Research on the Development and Application Innovation of Modern Artificial Intelligence Technology

Yimeng Fan

College of Communications, Liaoning Communication University, Shenyang, Liaoning, China

Abstract

With the rapid iteration of big data, cloud computing and chip computing power, artificial intelligence technology has entered a new stage of large-scale industrial application. As a core technology leading the technological revolution and industrial transformation in the new era, artificial intelligence has been widely penetrated into education, medical treatment, manufacturing, transportation, media and other fields. It has profoundly changed traditional production modes, service processes and social operation logic. This paper systematically sorts out the technical connotation, development evolution and core technical system of modern artificial intelligence. It analyzes the application status, technical advantages and existing bottlenecks of artificial intelligence in various industries. Combined with the current technical difficulties of intelligent algorithm generalization, data security risk and high-cost industrial deployment, the paper puts forward targeted optimization strategies and future development trends. The research aims to provide theoretical reference and practical inspiration for the innovative application and standardized development of artificial intelligence technology, and has certain academic value and engineering application significance.

Keywords

Artificial Intelligence; Machine Learning; Intelligent Application; Technology Evolution; Industrial Innovation.

1. Introduction

In the era of digital economy, artificial intelligence has become a key strategic technology for global scientific and technological competition and industrial upgrading. Different from the simple mechanical automation in the industrial era, modern artificial intelligence realizes autonomous learning, intelligent perception, logical reasoning and intelligent decision-making based on multi-dimensional data training and deep learning algorithms. It breaks through the limitations of traditional manual operation and fixed program execution, and realizes the intelligent upgrading of social production and life services.

In recent years, with the explosive growth of massive heterogeneous data and the continuous improvement of GPU parallel computing capabilities, artificial intelligence technology has achieved leapfrog development from shallow machine learning to deep neural network learning. A series of intelligent technologies such as natural language processing, computer vision, intelligent recommendation and generative artificial intelligence have been continuously mature and commercialized. At present, artificial intelligence is no longer a single laboratory theoretical technology, but a comprehensive technical system integrating algorithm model, data resources, computing power support and scenario application. It promotes the digital transformation and intelligent upgrading of all walks of life.

However, in the process of large-scale popularization of artificial intelligence technology, there are still many practical problems. The problems such as insufficient generalization

ability of intelligent algorithms, uneven quality of training data, potential risks of data privacy leakage, high cost of intelligent equipment deployment and imperfect industry supervision system restrict the high-quality development of artificial intelligence industry. Based on this background, this paper conducts in-depth research on the technical system, application scenarios, existing problems and innovative development paths of modern artificial intelligence, so as to lay a foundation for the standardized, safe and efficient application of artificial intelligence technology.

2. Connotation and Evolution of Artificial Intelligence Technology

2.1. Technical Connotation of Artificial Intelligence

Artificial intelligence is a comprehensive interdisciplinary technology integrating computer science, mathematics, cognitive science, statistics and engineering science. Its core goal is to enable machines to simulate human perception, memory, thinking, reasoning, decision-making and learning abilities. Different from traditional computer programs that rely on fixed logic and manual coding, modern artificial intelligence realizes autonomous rule summarization and model optimization through data-driven training. It can adapt to complex and changeable scenario environments and complete intelligent tasks that are difficult for traditional programs.

The technical system of modern artificial intelligence mainly includes three core layers: data layer, algorithm layer and application layer. The data layer provides basic data resources for model training, including structured data, unstructured text data, image video data and voice data. The algorithm layer is the core support of artificial intelligence, including traditional machine learning algorithms and deep learning neural network models. The application layer realizes scenario landing through model deployment, covering intelligent recognition, intelligent prediction, intelligent creation and intelligent control.

2.2. Evolution Stages of Artificial Intelligence Development

The development of artificial intelligence has gone through three typical evolutionary stages, from initial theoretical exploration to industrial popularization and intelligent innovation [1].

The first stage is the initial exploration stage of symbolic artificial intelligence. In the early stage of artificial intelligence research, researchers mainly relied on manual definition rules and logical reasoning to realize simple machine simulation. Limited by computer computing power and data scale, the intelligent level of this stage was low, and it could only complete single fixed tasks such as mathematical reasoning and simple game judgment, lacking autonomous learning ability.

The second stage is the rapid development stage of machine learning. With the improvement of computer performance and the accumulation of small-scale data, machine learning algorithms such as decision tree, support vector machine and Bayesian algorithm are widely used. The machine realizes preliminary autonomous learning based on sample data, which improves the accuracy of data classification and prediction. Artificial intelligence technology began to move from theoretical research to simple industrial application.

