Lecture Notes in Electrical Engineering 1217

Yan Pei
Hao Shang Ma
Yu-Wei Chan
Hwa-Young Jeong *Editors*

Proceedings of Innovative Computing 2024, Vol. 4

Proceedings of The 7th International Conference on Innovative Computing, Vol. 4 (IC 2024)

Springer

Lecture Notes in Electrical Engineering 1217

Series Editors

The book series *Lecture Notes in Electrical Engineering* (LNEE) publishes the latest developments in Electrical Engineering—quickly, informally and in high quality. While original research reported in proceedings and monographs has traditionally formed the core of LNEE, we also encourage authors to submit books devoted to supporting student education and professional training in the various fields and applications areas of electrical engineering. The series cover classical and emerging topics concerning:

- Communication Engineering, Information Theory and Networks
- Electronics Engineering and Microelectronics
- Signal, Image and Speech Processing
- Wireless and Mobile Communication
- Circuits and Systems
- Energy Systems, Power Electronics and Electrical Machines
- Electro-optical Engineering
- Instrumentation Engineering
- Avionics Engineering
- Control Systems
- Internet-of-Things and Cybersecurity
- Biomedical Devices, MEMS and NEMS

For general information about this book series, comments or suggestions, please contact leontina.dicecco@springer.com.

To submit a proposal or request further information, please contact the Publishing Editor in your country:

China

Jasmine Dou, Editor (jasmine.dou@springer.com)

India, Japan, Rest of Asia

Swati Meherishi, Editorial Director (Swati.Meherishi@springer.com)

Southeast Asia, Australia, New Zealand

Ramesh Nath Premnath, Editor (ramesh.premnath@springernature.com)

USA, Canada

Michael Luby, Senior Editor (michael.luby@springer.com)

All other Countries

Leontina Di Cecco, Senior Editor (leontina.dicecco@springer.com)

**** This series is indexed by EI Compendex and Scopus databases. ****

Yan Pei · Hao Shang Ma · Yu-Wei Chan ·
Hwa-Young Jeong
Editors

Proceedings of Innovative Computing 2024, Vol. 4

Proceedings of The 7th International Conference on Innovative Computing, Vol. 4 (IC 2024)

Springer

Editors
Yan Pei
Computer Science and Engineering
University of Aizu
Aizuwakamatsu Shi, Japan

Yu-Wei Chan
Department of Computer Science
and Information Management
Providence University
Taichung, Taiwan

Hao Shang Ma
Department of Computer Science
and Information Engineering
National Taichung University of Science
and Technology
North District, Taiwan

Hwa-Young Jeong
Humanitas College
Kyung Hee University
Dongdaemun-gu, Korea (Republic of)

ISSN 1876-1100 ISSN 1876-1119 (electronic)
Lecture Notes in Electrical Engineering
ISBN 978-981-97-4181-6 ISBN 978-981-97-4182-3 (eBook)
https://doi.org/10.1007/978-981-97-4182-3

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

ICIC 2024-3

The 7th International Conference on Innovative Computing (IC2024)

ICIC 2024-3

Application of Genetic Algorithms in Automated Mechanical Design

Jin Wang[1,2(✉)]

[1] Faculty of Technical and Vocational Education, Sultan Idris Education University, 35900 Tanjung Malim, Malaysia
18111241033@163.com

[2] Jiangsu Vocational College of Electronics and Information Digital Equipment College, Jiangsu 223003, China

Abstract. The application of automated assembly equipment plays an important role in the application of intelligent automated machinery design, but there is a problem of inaccurate application positioning. Traditional deep learning cannot solve the mechanical design problems in the application of intelligent automated mechanical design, and the effect is not ideal. Therefore, this paper proposes the application of automated machinery design based on genetic algorithm and analyzes the application in automated machinery design. Firstly, the influencing factors is located by natural selection theory, and the indicators is divided according to the requirements of the application of automated assembly equipment to reduce the interference factors in the application of automated assembly equipment. Then, the theory of natural selection is used to form the application scheme of genetic algorithm automatic assembly equipment, and the application results of automatic assembly equipment is comprehensively analyzed. The MATLAB simulation results show that under certain evaluation criteria, the genetic algorithm is superior to traditional deep learning in terms of application accuracy of automated assembly equipment and time of influencing factors of automated assembly equipment.

Keywords: natural selection theory · genetic algorithms · Automated assembly equipment · mechanical design · Application

1 Introduction

Mechanical automation design is an important part of modern manufacturing industry, which involves many disciplines such as machinery [1–3], electronics and control. With the continuous development of science and technology, the application of mechanical automation design is more and more extensive [4–6], which plays an important role in improving production efficiency, reducing production costs and improving product quality. In this paper, the research of mechanical automation design will be discussed in depth [7–12].

Y. Pei et al. (Eds.): IC 2024, LNEE 1217, pp. 3–11, 2024.
https://doi.org/10.1007/978-981-97-4182-3_1

2 Related Concepts

A. Mathematical description of the genetic algorithm

Automation design theory is the foundation of mechanical automation design, which involves computer technology, control theory, information processing and other disciplines. Through in-depth study of automation design theory, we can better understand the principles and methods of mechanical automation design, and provide theoretical support for practical application as Formula (1) shown.

$$\lim_{x\to\infty}(y_i \cdot t_{ij}) = y_{ij} \geq \max(t_{ij} \div 2) \tag{1}$$

Automatic design technology is the key to realize automatic design of machinery, which includes CAD/CAM technology, sensor technology, PLC technology and so on. Through the application of these technologies, the mechanical system can be simulated and simulated, the design parameters can be optimized, and the performance of mechanical equipment can be improved is shown in Eq. (2).

$$\max(t_{ij}) = \partial(t_{ij}^2 + 2 \cdot t_{ij}) \succ \frac{n!}{r!(n-r)!}(\sum t_{ij} + 4)\mathfrak{M} \tag{2}$$

Automation design application is the ultimate goal of mechanical automation design, which involves the automation design of various mechanical equipment, such as machine tools, robots, automatic production lines and so on. Through practical application, the feasibility and effect of automatic design can be verified, and the basis for further improvement and perfection can be provided.

