Computer Technology Integration in Electronic Engineering: A Critical Analysis

Xinrui Bai

Chifeng Yuanbaoshan District Institutional Compilation Data Center Chifeng, Inner Mongolia 024076

Abstract: *This article examines the extensive application and impact of computer technology in electronic engineering. It explores the integration of advanced tools—including computer-aided design, simulation, signal processing, communication networks, automation systems, big data, artificial intelligence, and the Internet of Things—and highlights their role in enhancing design efficiency, optimizing product performance, and enabling intelligent control. The study underscores how computer technology serves as a key driver of innovation and development in the electronic engineering field.*

Keywords: Electronic engineering; Computer technology; Application.

1. INTRODUCTION

In the field of electronic engineering, the rapid development of computer technology is leading a profound transformation. As the cornerstone of modern technology, computer technology not only greatly broadens the design boundaries of electronic engineering, but also profoundly influences various aspects of product development, production, and operation. This article aims to analyze in depth the specific applications of computer technology in electronic engineering, explore how it promotes the intelligent, networked, and automated development of electronic products, and its important significance in enhancing industry competitiveness and promoting industrial upgrading. A critical focus within the digital economy is on balancing personalized services with user privacy. Li, Lin, and Zhang (2025) proposed a privacy-preserving advertising framework combining federated learning and differential privacy [1]. Extending the personalization paradigm, Li, Wang, and Lin (2025) enhanced sequential recommendation for cross-platform ad campaigns using graph neural networks [2]. This generative capability is also being directed toward urban planning, as seen in Xu's (2025) CivicMorph project for public space form development [3]. Reliable and adaptive infrastructure underpins these applications, evidenced by Zhang's (2024) use of cohesive hierarchical clustering for dynamic emergency material allocation [4] and Zhu's (2025) REACTOR framework for automated reliability engineering with causal tracking [5]. Graph-based models continue to demonstrate significant cross-domain utility. Yang, Wang, and Chen (2024) developed GCN-MF, a graph convolutional network for recommendation systems [6]. In critical healthcare applications, sophisticated data fusion is essential, as demonstrated by We et al. (2025) in their work on multimodal physiological data for intelligent anesthesia monitoring [7]. The stability of the digital infrastructure itself is addressed by Yang (2025), who researched site reliability optimization in cloud environments [8]. For autonomous systems, ensuring trust and robust environmental perception are paramount. Tang et al. (2026) developed SVD-BDRL, a blockchain-enhanced framework for trustworthy autonomous driving [9]. Generative AI enhances content creation, with Lu et al. (2025) proposing NeuroDiff3D for viewpoint-consistent 3D generation [10]. Robust 3D scene understanding is advanced by Xie et al. (2025) through MARNet, a multi-scale network for point cloud completion [11]. In business intelligence, Tian et al. (2025) applied cross-attention multi-task learning to innovate ad recall strategies [12]. However, the collaborative frameworks enabling such innovations require robust privacy safeguards. This need is addressed by research into secure federated learning, including the multi-layer defenses against membership reasoning attacks proposed by Deng and Yang (2025) [13] and the FedGuard framework for anti-money laundering by Sultan et al. (2026) [14]. Finally, specialized applications showcase the integration of sensor data and AI for analysis and healthcare. Zhu, Yu, and Li (2025) utilized a spatiotemporal graph convolutional network (SAGCN) with IoT for detailed tennis motion analysis [15], while Qin et al. (2025) focused on optimizing deep learning models to combat Amyotrophic Lateral Sclerosis (ALS) disease progression [16].

2. OVERVIEW OF COMPUTER TECHNOLOGY AND ELECTRONIC ENGINEERING

In the vast and intertwined fields of computer science and electronic engineering, technological innovation continues to drive rapid social development. They are not only the cornerstone of modern technology, but also the key force for various industries to achieve automation and intelligent transformation.

