DOI: 10.53469/wjimt.2024.07(02).09

Enterprise Digital Intelligent Remote Control System Based on Industrial Internet of Things

Binbin Wu[1,*], Chenxi Shi[2], Wei Jiang[3], Tong zhan[4], Kun Qian[5]

[1]Heating Ventilation and Air Conditioning Engineering, Tsinghua University, Beijing China
[2]Telecommunication Systems Management, Northeastern University,Boston, MA, USA
[3]Computer Science, Xidian University, Xian,China
[4]Computer Science, Columbia University, NY, USA
[5]Business Intelligence,Engineering School of Information and Digital Technologies, Villejuif, France
[*]*Corresponding author, wubinbin.1@gmail.com*

Abstract: ***Based on the background of Industrial Internet of Things, this paper aims to explore the application of remote monitoring and maintenance technology in IT enterprise automation control system. IT equipment as the core of modern enterprise management, in today's industrial Internet of Things and intelligent development, how to better manage these equipment, do a good job of daily troubleshooting, daily maintenance, management is a moment to reflect the comprehensive strength of an enterprise. Improve the continuity of production and optimize the production process, so as to effectively and quickly deal with various problems in production and life. This paper will deeply study the basic principles, application cases, and maintenance and fault diagnosis strategies of this technology in the enterprise, in order to provide more efficient and intelligent production management solutions for the IT industry. The results show that remote monitoring and maintenance technology plays an important role in improving production efficiency, reducing costs, ensuring quality and ensuring equipment reliability, and has a positive impact on the development and sustainability of the industry.***

Keywords: Industrial Internet of Things; Enterprise information management; Remote operation and maintenance management; Enterprise management.

1. INTRODUCTION

According to the IT industry estimates that by 2020, there will be 50 billion to 100 billion IT devices in the world, which will carry countless services, covering all aspects of production and life such as the Internet, finance, Internet of Things, intelligent manufacturing, telecommunications, power grids, and government. In the context of industrial development, with the improvement of the level of enterprise information and data security, enterprise security policies and IT specifications have imposed strict restrictions on IT engineers' access to IT equipment, such as: (1) Set access levels; (2) Restrict IT engineers to pre-connect to "virtual private networks (VPNS) for IT management"; (3) The network policy of the enterprise blocks the TCP/UDP ports and network protocols that are not required by the service.

Based on this, this paper summarizes the following problems in the intelligent development of most enterprises: (1) Equipment operation: for widely distributed production equipment, it is impossible to remotely monitor the operation and failure of equipment; (2) Operation and maintenance costs: high maintenance costs, multiple invalid business trips, equipment failures can not be timely mastered; (3) Equipment operation services: equipment operation, failure, service, customer use, energy consumption and other data cannot be obtained in real time, and cannot effectively support operation services; (4) Equipment services: equipment problems are not reported in a timely manner, communication is not smooth, and workers' work conditions can not be timely mastered.

In today's large-scale distribution and operation of industrial equipment, enterprises must use centralized control and management systems combined with digital intelligence to carry out enterprise IT equipment management information, equipment maintenance remote, equipment status visualization. Only in this way can the entire system help manufacturing enterprises to monitor the status of production equipment in real time, shorten the maintenance cycle, reduce maintenance costs, improve service quality, maintain a competitive advantage, more likely to create new sources of revenue, to achieve the leap of industry 4.0.

2. RELATED WORK

With the deepening of the digital transformation of the IT industry, enterprises are gradually investing more smart devices on the production line. Enterprises that rely on a large number of intelligent equipment have fast hairpin, but how to carry out daily operation and maintenance management, how to improve efficiency and reduce costs in daily operation and maintenance is now a new issue facing the development of enterprises. For security reasons, most of the equipment on the production line has strict network isolation requirements. Therefore, remote O&M commissioning of production lines is usually deployed on the Intranet to isolate devices from the public network [1]. This brings great inconvenience to the daily operation and maintenance of IT engineers, increases the cost of enterprises, and is not conducive to the improvement of enterprise efficiency.

