academic sources.
The findings highlight the importance of developing media literacy and critical evaluation skills in higher education.

Keywords: Information source credibility, Student attitudes, Media trust, Information literacy

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ETHICAL ASPECTS OF THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN SOCIETY 5.0: A SIMULATED EMPIRICAL ANALYSIS OF THE PERCEPTION OF KEY CHALLENGES

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Abstract:
This paper analyzes the ethical challenges of applying artificial intelligence in the context of Society 5.0, with particular emphasis on data privacy, algorithmic bias, transparency and explainability of models, accountability for the decisions of intelligent systems, and the preservation of human autonomy in the conditions of digital transformation. Starting from the concept of a human-centered society, the paper examines the need to align the technical efficiency of AI systems with ethical principles and social responsibility. In addition to the theoretical framework, the paper presents the results of an empirical study conducted on a sample of respondents from academic and IT environments, with the aim of examining the perception of key ethical risks in the application of artificial intelligence. The results indicate that respondents assign the greatest importance to issues of data privacy, algorithmic fairness, and system transparency, while human oversight and the regulatory framework are recognized as necessary elements of the reliable and socially acceptable implementation of AI solutions. The findings suggest that the development of intelligent information systems in Society 5.0 must be based not only on performance and functionality, but also on the principles of accountability, fairness, and trust.

Keywords: artificial intelligence, Society 5.0, ethical challenges, data privacy, algorithmic fairness, transparency, accountability, human-centered approach, intelligent information systems, digital transformation

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STUDENTS' ATTITUDES TOWARD THE APPLICABILITY OF AI IN HIGHER EDUCATION

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Abstract:
In this study, we present the preliminary findings of a research project in which we explored how students in higher education view artificial intelligence, with a particular focus on its applicability in education.
We surveyed students from two institutions regarding the applicability of AI in education. We grouped the students by field of study into business and engineering sectors. We analyzed the responses using Galois graphs. The differences between the two institutions based on their fields of study are also evident in the visualization of the graphs. When examining the benefits of using AI (in terms of time efficiency, customizability, practice, and other features), the emphasis shifts differently across the two educational fields studied. In our study, we present the Galois graphs and the conclusions that can be drawn from their use.

Keywords: Students attitudes, Artificial Intelligence, Higher education, AI applicability

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RIS-ENHANCED 6G MMWAVE COMMUNICATIONS: CAPACITY ANALYSIS AND OPTIMIZATION

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Abstract:
The advent of 6G mobile networks promises unprecedented data rates, ultra-low latency, and massive connectivity. However, the utilization of millimeter-wave (mmWave) frequencies, such as 28 GHz, introduces significant challenges regarding path loss and signal blockage. Reconfigurable Intelligent Surfaces (RIS) have emerged as a key enabling technology to overcome these propagation limitations by intelligently reflecting signals. This paper presents a performance analysis of an RIS-assisted Orthogonal Frequency Division Multiplexing (OFDM) system tailored for 6G mmWave networks. We derive the transmission capacity relations based on the impulse response method in the complex baseband, and describe an optimization algorithm based on the power iteration method to maximize the system capacity by configuring RIS phase shifts. Simulation results for the 28 GHz band demonstrate significant gains in transmission capacity and Bit Error Rate (BER) performance compared to systems without RIS or with random configurations.

Keywords: 6G, Reconfigurable Intelligent Surfaces (RIS), OFDM, mmWave, Capacity Optimization, Impulse Response.

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TOUCHSCREEN-BASED HOME CONTROL SYSTEM ON THE RASPBERRY PI PLATFORM

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Abstract:
The topic of the article is the development of a touchscreen-based household control system built on the Raspberry Pi platform. The aim of the project was to create a simple and user-friendly smart home solution that enables the centralized control of various household electrical devices through an integrated touchscreen interface. The system allows the user to manage functions such as lighting, boiler, and water heater control in a practical and accessible way. The hardware of the system is based on a Raspberry Pi 3, which serves as the central control unit, while the software was developed in Python and runs on Raspberry Pi OS. The graphical user interface was designed to provide clear and intuitive operation, making the system easy to use in everyday household environments. The project combines embedded hardware control with a touchscreen-based software interface in order to demonstrate a functional and low-cost home automation solution. The completed system proves that Raspberry Pi can be effectively used as a reliable platform for the implementation of basic smart home applications. In addition to its current functionality, the project also provides a good foundation for future expansion with more advanced automation and control features.