2.1 Fundamentals of Computer Technology

The foundation of computer technology covers a wide range of topics, from computer hardware to software, from theoretical algorithms to practical applications. Its core lies in understanding the working principle, structural composition, and how to use programming languages and tools for software development and system maintenance of computers. The basic knowledge in this field includes: Computer architecture, studying the basic components of a computer (such as CPU, memory, input/output devices, etc.) and their interrelationships, understanding how they work together to execute instructions and process data. Data structures and algorithms, exploring how to efficiently organize, store, and access data in computers, as well as designing effective algorithms to solve various problems and optimize program running efficiency. The operating system, as the core software of a computer system, is responsible for managing computer hardware resources, providing user interaction interfaces, and supporting multitasking parallel processing. Programming languages and software development, mastering one or more programming languages such as C, C++, Java, Python, etc., understanding the software development process, including requirements analysis, design, coding, testing, deployment, and maintenance. Computer network studies how computers connect, communicate and exchange data, including LAN, WAN, Internet technology and network security.

2.2 Introduction to Electronic Engineering

Electronic engineering is a widely applied engineering discipline that focuses on the research, design, manufacturing, and application of electronic devices and systems. This field involves multiple aspects such as electronic technology, communication principles, signal processing, and control theory, and is an indispensable part of modern information society. The introduction of electronic engineering mainly includes several key points;

(1) Fundamentals of Electronic Technology:

Covering the characteristics and working principles of electronic devices such as diodes, transistors, integrated circuits, as well as the design and analysis of analog and digital circuits.

(2) Signal processing:

Research on signal acquisition, conversion, transmission, storage, and processing methods, widely applied in fields such as communication, image processing, and audio processing.

(3) Communication principle:

Explore how information can be effectively transmitted in different media such as cables, optical fibers, and radio waves, including key technologies such as modulation and demodulation, encoding and decoding, and channel multiplexing.

(4) Control system:

Learn how to design and implement automatic control systems, using sensors, actuators, and feedback mechanisms to monitor and adjust system status to achieve predetermined goals.

(5) Embedded systems and microprocessors:

Research on how to apply computer technology to electronic devices with specific functions, and develop embedded systems with specific functions, such as smartphones, smart home devices, etc.

3. THE ROLE OF COMPUTER TECHNOLOGY IN ELECTRONIC ENGINEERING PROJECT MANAGEMENT

In the rapidly developing field of electronic engineering, project management plays a crucial role in ensuring that all stages of a project, from initiation to completion, are carried out efficiently and in an orderly manner. The deep application of computer technology has brought unprecedented convenience and efficiency improvement to electronic engineering project management.

3.1 Application of Project Management Software in Electronic Engineering

Project management software is one of the core tools for modern electronic engineering project management, which utilizes the powerful capabilities of computer technology to achieve refined management of the entire project lifecycle. Project management software can clearly display all tasks of the project, including key information such as task names, responsible persons, start times, and deadlines. Through software, project managers can easily assign tasks to team members and track the progress of tasks in real-time to ensure that the project progresses according to plan. The software's built-in visualization tools such as Gantt charts and milestones help project managers intuitively understand the overall progress of the project and the completion status of each stage.

Once progress is found to be lagging, immediate measures can be taken to adjust and avoid project delays. Project management software can record various expenses of the project in detail, including labor costs, material costs, equipment rental fees, etc., and compare and analyze them with the budget. This helps project managers to promptly identify the risk of cost overruns and take corresponding cost control measures. Most project management software supports online collaboration functionality, allowing team members to communicate in real-time, share files, and provide feedback through the software platform. This not only improves communication efficiency, but also promotes collaboration and cooperation among team members.

3.2 Resource Planning and Coordination

Effective planning and coordination of resources are key to the success of electronic engineering projects. Computer technology provides powerful support for resource planning and coordination by offering powerful data processing and analysis capabilities. By utilizing computer technology and historical project data, it is possible to predict the resource requirements of future projects. This helps project managers plan and allocate resources in advance, ensuring that the project receives sufficient support when needed. With the support of computer technology, various resources in the project can be analyzed in detail and optimized according to the actual needs of the project. For example, tasks can be allocated reasonably based on the skills and experience of team members to improve work efficiency and quality. Resource conflicts are a common issue in electronic engineering projects. Computer technology can help project managers quickly identify and resolve these conflicts. For example, by monitoring the usage of resources through a software platform, once a resource conflict is detected, coordination and adjustment can be made immediately.