Suppose I Requirement analysis is the first step of mechanical automation design, which involves in-depth understanding and analysis of customer demand and market demand. Through requirement analysis, the purpose and requirement of mechanical automation design can be determined, which can provide guidance for subsequent design as shown in Eq. (3).

$$F(d_i) = \mathbb{R}\lim_{x\to\infty}\sum t_i \bigcap \xi \cdot \sqrt{2} \to \oint y_i \cdot 7 \tag{3}$$

B. Selection of application scheme of automated assembly equipment

Hypothesis II Scheme design is the core of mechanical automation design, which involves the overall planning and layout of mechanical system. In the scheme design, it is necessary to work out a reasonable scheme according to the results of demand analysis, including the structure, movement mode and control mode of mechanical system as shown in Eq. (4).

$$g(t_i) = \ddot{x} \cdot z_i \prod F(d_i)\frac{dy}{dx}\sqrt{2}\mathrm{B} \tag{4}$$

Based on assumptions I and II, the comprehensive function applied by the automated assembly equipment can be obtained, and the result is shown in Eq. (5).

$$\lim_{x\to\infty} g(t_i) + F(d_i) \leq \frac{n!}{r!(n-r)!}\max(t_{ij}) \tag{5}$$

Detailed design is the concrete design and realization of mechanical automation system, which involves the detailed design and calculation of each component. In the detailed design, CAD/CAM technology and other tools need to be used for modeling and simulation to optimize design parameters and improve the performance of mechanical equipment is shown in Eq. (6).

$$\widetilde{g(t_i) + F(d_i)} \leftrightarrow mean(\sum t_{ij} + 4) \tag{6}$$

C. Analysis of the application scheme of automated assembly equipment

Control system is the key to realize mechanical automation control, which involves the design and implementation of control system. In the design of control system, it is necessary to use PLC technology and other tools to write control programs to realize automatic control of mechanical equipment is shown in Eq. (7).

$$No(t_i) = \frac{\widetilde{g(t_i) + F(d_i)}}{mean(\sum t_{ij} + 4)} \frac{n!}{r!(n-r)!} \tag{7}$$

Testing and verification are the last step of mechanical automation design, which involves the actual testing and verification of the designed mechanical equipment. Through testing and verification, it can check whether the design effect and performance index meet the expected requirements, and provide a basis for further improvement and perfection is shown in Eq. (8).

$$Zh(t_i) = \bigcap [\sum \widetilde{g(t_i) + F(d_i)}] \tag{8}$$

Improve production efficiency: shorten production cycle and delivery time by optimizing design and manufacturing process is shown in Eq. (9).

$$accur(t_i) = \frac{\min[\sqrt{2}\Phi\mathfrak{M}]}{\sum \widetilde{g(t_i) + F(d_i)}} \times 100\% \tag{9}$$

Reduce production cost: Reduce equipment cost and maintenance cost by optimizing design parameters and using materials can be expressed as Eq. (10).

$$accur(t_i) = \frac{\min[\sum \widetilde{g(t_i) + F(d_i)}]}{\sum \widetilde{g(t_i) + F(d_i)}} + randon(t_i) \tag{10}$$

Improve product quality: achieve high-precision and high-quality product manufacturing by optimizing control system and sensor technology.

3 Optimization Strategies for Automated Assembly Equipment Applications

(1) Computer-aided design and computer-aided manufacturing technology can improve the efficiency and accuracy of mechanical design and manufacturing, and reduce manual errors and waste.

(2) Establish mathematical models and dynamic simulations to predict and adjust the operating status of the equipment. At the same time, the kinematic performance and stability of the equipment can be improved by optimizing the design parameters.
(3) The programmable logic controller can realize the automatic control and adjustment of the equipment. By writing efficient PLC programs, equipment failure rates and maintenance costs can be reduced.
(4) The sensor can detect and monitor the status and parameters of the equipment. By using high-precision sensors, the stability and reliability of the equipment can be improved.
(5) Artificial intelligence technology can realize autonomous decision-making and intelligent control of equipment. By applying machine Xi algorithms and adaptive control algorithms, the performance and efficiency of the equipment can be improved.
(6) The use of virtualization technology can separate and manage the various parts of the equipment, so as to improve the maintainability and scalability of the equipment.

4 Practical Examples of Automated Assembly Equipment Applications

A. Introduction to the application of automated assembly equipment

Optimize spindle speed and feed speed: By adjusting spindle speed and feed speed, machining efficiency and surface quality can be improved is shown in Table 1.

Table 1. Automated assembly equipment application requirements

Scope of application	Grade	Accuracy	Automated assembly equipment applications
Automotive industry	I	85.00	78.86
	II	81.97	78.45
Medical equipment	I	83.81	81.31
	II	83.34	78.19
Beverage industry	I	79.56	81.99
	II	79.10	80.11

The application process of automated assembly equipment in Table 1 is shown in Fig. 1.

B. Application of automated assembly equipment

Optimizing cutting force and tool path: By optimizing cutting force and tool path, machining accuracy and tool life can be improved as shown in Table 2.