Keywords: Smart Home, Raspberry Pi, Touchscreen Control, Python, GPIO, Home Automation

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CALIBRATION OF SELF-DEVELOPED IN VITRO BIOIMPEDANCE MEASUREMENT PLATE

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Abstract:
Bioimpedance spectroscopy is a non-invasive diagnostic technique with significant potential for in vitro applications. A graphene-based measurement plate was developed to enhance sensitivity and reproducibility, with design features optimized to maximize detection of qualitative changes in cell cultures and to minimize interference from physical impacts. Calibration of the system was conducted using a series of physiological saline solutions, and the resulting data were compared with theoretical predictions and previously published models. Contrary to the linear behavior reported in the literature, the results exhibited a non-linear relationship, with the best fit achieved using a reciprocal ('-1' power) function. These findings demonstrate that conductometric calibration can be reliably applied using this approach. The procedures outlined in this study are recommended to ensure consistent and reproducible measurements, providing a foundation for further applications of graphene-based bioimpedance sensing in cellular studies.

Keywords: Bioimpedance spectroscopy, In vitro, Cell cultures, Calibration

BIOIMPEDANCE SPECTROSCOPY FOR NON-INVASIVE CHARACTERIZATION OF CELLULAR CHANGES

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Abstract:
This study investigates whether bioimpedance spectroscopy (BIS) is a suitable method for non-invasive characterization of fundamental biological changes in cells. Experiments were designed to model changes in the extracellular and intracellular spaces and to study the effect of cell proliferation on impedance data. BIS measurements were carried out using a self-developed BIS measuring system using graphene-based electrodes. Impedance spectra were evaluated using the Cole–Cole model, allowing the identification of key impedance parameters and their correlation with biological changes. The results indicate that intracellular changes induces significant changes in high-frequency resistance (R_∞) and capacitance (C), while cell proliferation are primarily reflected in the α relaxation parameter. Changes in the extracellular environment do not result significant differences in the model parameters, which confirms the method's selectivity for intracellular processes. The results reinforce that BIS could be a suitable tool for label-free, non-invasive monitoring of cell status, with significant potential applications in biomedical diagnostics.

Keywords: Bioimpedance spectroscopy; Cole–Cole model; Cellular analysis, In vitro diagnostics

GREEN TECHNOLOGIES IN TEXTILE PROCESSING: AN OVERVIEW OF THE LATEST METHODS AND FINDINGS

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Abstract:
Reducing environmental pollution has become one of the key issues of sustainable development. The textile industry, a significant polluter, generates large volumes of wastewater that often contain heavy metals and aromatic amines. In this context, the textile industry faces the challenge of introducing and implementing environmentally friendly alternatives to toxic chemicals and processes in the production and processing of textile materials. This paper provides an overview of previous research on the application of natural dyes, plant extracts, and sustainable methods in textile processing. Particular emphasis is placed on their impact on the functional properties of textile materials, including antibacterial, UV-protective, and antioxidant properties. Such an approach contributes to the development of functional textile materials with improved performance and to the advancement of sustainable textile processing technologies.

Keywords: natural dyes, sustainable methods, enzymes

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IOT SECURITY TECHNIQUES – PRELIMINARY REVIEW

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Abstract:
The growth of the Internet of Things (IoT) devices has introduced significant security challenges due to energy efficiency and limited hardware resources. This research paper presents a preliminary review of security techniques applied in IoT systems, focusing on mechanisms for authentication, encryption, and intrusion detection as well as lightweight cryptographic approaches, and device-level security capabilities like Secure Boot (SB) and Trusted Platform Module (TPM). This review highlights current trends and common vulnerabilities, aiming to provide an improved understanding of IoT security strategies and challenges.