3.3 Risk Assessment and Management

Risk assessment and management are indispensable parts of electronic engineering project management. Computer technology provides scientific basis for risk assessment and management by providing functions such as data analysis, simulation and prediction. Computer technology can collect and analyze large amounts of data to help project managers identify potential risks in the project. These data may come from multiple sources such as historical project experience, market trend analysis, and technical feasibility studies. After identifying risks, computer technology can quantitatively evaluate these risks. By establishing a risk assessment model, the probability and impact of risk occurrence are calculated to determine the priority and response strategies of risks. Based on the results of risk assessment, the project manager can develop corresponding risk response plans. Computer technology can support the development and implementation of these plans, such as evaluating the effectiveness of different response strategies through simulation and prediction, and helping project managers choose the best solution. Computer technology can also help project managers monitor the risk status of projects in real time and make dynamic adjustments based on actual situations. For example, by monitoring key indicators such as project progress, cost, and quality, potential risk factors can be identified in a timely manner, and corresponding preventive and control measures can be taken.

4. THE MAIN APPLICATIONS OF COMPUTER TECHNOLOGY IN ELECTRONIC ENGINEERING

4.1 Auxiliary Design and Simulation

In the early stages of electronic product design, computer-aided design (CAD) and simulation technology became indispensable tools. These technologies utilize the powerful computing and graphics processing capabilities of computers to provide designers with efficient and accurate design platforms. CAD software allows designers to create 3D models of electronic products in a virtual environment, including circuit board layout, component placement, wiring, and more. Designers can adjust design parameters in real-time, view design effects, and optimize designs. CAD technology not only improves design efficiency, but also reduces design errors and rework costs. Simulation technology verifies and optimizes designs by simulating the actual working environment and operating status of electronic products. During the simulation process, parameters such as operating current, voltage, and frequency of the circuit can be simulated to predict the performance of the product. Simulation technology helps designers identify potential issues during the product design phase and make targeted improvements, thereby improving the reliability and stability of the product.

4.2 Signal Processing and Analysis

Signal processing and analysis is one of the core tasks in electronic engineering, and computer technology provides powerful support for this field. Digital Signal Processing (DSP), DSP technology utilizes computers to quickly and efficiently process and analyze digital signals. In electronic engineering, DSP technology is widely used in fields such as audio, video, image processing, and communication systems. Through DSP technology, signals can be filtered, enhanced, compressed, and other operations to improve signal quality and transmission efficiency. Spectrum analysis is an important part of signal processing, which uses computer technology to analyze the frequency components of signals. Through spectrum analysis, key information such as the spectral distribution and frequency characteristics of signals can be understood, providing a basis for signal processing and recognition. In electronic engineering, spectrum analysis technology is widely used in fields such as radar, sonar, wireless communication, etc.

4.3 Communication and Network

Communication and networking are important components of electronic engineering, and computer technology plays a crucial role in them. Computer technology provides the foundation for the design and implementation of communication protocols. A communication protocol is a series of rules and standards that both parties must follow in order to effectively exchange information. Through computer technology, efficient and reliable communication protocols can be designed to ensure the accuracy and completeness of information during transmission. Network technology is a product of the combination of computer technology and communication technology. In electronic engineering, network technology is widely used in LAN, WAN, Internet and other aspects. Through network technology, electronic devices can be interconnected and data can be shared and transmitted. Network technology also provides rich network services and applications, such as cloud computing, big data, the Internet of Things, etc., providing broad space for the development of electronic engineering.