C. Application and stability of automated assembly equipment

Optimize lubrication and cooling systems: By optimizing lubrication and cooling systems, wear and thermal deformation can be reduced is shown in Fig. 2.

Optimal control system and sensor technology: By optimizing control system and sensor technology, the stability and accuracy of machine tools can be improved is shown in Table 3.

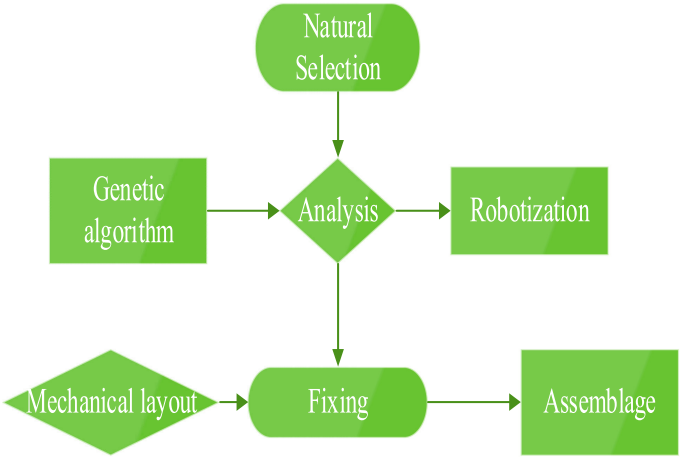

Fig. 1. Automate the analysis process of assembly equipment applications

Table 2. The overall situation of the application scheme of automated assembly equipment

Category	Random data	Reliability	Analysis rate
Automotive industry	85.32	85.90	83.95
Medical equipment	86.36	82.51	84.29
Beverage industry	84.16	84.92	83.68
Mean	86.84	84.85	84.40
X6	83.04	86.03	84.32
	P = 1.249		

Motion ability: The robot arm needs to have basic lifting, rotation and telescopic functions in Fig. 3 shown.

D. Rationality of the application of automated assembly equipment

Grasping mechanism: Equipped with grippers to grab objects of different sizes (Fig. 4).

Sensor feedback: It can detect the position and clamping state of objects for accurate control.

E. Effectiveness of automated assembly equipment applications

Process interface: Provides an easy-to-use programming interface for remote control and programming is shown in Fig. 5 shown.

The servo motor is used as the driving source to realize accurate position control is shown in Table 4.

The photoelectric sensor is used to detect the position of the object and the pressure sensor is used to detect the clamping state in Fig. 6 shown.

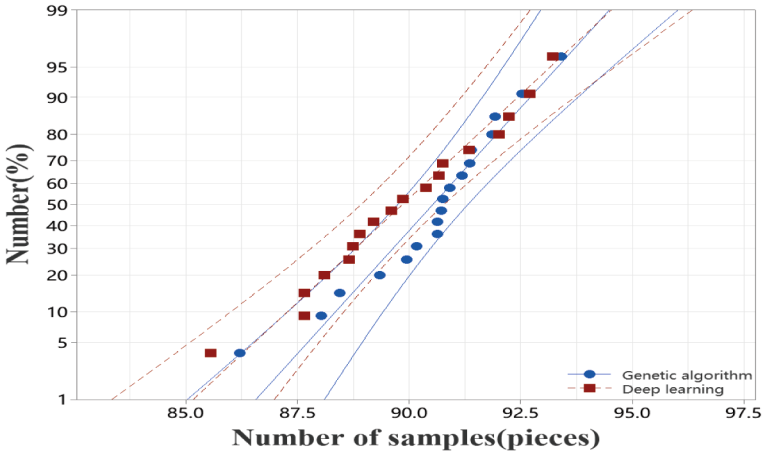

Fig. 2. Application of automated assembly equipment with different algorithms

Table 3. Comparison of application accuracy of automated assembly equipment by different methods

Algorithm	Survey data	Automated assembly equipment applications	Magnitude of change	Error
Genetic algorithm	85.33	85.15	82.88	84.95
Deep learning	85.20	83.41	86.01	85.75
P	87.17	87.62	84.48	86.97