Digital intelligent enterprise remote control technology is an important way to realize remote debugging operation and maintenance. This paper hopes that enterprises can learn from the successful experience of other enterprises to seek innovation and develop new technologies on the basis of making full use of existing investments.

2.1 Industrial Internet of Things

On 18 June 2009, the European Commission presented the EU Action Plan for the Internet of Things to the European Parliament and the Council. On September 15, 2009, the European Union issued the "EU Internet of Things Strategic Research Roadmap", determining the 2012, 2015 and 2020 [2] Internet of Things development roadmap, iot related technologies should be mainly used in industry, agriculture, transportation, energy and medical and other 18 fields. It identified 12 areas where major breakthroughs need to be made in key technologies such as image recognition, information processing, and iot architecture.

The "Internet of Things, Data and services" will play an increasingly important role in this industrial revolution, which will gradually change the current design and manufacturing model. This is a technological revolution from embedded systems to information physical systems [3]. Connecting physical devices with the Internet of Things enables these production tools to have five functions, such as computing, remote coordination, autonomy, communication, and control, so as to realize the information integration of virtual network structure and the real physical world.

At its core, the Industrial Internet is the convergence of digital technologies, the Internet and industrial processes, weaving them into a seamless structure that can revolutionize the way businesses operate. To put it simply, think of the Industrial Internet as a giant neural network of interconnected devices, machines, and systems within an industry. These components are no longer isolated entities, but part of a unified intelligent ecosystem. They communicate, analyze data and react in real time, making previously complex processes more efficient and simplified.

2.2 Enterprise digital intelligent transformation

Under the background of the industrial Internet of Things, more and more enterprises have to go to the road of digital transformation, in addition to the basic security needs, many manufacturing enterprises will pay attention to the actual business improvement brought by remote control, such as whether it can strengthen the competitiveness of the after-sales link and so on [4]. Over the past three years, these leaders' compound revenue growth rate has been as high as 14.3%, which is much higher than the 2.6% of the other companies in the study, and their sales profit margin is also much higher than the other companies, reaching 12.7%, which is only 5.2% in the same period. McKinsey's Analytics Quotient Quotient database surveyed a number of companies around the world and found that companies with a higher level of digital maturity have stronger business growth drivers. The revenue and profit growth rates of companies with strong digital integration capabilities are 2.4 times higher than the average of the rest of the sample.

Digital transformation can bring real value to enterprises and provide continuous impetus for enterprise development. The key to enterprise digitalization lies in the multi-business scenario application of cloud computing, big data, artificial intelligence, mobile [5] Internet, blockchain and other digital technologies to realize the enterprise's "sensitive operation, light management, easy finance, simple IT", so as to support the realization of business performance objectives such as "increasing revenue, reducing costs, improving efficiency, and controlling risks". The best representative of the digital transformation of enterprise IT equipment is the intelligent remote centralized management system.

2.3 Intelligent remote centralized management system

The global remote control software market size reached $1.762 billion in 2022 and is expected to reach $4.49 billion in 2029, with a compound annual growth rate (CAGR) of 14.37%. At present, major global enterprises include TeamViewer, Cisco WebEx, Splashtop, Zoho, LogMeIn, Rsupport (RemoteView), AnyDesk, Sunflower, SolarWinds Dameware, etc. In 2022, the share of Top 5 enterprises will exceed 38%.

The system generally consists of basic configuration, equipment remote control, equipment operating status monitoring, equipment field remote monitoring, equipment operating record generation, equipment operating rate, data collection, defect database establishment, record and report process management, system log management, accounting management and other parts [6]. With just one setup, engineers can eliminate a lot of red tape. Enter the IP addresses of centrally managed services into dispersed devices, deploy devices on the console, and deliver policies. When the network is abnormal or the control operation is abnormal, the controller can check the device status immediately to rectify the problem.

When remote operation and maintenance or external suppliers need access, you can use the fortress computer to access the Intranet computer installed with the main control terminal for remote operation and debugging. In this deployment mode, the remote control scheme is completely in the Intranet environment, narrowing the external access rights to a certain extent, and unified management of the fortress machine, which is more in line with the security compliance needs of the manufacturing industry [7]. At the same time, the fortress machine will no longer be occupied by a single remote access requirement, and the burden is greatly reduced. Realize enterprise remote control and deep business integration: visual after-sales operation and maintenance of production line equipment.