The third stage is the deep intelligence stage of deep learning. Relying on big data and high-performance computing power, deep neural network models such as convolutional neural network, recurrent neural network and transformer structure have been rapidly developed. Artificial intelligence has made major breakthroughs in computer vision, natural language processing and generative intelligence, realizing large-scale commercial application and scenario innovation.

3. Core Technical System of Modern Artificial Intelligence

3.1. Machine Learning and Deep Learning Technology

Machine learning is the basic core of artificial intelligence technology. Its core logic is to enable computers to automatically summarize data rules and optimize model parameters through training data without explicit programming. Traditional machine learning mainly relies on manual feature engineering to extract data features, which is suitable for small sample and simple scenario tasks.

Deep learning is an upgraded technology of machine learning. It constructs multi-layer neural network structures to realize automatic feature extraction, feature fusion and rule mining of high-dimensional complex data. At present, deep learning technology has become the mainstream technical framework of artificial intelligence. Convolutional neural networks are widely used in image recognition, face verification and defect detection. Recurrent neural networks are suitable for time series data analysis such as voice recognition and financial prediction. The transformer model lays a technical foundation for generative artificial intelligence and large-scale pre-trained models.

3.2. Computer Vision Technology

Computer vision is one of the most mature and widely applied branches of artificial intelligence. Its core function is to enable machines to simulate human visual perception ability, realize automatic acquisition, identification, analysis and understanding of image and video information. At present, computer vision technology has been widely used in industrial defect detection, intelligent monitoring, face recognition, autonomous driving and medical image diagnosis.

With the continuous optimization of neural network models, computer vision technology has realized the upgrading from single target recognition to fine-grained scene understanding. It can accurately complete complex tasks such as multi-target tracking, semantic segmentation and three-dimensional reconstruction, providing important technical support for industrial intelligent supervision and intelligent security prevention and control.

3.3. Natural Language Processing Technology

Natural language processing is a key technology for human-computer interaction. It enables computers to understand, analyze, generate and translate human natural language. This technology realizes the intelligent interaction barrier breaking between human and machine. Traditional natural language processing relies on lexical analysis and syntactic rule matching, with poor contextual understanding ability. Modern natural language processing based on large-scale pre-trained models can realize deep semantic understanding, context association and intelligent text generation.

At present, natural language processing technology has been applied in intelligent customer service, machine translation, text classification, emotional analysis and generative writing. It greatly improves the efficiency of text information processing and human-computer interaction experience [3].

3.4. Generative Artificial Intelligence Technology

Generative artificial intelligence is the latest development hotspot of modern artificial intelligence. Different from discriminant artificial intelligence which only completes classification and prediction tasks, generative AI can autonomously create new texts, images, videos, codes and design works based on existing data training [2]. It realizes the transformation of artificial intelligence from "recognition judgment" to "creative generation".

Generative artificial intelligence represented by large language models has strong generalization and scenario adaptation ability. It has produced innovative changes in content creation, industrial design, code development, educational teaching assistance and other fields, and becomes an important driving force for industrial innovation.

4. Existing Problems and Technical Bottlenecks of Artificial Intelligence

4.1. Insufficient Generalization Ability of Intelligent Algorithms

At present, most artificial intelligence models rely on specific scenario data training. The generalization and migration ability of the models are insufficient. The model with excellent training effect in a single scenario often has poor adaptability in complex and variable actual industrial scenarios [4]. The problems of over-fitting and under-fitting of the model are common, which affects the stability and accuracy of intelligent application. In addition, the large-scale pre-trained model has huge parameter quantity and complex structure, which leads to high model deployment cost and difficult lightweight application.

4.2. Data Quality and Data Security Risks

Data is the core resource of artificial intelligence model training. The quality of training data directly determines the performance of intelligent models. At present, many industry training data have problems such as uneven quality, incomplete labeling and single data dimension, which leads to low robustness of model training. At the same time, in the process of data collection, transmission and model training, there are hidden dangers of user privacy information leakage and illegal data crawling. The lack of perfect data security supervision mechanism restricts the safe and standardized development of artificial intelligence.

4.3. High Industrial Deployment Cost and Unbalanced Development

High-end artificial intelligence equipment, chip computing power support and model training require high capital and technical investment. Small and medium-sized enterprises lack sufficient funds and technical teams to complete intelligent transformation, resulting in unbalanced industrial development of artificial intelligence. The intelligent application of large enterprises is mature, while the digital and intelligent transformation of small and medium-sized industries is lagging behind, which restricts the overall popularization effect of artificial intelligence technology.

4.4. Imperfect Industry Standard and Supervision System

At present, the industry standards and ethical norms of artificial intelligence are not perfect. There are problems such as inconsistent model evaluation standards, unclear application boundary and insufficient risk supervision in the process of intelligent technology application. The intelligent algorithm may produce discrimination results and wrong decisions due to data deviation, which brings potential risks to social production and life. The lack of standardized supervision system affects the sustainable and healthy development of artificial intelligence industry.

