Multi-computer Communication Reliability Evaluation System Based on 8051 Microcontroller

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Abstract: With the progress of society, people have higher and higher requirements for the quality of life, and electronic products play an important role in daily life. Among them, single-chip control has become a key factor to measure the quality of products and work. This paper mainly introduces the reliability evaluation system of timing communication based on 8051 microcontroller series, taking 8051 microcontroller as the core to realize the data transmission and processing process, and using modular structure to carry out circuit simulation, hardware welding and other steps to complete the debugging of various chips and related software programs. This paper also displays the experimental results and test results on the physical object. The test results show that the reliability of the system is up to more than 90%. It has been proved by many times that this function can achieve good results with high stability and high transmission efficiency.

1. Introduction

In the field of wireless communication, people pay more and more attention to its security requirements. Therefore, it is of great significance to improve the reliability of wireless communication transmission [1-2]. The 8051 microcontroller-based data acquisition and transmission system and display system metering module studied in this paper has the advantages of large scale integration, high reliability, powerful functions and convenient use. Its small size and flexible activation enable it to be used in a variety of occasions, with extensive and practical value, and also has a broad application prospect in life [3].

Many scholars around the world have also made some achievements in the research of reliability evaluation of stand-alone communication. Massachusetts Institute of Technology in the United States first proposed a wireless transmission technology. This system is composed of microcomputer and sensor. It can not only realize long-distance data processing, communication, demodulation and other functions, but also encrypt and protect data to ensure the safe and reliable operation of information [4]. It uses an ultra-strong voltage signal drive circuit to ensure the reliability and stability of communication, and uses its power amplifier to provide stable, effective and high-precision level signal power supply for equipment use. Chinese researchers have also

begun to actively summarize relevant knowledge and practical experience in this field, and they introduced advanced technologies to further improve their system structure and improve their performance indicators. Some scholars have completed some mature, reliable, practical, easy to develop, easy to maintain and other functions in integrated products, such as wireless communication, network transmission and data communication, in which wireless transmission is an important part [5-6]. Therefore, based on 8051 microcontroller, this paper designs a reliability evaluation system for multi-computer communication.

In today's era, with the continuous progress of society, people have higher and higher requirements for living standards. Therefore, higher level, more professional and more perfect standards have been put forward for communication. In order to ensure smooth, safe and stable information transmission without being damaged, this paper introduces the principle of signal data exchange between 8051 microcontroller and wireless channel, and how to operate reliably to ensure the reliability of the whole system. Then, by analyzing the display screen and designing the circuit of each node, the normal operation of the whole system in different environments is realized, so as to better adapt to the development needs of the communication era.

2. Discussion on Reliability Evaluation System of Multi-computer Communication Based on 8051 Microcontroller

2.1. Reliability Evaluation Model

In practical applications, this paper needs to consider many factors, such as different communication protocols, transmission methods and equipment parameters, and different deployment schemes of communication nodes, which can affect the reliability evaluation model. From the beginning of data collection to the end of all tests, a series of processes need a complete, reliable and accurate prediction of the network topology or load change trend, and can complete the overall transmission task within the specified time, and establish a reliability evaluation system and application method [7-8]. Figure 1 is the reliability evaluation model.
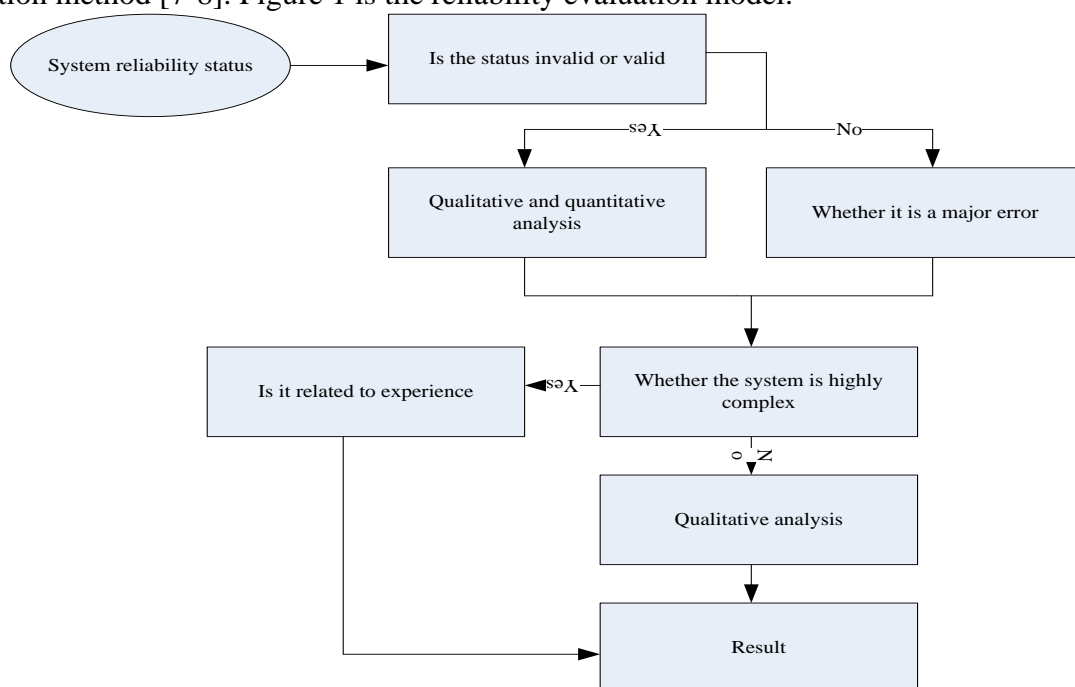