Through the introduction of technologies such as the Internet of Things, big data analysis, and machine learning, the production process is automated and intelligent, thereby improving production efficiency, reducing waste, and improving product quality. For example, use sensors to monitor the status of production lines, adjust production parameters in real time, or detect product defects through machine vision to ensure quality.

The new generation of information technology develops rapidly, has strong penetration ability, connects the original "digital island", expands the space to control production resources and production processes, and provides means for IT engineers. The rapid development of enterprise digital intelligent technology has promoted the social economy from "digital economy" to "intelligent economy", and the social form and production mode will also undergo great changes.

3. METHODOLOGY

Topic:Taking enterprises A, B, and C as examples, this paper shows that in order to further improve the efficiency of remote operation, maintenance, debugging and remote assistance at the production line end under the premise of meeting the security standards, the enterprise introduces the deployment scheme of remote centralized control system after the data security coordinator has met the specific requirements of the production line end. Unified management and implementation of production line remote operation and maintenance debugging and assistance, to provide safe and secure equipment operation and maintenance tools for the engineer team.

3.1 System model framework

The centralized management system of IT equipment consists of five modules: (1) Web service module: provides an HTTPs-based User interface, which can graphically display the design drawing of IT facilities and can be clicked to operate the equipment [7]. (2) User identity management: User management function, based on the OpenID Connect (OIDC) identity authentication protocol, uses JSON Web Token (JWT) to transmit and verify user authorization information [8]. (3) Gateway for device management connections: IT uses different interfaces and protocols to connect IT devices, and then converts all connections to HTTPS protocols to pass information between Web services and IT engineers [9]. (4) LLM-based information analysis module: IT can monitor the information between IT engineers and IT devices in real time, use LLM to intelligently analyze the possibility of failure causes, and provide operational suggestions [10]. (5) AI-based video analysis, the system will support real-time video communication with IT engineers in the future, and there can be a variety of use scenarios.

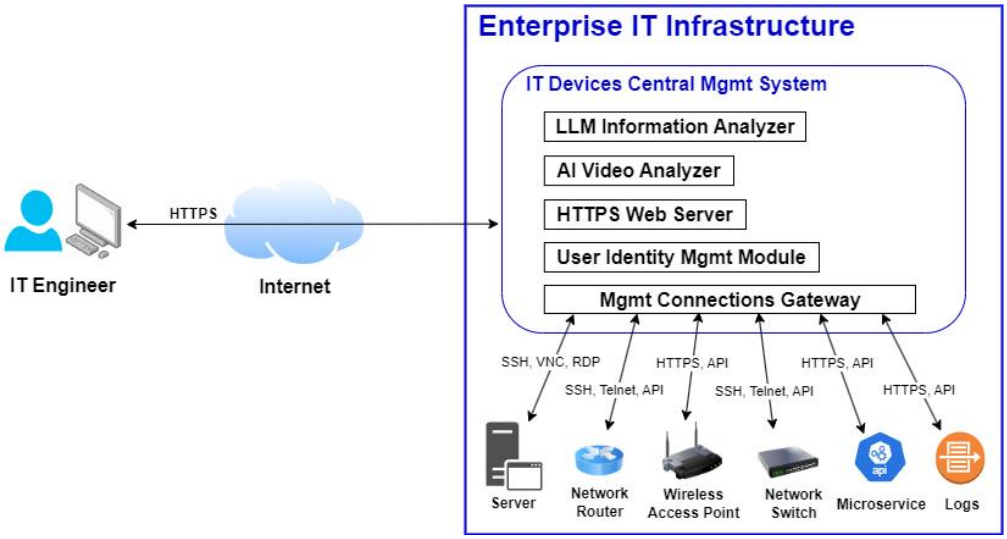

Figure 1: Intelligent remote centralized management system architecture diagram of enterprise IT equipment

3.2 Specific application case

Company A: As a large global automotive manufacturing industry, the company has deployed many new products in its data centers, and in order to make [11-13] IT easier for the company's employees in countries around the world to learn and operate the new equipment, the company has deployed a centralized IT equipment management system. The main control terminal is deployed on the Intranet computer of the production line, and customized controlled software is deployed in batches on the terminal devices of the production line to be maintained.

