Research on Key Technologies and Innovative Development of Electronic Communication System Based on Serial Communication

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Abstract. Today, with the rapid development of computer technology, communication between computer and modern energy instrument Xinxing is extremely important. Serial communication is widely used in on-line monitoring of process quantity in industrial enterprises. This paper analyzes the characteristics of this serial communication, and expounds the selection of communication mode for computer business, the connection of interface hardware and the programming of software. Ethernet technology is currently widely used in the industrial field. Because computer serial communication has shortcomings such as short communication distances and low transmission speeds, meanwhile, process quantity signals have many types, large differences in value ranges, and continuous changes. The key technical issues such as long-distance transmission of signals, real-time communication and display of process volume change curves must be properly resolved before a practical online monitoring system can be constructed. Or it has important reference value for personnel engaged in serial communication between computers and Ganneng instruments.

1. Introduction
With the gradual development of modern society, human beings have stepped into the information age, and the social life of human beings has a higher and higher demand for communication. Mobile communication has become an indispensable part of modern communication system, which has achieved the miracle of "unlimited communication for thousands of miles" in the history of human civilization and brought more convenience to people's life [1]. In the reconstruction and construction of urban and rural power grid in China, not only the low and medium voltage substations adopt automation technology to realize unattended operation, but also a large number of new automation technologies are adopted in the construction of 220 kV and above UHV substations, which greatly improves the modernization level of power grid construction, increases the possibility of power transmission and distribution and grid dispatching, and reduces the total cost of substation construction [2].

Ethernet technology has been widely used in the industrial field. Because computer serial communication has shortcomings such as short communication distances and low transmission speeds, and at the same time, process quantity signals have many types, large differences in value ranges, and continuous changes. The key technical issues such as long-distance transmission of signals, real-time
communication and display of process volume change curves must be properly solved before a practical online monitoring system can be constructed [3]. Ethernet has good development, stability, easy maintenance, fast transmission speed, low price, easy to achieve seamless connection with the upper-level management information network, and provides a unified interface for products from different manufacturers to facilitate interconnection And interoperability [4]. Therefore, Ethernet can be used to build a communication system in microcomputer protection. At the same time, in order to take into account the traditional communication mode, the serial communication interface is still retained in the design. This article takes the communication system combining serial communication and Ethernet communication as the starting point, and elaborates on related issues [5].

2. Electronic communication system for serial communication

2.1. Serial communication mode and link interface connection
Due to the combination of computer technology and measurement technology, a new field of measurement science and measurement technology has been opened up and the development of automated testing system has been promoted. The automatic test system is an automatic test system in which intelligent measuring instruments (hereinafter referred to as intelligent instruments) and computer parameters are used for error correction to complete the display, storage, transmission of measurement results and handling of faults of the automatic test system itself. The whole process is controlled, supervised and managed by the computer. The intelligent instruments with various functions are used as peripheral equipment of the computer, and the computer coordinates the work of the intelligent instruments to realize the program control of the test system [6]. Generally, the problem of computer-to-peripheral communication should be considered first. In principle, this communication can be carried out in parallel or in series in automatic test systems. The computer we mainly choose is IBMPC (including PC/XT, PC/AT and compatible computers) microcomputer [7]. It can be set to DTE or DCE mode as required. The intelligent instrument is also equipped with RS-232 or rs-423 interface and db-25p or db-gp socket. It can also be set in DTE or DCE according to requirements. When using cable to connect the two sides, the serial communication mode of both sides must be determined in advance. Serial link is the physical circuit connecting computer and intelligent instrument. It is the material basis of serial communication of automatic test system. The main principle of computer connection is to deal with it in different types according to the setting of db-25p or db-p used by the serial interface configured by computer and intelligent instrument. When connecting the serial link interface, we should mainly consider the agreement of the intelligent instrument to the signal lines. Generally speaking, they are different from the signal lines specified in the eia-rs232 standard, so we should pay special attention to them.