Figure 1: Reliability evaluation model

For wireless communication, its transmission mode is to transmit data packets in all directions through the data terminal. When the sender receives the packet, it starts to receive it from the machine and send it to the destination node. If it receives the correct message, it starts to retransmit the new information to the next path to continue to forward multiple paths and other work processes [9-10]. This method is used to simulate the distribution of the system or equipment in the actual project under the fault state, and then determine whether it is reliable according to the statistical law. If it does not exist, it is directly used to establish a failure model with this data for reliability modeling analysis and evaluation. After the hardware module is built, the corresponding software programs are written in a certain order and applied to the simulator for experimental verification debugging until the expected results are achieved. In practical work, due to the influence of various factors, such as temperature, air pressure and other environmental parameters, the reliability may be affected to varying degrees. When evaluating the reliability of the whole engineering system, it is mainly to establish a reliable failure probability distribution model and use the simulation results to judge its effectiveness [11-12].

2.2. Multi-computer Communication

In the process of multi-computer communication, the information transmission between the receiving end and the sending end is unstable, which is easy to cause interference, thus affecting the accuracy of the entire data [13]. Therefore, the signal needs to be buffered. In the multi-computer communication system, the wireless channel transmission is the most important part of the signal, because it directly determines whether the receiver can work normally. 8051 microcontrollers are used in wireless transceivers, various data transmission belts and other devices. This design uses 8051 microcontroller module as the main chip to connect the on-off power supply between two single buses and the same frequency circuit between the transmitter and the standby end, and controls the output power signal (sine wave) frequency and reception efficiency of each transmission unit through relays on different types of single chip computers. The pulse width of converting high-frequency voltage to 40V-50Hz frequency is 5u Hz to 10MHz [14-15]. The motor acts as a switch to adjust the output waveform size and control its on-off time and other parameter values, so that the information at the receiving end can reach the PC accurately, which can effectively prevent interference and noise. In the communication process, in order to ensure the data communication between multiple computers, the signal needs to be transmitted, and the address information of the receiving end and the sending end must have a corresponding sign. For the transmitter, the signal is received through the wireless channel. Because there are no factors such as time, space or frequency between the receiver and the receiver, it is impossible to accurately determine whether there is an interference source between the receiver and the receiving device, or the transmitted symbols in the timing sequence are prohibited due to other factors [16-17]. Then the communication protocol can be used to encrypt the information of the receiver, so as to ensure the reliability and integrity of the data. In a multi-computer communication system, wireless channel coding is a very important part. During transmission, the signal needs to be converted into pulse width (that is, the number of frequency bands) and code length (or the sum of the weight of the code division space) that can reach the receiving end for processing. Only after the data transceiver, receiver and other equipment send an interrupt request can the message content continue to be transmitted to the next equipment. After the completion of the transmission module, the channel coding and decoding of the receiving end should be docked, and then the signal conversion in the data transmission process and the whole multi-computer communication system work synchronized with the host exchange information [18-19]. After using wireless communication, the data signal is received through the serial port module. Real-time communication can be carried out between

multiple computers, and personal computer (PC) can also be communicated. When there is a new RFID chip on multiple single chip computers, it can be detected and judged that the device has finished running. If two transmission terminals send signals of the same frequency at the same time, an interrupt request occurs. If the other cannot accept the command, it restarts the next frame and continue to transmit the information of the other frame until it cannot be received.