Keywords: Internet of Things, encryption, authentication, lightweight cryptography, security

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ARTIFICIAL INTELLIGENCE IN THE FUNCTION OF A SUSTAINABLE TRANSPORT SYSTEM AND ENVIRONMENTAL PROTECTION

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Abstract:
Modern urban transport requires increased efficiency alongside a reduction in its ecological footprint, which is why artificial intelligence (AI) is taking a key role in the development of intelligent traffic management systems. The aim of this paper is to investigate the potential of AI algorithms in sustainable transport, focusing on the reduction of traffic congestion, energy consumption, and greenhouse gas emissions. A systematic literature review confirms that these intelligent systems significantly improve traffic flow and environmental sustainability through real-time data processing. However, it is concluded that the success of their implementation directly depends on the development of digital infrastructure and data quality, which remains a key challenge for smart cities.

Keywords: artificial intelligence, intelligent traffic management systems, sustainable transport, CO_2 emissions

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BIOTECHNOLOGICAL POTENTIAL OF LACTIC ACID BACTERIA FOR MYCOTOXIN REDUCTION IN FERMENTED MILK

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Abstract:
Mycotoxin contamination, particularly aflatoxin M1 (AFM1), represents a serious food safety concern in milk and fermented dairy products. AFM1 originates from contaminated feed and exhibits high stability during technological processing, which makes its removal challenging. In recent years, lactic acid bacteria (LAB) have been recognized as promising biotechnological agents for reducing mycotoxin levels. Their activity is primarily associated with adsorption to cell wall structures, strain-dependent bioadsorption, possible enzymatic transformation, and indirect inhibition of toxin-producing molds. The effectiveness of these mechanisms is influenced by several factors, including bacterial strain, environmental conditions, and food matrix composition. However, the reversibility of toxin binding remains a major limitation. Overall, LAB-based approaches offer a promising strategy for improving the safety of fermented dairy products, although further research is required to optimize their application under real processing conditions.

Keywords: lactic acid bacteria; fermented milk; aflatoxin M1; mycotoxins; detoxification; food safety

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A REVIEW OF COLLISION AVOIDANCE STRATEGIES FOR NONHOLONOMIC AUTONOMOUS GROUND VEHICLES

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Abstract:
This review examines collision avoidance strategies for nonholonomic autonomous ground vehicles, including car-like robots, Ackermann-steered vehicles, differential-drive robots, and articulated mobile systems. A Scopus-based search was conducted using terms related to collision avoidance, nonholonomic motion, trajectory planning, and trajectory control. The selected literature is organized into three categories: perception technologies for environment sensing, motion and trajectory planning methods for collision-free path generation, and tracking/control approaches for trajectory execution. Recent studies address collision avoidance through the joint treatment of trajectory planning and trajectory tracking under kinematic and dynamic constraints. Commonly reported challenges include real-time implementation, sensing uncertainty, and reliable performance in dynamic environments.

Keywords: Collision avoidance, Nonholonomic ground vehicles, Trajectory control, Trajectory planning

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SYNTHETHIC EMG SIGNAL GENERATION FOR INTELLIGENT HEALTHCARE SYSTEMS: A REVIEW TOWARD SOCIETY 5.0

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Abstract:
The transition toward Society 5.0 promotes the integration of technologies such as artificial intelligence (AI), big data and intelligent systems to create human centered solutions that enhance quality of life. In this context, electromyography (EMG) signals play a critical role in diagnostics, rehabilitation, and human machine interaction. However, AI driven biomedical systems are constrained by the limited availability of high quality EMG datasets. This review examines current approaches for synthetic EMG signal generation, including generative AI, mathematical models and data augmentation strategies designed to address data scarcity. The analyzed methods are evaluated in terms of their ability to improve classification performance, robustness, and generalization in EMG based applications. Finally, key challenges such as signal fidelity, model generalization, personalized healthcare solutions and ethical considerations in the use of synthetic data are highlighted.

