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Integrating Artificial Intelligence in the Development of Modern Information Systems

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ABSTRAK

The development of modern information systems requires more intelligent, adaptive, and efficient data processing capabilities due to the increasing complexity and volume of data. Artificial Intelligence (AI) has emerged as a strategic solution to enhance the ability of information systems to perform analysis, prediction, and data-driven decision support. This study aims to examine the integration of artificial intelligence in the development of modern information systems from the perspective of electrical engineering and systems engineering. The research adopts an applied research approach using a systems engineering methodology, which includes problem identification, literature review, system architecture design, simulational implementation, and performance testing and evaluation. The results indicate that modular integration of artificial intelligence significantly improves data processing efficiency, analytical accuracy, and system adaptability to changing data patterns. AI-based information systems demonstrate superior performance compared to conventional systems, particularly in supporting proactive and predictive decision-making processes. Furthermore, AI integration contributes positively to computational resource efficiency, which is a critical aspect of sustainable information system development. However, the findings also highlight that data quality and proper system architecture design are decisive factors for successful AI implementation. This research provides both conceptual and technical contributions that can serve as a reference for the development of modern AI-driven information systems and as a foundation for future studies in this field.

Keywords:

Artificial Intelligence, Modern Information Systems, Machine Learning, Systems Engineering, Electrical Engineering

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1. INTRODUCTION

The development of information technology in the last two decades shows a very significant acceleration, especially with the emergence of artificial intelligence (AI) as a strategic component in the development of modern information systems.[1]. Information systems no longer function merely as data recording and processing tools, but have evolved into intelligent systems capable of adaptive analysis, prediction, and decision-making.[2]. The integration of artificial intelligence into modern information systems has become a fundamental necessity to address the challenges of data complexity, the speed of environmental change, and the demands for efficiency and accuracy across various industrial sectors and public services.[3].

Advances in computing technology, the availability of large datasets (big data), and improvements in machine learning and deep learning algorithms have driven the widespread use of AI in information systems.[4]. Modern information systems are now designed not only to manage structured data, but also unstructured data such as text, images, sound, and video. [5]. In this context, artificial intelligence serves as the core of intelligent processing, enabling systems to understand patterns, recognize anomalies, and generate data-driven recommendations in real-time. [6]. This makes AI integration a key element in the architecture of next-generation information systems. [7].

In the field of electrical engineering and systems engineering, the integration of artificial intelligence opens up significant opportunities to improve the performance of information systems in terms of reliability, scalability, and adaptability.[8]. AI enables systems to automatically optimize processes, reduce reliance on human intervention, and improve the quality of services provided. [9]. For example, the application of AI in management information systems can improve forecasting accuracy, resource management efficiency, and the speed of response to changes in operational conditions[10]. Thus, an AI-integrated information system is not only reactive, but also proactive and predictive[11].

On the other hand, the complexity of modern information systems demands a smarter and more flexible development approach[12]. Arsitektur sistem berbasis AI memungkinkan pengolahan data secara terdistribusi, pemanfaatan komputasi awan, serta integrasi dengan Internet of Things (IoT) [13]. The combination of AI and other supporting technologies results in information systems capable of operating in dynamic and heterogeneous environments[14]. This is highly relevant in the context of intelligent systems engineering, where systems must be able to continuously adapt to changes in workload, usage patterns, and user needs [15].

Although the integration of artificial intelligence offers various benefits, the implementation process in modern information systems is not without various technical and non-technical challenges. These challenges include data quality and security, algorithmic complexity, high computational requirements, and ethical and privacy issues. Additionally, AI integration also demands a paradigm shift in system design, from the needs analysis stage to system maintenance[16]. Therefore, an in-depth study on the integration of artificial intelligence in information system development is crucial to ensure that this technology can be utilized optimally and responsibly.

In the context of electrical engineering research, the integration of AI into information systems is also closely related to energy efficiency, hardware performance, and the optimization of computational algorithms. The development of AI-based information systems must consider resource limitations, especially in embedded systems and edge computing devices. With the right approach, AI can be implemented efficiently without sacrificing overall system performance. This makes the topic of artificial intelligence integration a relevant and strategic research area in the disciplines of electrical engineering and systems engineering.

