The Research of Embedded Remote Monitoring System Based on B/S Framework

Xiaoyan Cheng*, Guoqing Dang
School of mechanical engineering, Xinyu University, Xinyu, China
*chenxiaoyuan@yeah.net

Abstract. With the continuous development of industrial automation, the requirement of monitoring system in industrial field is higher and higher. Various advanced computer technology, sensing technology and communication technology are more and more appearing in industrial field. Touch screen or computer are usually used to realize the visual monitoring of industrial production line. This monitoring system based on C/S mode is widely used. With its advantages, the monitoring system based on B/S mode is gradually applied to smart home, telemedicine, agriculture, power system and other occasions. The monitoring system based on B/S mode has more advantages in structure and application than C/S mode. How to further expand the application of B/S mode monitoring system is the key to upgrade and replace the current industrial monitoring system. The industrial Web monitoring system based on ARM proposed in this paper can improve the current monitoring system having practical significance both economically and technically.

1. Introduction
Embedded system is a highly decentralized and innovative integrated system, which can show rich content when combined with practical applications and tailored appropriately. In order to meet the requirements of the system in function, performance, cost and other applications, embedded systems need to tailor the software and hardware according to the specific requirements of the application. Therefore, if the established software and hardware foundation can be relatively universal, and then on the basis of this relatively general software and hardware to develop a system adapted to various applications, it will be a better development model[1, 2]. At present, the commonly used embedded system on the market is based on a small memory micro-kernel as the core, according to their actual use, expand or delete the corresponding functions. Because of the existence of microkernels, this extension or tailoring can be carried out smoothly. Embedded remote video mobile object monitoring system based on ARM collects video in a designated area by camera and transmits it to the remote client through the network after the corresponding image processing technology, so as to realize real-time monitoring of the corresponding area[3]. For a long time, video surveillance has a close relationship with people's lives. With the continuous progress of society, people's demand for quality of life is getting higher and higher, and the demand of video surveillance in various industries and different regions is also getting stricter and stricter.

Video surveillance pursues integrated front-end, network transmission, digital processing, integrated system and intelligent management. Pursue the unification of operation platform, so as to achieve the unification of management and control; Pursue the advantages of system security and fault-tolerant reliability, so as to achieve networking and integration. The development of network monitoring system has attracted the attention and involvement of many Internet enterprises, and the market share is also
increasing. Faced with the development trend, the current video surveillance technology still has many shortcomings, such as insufficient video storage space, non-standard concurrent scheduling, inconsistent charging rules, business integration and so on, which need to be improved and optimized.

2. the related technologies

2.1. The system structure of B/S

As early as the beginning of this century, in the feasibility study of the control system migration challenge (COSMOC) project of Stanford Accelerator Center in the United States, some people proposed to develop new applications, accept the configuration and commands from other applications, and realize online adding, deleting, saving and reloading of graphic objects. Then, the German elektronen synchrotron (DESY) developed the JoelMint integration tool, which initially possessed the epics client software function of B/S architecture. With the outstanding performance of B/S architecture, the epics client software in large-scale distributed monitoring interface, remote monitoring system and other fields, the research heat of domestic and foreign scientific research institutions for B/S architecture monitoring system is increasing year by year.

B/S mode, a widely used web technology mode, enables users to get the same user experience as the special software from the general browser through the work of the server, which is a cost-effective development technology. The main function is to realize information exchange and sharing. As long as there is a computer connected to the network, it can interact with the server. The browser for data interaction can communicate with the database through the web server. The main transaction logic runs on the server side, and only part of the transaction logic is implemented in the front end. Under the B/S structure, the data access layer, business logic layer and display layer implemented on the server end form a three-tier structure. Each system is relatively independent and does not affect each other.[4]

![Figure 1. Structure corresponding three-layer](image)

1) Data access layer. The data access layer is located at the database server port, and various operation logic of software information is included. It is mainly to collect the relevant instructions that web server transmits to database, update, change and query the database information, and finally feed back the execution results to web server.

2) Business logic layer. The web server port is the location of the functional layer, and the operation logic of the software task is basically included. It is mainly to collect the needs of the corresponding customers, build a bridge between the instructions and the database, obtain the server information through SQL and other methods, and then complete the information processing, and then transmit the logical results to the web server, so that users can get the information in time Feedback.

3) Display layer. The client is the location of the display layer, and various display logic of the software is included. The data is transmitted to the corresponding server through the web browser. Once the authentication is passed, the client can receive the corresponding page and information. The three-tier client / server structure is mainly to isolate the task operation logic module of the end machine, and the structure layer to complete this work is relatively independent. The web server can share many tasks, which greatly reduces the workload of the user machine and greatly reduces the burden of the user end. There are three layers of structure in B/S mode. The center is the data access layer, namely web database.
The client uses the browser to make connection request to the web server. The corresponding three-layer structure is shown in Figure 1[5].