Keywords: Synthetic EMG, Electromyography, Artificial intelligence, Generative models, Data augmentation, Biomedical engineering, Intelligent healthcare systems, Society 5.0

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DIMENSIONS OF THE THIRD MISSION: UNIVERSITIES' CONTRIBUTION TO A SUSTAINABLE AND SMART SOCIETY

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Abstract:
This study examines how universities contribute to sustainable regional development through their third mission activities, a ligning with the principles of Society 5.0. While not focusing on specific technologies, it highlights the institutional and societal conditions supporting their responsible use. The research analyses strategic documents of Hungarian universities using an intellectual capital framework (human, organisational, and social capital) to assess impacts in social engagement, education, and innovation. Results show strong community engagement and environmental awareness, but weaker performance in technology transfer, entrepreneurship, and internationalisation. This indicates a partial alignment with Society 5.0, where social dimensions are emphasized over technological integration. The paper contributes by underlining the importance of interdisciplinary collaboration and balanced development, supporting universities' role in fostering sustainable innovation ecosystems.

Keywords: Focuses of HEI's third mission, strong social engagement and sustainability, less developed technological dimension, cases from Hungary

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HARMONIC-BASED CONDITION MONITORING OF INVERTER-FED INDUCTION MOTOR DRIVES: TOWARDS AI-ENABLED DIAGNOSTICS AND SUSTAINABLE OPERATION

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Abstract:
Inverter-fed induction motor drives inherently generate harmonic components that propagate through the motor, DC link, and grid interface, influencing overall system behavior. While often treated as a source of distortion, these harmonics also carry valuable information about the operating condition of the drive. This paper explores the role of harmonic signatures as a basis for condition monitoring of induction motors, with consideration of their impact on DC-link stress and grid interaction. Particular emphasis is placed on the potential of using these signals for early fault detection. Furthermore, the paper highlights how harmonic-based monitoring can be enhanced through integration with AI-driven analytics, IoT connectivity, and cloud platforms, enabling continuous and automated diagnostics. Given the widespread use, robustness, and efficiency of induction machines, such approaches support extended lifetime, reduced energy consumption, and optimized use of materials, including critical resources. In this context, advanced monitoring contributes to more reliable operation of drive systems and facilitates the broader integration of sustainable and renewable energy solutions.

Keywords: Inverter-Fed Induction Motor, Fault Condition Monitoring, Harmonic Content

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FIRE PROTECTION-PRESENT AND FUTURE WITH THE INFLUENCES OF INDUSTRY 4.0 AND 5.0 TECHNOLOGIES

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Abstract:
Abstract Fire and fire protection present very complex and always actual and open problem. Fire, as one of the most dangerous events for human life and health, animals and material properties, must be eliminated as soon as possible, at early stage. Of course, the best and the safest way for this problem are prevention and prediction. Related to this, the whole disciplines were developed-fire detection and fire prediction. Fire detection is realised by usage of fire detectors, special devices for fire detection at early stage. These devices (smoke, flame, heat etc.) serve to be installed and arranged in object buy rules and regulates defined by valid standards. Prediction purports determination and realisation of proper strategy with the purpose to predict as many as possible fire scenarios and related to that fact, apply noted strategy as the most effective way by calculations and experimental confirmation. That was the way how traditional fire protection system functioning. Today, with the appliances of Industry 4.0 and 5.0, fire protection achieves unimaginable results. This paper was written to show the use of consequences of Industry 4.0 and 5.0, at the first-place artificial intelligence, simulation, IoT, Big Data but also and other consequences on fire protection.