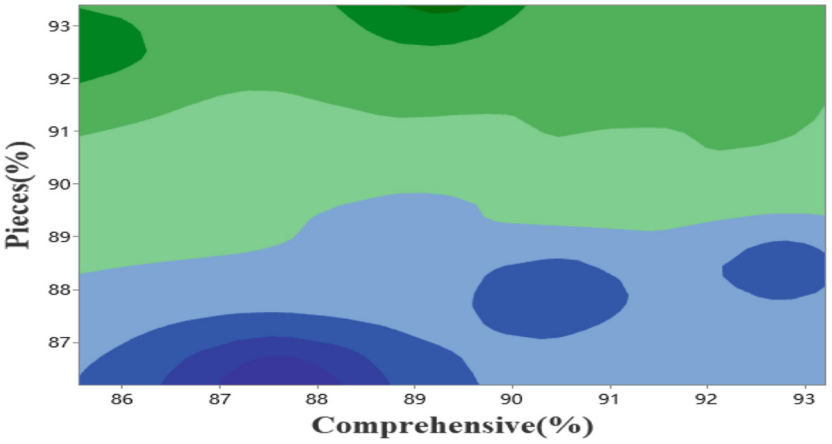

Fig. 3. Automated assembly equipment application of genetic algorithms

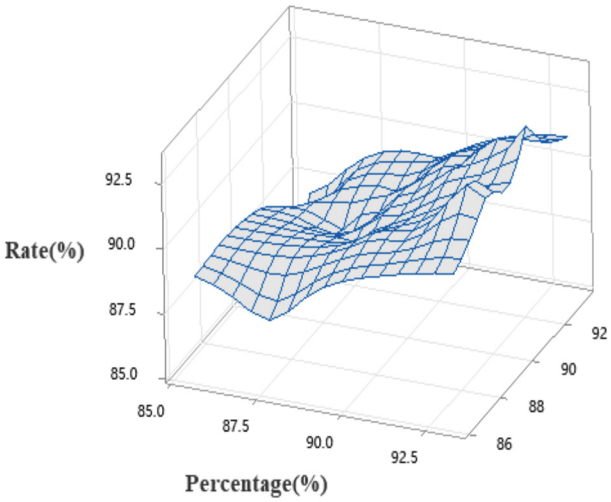

Fig. 4. Application of automated assembly equipment with different algorithms

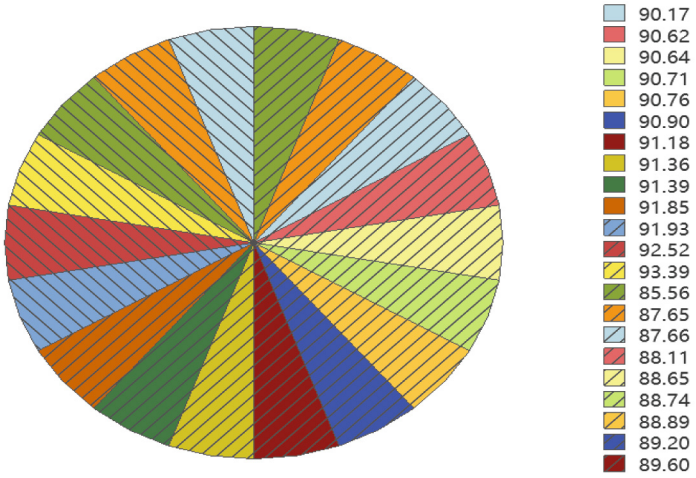

Fig. 5. Application of automated assembly equipment with different algorithms

Table 4. Comparison of application effectiveness of automated assembly equipment with different methods

Algorithm	Survey data	Automated assembly equipment applications	Magnitude of change	Error
Genetic algorithm	82.21	85.92	84.59	82.85
Deep learning	83.73	84.23	84.41	83.55
P	84.20	87.39	84.76	83.90

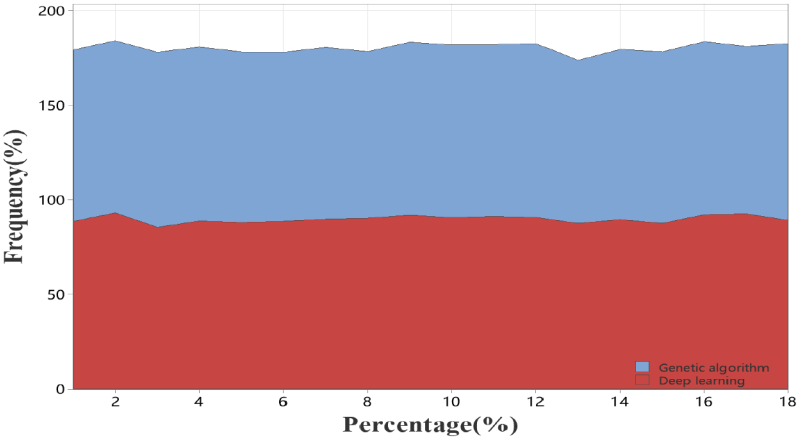

Fig. 6. Genetic algorithm automated assembly equipment application

5 Conclusion

With the continuous progress and development of science and technology, mechanical automation design will face more challenges and opportunities. In the future, we need to further study and apply new technologies and methods, such as artificial intelligence and big data, to improve the efficiency and intelligence level of mechanical automation systems. At the same time, we also need to pay attention to personnel training and team building, strengthen cross-cooperation with other disciplines, and jointly promote the development and application of mechanical automation technology.

References

1. Liu, L., et al.: Application research of genetic algorithm in structural optimization design of buildings. China Sci. Technol. Investment (2021)
2. Zhang, B., Xu, H., Mu, C., Yang, Y.: Application of genetic algorithm in control rate parameter identification (6) (2022)
3. Deng, W., Chen, F., Cheng, F., Lai, J.: Application of genetic algorithm in optimization design of communication satellite orbits. Flight Control Detect. **3**(3), 8 (2020)

4. Yao, J.: Application of multi-objective genetic algorithm in shear-type lifting platform optimization design. Mach. Des. Manuf. **2**, 4 (2020)
5. Luo, Y., Che, Y.: Application of hybrid genetic algorithm in optimization design of ceramic raw material formulation. J. Guizhou Univ. Nat. Sci. Ed. **37**(2), 5 (2020)
6. Liang, B., Yu, F., Tang, B., Wu, H.: Application of interactive genetic algorithm in indoor layout design. Comput. Syst. Appl. **007**, 031 (2022)
7. Huang, W.: Application exploration of genetic algorithm in damper optimization layout. Jiangxi Building Mater. **8**, 2 (2020)
8. Liu, X., Chen, W., Zhong, C., Liu, C.: Application of an improved dual-population genetic algorithm in service robot simulation. Ind. Control Comput. **34**(6), 62–63 (2021)
9. Yan, R.: Research on the application of genetic algorithm in tourism itinerary planning system. Comput. Prod. Circ. (2020)
10. Tang, Y.: Research on the application of genetic algorithm in production line balancing of Company H. Doctoral dissertation, Dalian Maritime University (2020)
11. Wang, Q., Qi, J., Cui, X., Li, W.: Application of improved genetic algorithm in configuration design of seed orchard clonal lines (4) (2022)
12. Zhang, G., Tian, L.: Research on the application of genetic algorithm in RFID intelligent wishousing system. Manuf. Autom. **008**, 044 (2022)