The biggest advantage of B/S lies in its use and system service management and upgrade have great convenience. The client side is easy to maintain and the system has strong expansibility. As long as the user is connected to the corresponding network, he/she can log in with a valid user password, even without the participation of personnel. But its biggest disadvantage also lies in this, namely to the environment dependence degree is high, need to connect with the server network. At the same time, the main access tool of the system is the browser, with fewer restrictions on the user's login, and authority management needs to be strengthened to avoid security holes.

2.2. Embedded hardware platform
In order to achieve a complete monitoring system, the most important thing is to be able to monitor the real-time working conditions of the scene through the monitoring screen at the monitoring end of the host computer. In this system, in order to realize Web monitoring, i.e. monitoring on the browser interface, similar to other PC monitoring software, it is necessary to list all the devices, instruments and instruments that need remote monitoring in the industrial field on the Web interface, and display their running status and data. At the same time, users can switch the devices[6]. And parameter setting, and with alarm function. Taking steel wire heat treatment production line as an example, its monitoring system needs to monitor the operation status of electrical machinery, valves, pumps, frequency converters, medium frequency induction heating power supply and high frequency induction heating power supply, and real-time display the heating temperature and cooling temperature of steel wire, frequency of frequency converter, opening of cooling water valve and other parameters. In addition to on-site condition monitoring, the upper computer monitoring also has an important function of historical data query. The historical data records all the parameters produced in the industrial production process. These parameters change with time in real time. They are of great value to the enterprise in process improvement, trend analysis of parameters, accident analysis, cost analysis and so on.

The historical data in industrial automation system are mainly digital or analog quantities which change continuously with time (such as switch, temperature, flow, pressure, voltage and current of valves and motors etc.). They are totally different from the discrete, time-independent and discontinuous two-dimensional relational table data[7, 8]. The historical data have the number of measuring points. It has many characteristics, such as large data storage, strong timeliness, high repetition rate and slow change of some data. It is estimated that there are about 120 GB to 200 GB process data to be stored in a medium-sized chemical system every year. Because of the limited storage space of embedded system, although the system expands the SD card, the larger the SD card capacity, the higher the price, which is not conducive to cost savings. In addition, the huge amount of data will also affect the stable operation of the system. Therefore, in order to ensure the effective storage of large amounts of data and improve the storage efficiency, so as to reduce the cost as much as possible, and reduce the impact of large amounts of data on the stability of the system, it is necessary to use data compression technology to compress historical data. In addition to the above functions, the monitoring system also needs to ensure the real-time and security of the system. Real-time is to ensure that the monitoring system can timely feedback the situation of the scene. For the alarm and some parameters with high control accuracy, timely feedback and control are needed to avoid property loss or affecting the production process. Security is to ensure that enterprise secrets are not leaked. In the era of big data, the security of data becomes more and more important. A large number of historical data stored in the system can reflect the information of process, formula and output of the system[9]. These are all part of enterprise property. Therefore, it is necessary to strengthen the security of the system.
The software and hardware selection of industrial Web monitoring system must combine monitoring requirements, software and hardware costs, development costs, system performance and other factors to make the system design more reasonable[10]. The hardware and software selection of this system mainly focuses on the embedded system used for data storage and Web publishing, that is, the hardware and software selection of ARM board, including the selection of embedded microprocessor, embedded operating system and related communication technology. In addition, according to the requirements of the system for data processing, the correlation of data processing is determined. Scheme. In order to realize the function of Web monitoring system, the hardware circuit of ARM board is divided into four parts: basic function module, upper computer communication module, lower computer communication module and storage expansion module. The hardware block diagram of the ARM board is shown in figure 2.

3. Embedded remote monitoring system platform design

Figure 2. Physical structure diagram of the system

Figure 3. Embedded remote monitoring system using iTOP 4412
The embedded remote monitoring system using iTOP 4412 is shown in figure 3. Embedded microprocessor is the core component of this monitoring system, all functions of the system need to rely on it to achieve, so the selection of embedded microprocessor is very important. The selection of embedded microprocessor needs to take into account the functions that the system needs to achieve, so as to determine the peripherals, memory and operating system needed by the system, and further consider the performance, cost, power consumption, volume, packaging, software support tools and other factors of the processor. In this monitoring system, the functions of Web publishing and storage of field data need to be realized by embedded operating system. RS485 communication, Ethernet communication and wireless Wi-Fi communication need serial port, Ethernet controller and port, USB HOST port respectively. In addition, the functions of data processing and storage are also involved. Yes, it is obvious that ordinary single-chip computers can no longer meet the demand.

