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Research on the dynamic monitoring system of intelligent cluster-chemical welding equipment

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Abstract. With the steady development of computer technology and communication technology, the research and application of intelligent group-dominated welding equipment dynamic monitoring system can provide an effective basis for improving the management level and production capacity of manufacturing enterprises. Welding, as the longest applied thermal processing method in the manufacturing field, contains a wide range of technical equipment, the production area is too scattered, covers a large area, and the practical operation requirements are high. Therefore, scholars from various countries have strengthened the research on the dynamic monitoring system of welding equipment based on the theory of artificial intelligence technology. In this paper, on the basis of understanding the cluster welding equipment and production process, a real-time monitoring system of multi-technology integration development is proposed. The ZigBee technology is used to transmit the electric signal generated during welding wirelessly, the MYSQL is used to build the welding process database, and the remote access function of enterprise LAN is completed by using DataSocket. The final experimental results show that the overall system design is stable and safe, which meets the real-time monitoring requirements in the manufacturing field in the new era.

Keywords: Intelligent; Group formation; Welding equipment; ZigBee technology; Database

1. Introduction

In recent years, according to the application of welding equipment dynamic monitoring system in our country, the number of welding equipment applied in the manufacturing field is very large, during the production management faced more problems, specifically reflected in the following points: First of all, energy excessive loss, working process management difficulty is higher. Because welding machinery and equipment need a long time standby, the technical parameters should meet the process requirements, so in the working state, there will often be unstable welding process, technical parameters do not meet the requirements and other problems, which is easy to produce energy waste and quality hazards; Secondly, the difficulty of equipment installation and control is high. Whether in the customized mode or in the non-customized mode, how to scientifically install and dynamically control the welding machinery in the production area is the main problem discussed by the staff. However, due to the lack of real-time data and rule analysis, the practical work has not achieved the expected effect; Finally, the comprehensive production management capacity is too weak. [1-3]Nowadays, welding production generally lacks regular statements, data tracing, statistical analysis and other technical means, and does not fully implement modern concepts during production management, which leads to lower and lower practical production management ability. After entering the era of big data, in order to solve the above problems as soon as possible, researchers strengthened the research on intelligent group-dominated welding equipment dynamic monitoring system based on the theory of artificial intelligence technology. From the level of parameter acquisition and data transmission, scholars from various countries have proposed a variety of technical means, such as Ethernet, CAN bus technology, RS-485 communication technology; From the perspective of welding process management, research and promotion of welding process management database according to different system structures is also the core issue discussed by current researchers. In order to better meet the requirements of manufacturing enterprises for clustered welding equipment and production work, managers should build an online monitoring system based on modern management concepts,

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including remote data access, information communication, information collection and other functions, which can not only provide effective parameter information for employees of all departments. It can also be stored in the database to provide reference for subsequent technical research.[4]

With the continuous improvement of welding technology in our country, there is more and more technical experience stored in our welding industry. Although there is still a big gap between China and developed countries, the machinery manufacturing industry does not get rid of the labor-intensive management mode, but after entering the era of big data, scientific scholars strengthened the research of welding equipment and welding production process, and introduced the policy concept of online management and stability. Improve the welding quality from the basis, effectively control the production cost. As early as the 1970s, some scholars put forward the concept of welding monitoring. In the experimental analysis, the use of computer and other technical ways to calculate the measurement implementation parameters, the final research results achieved excellent results; In the late 1980s, some scholars applied for technical patents in the field of welding power control based on the welding monitoring theory. These two technical studies mainly focus on the upper and lower bounds of welding values set by computer, and will be modified on the basis of calculating and comparing the values obtained by sensors in welding. In the 21st century, American scholars put forward a new welding power supply frequency control theory, which will compare and analyze the working frequency of welding power supply and the pre-set basic values, so that the final results can be obtained according to the spectral density under different frequencies. In the monitoring experiment of arc welding, some scholars used the monitoring system to select the special waveform state, and after reading the real-time data, compared and analyzed the real-time data and the data obtained by a function calculation, so as to obtain the working state during welding. But because our integrated production level and the pace of technological innovation is slower, so the field of welding monitoring research is less, until the end of the 20th century and the 21st century to get relatively mature research theory. For example, some scholars have deeply discussed the dynamic signal during welding, and comprehensively summarized the domestic technical research results in this field. Some scholars have used Visual Basic language programming to monitor the user's spot welding current and pressure in real time, so as to help the staff to assess the quality of spot welding joints online, identify the operating status of the welding system, intuitively analyze the influencing factors contained in it, and identify the influence of welding current and electrodynamic changes, so as to provide technical basis for the subsequent parameter joint control. On the basis of understanding the research status of welding equipment dynamic monitoring system in the new era, this paper mainly discusses the dynamic monitoring system with ZigBee technology as the core, and combined with practical application cases, defines the main objectives of the overall system design and application, in order to provide technical support for the innovation and development of manufacturing industry in the new era.[5-6]