Artificial Intelligence of the Community Street Stall Economy Big Data Management System

Daquan Yu(✉) and Liang Chang

Heilongjiang University of Technology, Jixi 158100, Heilongjiang, China
yudaq@163.com

Abstract. Community stall economy based on artificial intelligence is a new concept of community economy based on artificial intelligence technology. This is an economic system, which has been widely used in China, India, Africa and other countries. In this economic system, there is no fixed price for goods or services; Instead, it depends on demand and supply. The price paid to each member is determined by his/her ability to sell goods or provide services at a specific time. Members can make money by selling their products and services in the virtual market. Members can also sell other products or services produced by themselves and get remuneration. The system will be operated by an AI robot that will manage all transactions between buyers and sellers. All data generated will be stored in blockchain technology, which will protect it from any type of manipulation or hacker attacks.

Keyword: artificial intelligence · street-stall economy Big data management system

1 Introduction

The stall economy is a relatively broad concept, to the effect that it refers to an economic form in which the income source is obtained by setting up the stall, which is regarded as a marginal economic form in the city due to the dispute on its legitimacy. Throughout the country, the "natural enemies" of the stall vendors and the urban management have been "fighting wits and courage" for decades. From "cat catching mouse" to violent confrontation, the market plays have been staged in the eyes that people are accustomed to. Many cities have banned the stall economy from running stalls, This is mainly due to the external cost spillover effect of the land sharing economy ". Although the stall economy has brought various external costs to urban development and residents' lives, its social benefits should not be ignored [1]. For example, it facilitates residents' living and shopping nearby, reduces transaction costs; caters to the consumption of low-income groups, which is a beneficial supplement to the level of urban consumption; promotes the employment of low skilled people, and enriches urban culture. Experience tells us that to regulate the stall economy, we can't just ban it, but mainly rely on guidance and regulation. Only Only by reasonable means and standardizing the development of the stall economy can everyone be happy.

Y. Pei et al. (Eds.): IC 2024, LNEE 1217, pp. 12–17, 2024.
https://doi.org/10.1007/978-981-97-4182-3_2

At present, we should adopt "humanized" management for small vendors, so that the stall economy can develop in an orderly way. For example, speeding up urban legislation and recognizing the legitimacy of land sharing economy; Standardize the setting of stalls, limit time and roads, and operate in different areas, different stations and different times; Strengthen health and safety management and improve the economic quality of the stalls. Modern cities should be tolerant of the stall economy [2]. As the government and functional departments, they should more adopt humanistic and scientific management to maximize the social and economic benefits of the stall economy after offsetting the cost of urban life, so as to achieve multi win [3].

Big data technology is a new generation of revolutionary information technology with data as its essence. In the process of data tapping, it can drive the innovation of ideas, models, technologies and application practices. This book systematically introduces the concept, development history, market value, big data related technologies of big data, as well as the core supporting role of big data in China's information construction, smart city, advertising, media and other fields, and makes a preliminary exploration of data science theory.

At present, there are many community stalls, and the sales and personnel status of each stall are different, which cannot promote the economic development. Therefore, how to upgrade the consumption experience of the stall economy, improve the physical passenger flow and increase the physical sales volume is an important problem to revitalize the real economy.

2 Related Work

2.1 Research Status of Stall Economy

In terms of the floor stall economy and the management right of mobile vendors. Liu Xinyu pointed out in the article "Economic Analysis of the Property Rights of the Stall Seller Problem" that the reason why the stall seller problem has become a persistent disease is the misplacement of property rights. According to the principle of property rights economics, the author puts forward the countermeasures of reallocating property rights to form a long-term mechanism of vendor management. The specific countermeasures are put forward: First, recognize the stall setting right of stall vendors, because it comes from their natural right to exist, and only the negative externalities arising from stall setting are to be controlled. Second, define the right to environment and the right to restrict vendors to the community, so that the relevant externalities can be internalized at the community level. Third, vendors should enjoy the "residual claim" for environmental improvement. In fact, from the perspective of economics, the author emphasizes that the externalities of street vendors' business activities can be contained, so that society, including the government, can adopt a more tolerant attitude towards mobile street vendors, which will help alleviate social conflicts [4].

In terms of the economic characteristics of land stalls. Lin Lin and Ma Fei pointed out in the article "Characteristics and Evaluation of the Urban" Ghost "Phenomenon that the" ghost "group is actually a part of the social vulnerable groups. It is not an unchanging concept. Its formation and evolution track is the political, economic The result of the comprehensive effect of culture and other factors [. Through the investigation of the

phenomenon of "ghost walking" in Xingang West Road, Guangzhou, this paper reveals the group characteristics and activity rules of "ghost walking" and its inherent nature as a vulnerable group. The "ghost walking" in this article is a street hawker When selling illegal goods, the code words of greeting and leaving each other to escape the punishment of urban management law enforcement officers were later used as a synonym for mobile traders [5]. It can be seen from this title that the society has not been so friendly to urban mobile vendors.

2.2 Functions of the Stall Economy

(1) Expand employment and provide employment opportunities to a certain extent

At present, the pressure of employment has hit many people in varying degrees. The huge gap between people to be employed and jobs leads many people to seek new breakthroughs. The stall provides a number of opportunities for the unemployed who are relatively poor in technology and knowledge. For example, laid-off workers, the unemployed, the newly added labor force, farmers who have left the land, and many employees who are on the job may go to sell land stalls after work to supplement their income. Such spontaneous and informal employment mode alleviates the employment pressure to a certain extent, which not only has sufficient basis for existence, but also has positive significance [6].