Enterprises are gradually investing in more intelligent equipment at the production line end. One of the more significant advantages of digital and intelligent equipment is that it can rely on the Internet to achieve remote operation and debugging [14], which greatly improves the stability and work efficiency of production line equipment. An important way to realize remote debugging operation and maintenance is through remote control technology. When a device in the production line is faulty, the device engineer enters the verification code and identification code of the device in the production line on the Intranet computer to operate and commission the device in remote desktop mode. In addition, field operators can see the engineer's operation on the screen and cooperate with the engineer according to the engineer's instructions. The company's technical experts also use the system to simulate complex failures of remote devices [15-16]; Or reproduce the abnormal situation reported by the end user, remotely adjust various professional parameters of the industrial computer, and eliminate hidden faults and problems by technical experts at the headquarters. At the same time, IT engineers can debug in the actual remote equipment, find and solve many practical problems, and confirm the bug of the new equipment and report it to the R&D team in detail.

Unified management and implementation of production line remote operation and maintenance debugging and assistance, to provide safe and secure equipment operation and maintenance tools for the engineer team. At present, the operation of the enterprise is in good condition, covering nearly [17] 400 production line terminal equipment, improving the operation and debugging efficiency of the production line equipment under the premise of safety and compliance, ensuring the stable production of the production line of the enterprise 24 hour.

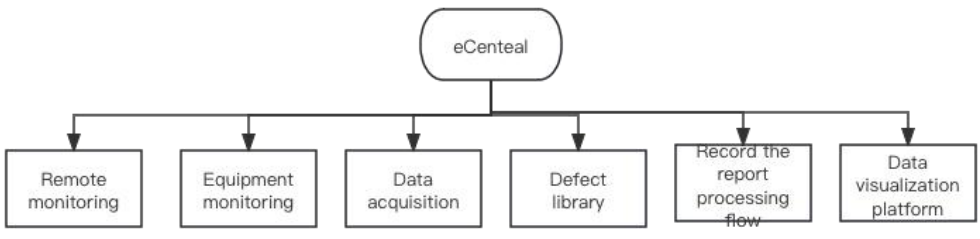

Figure 2: Centralized control (remote control) platform function diagram

Company B (retail industry): In the digital transformation of the retail industry needs to rely on a large number of smart devices, the number of the highest proportion is the smart devices in [18-20] first-line stores, for an enterprise that has developed to a certain scale, the order of magnitude of equipment is likely to be thousands or even tens of thousands, Company B is a typical one.

B Company is a fast food chain operating enterprises, has nearly 400 direct stores, the number of store equipment reached thousands of units. At the beginning, Company B adopted the traditional operation and maintenance scheme, and there was no unified and professional management system for the tool scheme used in remote operation and maintenance work, and the front-line operation and maintenance personnel were in a state of "fighting for themselves".

The result of the lack of unified scheduling management is the heavy burden and low efficiency of front-line IT operation and maintenance. At the same time, the number of equipment in the chain retail and catering industries, complex models, frequent failures and other problems also seriously affect the effect of IT operation and maintenance management. IT is urgent to introduce a professional remote IT operation and maintenance scheme with clear behavior authority, equipment management and ownership.

The company deploys products and solutions in the data center, and builds a set of remote [21] IT operation and maintenance system suitable for the current situation of chain retail enterprises with multi-platform, cross-terminal, soft and hard combined remote control technology as the core. After the store equipment is installed in a unified client, the cloud management platform can be used for centralized device management and device alarm setting. Enterprise managers adopt enterprise + hierarchical management planning organization structure, assign employee accounts to employees, authorize store equipment distribution to branch operation and maintenance personnel for management and security audit, so that management is more effective; Branch operation and maintenance personnel use the control terminal to maintain and manage store equipment, monitor equipment, and distribute files in batches, which can solve equipment problems in time and reduce personnel and operation and maintenance costs, realize fast and remote maintenance, and ensure normal business operations. Make operation and maintenance easier [22]. In order to facilitate management, the store equipment is named and grouped according to the region. When the operation and maintenance needs occur, the corresponding operation and maintenance personnel can quickly find the corresponding equipment from the corresponding group, initiate remote control to implement the operation and maintenance, and solve the equipment problems of first-line stores in the first time.

