Design of Remote Eater Conservancy Information Monitoring System Based on Embedded Technology

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***Abstract*—This paper studies the application of embedded system in water conservancy information remote monitoring, structured, modular scheme is adopted to improve the system of software and hardware design, debugging and implementation, and puts forward a set of embedded control, data acquisition and transmission, friendly interface in the integration of monitoring information management system design. This system based on the wide coverage of the GSM short message service provided mobile communication public transport hydrologic data, without networking, suitable for actual, system operation cost is low, the data transmission reliable and rapid. For water conservancy department of information management system of water resources to provide a complete set of hardware and software solutions, in areas such as DAMS, reservoirs, lakes has more broad application prospects.**

Keywords-Embedded systems; The remote water conservancy; Information monitoring; GPRS

I. PREFACE

With the rapid development of national economy, water conservancy project in the national economy role is more and more big, the flood control but also directly affect national economic development an important aspect. Because the information of flood prevention is not high, the error of artificial observation data is large, the system maintenance is difficult, easy to be wrong. In the event of abnormal weather, the flood control safety of major reservoirs and floodgates is a concern, while also causing great pressure on city flood control. At present, the state has put forward the goal of constructing "digital water conservancy", which is the policy of the ministry of water resources to promote and promote the modernization of water conservancy. We will fully implement the construction of water conservancy informationization to improve the work of flood prevention and flood prevention and flood prevention and flood control. In order to further improve the effectiveness and reliability of the flood control decision-making, the implementation of flood control and remote real-time monitoring system construction, can timely to possible or is happening flood dynamic monitoring, danger and disaster, informed the scene, in order to take corresponding preventive and remedial measures to ensure the safe operation of the reservoir. It is of great importance for leading decision making and reducing flood disaster, relieving the flood control pressure in the city, and safeguarding the safety of people's life and property. Under normal circumstances, such as dam water conservancy monitoring stations distributed in a wide range, and with the monitoring center distance is far, using the traditional way of cable connection, the circuit of the high cost of laying and construction cycle is long, and at the same time because of the physical factors such as canyon mountain barriers to using cables. The wireless monitoring solution addresses these problems well. Wireless monitoring solution without laying cable network, can quickly and easily deployed where various needs digital monitoring equipment, a new monitoring system or extensions to the existing monitoring system, has the very strong flexibility and expandability. The water flood control monitoring system USES the GSM/GPRS network communication lines, and USES wireless network technology to carry out remote monitoring of important water conservancy facilities such as reservoir DAMS. Can monitor at the same time on different positions in the water, will be monitoring the real-time collection of water conservancy information in a timely manner to the monitoring center, real-time dynamically, report the monitoring, timely find problems and processing, conform to the reservoir flood control, water supply, irrigation, power generation of the actual needs, and implement the requirements of modern water conservancy[1-2].

II. THE OVERALL STRUCTURE OF THE SYSTEM

This system adopts the pattern of decentralized monitoring and centralized processing. The entire monitoring control, transmission, and data reception processing system constitutes a system of distribution, including three large parts:

A. Field Monitoring Section

It is mainly based on the data collection equipment of the S3C2410 ARM9 chip, and has increased the GPRS

communication module which supports short message and data communication. The terminal data collection device can be sent to the monitoring center through GPRS Modem, while also receiving monitoring center commands for the operation.

B. Transport Links Section

The terminal data collection equipment and monitoring center communicate through GPRS Modem through GPRS wireless network.

C. Data Monitoring and Processing Centers

With access to mobile communication enterprise SP server, remote from the measured data, complete the hydrologic data processing, preservation, and other functions, also send control commands to the remote terminal of Modem equipment. When the alarm is called, the message can be forwarded to the remote operator's phone.

System function concrete realization process is: the data acquisition front-end at regular intervals to measure water level, water level, time and other useful information coding, according to the specific agreement for the accuracy of the sensor information processing, packaging, forming a short message, through the GPRS communication module will be sent to the monitoring center. Monitoring center will receive the message in the corresponding decoding and processing, the flow of statistical time out at a specific location, sent to various water control and decision making personnel and stored in the database for hydrologic information query in the future, the whole monitoring system structure as shown in Fig .1[3-5].

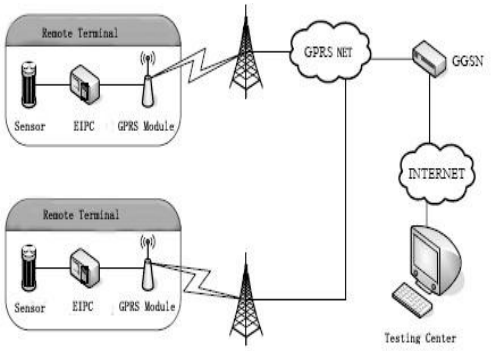


Figure 1 System structure diagram

III. THE MAIN FUNCTIONAL MODULE OF THE SYSTEM

In view of the present in the domestic area of water management in water conservancy information monitoring and sin problem, using the modern electronic technology and network communication technology, considering practicality, versatility, and scalability of the system, the system main function is divided into three modules.

