ABSTRACTS

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Impact of cross-border traffic and migration on road traffic safety systems in Poland

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Keywords: road traffic safety, Ukraine migration, road accidents.
Abstract: This study examines the relationship between road traffic incidents in Poland and the influx of vehicles and drivers from Ukraine over the period 2010–2024. Log-linear regression models were employed to analyze three dependent variables: the total number of road accidents (NRA), the number of fatalities (NFA), and the number of injuries (NIA). Independent variables included the volume of passenger cars and trucks entering Poland from Ukraine, migration flows, population size, number of registered vehicles, Ukrainian drivers involved in accidents, and weather conditions. The results indicate that the number of vehicles entering Poland, accidents involving Ukrainian drivers, overall population, and the number of registered vehicles significantly increase both the number of road accidents and their associated consequences. In contrast, weather conditions were found to have a limited impact. Three of the four research hypotheses were confirmed, underscoring the critical role of traffic volume and migration-related factors in shaping road safety outcomes. These findings carry important implications for traffic management policies and the integration of foreign drivers into the national road system.

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Digital value chain with cognitive technologies: a conceptual framework and small-scale prototype

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Keywords: digital value chain, MQTT, OPC UA, cognitive manufacturing, discrete event simulation.
Abstract: This paper proposes a conceptual framework linking digital value chain integration with cognitive technologies and demonstrates it through a simulation-based micro-prototype. The framework combines discrete-event simulation, event-driven communication, and an external decision component to realize a minimal perception–decision–action loop. A discrete-event model was implemented in Tecnomatix Plant Simulation and connected to external components via MQTT publish/subscribe messaging. During runtime, the simulation emits process events (e.g., station start/finish) that can be observed through standard MQTT tooling. External commands are delivered through the broker to control execution (START/STOP) and to actuate a selected model parameter (processing-time updates), while a simple constraint mechanism provides alert signaling for out-of-range inputs. To support reproducibility and offline analysis, a lightweight Python MQTT bridge captures message streams and exports structured telemetry logs (JSONL/CSV). The prototype illustrates how cognitive logic can be decoupled from the simulation environment while remaining dynamically integrated through events and commands. Although the demonstrator is intentionally minimal and not intended for industrial optimization, it provides an experimentally grounded example of modular integration principles applicable to scalable and interoperable digital value chain architectures. The contribution of this work lies in demonstrating a minimal and reproducible event-driven integration pattern rather than an industrial-scale digital twin or optimization solution.

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Advancements in sustainable public transportation systems: a systematic review

(pages 75-84)

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Keywords: sustainability, public transportation, electrification, data-driven solutions, intelligent transportation systems.
Abstract: Sustainable public transportation system developments from 2020 to 2024 are examined in this systematic literature evaluation. It emphasizes the use of electric and hybrid buses, intelligent transportation systems (ITS), and data-driven approaches to improve operational efficiency, user happiness, and pollution reduction. The main goals were to identify trends in sustainable public transportation, evaluate technology and policy initiatives, and provide recommendations for future research and policymaking. Using the PRISMA methodology, the review initially identified 1,400 peer-reviewed papers from Scopus. In total, 11 articles were selected for their relevance to sustainable transportation. The results indicate notable progress in the use of sustainable technology, as the implementation of Intelligent Transportation Systems (ITS) and data-driven techniques has improved efficiency and satisfaction. Public involvement and instruction are crucial for successful acceptance. The study acknowledges limitations, including its narrow focus on English-language papers and its reliance on the Scopus database, which may result in the exclusion of pertinent studies. The study's findings indicate that although significant advances have been made, ongoing efforts are necessary to address remaining obstacles and deficiencies. Future study should expand their scope to encompass numerous languages, diverse databases, and the most recent technical advancements. This study offers significant insights and practical recommendations for promoting sustainable public transportation, thereby enhancing urban environments in terms of efficiency, environmental sustainability, and liability. The contributions encompass a thorough synthesis of recent progress, identification of key patterns and deficiencies, and practical recommendations for policymakers and researchers.