With stable performance, convenient equipment management and reasonable organizational structure management, remote service has become an indispensable tool for equipment operation and maintenance management of B Company's stores. On the basis of quickly solving equipment operation and maintenance, it can also reduce the number of operation and maintenance personnel, reduce operation and maintenance costs, and ensure the normal operation of stores.

Company C: The company uses this system to implement its [23] IT certification, full-process SaaS services based on AI technology, combined with face core body, face detection, voice detection, environmental monitoring capabilities and powerful algorithms of cloud services, to provide global users with safe, stable, efficient and convenient online assessment services. Create an unprecedented new AI examination model in the fields of internal training, job promotion, certification examination and academic examination. The remote authentication adopts the mode of "dual-station video invigilator", and the iTEST system is used simultaneously by both stations. Among them, the computer as the first location, the test system dynamic capture images, and intelligent real-time record screen cutting behavior [24-26]; Mobile phone as the second phone, real-time video recording, effective monitoring of candidates' behavior and surrounding environment. Finally, all the audio and test data are sent back to the data center, and with the help of AI analysis in the certification exam, remote control of the exam is realized. Make IT possible for engineers anywhere in the world to take their certification at home, as the highly confidential IT certification exam can only be taken at the test center of the manufacturer and its authorized partners. Many candidates are inconvenient or unable to take IT certification. As a result of the rapid growth of its certification population, which has exceeded 176,000 people to date, the impact of its products has significantly increased, making its products one of the most popular choices in the industry.

3.3 Practical Conclusion

Through the enterprise centralized remote management system, operation and maintenance engineers can monitor the working status of IT equipment at any time, large-screen display and remote monitoring, remote task

scheduling improve work efficiency and reduce enterprise equipment maintenance costs. Real-time alarms improve the efficiency of fault handling and enhance the trust of end users [27-29]. Various statistical reports and analysis, timely grasp the operation situation, greatly reduce the operation and maintenance labor costs. Through detailed comparative analysis of operation and maintenance efficiency, timely optimization of operation and maintenance management mode. In all walks of life have reflected excellent results, and at the same time in today's combination of AI technology, help IT engineering remote online certification exam, and a variety of distance education, greatly convenient life, to achieve the development of intelligent 4.0.

4. CONCLUSION

In conclusion, with the emergence and rapid development of network information technology and artificial intelligence, industrial Internet of Things is gradually becoming a hot topic. Through digital transformation, enterprises carry out centralized intelligent control of enterprise equipment with the help of artificial intelligence, cloud computing, and Internet of Things technology, which has injected new and powerful impetus into all walks of life.

With the support of advanced industrial analysis and intelligent machine applications, its functions play an increasingly important role, remote control technology has been widely used in enterprise remote office, remote IT [30-31] operation and maintenance, remote technical support and many other scenarios, for enterprises to improve business quality, reduce costs, improve efficiency has played an important role. Establish centralized management of operation and maintenance data and unified operation analysis center. Through the association analysis of various types of data, the production efficiency of enterprises is improved, and the daily operation and maintenance work of IT engineers is convenient, so as to comprehensively ensure the safety, stability, and health of the production system, and improve service and customer perception.

ACKNOWLEDGEMENT

We would like to thank Li, X., Zheng, H and others for their research work, In their article "User Interaction Interface Design and Innovation Based on Artificial Intelligence Technology" brings a new thinking paradigm to the field of education, especially in the field of artificial intelligence computer education. Under the background of educational innovation, it highlights the application potential of artificial intelligence technology in teaching, and puts forward the corresponding teaching model and methodology. These innovative ideas provide a new path and strategy for educational practice, and promote the development of education field to a more intelligent, personalized and innovative direction. At the same time, the study also provides inspiration for researchers and practitioners in the field of educational technology, encouraging them to deeply explore the application of artificial intelligence in education, and promoting the integration and development of the education field and cutting-edge technology. This article provides important ideas and directions for progress and development in the field of education.