(2) Meet the consumption needs of people at different levels (especially at the lower level)

Due to the high price or lack of commodities in other places, it is difficult for some people with low purchasing power or preference for certain commodities to buy satisfactory products. The floor stall provides a way to make up for this shortcoming. There may be many cheap and practical goods in the floor stall that are difficult to buy in large shopping malls and stores, so that people can meet some personal consumption needs here, which is very important. The stall is especially suitable for the needs of low-income people. Now, the product homogeneity is serious. The price of things sold in formal shopping malls is often on the high side. Low income people generally need products with low quality and real price. Moreover, when buying products of the same quality, consumers will certainly tend to buy at a lower price. The stalls offer a wide range of products, ranging from clothes, pants, handbags, fruits, daily necessities, cosmetics, jewelry and other categories, meeting the needs of many consumers.

(3) Enrich the economic and cultural life of the city

The stall is also a kind of culture, which brings more vitality to the city. It is undeniable that the stalls have brought negative impacts on the city in terms of noise, sanitation, etc., but the items placed on the stalls can often reflect the local customs, whether it is living areas, downtown areas, or tourist attractions, which can make citizens and tourists feel the special flavor of the place. This is also very beneficial to the development of the city. In addition, streets with street stalls are usually busy and prosperous [7]. Cheap street stalls can attract consumers to gather, cause consumers' desire to buy, and drive the flow of regular shops around to a certain extent.

3 Analysis of Big Data Management System of Community Stall Economy

The purpose of this paper is to provide an AI based big data management system for community land sharing economy to solve the problems raised in the above background technologies.

To achieve the above purposes, this paper provides the following technical solutions: an AI based big data management system for community stall economy. The big data management system includes a central processor, a stall positioning unit, a stall merchant database, a user database, an image collector, a sales volume management unit, a query unit and a signal transmission unit [8]. The stall positioning unit, a stall merchant database, a user database, an image collector The sales management unit and the query unit are respectively connected to the central processor, which is connected to the background management center through the signal transmission unit, as shown in Fig. 1.

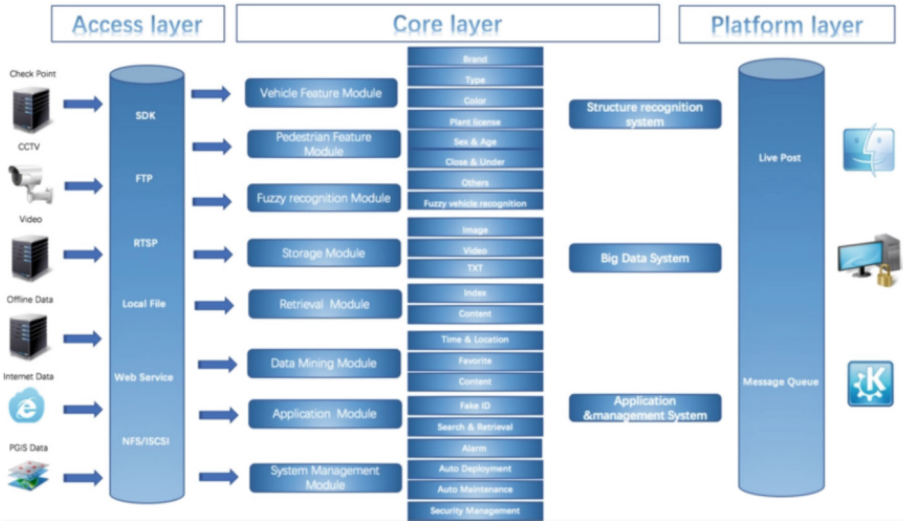

Fig. 1. Structure of big data management system for community stall economy

Preferably, this paper provides a big data management system for community land sharing economy based on artificial intelligence, which also includes big data classification unit and data analysis unit, which are respectively connected to the central processor. Preferably, please provide an AI based big data management system for community floor sharing economy, in which the signal transmission unit adopts 4G network transmission module or 5G network transmission module [9]. Preferably, this paper provides a big data management system for community land sharing economy based on artificial intelligence, in which the use method includes the following steps:

A. The booth positioning unit and the image collector collect the location, size and people of the community stalls in real time.

The number of staff information, and the collected signals are transmitted to the central processor;

B. The central processor transmits the signals collected by each stall to the stall merchant database and user database respectively.

Internal preservation;

C. At the same time, the stall merchant transmits the stall sales data to the sales management unit in real time through the mobile APP;
D. The central processor classifies the location, sales volume and number of personnel of each stall through the big data classification unit, and transmits the classified data to the background management center in real time through the signal transmission unit;
E. After analyzing the economic data of each stall, the back office management center outputs the analysis report and transmits it to the mobile APP of each stall owner for the stall owner to view, so that the stall owner can adjust and promote the development of the stall economy.

4 Big Data Management System of Community Stall Economy Based on Artificial Intelligence

In the description herein, it should be noted that, unless otherwise specified and defined, the terms "installation", "set with", "connection", etc. should be broadly understood, such as "connection", which can be fixed connection, removable connection, or integrated connection; It can be mechanical connection or electrical connection; It can be directly connected, or indirectly connected through intermediate media. It can be the connection between two components. For ordinary technicians in the art, the specific meaning of the above terms in this article can be understood in specific cases [10]. In this paper, the classification methods of big data classification units are as follows:

a. Read attribute vector data, and obtain multiple preset clustering centers for processing data.
b. Classify the processed data according to multiple preset cluster centers to obtain post classification data;
c. Establish multiple merging computing tasks according to post classification data.
d. Use multiple calculation threads to calculate the combined calculation tasks, and combine the calculation results.
e. Modify and save the preset cluster center according to the combined calculation results; And determining the data classification processing result according to the preset clustering center, the modified preset clustering center and the number of correction operations.