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Smart infrastructure modeling

(pages 85-94)

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Keywords: digital twin, logistics management, asset management, predictive maintenance, digital transformation.
Abstract: Digital twin technology has emerged as a significant enabler of digital transformation in logistics and asset-intensive systems by integrating physical assets with real-time virtual models through continuous data exchange. This study investigates the role of digital twins in enhancing organizational and logistics performance, with particular focus on asset monitoring, predictive maintenance, and operational control. A conceptual and analytical approach is adopted to evaluate the impact of digital twin integration on system efficiency and decision-making processes under conditions of operational uncertainty. The results indicate that digital twin implementation substantially improves real-time diagnostics, automated fault detection, and predictive maintenance performance, leading to reduced downtime, enhanced operational efficiency, and improved responsiveness of logistics systems. Compared to conventional asset and logistics management practices, digital twins provide a scalable and cost-effective framework by strengthening data-driven decision-making and minimizing manual intervention. From a strategic perspective, adoption of digital twin technology supports the development of dynamic capabilities, enhances supply chain resilience, and extends asset life cycles. The study concludes that digital twin technology constitutes a critical technological foundation for achieving sustainable performance improvement and long-term competitive advantage in modern logistics environments.

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Optimization of task scheduling and sequencing operations in multi robot assembly line using Hybrid GA - SA algorithms in Industry 5.0 context

(pages 95-106)

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Keywords: Industry 5.0, multi-robot assembly line, task scheduling and operation sequencing, genetic algorithm and simulated annealing, hybrid optimization and smart manufacturing.
Abstract: The transition to Industry 5.0 underscores the significance of manufacturing systems that focus on human-centric needs, resilience, and sustainability, with intelligent multi-robot assembly lines playing a vital role in enhancing productivity and operational flexibility. However, optimizing task scheduling and sequencing in multi-robot environments remains a complex combinatorial challenge due to factors such as precedence constraints, resource sharing, collision avoidance, and changing production requirements This research introduces a robust optimization framework combining Genetic Algorithms (GA) and Simulated Annealing (SA) to efficiently manage task allocation and operation sequencing in a multi-robot assembly line, within the scope of Industry 5.0. The suggested method uses GA as a global search mechanism with a customized chromosomal encoding strategy that preserves feasibility restrictions while concurrently representing task sequencing and robot assignment. The purpose of customized crossover and mutation operators is to minimize impractical solutions while preserving precedence relationships. Using an adaptive cooling schedule and neighborhood exploration mechanism, SA is performed as a local search refinement method to high-quality GA individuals in order to improve convergence accuracy and prevent premature stagnation. The hybrid GA–SA framework seeks to reduce robot idle time, balance workload distribution, minimize makespan, and enhance system sustainability indicators. The suggested model outperforms standalone metaheuristic methods in terms of convergence stability and solution quality, according to computational studies on benchmark multi-robot assembly situations. According to Industry

5.0 goals, the outcomes confirm how well the hybrid optimization approach supports resilient, intelligent, and sustainable production systems.

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Applications of VSELP coding in US patents

(pages 107-110)

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Keywords: US patents, VSELP coding, applications.
Abstract: At data rates as low as 4800 bps, Code Excited Linear Prediction (CELP) speech coders perform well. The primary disadvantage of CELP type coders is their high processing demands. A structured codebook is used by the Vector Sum Excited Linear Prediction (VSELP) speech coding, enabling a highly effective search process. Additional benefits of the VSELP codebook structure will be covered in this paper. VSELP codec(coder/decoder) uses a single VSELP excitation codebook, a novel gain quantizer that is resistant to channel errors, an adaptive pre/postfilter arrangement, and a subsample resolution single tap long term predictor. This paper provides a brief explanation of the uses of VSELP in US patents in addition to its structure.

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3D cultivation of mesenchymal stem cells on polylactide scaffolds

(pages 111-114)

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Keywords: 3D cultivation, mesenchymal stem cells, hCMSC, PLA scaffold, sterilization.
Abstract: The aim of this article optimizes the methodology for three-dimensional (3D) culture of human chorionic mesenchymal stem cells (hCMSCs) on polylactide (PLA) scaffolds, with a focus on the preparation and sterilization of the scaffolds. A significant problem when using PLA scaffolds is ensuring effective sterilization while maintaining the structural integrity of the material sensitive to elevated temperatures. A combined sterilization protocol using thermal and chemical decontamination was applied in the work. Scaffolds with a lattice architecture and 50% filling were prepared by 3D printing technology and subsequently seeded with hCMSCs. During the preparation of the scaffolds, technical complications related to their porous structure were observed, which required adjustment of the cultivation procedure before cell seeding. Preliminary results confirmed the preservation of sterility during cultivation without visible degradation of the scaffolds and at the same time demonstrated satisfactory cell viability. The obtained knowledge points to the potential of a combined sterilization approach in the preparation of 3D printed PLA scaffolds for tissue engineering applications.