The hardware system of remote monitoring includes PC module, GPRS wireless transmission, embedded system core and development board, data acquisition module. This section starts with the introduction and selection of hardware. According to the different functions of the remote monitoring system, the design of hardware components of the whole system is proposed. Some mature technologies and equipment developed recently are considered in the selection of hardware components.

Selection of ARM microcontroller in embedded system: The working condition of the lower computer of remote monitoring system is complex, so it is necessary to consider the influence of various factors when purchasing hardware, such as bad weather and temperature on the overall performance of fault diagnosis monitoring device. Embedded ARM system is the core component of the lower computer, which is responsible for the important task of data acquisition, data processing and on-site control and diagnosis of the electrical system. Embedded microcontroller chip is the core of embedded system. In the environment, embedded microcontrollers are required not only to meet the system requirements of stability and reliability, but also to have strong anti-interference ability and data processing ability. Therefore, the best microprocessor should be selected for hardware design. On this basis, we determined the microcontroller LPC2210 using ARM7TDMI-STMCPU.

The selection of sensors should take into account the stability of the sensor and the adaptability to the complex marine environment. Data acquisition is based on voltage, current, vibration and temperature sensor to collect the analog voltage and current of wave power motor respectively. The signal is amplified by amplifying circuit and converted into digital signal. Then it is stored and processed by embedded ARM system. On the basis of accurate and reliable data acquisition system, the causes, phenomena or characteristics of fault of wave generator are analyzed and diagnosed. Therefore, data acquisition module determines the accuracy of fault diagnosis, and the performance of data acquisition system mainly depends on the sensor performance of data acquisition module. The system needs to monitor the vibration, temperature, voltage and current of the wave generator.

4. Conclusion
This paper presents a Web monitoring system applied to industrial automation, and studies and implements it according to the actual needs. Firstly, the software modes of communication network and monitoring system commonly used in industrial field are studied, three kinds of monitoring systems based on B/S mode are analyzed and compared, and embedded Web server is selected to implement industrial Web monitoring system. By analyzing the requirement of industrial Web monitoring system, the monitoring function, historical data storage and query function, as well as the consideration of real-time and security of the system are defined, and the overall scheme of the system is designed according to the requirement. The monitoring system based on B/S mode has more advantages in structure and application than C/S mode. How to further expand the application of B/S mode monitoring system is the key to upgrade and replace the current industrial monitoring system. The industrial Web monitoring system based on ARM proposed in this paper can be used as the current monitoring system. An attempt and reference to improve the system.
References

[1] Joseph, A., Vasanthi, D., & John, M. (2018, December). Low Cost Embedded Design for Wireless Remote Monitoring of Measurement Data in LabVIEW. In 2018 International Conference on Circuits and Systems in Digital Enterprise Technology (ICCSDET) (pp. 1-9). IEEE.

[2] Liu, X. (2018, October). Research and Implementation of PLC Remote Monitoring System Based on Embedded System. In 8th International Conference on Management and Computer Science (ICMCS 2018). Atlantis Press.

[3] Zhang, W., & Shi, F. (2019, May). Design and Implementation of Home Remote Monitoring System Based on Embedded Gateway. In 2019 IEEE 2nd International Conference on Electronics Technology (ICET) (pp. 504-508). IEEE.

[4] Zhang, W., & Shi, F. (2019, May). Design and Implementation of Home Remote Monitoring System Based on Embedded Gateway. In 2019 IEEE 2nd International Conference on Electronics Technology (ICET) (pp. 504-508). IEEE.

[5] Fu, W., & Narayan, D. (2018). Optimization algorithm for embedded Linux remote video monitoring system oriented to the internet of things (IOT). Discrete & Continuous Dynamical Systems-S, 12(4&5), 1341.

[6] Garcia, V. H., Ortega, R., & Romero, R. J. (2018, November). Embedded system for the communication and monitoring of an electric microgrid using IoT. In International Congress of Telematics and Computing (pp. 158-170). Springer, Cham.

[7] Gupta, S., Talwariya, A., & Singh, P. (2020). Development of Arduino-Based Compact Heart Pulse and Body Temperature Monitoring Embedded System for Better Performance. In Performance Management of Integrated Systems and its Applications in Software Engineering (pp. 189-197). Springer, Singapore

[8] Haikun, T., Xinsheng, L., & Lunbin, L. (2018). Research and Design of Embedded Java Compiler. Microcontrollers & Embedded Systems, (4), 6.

[9] De Venuto, D., & Mezzina, G. (2019). Field Programmable Gate Array-Embedded Platform for Dynamic Muscle Fiber Conduction Velocity Monitoring. Sensors, 19(20), 4594.

[10] Dong, Y. (2019, October). Design and Implementation of Embedded Web Server Based on ARM. In IOP Conference Series: Materials Science and Engineering (Vol. 612, No. 5, p. 052067). IOP Publishing.