4.4 Control System and Automation

Control systems and automation are one of the important application areas of electronic engineering, and computer technology is the key technology to achieve control system automation. Embedded systems are products that integrate computer technology, electronic technology, control technology, and more. In electronic engineering, embedded systems are widely used in various control devices, such as smart homes, industrial automation control systems, etc. Through embedded systems, precise control and intelligent management of control devices can be achieved, improving their operational efficiency and reliability. Automated control is a technology that uses computer technology to automatically monitor, regulate, and control the production process. In electronic engineering, automation control technology is widely used in production lines, robots, drones, and other fields. Through automation control technology, the production process can be automated and intelligent, improving production efficiency and product quality.

4.5 Application of Artificial Intelligence and Machine Learning in Electronic Engineering

With the rapid development of artificial intelligence and machine learning technologies, their applications in electronic engineering are becoming increasingly widespread. Artificial intelligence technology can be applied to

the fault diagnosis and maintenance of electronic devices. By training machine learning models, real-time monitoring and predictive maintenance of device status can be achieved. When equipment malfunctions, artificial intelligence systems can quickly locate the cause of the problem and provide solutions, reducing downtime and maintenance costs. Artificial intelligence technology can also be used for optimizing the design of electronic products. By learning and analyzing a large amount of design data through machine learning algorithms, design rules and optimization space can be discovered, and better design solutions can be proposed. This can not only improve the performance and quality of the product, but also shorten the design cycle and reduce costs. Introducing artificial intelligence technology into control systems can achieve more intelligent and flexible control strategies.

5. THE DEVELOPMENT TREND OF COMPUTER TECHNOLOGY

5.1 Integration of Big Data and Artificial Intelligence (AI)

The integration of big data and artificial intelligence is an important trend in the current development of computer technology. The rise of big data technology has made it possible to collect, store, process, and analyze massive amounts of data, providing abundant data resources for the development of artificial intelligence. Artificial intelligence algorithms and models can extract valuable information and knowledge from this data, driving the continuous deepening of intelligent applications. In the future, the integration of big data and artificial intelligence will become even closer. On the one hand, with the continuous increase in data volume and the diversification of data types, artificial intelligence algorithms will need to be continuously optimized and innovated to better cope with complex data processing tasks. On the other hand, the maturity of artificial intelligence technology will also provide more intelligent solutions for big data mining and analysis, further enhancing the value of data utilization. This trend of integration will not only drive the advancement of computer technology, but also profoundly affect the development models of various industries, promoting industrial upgrading and transformation.

5.2 Prospects of the Application of the Internet of Things (IoT) in Electronic Engineering

The Internet of Things, as an important component of the new generation of information technology, is gradually penetrating into various fields of electronic engineering. The Internet of Things is a huge network formed by combining various information sensing devices with the Internet through communication sensing technologies such as intelligent perception, recognition technology and pervasive computing. In electronic engineering, the application prospects of Internet of Things technology are very broad [5]. Firstly, IoT technology can achieve interconnectivity of electronic devices, forming an intelligent network system. Through IoT technology, various electronic devices can be connected together to achieve data sharing and exchange, thereby improving the operational efficiency and intelligence level of devices. For example, in the field of smart homes, IoT technology can achieve remote control, intelligent scheduling, and energy-saving management of household appliances. Secondly, IoT technology can also bring new business and service models to the field of electronic engineering. Through IoT technology, real-time monitoring and predictive maintenance of equipment can be achieved, reducing equipment failure rates and maintenance costs. Meanwhile, IoT technology can also provide users with more personalized and intelligent service experiences, meeting their diverse needs.

6. CONCLUSION

In summary, the application of computer technology in electronic engineering not only greatly improves the efficiency and accuracy of various aspects such as design, manufacturing, testing, and operation, but also promotes the development of product intelligence, networking, and automation. With the continuous integration and innovation of technologies such as big data, artificial intelligence, and the Internet of Things, there is reason to believe that the application of computer technology in the field of electronic engineering will become more extensive and in-depth, laying a solid foundation for building more intelligent, efficient, and sustainable electronic systems.