2. Method

2.1 System Design

The overall system structure is shown in Figure 1 below, where the signal acquisition and processing module is used to collect, process and transmit electrical signals, the site center node needs to receive and process the data information sent by all welding equipment, the site computer needs to collect and record various information through serial ports, and the sub-database needs to complete data integration and data backup in the server. Authorized users on the LAN can learn about data reports through remote access.[7-8]

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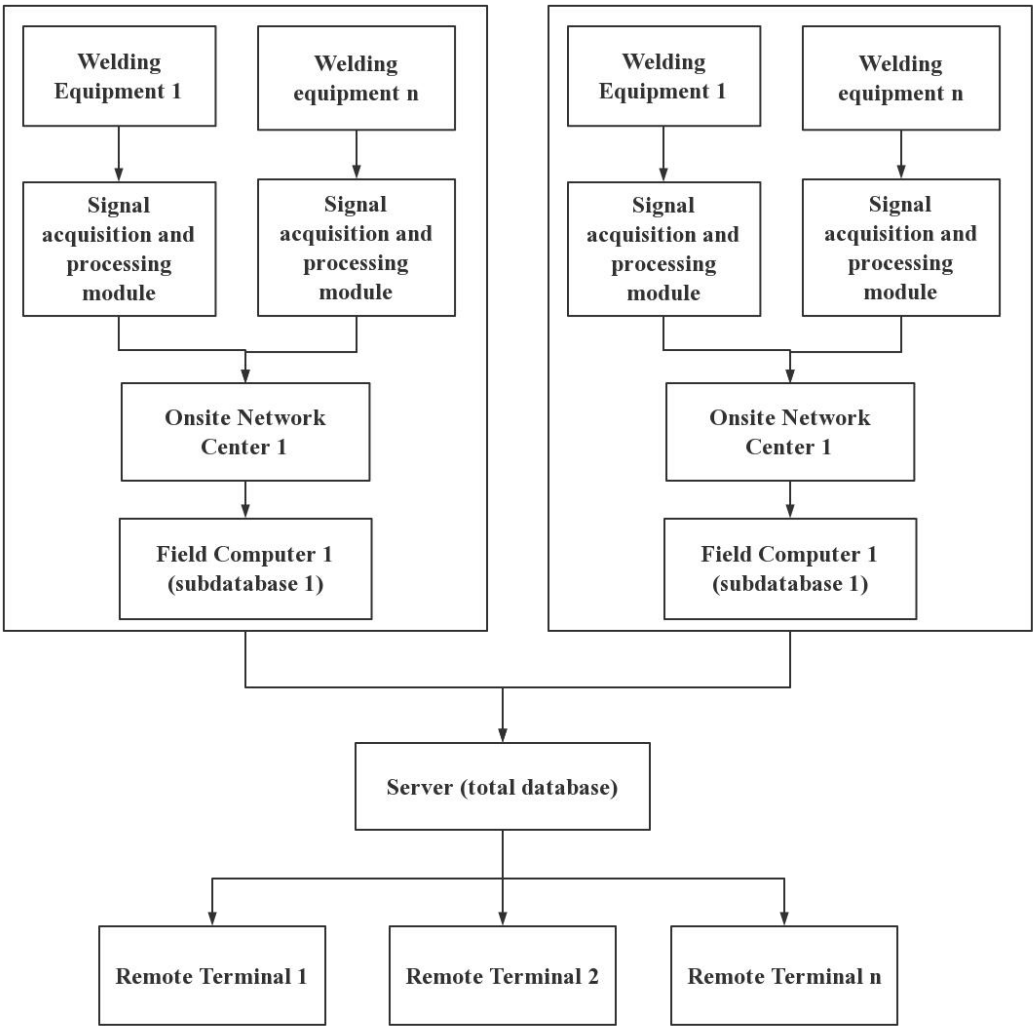