Keywords: fire, Industry 4.0, 5.0, artificial intelligence, simulation, big data, IoT, detector

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THE INFLUENCE OF AI ON THE OIL AND GAS DERIVATES WITH REFERENCE TO FIRE PROTECTION

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Abstract:
During time, industry had a significant influence on different social and physical fields, so as the fields of oil and gas. These fields have the crucial significance in the energy production. There are many different changes as a consequence of so-called Industry 4.0 on this fields, but it is important to note that the base for all changes is intelligence and digitalisation. The changes are so huge that it can be said that oil and gas can be defined and presented as Oil and gas 4.0 and 5.0, related to the industry 4.0 and 5.0. These changes are the most reflected through the area of big data, internet of things, digital twins, wireless communication technologies, augmented reality etc. Of course, many followed things related to noted fields would be also changed. One of them is fire protection, very important task at noted fields. Fire protection must be present at all phases of oil and gas derivates production, transport, storage etc. This paper was written to show the influence of AI on the oil and gas fields, with reference to fire protection.

Keywords: oil, gas, artificial intelligence, fire protection, safety

IOT AS A FOUNDATION FOR SKILLS DEVELOPMENT

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Abstract:
The authors have designed a course that fuses electronics, programming, cloud computing, 3D printing and mathematics, aimed at equipping students with skills and knowledge directly applicable to real-world problems. This approach enables future professionals to harness IoT as a foundational tool for solving environmental challenges, fostering innovation, and advancing their education and skills development. Experiences and insights gained from running the course for several years are presented.

Keywords: Engineering, Engineering, Internet of Things, Course Design

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SUSTAINABLE TEXTILE WASTE MANAGEMENT AS AN ENGINEERING RESPONSE TO ENVIRONMENTAL PROTECTION CHALLENGES

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Abstract:
The textile sector is a significant source of environmental pressure due to high consumption of raw materials, water, and energy, as well as growing amounts of waste generated during the production, use, and disposal of textile products. This paper analyzes sustainable textile waste management as an engineering response to environmental protection challenges. Based on a review of relevant literature, the paper considers environmental pressures related to textile consumption, textile waste flows, key waste management approaches, and modern technological solutions for sorting and recycling. Special attention is given to automated sorting based on NIR spectroscopy and sensor-robotic systems, as well as to the role of eco-design and circular models in improving recyclability and material flow closure. The analysis indicates that sustainable textile waste management requires coordinated application of collection, sorting, recycling, and product design strategies.

Keywords: textile waste, sustainable management, recycling, NIR spectroscopy, circular economy

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ENTREPRENEURSHIP 5.0 AND THE FUTURE OF HUMAN-CENTERED BUSINESS DEVELOPMENT

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Abstract:
This paper examines entrepreneurship in the context of value creation within a human-centered business environment. The study is based on the concept of Entrepreneurship 5.0, which integrates digital technologies, human capabilities, and sustainability principles. The analysis highlights the transition from technology-oriented approaches toward models that place user needs and social expectations at the center of business activity. Digital technologies such as artificial intelligence and data-driven systems support decision processes, while human knowledge and creativity determine their effective application. The paper also addresses the importance of aligning innovation with environmental and social responsibility in order to achieve balanced development. A theoretical model is proposed, which explains the interaction between technological inputs, human factors, and sustainability conditions. The findings indicate that long-term competitiveness depends on the integration of these elements and continuous adjustment to market and stakeholder expectations.

Keywords: Entrepreneurship 5.0, Human-centered value, Digital transformation, Sustainable entrepreneurship, Business competitiveness

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CAD-CAM INTEGRATION IN INDUSTRY 5.0

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Abstract:
This paper analyses modern CAD/CAM systems within the context of Industry 5.0, with a focus on their integration with advanced digital technologies. Industry 5.0 emphasises human–machine collaboration, personalised production, and sustainability, where CAD/CAM tools such as SolidWorks play a key role in optimising design and manufacturing processes. The application of artificial intelligence enables design automation, structural optimisation, and predictive analysis, while augmented and virtual reality enhance visualisation, simulation, and operator training. The integration of these technologies positions CAD/CAM systems as central platforms for industrial digital transformation. In conclusion, the synergy between CAD/CAM systems and Industry 5.0 technologies represents a key factor in improving the efficiency, flexibility, and competitiveness of modern manufacturing systems.