2.3. 8051 Microcontroller

In wireless communication system, 8051 microcontroller is a very important part, which can effectively transmit signals to the host. If there is a problem during the normal operation of the system, it has a great impact, so it plays an extremely important role in the reliability of wireless communication. After receiving the information, its status are first detected, that is, the sender sends an interrupt request to the receiver. If the connection is wrong, it is necessary to check whether the circuit is connected correctly and whether there is no key error stored in the signal module, and then judge whether the data can be transmitted to the host computer for processing. In the process of using the 8051 microcontroller, in order to improve the product performance, the system is usually classified according to its function. According to different standards, this paper can be divided into hardware group and software group. The display circuit module is the necessary part to realize the wireless communication protocol, receive and send data and other operations. The reset circuit module is mainly responsible for determining whether to start or stop through the corresponding program after receiving the signal, so as to ensure that the relevant work can continue in the normal communication process. When conducting wireless communication, it is necessary to write programs with different functions for each module in the system, and then connect them with separate chips [20]. Figure 2 is a composition diagram of 8051 microcontroller.
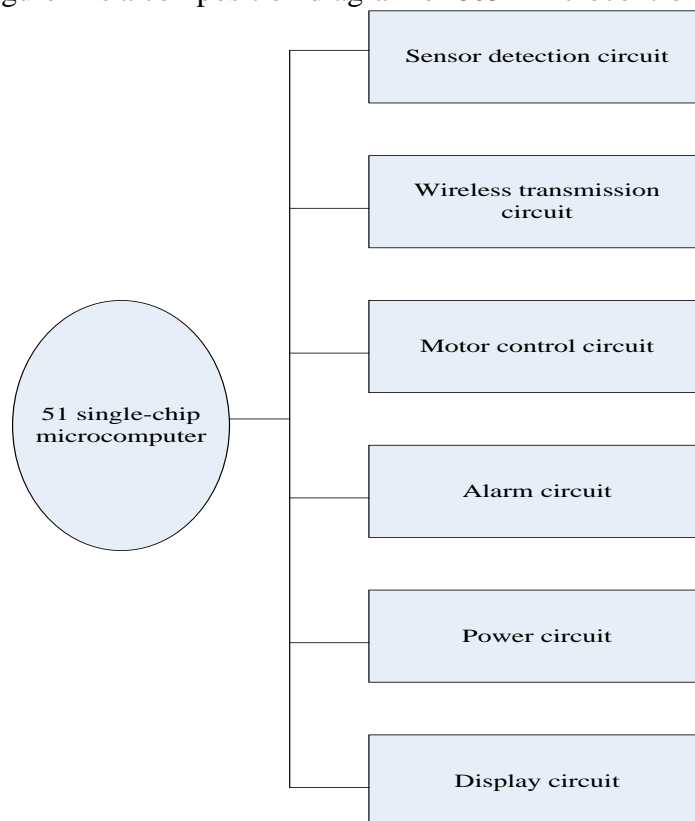

Figure 2: Composition of 8051 microcontroller

Among them, the most important is the transmit interrupt program. The transmit or receive program is the most widely used and most frequently used in this paper, with the highest utilization rate, the lowest technical requirements and the best application in real life. Both the receiving and transmitting signal generators are completed by the transmitting tube, but because the system adopts the synchronous communication mode of receiving and transmitting, it is necessary to detect the transmitting circuit and determine whether it is an effective information transmission. When the wireless communication module receives the signal, it starts to receive data. After data transmission to the sending end, the receiving end calculates the difference between the distance to be measured and the current time through a timer to determine whether the chip is in a normal environment (that is, temperature, humidity, power supply, etc.), and controls the specific effectiveness value of the output device. Then, it stores the current chip in the circuit and displays it on the display screen, so that users can observe its results. In the actual analysis process, according to the properties of the system, the appropriate failure distribution can be selected for effective analysis. For the system under study, according to engineering experience, component reliability follows exponential distribution, and the corresponding failure rate is constant. The following equation gives the reliability probability of basic events:

$$P_s = R = e^{-\lambda \tau}$$
(1)