Figure 1 System architecture diagram

Combined with the system structure analysis shown in the figure above, it can be seen that the signal acquisition installed inside the welding power supply by embedding method only needs to leave the transmitting antenna at the front plate of the welding equipment, while the network center and the field computer should be installed in the production area as close as possible to the welding operation area, which will help the field construction management become more standardized and scientific. The server can be installed in different areas of the enterprise. After obtaining the name and password of authorized users, production management departments at all levels of the enterprise can use the remote access function to query, collect, download, print and other data information.[9-11]

2.2 Signal Collection

According to the structural diagram shown in Figure 2 below, the signal acquisition and processing module includes three contents: data collection, data processing and data transmission. After the welding equipment is powered on, the module power supply will convert the power-frequency AC power into DC power, which will be directly transmitted to other unit modules to ensure that the processing module can start working immediately after the power supply; After the power is turned off, the welding machine will stop working automatically. Recording the working state and specific time of welding power supply in strict accordance with the technical requirements can provide an effective basis for the subsequent parameter research.

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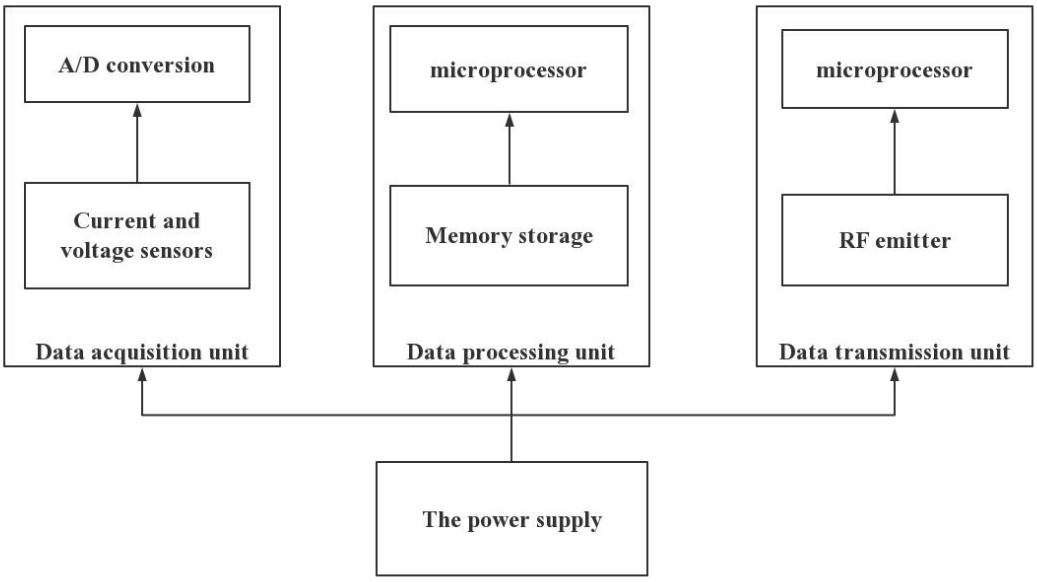