5. Innovative Development Strategies of Artificial Intelligence Technology

5.1. Optimize Algorithm Model and Improve Generalization Ability

Strengthen the research of lightweight neural network algorithms and migration learning technology, optimize the model structure, reduce model parameters and computing consumption, and realize the lightweight deployment of artificial intelligence models in terminal equipment. Adopt multi-scenario data fusion training and data enhancement technology to improve the model's adaptability to complex scenarios. Optimize the model

evaluation system, take accuracy, stability and generalization as the core evaluation indicators, and improve the comprehensive performance of intelligent algorithms [5].

5.2. Build High-quality Data System and Strengthen Data Security

Establish standardized data collection, screening, labeling and storage mechanisms to improve the quality and diversity of artificial intelligence training data. Build a data security protection system based on encryption technology and access control mechanism to prevent data privacy leakage and illegal use. Clarify the ownership and use specifications of industry data, formulate unified data application standards, and provide safe and reliable data support for artificial intelligence model training.

5.3. Reduce Industrial Application Cost and Promote Balanced Development

Strengthen the research and development of domestic low-cost intelligent chips and terminal equipment, reduce the hardware deployment cost of artificial intelligence. Promote the sharing of public computing power resources and open artificial intelligence basic platforms for small and medium-sized enterprises, so as to reduce the threshold of intelligent transformation. Carry out industry targeted intelligent transformation services, formulate personalized application schemes according to the characteristics of different industries, and promote the balanced development of artificial intelligence in various fields.

5.4. Improve Industry Standards and Ethical Supervision Mechanisms

Establish unified artificial intelligence technology evaluation standards, application specifications and ethical norms, clarify the application boundary and responsibility boundary of intelligent technology. Strengthen the whole-process supervision of artificial intelligence algorithm training, model deployment and scenario application, and avoid algorithm discrimination and wrong decision-making risks. Establish an artificial intelligence risk early warning and emergency response mechanism to ensure the standardized, safe and orderly development of artificial intelligence industry.

6. Conclusion

As a core strategic technology in the digital era, artificial intelligence has profound reform power and wide application value. This paper systematically sorts out the technical connotation, evolution process and core technical system of modern artificial intelligence, analyzes the practical application status of artificial intelligence in manufacturing, education, medical treatment and media industries, and summarizes the technical bottlenecks such as insufficient algorithm generalization, uneven data quality, high deployment cost and imperfect supervision system existing in the current development process.

Aiming at the existing problems, this paper puts forward optimization strategies from algorithm upgrading, data construction, cost control and standard supervision, and prospects the future development trend of artificial intelligence technology. The research shows that modern artificial intelligence technology is in a period of rapid development and scenario innovation. Only by continuously optimizing technical systems, standardizing industry applications and strengthening risk supervision can we realize the high-quality development of artificial intelligence technology and better empower industrial transformation and social progress. In the future, with the continuous innovation of basic algorithms and supporting technologies, artificial intelligence will play a more important role in all fields of society and bring more intelligent and convenient changes to social production and people's life.

References

[1] Sun, J. J., Wu, X. Y., Zhang, C. H., et al. (2026). The configuration incubation path of technology-based enterprises in the 'AI+' low-altitude economy. *Journal of Resources and Environment*, *48*(3), 595-610.

[2] Chen, C. J. (2025). Decoding the digital transformation of optoelectronic manufacturing enterprises: these paths are crucial. *Chinese Business*, (4), 78-79.

[3] Jiang, L. Y., Yu, J., & Lv, W. J., et al. (2025). The ethical dilemma and governance path of artificial intelligence in medical research and academic publishing. *Chinese Journal of Clinical New Medicine*, *18*(12), 1425-1428.

[4] Sobeh, T., Shrot, S., Bakon, M., et al. (2025). Retrospective detection of missed intra-cranial aneurysms on computed tomography angiography using a commercial deep learning algorithm. *Neuroradiology*, *67*(12), 1-9. https://doi.org/10.1007/s00234-025-02789-5.

[5] Damir, D., Goran, S., & Darko, M., et al. (2025). Cybersecurity in the Age of AI: Challenges and Solutions. *ENTRENOVA - ENTerprise REsearch InNOVAtion Journal*, *11*(1). https://doi.org/ 10.33134/ eeij.2025. 11. 1.07.

[6] Jaworski, W., Dolata, T., Sawina, P., et al. (2026). Comparison of GPT-5 and GPT-4o in Solving the Polish Centre for Medical Examinations (CEM) Gastroenterology Examination. *Cureus*, *18*(1), e102497. https://doi.org/10.7759/cureus.102497.