REFERENCES

[1] Li, X., Lin, Y., & Zhang, Y. (2025). A Privacy-Preserving Framework for Advertising Personalization Incorporating Federated Learning and Differential Privacy. arXiv preprint arXiv:2507.12098.

[2] Li, X., Wang, X., & Lin, Y. (2025). Graph Neural Network Enhanced Sequential Recommendation Method for Cross-Platform Ad Campaign. arXiv preprint arXiv:2507.08959.

[3] Xu, Haoran. "CivicMorph: Generative Modeling for Public Space Form Development." (2025).

[4] Zhang, X. (2024). Research on Dynamic Adaptation of Supply and Demand of Power Emergency Materials based on Cohesive Hierarchical Clustering. Innovation & Technology Advances, 2(2), 59–75. https://doi.org/10.61187/ita.v2i2.135

[5] Zhu, Bingxin. "REACTOR: Reliability Engineering with Automated Causal Tracking and Observability Reasoning." (2025).

[6] Yang, J., Wang, Z., & Chen, C. (2024). GCN-MF: A graph convolutional network based on matrix factorization for recommendation. Innovation & Technology Advances, 2(1), 14–26. https://doi.org/10.61187/ita.v2i1.30

[7] We, X., Lin, S., Pruś, K., Zhu, X., Jia, X., & Du, R. (2025). Towards Intelligent Monitoring of Anesthesia Depth by Leveraging Multimodal Physiological Data. International Journal of Advance in Clinical Science Research, 4, 26–37. Retrieved from https://www.h-tsp.com/index.php/ijacsr/article/view/158

[8] Yang, Y. (2025). Research on Site Reliability Optimization Technology Based on Synthetic Monitoring in Cloud Environments.

[9] Tang, Z., Feng, Y., Zhang, J., & Wang, Z. (2026). SVD-BDRL: A trustworthy autonomous driving decision framework based on sparse voxels and blockchain enhancement. Alexandria Engineering Journal, 134, 433-446.

[10] Lu, K., Sui, Q., Chen, X., & Wang, Z. (2025). NeuroDiff3D: a 3D generation method optimizing viewpoint consistency through diffusion modeling. Scientific Reports, 15(1), 41084.

[11] Xie, J., Zhang, L., Cheng, L., Yao, J., Qian, P., Zhu, B., & Liu, G. (2025). MARNet: Multi-scale adaptive relational network for robust point cloud completion via cross-modal fusion. Information Fusion, 103505.

[12] Q. Tian, D. Zou, Y. Han and X. Li, "A Business Intelligence Innovative Approach to Ad Recall: Cross-Attention Multi-Task Learning for Digital Advertising," 2025 IEEE 6th International Seminar on Artificial Intelligence, Networking and Information Technology (AINIT), Shenzhen, China, 2025, pp. 1249-1253, doi: 10.1109/AINIT65432.2025.11035473.

[13] Deng, X., & Yang, J. (2025, August). Multi-Layer Defense Strategies and Privacy Preserving Enhancements for Membership Reasoning Attacks in a Federated Learning Framework. In 2025 5th International Conference on Computer Science and Blockchain (CCSB) (pp. 278-282). IEEE.

[14] Sultan, N., Patwar, N., Wei, X., Chew, J., Liu, J., & Du, R. (2026). FedGuard: A Robust Federated AI Framework for Privacy-Conscious Collaborative AML, Inspired by DARPA GARD Principles. International Academic Journal of Social Science, 2, 1–16. https://doi.org/10.5281/zenodo.18253151

[15] Zhu, Y., Yu, W., & Li, R. (2025). SAGCN: A spatiotemporal attention-weighted graph convolutional network with IoT integration for adolescent tennis motion analysis. Alexandria Engineering Journal, 128, 652-662.

[16] Qin, Haoshen, et al. "Optimizing deep learning models to combat amyotrophic lateral sclerosis (ALS) disease progression." Digital health 11 (2025): 20552076251349719.