FIG. 2 Structure diagram of signal acquisition

2.3 Wireless communication network

ZigBee technology, as a fusion product of two-way wireless communication technology and wireless network technology discussed in the new era of scientific research, is applied in the network system to define three roles: the first is the central node of the network, which is mainly responsible for the construction of the network and the allocation of network location; The second is the repeater, which mainly seeks, establishes and repairs the routing path of the information packet, and is responsible for forwarding the information packet. Finally, the terminal device can only choose to join the network that has been formed. It can obtain information but cannot forward information. It does not have the routing function. The format of sent data packet is shown in Table 1 below:[12-13]

Table 1 Format analysis of technical sent packets

Serial number	Mean current value	Average voltage value	Check check bit	Bit of state
1B	1B	1B	4bits	4bits

2.4 Database

Combined with the database structure diagram shown in Figure 3 below, it can be seen that as an important tool to supervise the production process and product quality information in the manufacturing management system, it is the basic content of the research on the dynamic monitoring system of intelligent group-dominated welding equipment. Due to the large number of welding equipment in manufacturing enterprises during production, the practice operation is more frequent, so the amount of data generated and stored is very large. The use of MYSQL to build the corresponding database structure, in-depth understanding of the fundamental needs of enterprise practice and development, scientific preservation of all the monitoring work obtained process parameters, technical information, etc., can lay a foundation for subsequent research.[14-15]

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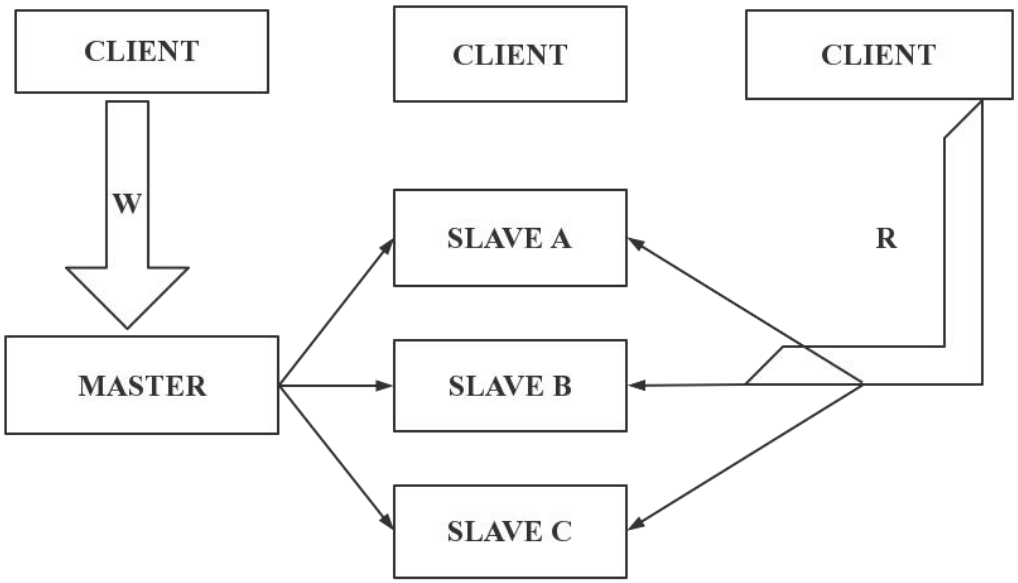

Figure 3 Structure of MYSQL database

2.5 Remote Access

During the construction and development of large-scale manufacturing enterprises, multiple welding operation areas will be set up. When the distance between these areas exceeds the maximum communication distance of wireless network, multiple on-site monitoring subsystems will be set up, and the system database will be combined and stored in the server, so that the staff can directly retrieve the data information of welding equipment from the total database. In this context, technical personnel of all departments need to fully understand and clarify the welding process, and use the remote access technical process as shown in Figure 4 below to quickly collect relevant data and information, so as to ensure that technical personnel can still monitor the working condition of welding production site in real time in the office far away from the production area, and support multiple users to access the database together. In order to improve the convenience of enterprise production management.