2.2. Features of serial communication
The research shows that the real-time problem can be well solved by using ActiveX component technology from Microsoft Company. Firstly, a communication component of multi-process or multi-thread (depending on whether it is an in-process component or an out-of-process component) is established. The component object model works to complete serial port operation and communication protocol conversion between upper and lower computers. The system scheduling module communicates with the component through a public interface to perform data exchange tasks. When in use, a plurality of serial ports are respectively bound on different components, and by utilizing the preemptive multitasking characteristic of the Windows operating system, the CPU switches between the components at high speed instead of stopping to wait for a low-speed serial port response. Therefore, all ports are running in parallel, thus greatly improving the real-time response capability of the online monitoring system and simplifying the structure of the application program. The serial port of computer is usually called COM port, which is the serial data interface standard formulated by the electronic industry association. The formal name is eia-r2s32e. It is widely used as the standard communication interface of various industrial control equipment and widely used in various industrial
sites. However, due to its short communication distance (about 15 m) and low speed (up to 20 KB/s), it brings a lot of troubles in practical application. In order to improve the shortcomings of RS232, IEA has successively formulated RS422 and RS485 interface standards. The former is a one-way balanced transmission specification of single point transmission and multi-point reception, which increases the transmission rate to 0MB/s, extends the maximum transmission distance to 4000ft (about 1200m), and can connect 10 receiving devices on a balanced bus. The latter further increases the functions of multi-point transmission and two-way communication, and the settings on the bus The number of standby can reach 32. In practical application, in addition to electromagnetic shielding, lightning protection and other issues that usually need to be considered, reasonable and optimized wiring design and correct use of terminal resistance are also very important.

3. Software programming

3.1. Serial Communication Protocol and Programming Choice
To achieve serial communication between a computer and an intelligent instrument, two tasks are needed: first, to complete the line connection between the two parties in the communication; second, to prepare a communication program according to the communication method. The communication between computer and intelligent instrument is realized by communication software. For the programming of serial communication software, combining the different characteristics of computer and intelligent instrument, the following issues should be dealt with. The link communication protocol (protocol) of serial communication is a rule to ensure the correct and reliable transmission of information. For serial links, there are three standard link communication procedures: TTY, BSC, SDLC / HDLC. The communication between the computer and the intelligent instrument is mainly based on the BSC protocol. The sun-receiving function (DSR, DTR, CTS, RTS) designed by it is essential for serial link control and a rule that must be followed in software programming. The rules used in the communication between computer and intelligent instrument are the rules that both sides of communication must abide by. They are completed by the hardware circuit of equipment, also known as hardware protocol, which is different from the software protocol used in the communication between computers. In the communication between computer and intelligent instrument, the computer can change the communication status according to the communication requirements and under the conditions of meeting the protocol, but the intelligent instrument can only produce and operate according to the protocol requirements. Moreover, because the interface functions of various intelligent instruments are not the same, this is mainly reflected in having different RTS, CTR, DSR, DTR. Therefore, in the actual programming of software, we should pay full attention to these contents. The break mode programming is more complex, but the computer is more flexible, which can make the computer set as the front and back working mode, and can operate other contents in the communication gap. The computer utilization efficiency is higher. Compared with the advantages and disadvantages, in the software programming, the sending mode is query mode, while the receiving mode is interrupt mode, which is more suitable for the characteristics of serial communication between the computer and intelligent instruments. The flow control in the link includes the realization of flow control by program and the realization of flow control by interface hardware.