REFERENCES

[1] Li, X., Zheng, H., Chen, J., Zong, Y., & Yu, L. (2024). User Interaction Interface Design and Innovation Based on Artificial Intelligence Technology. Journal of Theory and Practice of Engineering Science, 4(03), 1-8.
[2] Duan, Shiheng, et al. "THE INNOVATIVE MODEL OF ARTIFICIAL INTELLIGENCE COMPUTER EDUCATION UNDER THE BACKGROUND OF EDUCATIONAL INNOVATION." The 2nd International scientific and practical conference “Innovations in education: prospects and challenges of today”(January 16-19, 2024) Sofia, Bulgaria. International Science Group. 2024. 389 p.. 2024.
[3] Qian, Wenpin, et al. "NEXT-GENERATION ARTIFICIAL INTELLIGENCE INNOVATIVE APPLICATIONS OF LARGE LANGUAGE MODELS AND NEW METHODS." OLD AND NEW TECHNOLOGIES OF LEARNING DEVELOPMENT IN MODERN CONDITIONS (2024): 262.
[4] Song, T., Li, X., Wang, B., & Han, L. (2024). Research on Intelligent Application Design Based on Artificial Intelligence and Adaptive Interface.
[5] Qi, Y., Wang, X., Li, H., & Tian, J. (2024). Leveraging Federated Learning and Edge Computing for Recommendation Systems within Cloud Computing Networks. arXiv preprint arXiv:2403.03165.
[6] The Credit Card Anti-fraud Detection Model in the Context of Dynamic Integration Selection Algorithm. (2024). Frontiers in Computing and Intelligent Systems, 6(3), 119-122. https://doi.org/10.54097/a5jafgdv