Compared with the prior art, the beneficial effects of the invention are: the working principle of the invention is simple, the degree of intelligence is high, the operation status, personnel status, and sales information of each community stall can be analyzed and managed, and adjusted in a timely manner, which promotes the development of the stall economy and reduces the cost of manual management; In addition, the big data classification unit classification method adopted by the invention can reduce the overall calculation complexity and improve the stability of the calculation, and has strong data

profile analysis ability, which is suitable for rapid classification processing of massive data, and further improves the accuracy of data classification.

5 Conclusion

To sum up, the AI based big data management system for community stall economy has a simple working principle and a high degree of intelligence. It can analyze and manage the business status, personnel status, and sales information of each community stall, and make timely adjustments, promoting the development of the stall economy and reducing the cost of manual management; In addition, the big data classification unit classification method adopted can reduce the overall computational complexity and improve the stability of the calculation. Moreover, the data profile analysis ability is strong, which is suitable for rapid classification processing of massive data, and further improves the accuracy of data classification.

Acknowledgements. 2021 Project of Fundamental Scientific Research Professional Expenses for Undergraduate Universities in Heilongjiang Province, item number 2021-KYYWF-1172.

References

1. Li, M.: Research on financial management algorithm based on machine learning in big data era (2021)
2. Yu, H., Wang, J., Murugesan, M., et al.: Artificial intelligence-based quality management and detection system for personalized learning. J. Interconnection Netw. **22**(Supp02), 2143004 (2022)
3. Spmaa, A., Joo, B., Mzmn, C., et al.: Evaluating the role of environment management system based on artificial intelligence (2021)
4. Ping, W.: Data mining and XBRL integration in management accounting information based on artificial intelligence. J. Intell. Systems Appl. Eng. Technol. **4**, 40 (2021)
5. Pedersen, R.D.: Internet Of Things (IOT) big data artificial intelligence expert system information management and control systems and methods, US20210201165A1[P] (2021)
6. Locke, R., Sinha, S.R.: Building management system with artificial intelligence for unified agent based control of building subsystems, US20210208546A1[P] (2021)
7. Tian, Y.: AI-Assisted Dynamic Modeling for Data Management in a Distributed System. J. Interconnection Netw. **22**(Supp05), 2147002 (2022)
8. Shahbaz, M., Gao, C., Zhai, L.L., et al.: Environmental air pollution management system: Predicting user adoption behavior of big data analytics (2021)
9. Kai-Tao, H.E., Zhi-Zhong, L.I., Wang, D.M.: Overview on the design of the service and management system for field geological survey based on the remote sensing and Beidou satellites. J. Geomech. **18**(3), 203–212 (2022)
10. Chaurasia, A.K., Greatbatch, C.J., Hewitt, A.W., et al.: Diagnostic accuracy of artificial intelligence in Glaucoma screening and clinical practice. J. Glaucoma **31**(5), 285–299 (2022)

Automatic Control System of Electronic Network Communication Equipment Based on PLC

Qi Wang(✉)

Department of Electrical and Control Engineering, Nanjng Polytechnic Institute, Nanjing 210044, Jiangsu, China
zhang1631632021@163.com

Abstract. The automatic control system is critical in electronic network communication equipment, however it has an issue with erroneous performance positioning. The typical Genetic algorithm is unable to address the automatic control in electronic network communication equipment issue in electronic network communication equipment, and the result is insufficient. As a result, a PLC-based automatic control system of electronic network communication equipment is provided, and automatic control system of electronic network communication equipment is assessed. To begin, the modern control theory is used to discover the influencing elements, and the indicators are split based on the automatic control system's needs to decrease interference factors in the automatic control system. The modern control theory is then used to create a PLC automatic control system scheme, and the outcomes of the automatic control system are thoroughly examined. The MATLAB simulation results reveal that, under particular evaluation conditions, the PLC outperforms the standard Genetic algorithm in terms of automatic control system accuracy and time of influencing variables.

Keywords: modern control theory · PLC · Automatic control system · Electronics · Communications · Network

1 Introduction

With the rapid development of information technology [1–3], electronic network communication equipment plays an increasingly important role in daily life and work [4–6]. In order to improve the operation efficiency and stability of communication equipment, automatic control system has become an important research direction. This paper will discuss the design and implementation of automatic control system for electronic network communication equipment in detail [7–13].

2 Related Concepts

A. The PLC is described mathematically.

Y. Pei et al. (Eds.): IC 2024, LNEE 1217, pp. 18–26, 2024.
https://doi.org/10.1007/978-981-97-4182-3_3

Real-time monitoring: The automatic control system needs to monitor the running status of communication equipment in real time to ensure the normal operation of the equipment is shown in Eq. (1).

$$\lim_{x\to\infty}(y_i \cdot t_{ij}) = \frac{n!}{r!(n-r)!} y_{ij} \geq \max(t_{ij} \div 2) \tag{1}$$

Equation illustrates the evaluation of outliers among them (2).

$$\max(t_{ij}) = \frac{dy}{dx}(t_{ij}^2 + 2 \cdot t_{ij}) \succ \sqrt{2}(\sum t_{ij} + 4)\mathfrak{M} \tag{2}$$

Fault diagnosis and treatment: When the communication equipment fails, the automatic control system needs to be able to quickly diagnose the cause of the failure and deal with it accordingly, so as to reduce the downtime of the equipment as shown by Eq. (3).