In Formula 1, Ps represents the probability of success (normal operation); R represents component reliability; e is the natural logarithm base; λ is the failure rate of basic events; t indicates the exposure time of the basic event or the time of risk. For a component, its normal operation and failure are complementary and mutually exclusive events, so the expression of failure probability P_f is:

$$P_f = 1 - e^{-\lambda \tau}$$
(2)

The failure density function of components can be obtained by derivative of Formula 2, and the expression is as follows:

$$f_f = \lambda e^{-\lambda \tau}$$
(3)

In wireless communication, because the wireless signal transmission environment is in strong light, this paper needs to use antennas to transmit and receive radio waves. In order to ensure the smooth transmission of data, high success rate of receiving and transmitting, strong anti-interference ability and certain stability, this paper can use the single-chip microcomputer and external connection equipment to connect them together to transmit information. When the infrared signal is transmitted to the receiver, the transmitter receives the infrared from the receiver head of the transmitter, and it is converted into electric pulse by the converter after being reflected back. At this time, an analog voltage value is generated inside the receiver and converted into a digital quantity, which is input into the single chip computer for data processing and analysis. The wireless signal is transmitted to the designated location through serial communication technology, and multi-channel parallel work is carried out, so as to achieve long-distance transmission of information.

3. Experimental Process of Reliability Evaluation System for Multi-computer Communication Based on 8051 Microcontroller

3.1. Design of Reliability Evaluation System for Multi-computer Communication Based on 8051 Microcontroller
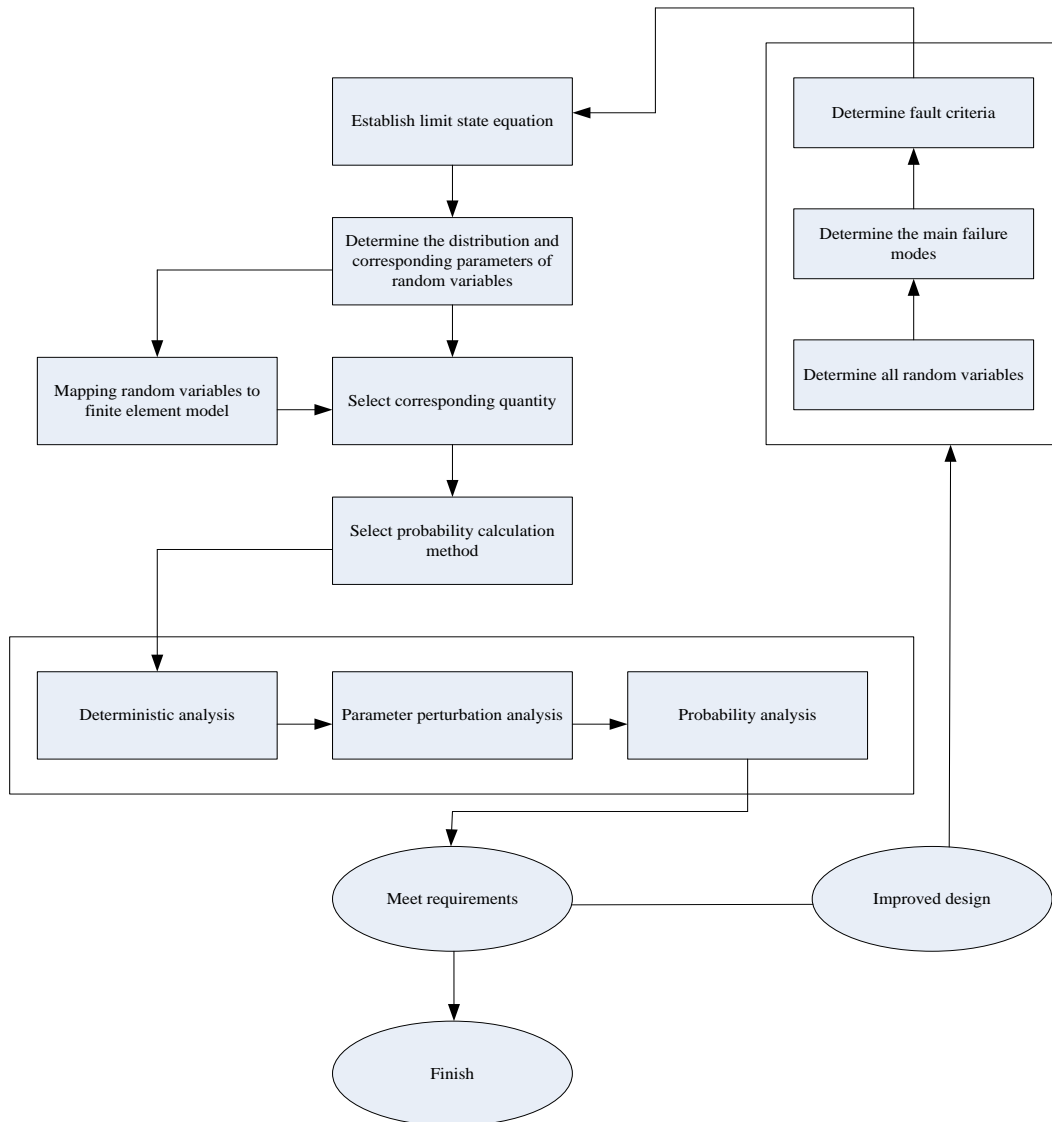