3.2. Software implementation of communication functions
Using VB to realize the communication between PLC and PC upper computer requires a specific communication protocol to complete. On the one hand, the upper computer can send data and control instructions to PLC, on the other hand, the upper computer can correctly read the contents of the designated data area of PLC. In the system, the data and control commands of the upper computer include: a PLC system time download PLC does not have system time, and system time needs to be written from outside to complete the design requirements of the system b irrigation time download is mainly to write the timing time of the irrigation solenoid valve in the greenhouse in the irrigation system into the real-time query of the operation status of the c solenoid valve in the PLC to query the
operation status of the solenoid valve in each greenhouse to monitor its operation status. The process signal has the characteristic of continuous change, and its change process is usually displayed by two ways: real-time curve, which can meet the monitoring and scheduling requirements in the production process, and historical curve, which is convenient to find out the change rule of process quantity and provide decision basis for fine production management [14]. Except that the sending and receiving program segments are executed during the timer interruption to ensure a stable communication rate, most of the work of the protection software communication module is carried out in the dead cycle after the initialization of the main program. The FIFO function of serial port chip is used to improve the communication speed. Master-slave communication is adopted between the agreed monitoring system and the protection system, so the protection system always receives instructions passively, i.e. it is always a slave station. The communication module of the protection system enters the receiving state immediately after completing the initialization. When the communication interface receives the complete link protocol data unit (LPDU), it will correct the error and discard the data unit in error. There are three types of LPDU received by the protection system: the first is the level-2 data request frame, and the protection system will respond with the measured value LPDU; the second is the level-1 data request frame. At this time, first judge whether the FCB changes, and then form the LPDU with the new asdu and fill the transmission buffer, and then resend the previous LPDU if there is any change; the third is the command frame or the next data frame. When the protection system completes the monitoring command or is ready to answer the data, several asdu sending data packets will be formed to wait for transmission, and then send the command confirmation frame in the specified format to inform the monitoring system to receive the command execution result or feedback data. In addition, in case of startup event or fault event, the protection system will upload the ACD position of LPDU to inform the monitoring system to establish the startup / fault data transmission process. Through the DSP programming, RTL8019AS initialization, sending data, receiving data, embedded TCP / IP protocol and other functions can be realized. Before the data processing steps, the network controller needs to be detected, reset and initialized. The network interface receives and transmits data through two DMA operations. Local DMA completes the data transfer between RTL8019AS and its internal FIFO queue, and remote DMA completes the data transfer between RTL8019AS and CPU. For a typical flow online monitoring system, the temperature, pressure, differential pressure, and instantaneous flow signals vary greatly in magnitude, and cannot be displayed in the same coordinate system; if multiple graphics screens and multiple coordinate systems are used, the display is limited by the screen size, and it is not easy to find the internal connection of the data. According to the control tasks and requirements of the system, OMRON’s PLC is selected as the control core of the lower computer. The PLC has 60 interfaces, the power supply is 24 V DC or 220 V AC, and it has an RS232 interface. Serial communication directly with the PC. The PC chooses a general personal computer, which is affordable, simple and convenient to operate, large in memory, and has a friendly human-machine interface. Reduce the cost of the system, choose OMRON programming cable as the connection cable between the PC and PLC. The 9-pin end of the cable is connected to the computer serial port, and the other end is connected to the PLC’s programming port. The system structure is shown in Figure 1.

![Diagram](image)

**Figure 1** System composition

### 3.3. Error detection

Any communication line inevitably has a certain degree of noise, and the communication between computers and intelligent instruments is no exception. The result of link noise is transmission error of communication information, which is especially serious when the distance between computer and
A intelligent instrument is very far (tens of meters away). In order to ensure the error-free transmission of information, a special error detection sum check bit code 2I is set in the serial communication format of some intelligent instruments. When the computer receives the sent information, the information shall be summed and checked to determine whether there is any error in the transmission information. If there is an error, it can be corrected by sending the intelligent instrument again. However, when the computer sends information to the intelligent instrument to generate an error, the general intelligent instrument does not set the detection function, except for the command information error, other information will be received according to the correct information. In order to ensure the correctness of the information received by the intelligent instrument, we use the method of reading back the sent information to control the error. Therefore, as long as conditions permit, we should try to use the error detection function. Scanning frequency test of network is an important method to test network characteristics in frequency domain. It can test frequency response and transfer function of network. In order to ensure the effective transmission of information without losing, we should advocate the method of combining software and hardware and adopt the above two methods to realize the flow control of information simultaneously when actually realizing the communication between computers and intelligent instruments.