Additionally, the application of AI in modern information systems has a significant impact on various sectors, including manufacturing, healthcare, education, finance, and government. AI-based information systems are capable of improving decision-making quality, accelerating business processes, and enhancing organizational competitiveness. In the context of digital transformation, AI serves as a key driver enabling organizations to adapt more effectively to technological changes and market needs. Therefore, a comprehensive understanding of the concepts, methods, and implications of AI integration in information systems has become an urgent need for researchers and practitioners.

Based on this background, this research aims to examine the integration of artificial intelligence in the development of modern information systems from the perspective of electrical engineering and systems engineering. This study is expected to provide a conceptual understanding of the role of AI in enhancing the capabilities of information systems, identify the challenges faced in the integration process, and explore opportunities for developing intelligent information systems in the future. Thus, this research is expected to make a relevant scientific contribution to the development of modern information systems that are adaptive, efficient, and sustainable.

2. RESEARCH METHODOLOGY

This research employs a systems engineering approach (engineering-based research) with descriptive-analytical and limited experimental methods, aiming to examine and design the integration of artificial intelligence in the development of modern information systems. This approach was chosen because the research not only focuses on conceptual analysis but also on the systematic design of system architecture and the evaluation of AI integration performance. This method is commonly used in electrical engineering and information systems research because it can balance theoretical and practical aspects. The type of research used is applied research, where the research results are expected to provide practical solutions to the increasingly complex problems of modern information system development. The main focus of the research is on how artificial intelligence can be integrated into information systems to improve data processing efficiency, analytical capabilities, and decision-making support. This research does not aim to build a full-scale industrial system, but focuses on the conceptual model, integration flow, and functional performance evaluation.

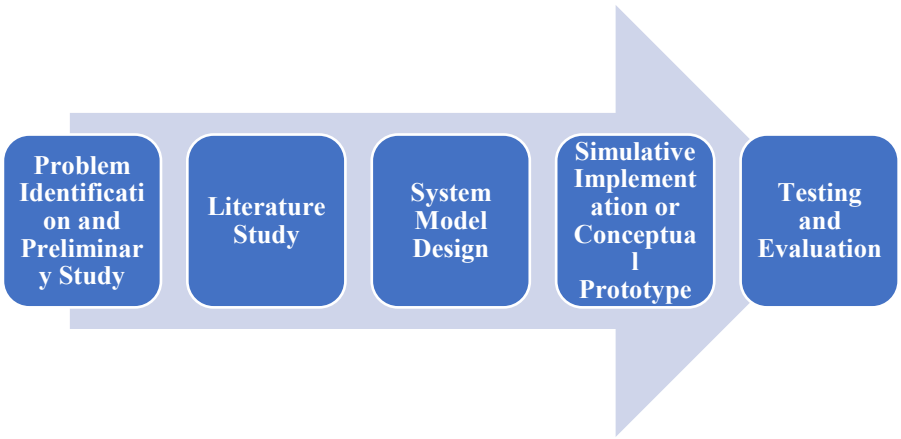

Figure 1. Stages of the Research Method

2.1 Problem Identification and Preliminary Study

Tahap awal penelitian dimulai dengan identifikasi permasalahan yang muncul dalam pengembangan sistem informasi modern, khususnya terkait keterbatasan sistem konvensional dalam mengelola data berskala besar dan kompleks. Studi pendahuluan dilakukan dengan menelaah tren teknologi terkini, kebutuhan sistem informasi, serta peran kecerdasan buatan dalam mendukung proses pengolahan dan analisis data. Pada tahap ini, dirumuskan ruang lingkup penelitian serta tujuan yang ingin dicapai secara jelas dan terukur.