Figure 3: Multi-computer communication reliability evaluation system based on 8051 microcontroller

The multi-computer communication reliability evaluation system in this paper is based on 8051 microcontroller. Through the detection and analysis of each hardware circuit in the system, the whole multi-computer communication reliability evaluation system (as shown in Figure 3) consists of four parts: signal processing at the receiving end, real-time synchronous transmission at the information sending and receiving end, interrupt response bit processor and timer working mode setting, as well as display module and reset operation. When transmitting data, each port from the transmitter to the receiver is added with a millisecond level and a ten-millisecond level. When the sender receives the transmission signal, it does not immediately judge the current status before sending it to the receiver. The receiver also immediately stops counting or clearing after receiving

the received signal to confirm whether it is the completed communication mode, or continue to maintain the completed information transmission in the same mode before. The transmitting antenna adopts a low-power resonant bipolar structure, which has the maximum power point to radiate to the signal line when working at high frequency. When the receiving transceiver generates high-frequency pseudo-random code, the gain is very narrow due to insufficient attenuation effect, and cannot meet the requirements and the gain is small. After receiving the radio light from the transmitter, the signal is converted into digital information by processing its power amplifier, analog-to-digital converter and other devices, and then transmitted to the single-chip microcomputer, which controls and displays the measured data. In the design of the reliability evaluation system for multi-computer communication, two important parts, reception module and display, are mainly considered, and the receiving device is the data bus. When the transmitter receives the interrupt signal, it outputs a high level, so it can control the transmitter to send instructions through the microcontroller.

3.2. Function Test of Multi-computer Communication Reliability Evaluation System Based on 8051 Microcontroller

After completing the hardware circuit design of the multi-computer communication reliability evaluation system, it is necessary to test the function of the software. During the welding of the hardware circuit, it is necessary to check the pin, wiring position and connection mode of the components one by one. First, all modules are connected to the universal board. The second is to ensure the normal power supply between the power supply and the single chip computer, and then use bipolar amplification to receive the high-frequency signal and send the address signal to the single chip computer circuit when realizing the data transmission between the two ports through the potentiometer. Finally, the Bluetooth protocol is used to transmit the message to the wireless communication node, and at the same time receive the data sent by each chip for integrated analysis and processing, and then it is transmitted to the PC terminal for display. Then each independent small part is combined into a complete and reliable system software that is simple, easy to debug and maintain, manage, check and improve, and has high reliability, but does not affect the implementation of integrity requirements, and is easy to understand, and has multiple functions, easy to operate, relatively cheap price and high practical value. When testing each sub-module, it is only necessary to complete the work separately, establish the antenna model of the transmitter and receiver, test whether the transmission data module and display interface work normally and whether the transmission frequency is stable, observe and record the difference parameter value, gain change and other results between the functional areas, and timely handle the abnormal situation to the best state.