[7] Chen, W., Shen, Z., Pan, Y., Tan, K., & Wang, C. (2024). Applying Machine Learning Algorithm to Optimize Personalized Education Recommendation System. Journal of Theory and Practice of Engineering Science, 4(01), 101-108.
[8] K. Xu, X. Wang, Z. Hu and Z. Zhang, "3D Face Recognition Based on Twin Neural Network Combining Deep Map and Texture," 2019 IEEE 19th International Conference on Communication Technology (ICCT), Xi'an, China, 2019, pp. 1665-1668, doi: 10.1109/ICCT46805.2019.8947113.
[9] Shi, Peng, Yulin Cui, Kangming Xu, Mingmei Zhang, and Lianhong Ding. 2019. "Data Consistency Theory and Case Study for Scientific Big Data" Information 10, no. 4: 137. https://doi.org/10.3390/info10040137.
[10] Xiao, J., Chen, Y., Ou, Y., Yu, H., & Xiao, Y. (2024). Baichuan2-Sum: Instruction Finetune Baichuan2-7B Model for Dialogue Summarization. arXiv preprint arXiv:2401.15496.
[11] Huo, Shuning, et al. "Deep Learning Approaches for Improving Question Answering Systems in Hepatocellular Carcinoma Research." arXiv preprint arXiv:2402.16038 (2024).
[12] Zhu, Mengran, et al. "Enhancing Credit Card Fraud Detection: A Neural Network and SMOTE Integrated Approach." Journal of Theory and Practice of Engineering Science 4.02 (2024): 23-30.
[13] Xiang, Yafei, et al. "Integrating AI for Enhanced Exploration of Video Recommendation Algorithm via Improved Collaborative Filtering." Journal of Theory and Practice of Engineering Science 4.02 (2024): 83-90.
[14] Zhenghua Hu, Xianmei Wang, Kangming Xu, and Pu Dong. 2020. Real-time Target Tracking Based on PCANet-CSK Algorithm. In Proceedings of the 2019 3rd International Conference on Computer Science and Artificial Intelligence (CSAI '19). Association for Computing Machinery, New York, NY, USA, 343–346. https://doi.org/10.1145/3374587.3374607.
[15] Ji, H., Xu, X., Su, G., Wang, J., & Wang, Y. (2024). Utilizing Machine Learning for Precise Audience Targeting in Data Science and Targeted Advertising. Academic Journal of Science and Technology, 9(2), 215-220.
[16] Zhu, M., Zhang, Y., Gong, Y., Xing, K., Yan, X., & Song, J. (2024). Ensemble Methodology: Innovations in Credit Default Prediction Using LightGBM, XGBoost, and LocalEnsemble. arXiv preprint arXiv:2402.17979.
[17] Niu, H., Li, H., Wang, J., Xu, X., & Ji, H. (2023). Enhancing computer digital signal processing through the utilization of rnn sequence algorithms. International Journal of Computer Science and Information Technology, 1(1), 60-68.
[18] Gong, Yulu, et al. "RESEARCH ON A MULTILEVEL PRACTICAL TEACHING SYSTEM FOR THE COURSE'DIGITAL IMAGE PROCESSING." OLD AND NEW TECHNOLOGIES OF LEARNING DEVELOPMENT IN MODERN CONDITIONS (2024): 272.
[19] Wang, Y., Bao, Q., Wang, J., Su, G., & Xu, X. (2024). Cloud Computing for Large-Scale Resource Computation and Storage in Machine Learning. Journal of Theory and Practice of Engineering Science, 4(03).
[20] Shen, Zepeng, et al. "EDUCATIONAL INNOVATION IN THE DIGITAL AGE: THE ROLE AND IMPACT OF NLP TECHNOLOGY." OLD AND NEW TECHNOLOGIES OF LEARNING DEVELOPMENT IN MODERN CONDITIONS (2024): 281.
[21] Wu, J., Wang, H., Ni, C., Zhang, C., & Lu, W. (2024). Data Pipeline Training: Integrating AutoML to Optimize the Data Flow of Machine Learning Models. arXiv preprint arXiv:2402.12916.
[22] Zhang, C., Lu, W., Ni, C., Wang, H., & Wu, J. (2024). Enhanced User Interaction in Operating Systems through Machine Learning Language Models. arXiv preprint arXiv:2403.00806.
[23] Wang, H., Bao, Q., Shui, Z., Li, L., & Ji, H. (2024). A Novel Approach to Credit Card Security with Generative Adversarial Networks and Security Assessment.
[24] Yu, Hanyi, et al. "Machine Learning-Based Vehicle Intention Trajectory Recognition and Prediction for Autonomous Driving." arXiv preprint arXiv:2402.16036 (2024).
[25] Zhu, M., Zhang, Y., Gong, Y., Xing, K., Yan, X., & Song, J. (2024). Ensemble Methodology: Innovations in Credit Default Prediction Using LightGBM, XGBoost, and LocalEnsemble. arXiv preprint arXiv:2402.17979.
[26] Xiang, Yafei, et al. "Text Understanding and Generation Using Transformer Models for Intelligent E-commerce Recommendations." arXiv preprint arXiv:2402.16035 (2024).
[27] Zhu, Mengran, et al. "Utilizing GANs for Fraud Detection: Model Training with Synthetic Transaction Data." arXiv preprint arXiv:2402.09830 (2024).
[28] Gong, Yulu, et al. "Enhancing Cybersecurity Resilience in Finance with Deep Learning for Advanced Threat Detection." arXiv preprint arXiv:2402.09820 (2024).
[29] Sun, Guolin, et al. "Revised reinforcement learning based on anchor graph hashing for autonomous cell activation in cloud-RANs." Future Generation Computer Systems 104 (2020): 60-73.

[30] Wu, Yichao, et al. "LoRA-SP: Streamlined Partial Parameter Adaptation for Resource-Efficient Fine-Tuning of Large Language Models." arXiv preprint arXiv:2403.08822 (2024).
[31] Che, C., Lin, Q., Zhao, X., Huang, J., & Yu, L. (2023, September). Enhancing Multimodal Understanding with CLIP-Based Image-to-Text Transformation. In Proceedings of the 2023 6th International Conference on Big Data Technologies (pp. 414-418).