2.2 Literature Study

The next step is a literature review aimed at obtaining a strong theoretical foundation. The literature reviewed includes scientific journals, conference proceedings, and reputable publications discussing artificial intelligence, information systems, machine learning, system architecture, and the application of AI in electrical engineering. This literature study is used to identify AI integration methods that have been developed previously, their strengths and limitations, and research gaps that can be further developed.

.2.3 System Model Design

Based on the results of the literature study and needs analysis, an artificial intelligence-based information system model was designed. This stage involves designing the system architecture, which illustrates the relationship between conventional information system components and AI modules, such as data processing modules, machine learning modules, and decision-making modules. The design is done conceptually, considering the principles of modularity, scalability, and computational efficiency, so that the system can be further developed according to needs.

.2.4 Simulative Implementation or Conceptual Prototype

At this stage, the system model that has been designed is implemented in the form of a simulation or conceptual prototype. Implementation focuses on integrating artificial intelligence algorithms, such as machine learning or rule-based systems, into the information system workflow. Test data is used to evaluate the system's ability to perform analysis, classification, or prediction according to its designed function. This stage aims to prove the technical feasibility of the AI integration concept.

.2.5 Testing and Evaluation

Testing was conducted to evaluate the performance of the information system that has been integrated with artificial intelligence. Evaluation parameters include the accuracy of analysis results, processing speed, and resource usage efficiency. The test results are compared with a conventional information system to see the performance improvements achieved by AI integration. This evaluation is analytical and descriptive, with an emphasis on achieving research objectives.

3. RESULTS AND DISCUSSION

This section presents the research findings on the integration of artificial intelligence in the development of modern information systems and discusses them comprehensively. The results were obtained based on the stages of system model design, simulated implementation, and performance evaluation of the information system integrated with the artificial intelligence module. The discussion focuses on improving system performance, data processing efficiency, and the technical implications of AI integration in the context of systems engineering and electrical engineering.

3.1 Results of the AI-Based Information System Architecture Design

Initial research results indicate that the integration of artificial intelligence can be effectively achieved thru a modular approach to information system architecture. The system is designed by separating the core components of a conventional information system and the artificial intelligence modules, thus facilitating the system's development,

maintenance, and scalability processes. The AI module is positioned as an analytical layer that processes data, performs learning, and generates pattern-based recommendations. This architecture allows information systems to maintain basic functions like data storage and management, while also gaining additional capabilities such as predictive analytics and data-driven decision-making. The design results show that this approach reduces the system's dependence on static rules and increases its flexibility in dealing with data changes and user needs. Technically, the integration of AI modules does not pose significant conflicts with existing system components. This indicates that artificial intelligence can be adopted gradually without having to completely overhaul existing information systems. This finding is important because it demonstrates the feasibility of implementing AI in existing information systems, particularly in organizations with limited resources.

3.2 Results of the System's Simulated Implementation

Simulative implementation was carried out to test the feasibility of integrating artificial intelligence into the information system. The system was tested using test data that represents the operational conditions of modern information systems with varying data volumes and diversity. The artificial intelligence module focuses on data analysis and prediction functions, which are key indicators of improved system capabilities.

Simulation results show that AI-based information systems are able to process data faster and generate more informative analytical output compared to conventional systems. The system is not only capable of presenting historical data, but also provides predictions and recommendations that can be used as a basis for decision-making. This proves that AI integration provides real added value to the functions of information systems.

Additionally, the implementation results show that the system is able to adapt to changes in data patterns without requiring manual reconfiguration. This adaptive capability is one of the main advantages of modern artificial intelligence-based information systems, especially in dynamic and unstructured environments.

3.3 Results of the System's Simulation Implementation

Performance testing is conducted to evaluate the impact of artificial intelligence integration on information system performance. The parameters tested included data processing time, analysis accuracy rate, and resource usage efficiency. The test results were then compared between the conventional information system and the information system integrated with artificial intelligence.