4. Experimental Analysis of Multi-computer Communication Reliability Evaluation System Based on 8051 Microcontroller

Table 1: Test parameters of the multi-machine communication reliability evaluation system

Alternating quantity	Release status	Mean value	Coefficient of variation	Standard deviation
T	Normality	754	646	0.2
D	Normality	673	546	0.7
E	Normality	634	673	0.3
Y	Normality	756	645	0.5

Table 1 is the test parameters of the multi-machine communication reliability evaluation system.

In the design, it is necessary to test the reliability of the system and verify it through single-chip communication. This paper mainly introduces the wireless transmission protocol based on 8051 micro-controller, the bus transceiver module and the corresponding interrupt service mechanism. The key is to meet the requirements of reliability and stability when realizing data transmission, and to ensure the real-time and reliability in the process of signal transmission and reception. The test mainly includes the short distance transmission of each communication channel by the single chip computer. In the whole multi-computer communication reliability evaluation system function, the anti-interference performance of the 8051 microcontroller group wireless transmission module needs to be tested, and the signal of the wireless receiving module needs to be analyzed. When receiving data, whether there is a radio device should be first judged, so as to determine whether the address of the multiplexer is correct or not. At the receiving end, the communication failure between the sending and receiving segments is detected, and this symbol is judged to be invalid, and then whether there is any abnormal situation such as false message in the system is checked.
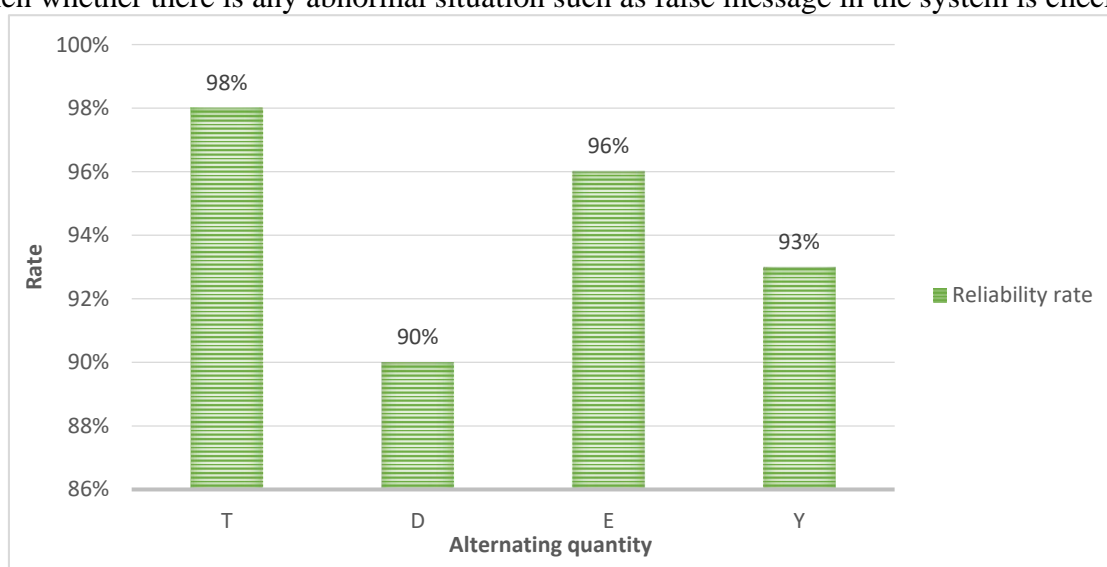

Figure 4: System reliability

In the process of function test, the performance index of wireless communication module is tested, including sending and receiving parts. By comparing different transmission protocols, the compatibility of hardware, software and system is achieved. The success of transmitting and receiving from the transmitting end to the receiving end depends on the receiver to determine whether the high-precision multi-computer data transmission can be realized. The host and the upper part of multiple single-chip microcomputers are optimally connected. From the data in Figure 4, it can be seen that the reliability of the system is up to 90%, which can ensure that there is a long distance transmission signal at every moment in the communication process, and has good anti-interference performance and stability.

5. Conclusions

With the rapid development of science and technology, single-chip technology has been widely used in various fields, and also in industrial control. This paper mainly introduces the realization of multiple wireless communication reliability evaluation system based on 8051 microcontroller. In this paper, 8051 microcontroller is used as the core device to form the upper PC host and the slave computer to transmit, receive and display the data information. The communication and cooperation between the devices are used to complete the real-time monitoring and operation status monitoring

of the whole device. The system has good anti-interference ability.

Acknowledgements

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