$$F(d_i) = \ddot{x} \sum t_i \bigcap \xi \cdot \sqrt{2} \to \oint y_i \cdot 7 \tag{3}$$

B. Selection of automatic control system scheme

Hypothesis II Remote control: Through the automatic control system, the administrator can control and manage the communication equipment remotely is thus required by the automatic control system (4).

$$g(t_i) = \ddot{x} \cdot z_i \prod F(d_i) \frac{dy}{dx} - w_i \lim_{\delta x\to 0} \kappa \tag{4}$$

Data recording and analysis: The automatic control system needs to record the operation data of communication equipment and analyze these data deeply in order to optimize the operation performance of the equipment is shown in Eq. (5).

$$\lim_{x\to\infty} g(t_i) + \ddot{x}F(d_i) \leq \bigcap \max(t_{ij}) \tag{5}$$

Safety and stability: The automatic control system must ensure the safety and stability of communication equipment to prevent data leakage and equipment collapse are presented in Eq. (6).

$$g(t_i)\widetilde{+F}(d_i) \leftrightarrow \sqrt{b^2 - 4ac}(\sum t_{ij} + 4) \tag{6}$$

C. Analysis of automatic control system scheme

Software design: Develop a complete software system, including real-time monitoring module, fault diagnosis module, remote control module, data recording and analysis module, etc. is shown in Eq. (7).

$$No(t_i) = \frac{g(t_i)\widetilde{+F}(d_i)}{mean(\sum t_{ij} + 4)} \frac{\partial^2 \Omega}{\partial u \partial v} \tag{7}$$

Network design: Establish a stable and efficient data transmission network to ensure unimpeded data transmission between various modules is illustrated in Eq. (8).

$$Zh(t_i) = \lim_{x\to\infty}[\sum \widetilde{g(t_i) + F(d_i)}] \lim_{x\to\infty} \tag{8}$$

Security design: Take necessary security measures at hardware and software levels, such as encrypted communication, access control, etc., to ensure the security of data and equipment as stated in Eq. (9).

$$accur(t_i) = \frac{\min[\sum \widetilde{g(t_i) + F(d_i)}]}{dy \sum \widetilde{g(t_i) + F(d_i)}} \times 100\% \tag{9}$$

The analysis of the automatic control is the computation of Eq. (9) may be represented as Eq. (10).

$$accur(t_i) = \frac{\min[\sum \widetilde{g(t_i) + F(d_i)}]}{dy \sum \widetilde{g(t_i) + F(d_i)}} + randon(t_i) \tag{10}$$

3 Automatic Control System Optimization Approach

Hardware integration: Integrate selected hardware devices into the system and perform the necessary tests to ensure they work properly.

Software development and testing: Develop the software system according to the design requirements, and conduct rigorous testing to ensure the normal function of each module.

Network debugging: Debugging the data transmission network to ensure the stability and efficiency of data transmission.

System joint commissioning: Connect all modules for system-level testing to ensure that the entire system can work together.

Deployment and maintenance: Deploy the system to the actual operating environment, and carry out continuous maintenance and optimization to ensure the stability and performance of the system.

4 Practical Examples of Automatic Control System

A. Introduction to the automatic control system

Because the operation of the system depends on the wireless network, the stability of the network is very important. The system needs to have good network anti-interference ability and fault-tolerant mechanism to ensure the reliability and real-time data transmission is shown in Table 1.

The automatic control system process in Table 1 is shown in Fig. 1.

The architecture of automatic control system of electronic network communication equipment usually adopts distributed structure, which is composed of master control

Table 1. Automatic control system automatic control system requirements

Scope of application	Grade	Accuracy	automatic control system
Low voltage energy meter	I	88.36	89.92
	II	89.50	87.58
Medium voltage energy meter	I	89.40	89.59
	II	86.99	89.78
High voltage energy meter	I	89.89	91.59
	II	92.44	90.05

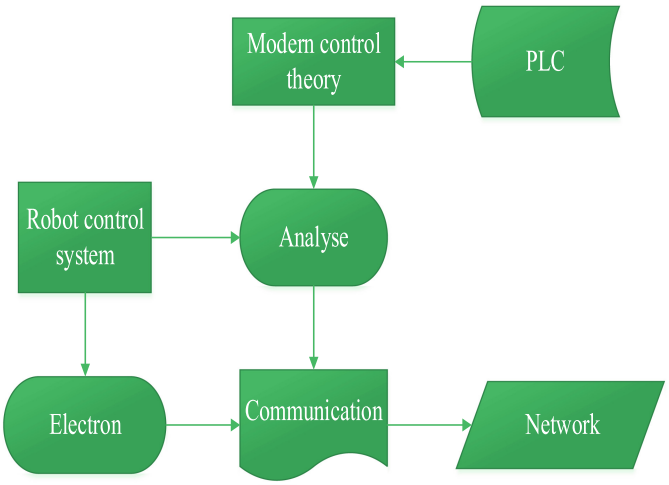

Fig. 1. Analysis process of automatic control system

center, slave control terminal and sensor. The main control center is responsible for monitoring and managing the whole system, the slave control terminal is responsible for controlling each device, and the sensor is used to collect the status information of the device.

B. Automatic control system

The system needs to protect the privacy of users and the security of devices, and prevent unauthorized personnel from operating the system. Therefore, the system needs to adopt encryption technology and access control measures to ensure the security of user authentication and data transmission (Table 2).

C. Automatic control system and stability

Scalability: With the increase of the number of devices and the continuous expansion of functions, the system needs to have good scalability, which is convenient for upgrading and expanding. The system should support a variety of protocols and interface standards to meet the access requirements of different devices is shown in Fig. 2.