3.4. Data transmission and reception and Ethernet

Receive and send Ethernet frames by reading and writing addresses and data ports. To receive or send data packets, you must read and write the 16KB of RAM in the network control card RTL8019AS. You must read and write through DMA. The network interface uses two DMA operations to complete the reception and transmission of data. That is, the local DMA completes the data transfer between the RTL8019A S and its internal FIFO queue, and the remote DMA completes the data transfer between the RTL8019AS and the CPU. Receiving a data packet generally includes three steps: encapsulation of the data packet, sending the data packet to the data transmission buffer area through remote DMA, and sending the data into the FIFO for transmission through the local DMA of RTL8019AS. The Ethernet data packet receiving process and the data packet sending process are just the opposite. Among them, the computer knowledge and technology include (1) the ARP (Address Resolution) protocol is implemented in the link layer. It mainly maps a 32-bit IP address to a 48-bit Ethernet address dynamically to ensure the correct transmission of the network. In addition, in the design, the IP address is stored in the local memory, so it is not necessary to get the IP address from other servers, so it is not necessary to implement the RARP (reverse address resolution) protocol. (2) IP (Internet) protocol and ICMP (network control message) protocol are mainly implemented in the network layer. IP protocol is the core protocol in the TCP / IP protocol cluster. It provides connectionless datagram transmission service. All the upper protocols should be transmitted in the IP packet format. ICMP Protocol is responsible for transmitting error messages and other information that needs attention. In the design, it only implements the processing of echo request (type code 0) messages. After receiving ICMP packets from IP layer, it determines whether the type code segment is 0. If so, set the type field and code field to 00 (echo response), calculate, verify and then send them to IP layer; if not, it will send them Discard. Thus, the ping function is supported. (3) UDP (user datagram) protocol is implemented in transport layer. There are two different protocols in the transport layer: TCP (transmission control protocol) and UDP (User Datagram Protocol). TCP is a connection-oriented and reliable transport layer protocol, but its delay is difficult to grasp, which is not conducive to the transmission of real-time data. UDP protocol is a non-connection oriented protocol. It simply sends datagrams from one host to another, but it does not guarantee that the datagrams can reach the other end. The reliability must be provided by the application layer, but it has strong real-time characteristics and can transmit information to all nodes at the same time. Therefore, considering the requirement of rapidity, UDP protocol was chosen in the microcomputer protection device. (4) The application layer mainly refers to the user process. The protection device adopts IEC61850 standard newly formulated by the International Electrotechnical Commission, which can be used to realize seamless connection communication between object-oriented and equipment.
4. Summary
After a period of research and application, the serial communication system developed based on embedded chips can achieve three-phase voltage, three-phase current, three-phase power factor, three-phase active power, and three-phase reactive power in terms of data acquisition and comprehensive load measurement. The power data collection meets certain transmission protocols. At the same time, it can monitor various power quality parameters with a simple button system and a host computer. The data transmission is stable and the first-hand power quality data can be obtained efficiently and reliably. With the continuous development and expansion of iLnux, its superiority will certainly become more apparent in the development of embedded systems. Although new hardware is constantly coming out, as long as you are familiar with the method and process of writing device drivers, you can easily incorporate them into your own applications. After the breakpoint, the device can make user passwords Effective protection is more convenient for the combined use of a single machine and the Internet. A two-layer communication protocol can be used. After packet switching, the communication protocol can run in a serial protocol. The bus communication equipment will work after power on reset. If the serial communication phenomenon is realized by means of interruption, it will be shared on the host by means of full duplex division. And the management of bus communication and the management equipment of its subordinate electronic password lock are mainly placed on the link of serial communication data information, which can effectively build a perfect master-slave bus network. There is also a protocol in the communication protocol. To ensure that all devices can use the bus communication of the system, and on the premise of using, priority must be given to the floating power of the bus. Only when there is no abnormal situation or no jumping bus can send packets, and the bus to be applied in this must be subject to the protocol Protection. The communication system can not only meet the requirements of Ethernet networking, but also can be compatible with the traditional serial communication requirements, which will greatly promote the process of integrated automation of power plants and substations.

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