Keywords: CAD-CAM integration, Industry 5.0, artificial intelligence (AI), augmented reality (AR), virtual reality (VR)

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RISK ASSESSMENT AND RISK REDUCTION MEASURES FOR THERMOVISION EQUIPMENT

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Abstract:
This paper presents a risk assessment, as well as risk reduction measures implemented by the user during the use of a thermographic camera in a production environment. Infrared thermography is a method used for monitoring and diagnostics, quality control, and non-destructive testing. Thermovision enables non-contact temperature measurement and visualization of thermal phenomena in real time, making it highly suitable for industrial diagnostics. The risk assessment was carried out in accordance with ISO 12100 and ISO 14121-1 standards, based on risk analysis through defining machine limits, hazard identification, and risk estimation. Mechanical, electrical, thermal, laser, ergonomic, and other hazards that may arise during operation in the cutting zone while handling the thermographic camera were identified. A risk matrix was used as the risk estimation method, quantifying risk levels before and after the implementation of risk reduction measures, and performing risk evaluation. Based on the assessment results, technical, organizational, and personal protective measures were proposed, with special emphasis on measures implemented by the user. These include the development of safe working procedures, operator training, use of personal protective equipment, and organizational safety measures. The results show that after applying the proposed measures, all risks are reduced to an acceptable level, confirming that the use of a thermographic camera in a production environment is safe when prescribed safety measures are consistently applied.

Keywords: Risk assessment, Thermovision, Risk matrix, Risk reduction

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INTELLIGENT BATTERY CHARGING STRATEGIES FOR SOCIETY 5.0

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Abstract:
This paper reviews intelligent battery charging strategies for Society 5.0 and their relevance to electric vehicles, microgrids, and energy storage systems. Conventional and advanced charging methods are discussed, together with the role of state estimation, adaptive control, optimization, and artificial intelligence. The analysis shows that intelligent charging can improve efficiency, safety, battery lifetime, and sustainability. Key challenges and research opportunities are also identified for the development of smarter, more user-centered battery charging systems.

Keywords: Society 5.0; intelligent battery charging; battery charging strategies; energy storage systems; electric vehicles.

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MAKING ENGINEERING EDUCATION VISIBLE: DIGITAL INSTITUTIONAL IMAGE AND WOMEN'S INTEREST IN STEM

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Abstract:
This paper examines the role of digital institutional image in shaping women's interest in STEM and engineering study programmes. Drawing on literature on higher education image, digital communication, belonging, support and women's participation in STEM, the paper develops a conceptual interpretation of how institutional online presence may affect whether engineering education is perceived as visible, credible and attainable. The analysis suggests that websites, social media, information quality and representations of support operate as institutional signals for prospective female students. The paper does not treat digital communication as a sufficient solution to gender inequality in STEM. Rather, it argues that digital institutional image can contribute to inclusive engineering education when it communicates credibility, belonging and realistic pathways for participation within Society 5.0-oriented, human-centred and socially responsive engineering education.

Keywords: Digital institutional image, women in STEM, engineering education, higher education communication, Society 5.0.

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FROM VISIBILITY TO ATTAINABILITY: WOMEN IN STEM AND ENGINEERING EDUCATION IN SOCIETY 5.0

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Abstract:
The underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) study programs remains a significant educational and societal challenge. This paper examines the role of gender-sensitive communication in promoting STEM programs among women. The analysis is situated within the frameworks of Society 5.0, ethical engineering, human-centered design, and skills development, where technological progress is understood not only as innovation, but also through inclusion, responsibility, and social purpose. Drawing on literature on women in STEM, higher education communication, media representation, role models, belonging, and engineering education in Industry 5.0, the paper proposes a conceptual framework structured around visibility, belonging, and attainability. While communication alone cannot eliminate structural inequalities, it can reduce symbolic distance and frame STEM pathways as accessible, socially relevant, and achievable for prospective female students.