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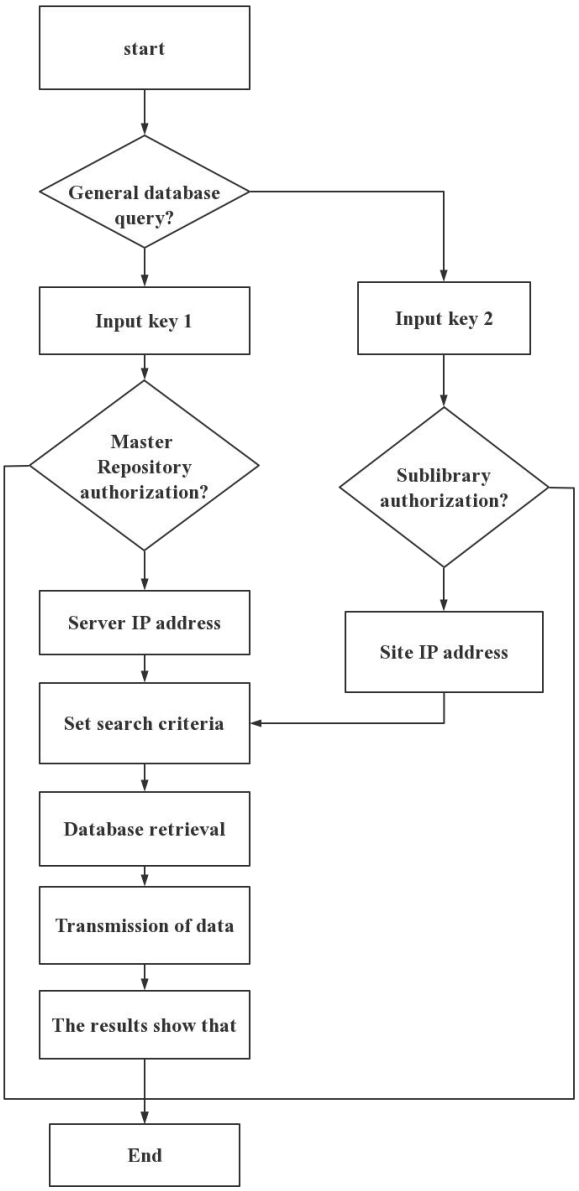

Figure 4 Flowchart of remote access technology

3. Result analysis

From the perspective of practical application, in the practice of applying the above intelligent group-oriented welding equipment dynamic monitoring system, employees of all departments can intuitively see the working status of all welders in the whole monitoring area, in which the normal work is displayed as green, when the current or voltage exceeds the specified value, the indicator light is displayed as red, requiring effective intervention by the field staff; When the device is powered on but cannot work normally, the indicator light will be blue; If the standby state exceeds the set time, the indicator light will be yellow, indicating that the welder has been on standby over time, resulting in excessive energy consumption; After the device is turned off, the indicator light shows black; The color of the standby module is gray, which provides technical support for subsequent on-site device adjustment. The stability of wireless communication network in welding production environment is one of the core contents of the system extension in this paper. According to the practical investigation and research, the causes of data storage and transmission problems are that the distance between the equipment and the central node is too far, the network data transmission capacity is not strong, and the large steel structure will affect the signal transmission.

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In the research experiment of this paper, it is found that the maximum communication distance between the equipment and the central node is 1 km. In the case that the distance between the welding equipment and the central node is too far, or the steel structure between them, it is necessary to install a repeater to ensure that the system has anti-interference.

Conclusion

In summary, this paper studies the main composition and application technology of the intelligent group-dominated welding equipment dynamic monitoring system, and defines the application effect of the system combined with the experiment. Therefore, in the future technological innovation and development, scientific research scholars in the field of manufacturing should continue to explore related topics, solve the problems of traditional equipment by scientific use of welding equipment network cluster supervision system, gradually optimize the internal application technology and topology, and further improve the management level of welding production line on the basis of mastering more parameter information.

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