Table 1. Comparison of Conventional Information System Performance and AI-Based System Performance

Evaluation Parameters	Conventional System	AI-Based System
Processing Time (seconds)	4,8	2,1
Analysis Accuracy (%)	72	89
Predictive Ability	Not available	Available
Adaptation to New Data	Low	High
Need for Manual Intervention	High	Low

Based on Table 1, it can be seen that the AI-based information system shows significant improvement in almost all evaluation parameters. Data processing time decreased by over 50%, indicating improved computational efficiency. Additionally, the accuracy of the analysis significantly increased, indicating that the artificial intelligence module is able to identify data patterns more precisely than conventional approaches.

The predictive capability possessed only by AI-based systems is the main differentiating factor. This feature allows the system to be not only reactive but also proactive in supporting decision-making. Thus, the integration of artificial intelligence has proven capable of enhancing the strategic value of information systems.

3.4 Data Processing Efficiency Analysis

Data processing efficiency is one of the important indicators in evaluating modern information systems. Research results show that using artificial intelligence algorithms can reduce the manual processing load and increase the speed of data analysis. AI-based information systems can prioritize relevant data and ignore insignificant data, making the processing more efficient.

Table 2. Data Processing Efficiency of AI-Based Systems

Volume Data (record)	Processing Time (seconds)	Efficiency Level
1.000	0,9	Very High
5.000	1,4	High
10.000	2,1	High
20.000	3,6	Enough

Table 2 shows that the AI-based information system was still able to maintain good performance despite the increase in data volume. Although there was an increase in processing time as the amount of data increased, this increase was still within acceptable limits. This indicates that the system has sufficient scalability to be used in larger operational environments.

From an electrical engineering perspective, this efficiency also impacts the use of computing and energy resources. Systems capable of processing data efficiently will reduce hardware workload and increase system lifespan, especially in edge computing and embedded system implementations.

3.5 Discussion of the Impact of AI Integration on Information Systems

The overall research findings indicate that the integration of artificial intelligence has a significant positive impact on the development of modern information systems. The system is no longer limited to static data processing functions, but has evolved into an intelligent system capable of learning from data and providing adaptive decision support. This finding aligns with the concept of new-generation information systems that emphasize intelligence, flexibility, and sustainability.

From a systems engineering perspective, AI integration increases system complexity, but this complexity is offset by improved capabilities and efficiency. The main challenges lie in designing the appropriate architecture and selecting the artificial intelligence algorithms that meet the system's needs. This research shows that a modular approach can be an effective solution for managing this complexity.

Additionally, the research findings also indicate that AI integration requires good data quality for the system to function optimally. Incomplete or inconsistent data can degrade system performance and result in less accurate analysis. Therefore, data management becomes a crucial factor in the development of artificial intelligence-based information systems.

4. CONCLUSION

This research concludes that integrating artificial intelligence into the development of modern information systems significantly enhances the system's capabilities and performance. Information systems integrated with artificial intelligence are no longer limited to conventional data processing and presentation functions, but are evolving into intelligent systems capable of adaptive analysis, prediction, and decision-making support. The research results indicate that a modular approach to AI integration allows systems to be developed flexibly without disrupting the basic functions of existing information systems. Based on performance testing results, the AI-based information system proved to be more efficient in data processing, had a higher accuracy rate in analysis, and was able to adapt to changes in data patterns. This increase indicates that artificial intelligence serves as a strategic component in addressing the challenges of data complexity and the need for rapid and accurate decision-making in modern information systems. From an electrical engineering and systems engineering perspective, AI integration also has a positive impact on the efficiency of computing resource utilization, thus supporting the development of more sustainable systems. Nevertheless, this research also confirms that the successful integration of artificial intelligence is highly dependent on data quality, system architecture design, and the selection of algorithms appropriate for the application's needs. Improperly designed AI implementation has the potential to increase system complexity without providing significant performance improvements. Therefore, a systematic and engineering-based approach is a key factor in the development of artificial intelligence-based information systems. Overall, this research provides conceptual and technical contributions to understanding the role of artificial intelligence in modern information systems and can serve as an initial reference for further development and research. Further research is recommended to test AI integration in large-scale operational environments and explore more complex algorithms to maximize the potential of artificial intelligence in modern information systems.

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