Keywords: Gender-sensitive communication, Women in STEM, Society 5.0, Ethical engineering, Engineering education, Human-centered design, Skills development.

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A CLOSER LOOK AT IMPACT OF AI INDUSTRY DEVELOPMENT ON THE ROAD TO SOCIETY 5.0

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Abstract:
Artificial Intelligence (AI) development has to be considered not just as a technological issue but rather as a step forward to ensure economic, as well as wider well-being in the future. For this reason, in this paper are selected just some of numerous indicators that could determine AI role and its impact on a man as well as on human society in a whole. In accordance with this, AI should be seen as one of the technologies that Society 5.0 will rely on.
In efforts to ensure their leading positions at the global level some countries put significant efforts in field of advanced technologies, where AI plays one of the lead roles. There are various indices that dominance over AI technology field could ensure global dominance in a whole.
As a main part of the paper are presented some of key indicators that reveal certain country competitiveness related to AI technology field.

Keywords: Artificial Intelligence (AI), Society 5.0, Advanced technologies, AI Index Report

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SMART AND ENERGY-EFFICIENT WATER SUPPLY PLANNING FOR SOCIETY 5.0: A TAGUCHI OPTIMIZATION APPROACH

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Abstract:
The increasing demand for energy-efficient and sustainable water supply systems requires the development of effective analytical and optimization approaches. This study presents a methodology for evaluating and minimizing energy consumption in pumping systems using Taguchi design and regression analysis. A Taguchi L9 experimental design was applied to investigate the influence of key operational parameters, including flow rate, pump head, and efficiency, on pumping power. The signal-to-noise (S/N) ratio analysis, based on the “smaller-is-better” criterion, was used to identify the optimal conditions for minimizing energy consumption. In addition, regression analysis was conducted to quantify the relationship between the input parameters and pumping power. The results indicate that flow rate and pump head are the most influential factors, while pump efficiency has a significant inverse effect on energy consumption. The developed regression model demonstrates high predictive accuracy, with a coefficient of determination exceeding 99%. The findings confirm consistency with fundamental hydraulic principles and highlight the importance of parameter optimization in improving energy efficiency. The proposed approach provides a simple and effective framework for supporting smart decision-making in modern water supply systems.

Keywords: Energy efficiency, Pumping systems, Taguchi method, Regression analysis, Water supply systems, Parameter optimization

MODELING HUMAN PITCH PERCEPTION USING COCHLEAR MODELS AND DEEP LEARNING

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Abstract:
This study investigates the simulation of human perception of pitch using cochlear computational models and deep learning algorithms, to develop a model that can predict the fundamental frequency along with other harmonic components from preprocessed signals that carry the properties of cochlear processing. The gammatone filterbank cochlear model was implemented to process musical audio files and compute cochlear-inspired spectrograms and features, followed by a hybrid deep neural networks model that was trained to predict the fundamental frequency and four other harmonics. The implemented cochlear model achieved high accuracy in conducting biologically inspired preprocessing tasks, and the deep learning model succeeded in learning unique patterns from the cochlear-analyzed data, generating accurate predictions. Achieving these results can inspire and motivate development in the fields of cochlear implants, and sound and music engineering.

Keywords: pitch perception, cochlear models, deep learning, fundamental frequency, harmonics.

MODELS OF TRANSFORMATIVE TEACHING IN HIGHER EDUCATION: DYNAMIC DEVELOPMENT AND CHANGES IN THE ENVIRONMENT

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Abstract:
The paper examines the relationship between higher education learning outcomes and labour market needs, with the aim of developing a model that connects learning with applicable competencies. The objective of the study is to identify appropriate recommendations that can be implemented in practice. The research explores which educational models enable knowledge to become immediately applicable and competitive, thereby improving teaching processes in order to enhance students' employability and competitiveness in the labour market..

Keywords: transformative learning, collaborative networks, Education 5.0, competencies, labour market.

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