A. Hydraulic Information Collection Module

General system of water conservancy projects in the field, even in remote mountainous area, information collection and communication influenced by natural environment conditions, all equipment shall be taken into account can continuous work in bad weather conditions, the encounter the most adverse circumstances can still achieve the most basic request of information transmission system design. In addition, because of incomplete and sin area field power supply facilities in a wide range of measuring point, low power consumption and low cost are put forward according to functional units and maintainability high demand.

B. GPRS Communication Module

For sin district of hydrologic data collection with measuring point, scattered layout, real-time demand is not high, the data transmission flow of small, send the low frequency characteristics, the existing cable communication mode hardware cost is too high. In recent years, with the rapid development of GSM, GPRS and CDMA technology, wireless data transmission speed and stability has been greatly improved, especially suitable for application in water conservancy information monitoring is not easy to wiring, a little quantity of monitoring data transmission field. Because GPRS technology can connect directly to the Internet via a gateway, the overhead machine does not need to receive a module of information, which greatly reduces the hardware cost and optimizes the composition of the system.

C. The Upper Machine Management Module

The management software is responsible for the data processing and the data processing. The database construction in the flood area is at the core of the construction of water resources real-time monitoring and management system. Sin area includes two aspects the contents of the database construction and the construction of the content of the construction of the database structure and database, the database structure refers to the anatomy of sin area, carry on the reasonable classification to the sin information, in accordance with the related theory and method of database design design is reasonable in structure, easy to implement in technology, and meet the application requirements of logical database and the physical database. Database content is according to the actual situation of sin area, using the database management system to provide the input tool will sin the data input to the database, the database become a have abundant information database warehouse, meet the requirements of sin daily management and decision support.

IV. SYSTEM HARDWARE DESIGN

The hardware components of this system are mainly composed of water level information collection devices, measurement and control units, communication module and monitoring center computer. We can see it in Fig.2.The measurement and control unit by A microprocessor, A/D, sensors, actuators, mainly to complete the data collection and processing, to control command decoding execution, etc. Communication module chooses special industrial GPRS communication module, complete to send and receive SMS text messages and connect the Internet network, etc, under a

communication module to realize the receiving and sending of information, upper monitor computer access to the Internet, from the Internet directly to in the form of short message sent to the hydrologic data and complete the control commands sent, finally will classify the collected data is stored in the corresponding database for inquiry calls. The water management department can obtain the water information in the flood area in time to make use of the water service.

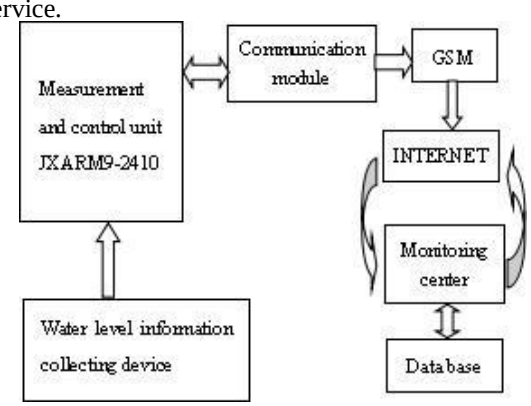
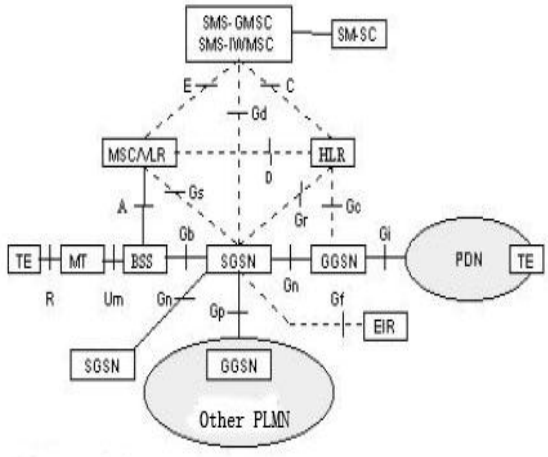


Figure 2 A structure diagram of the system hardware

V. RESEARCH AND IMPLEMENTATION OF TERMINAL NETWORK ACCESS

A. The Node Associated with the Terminal Access Network

Logically, GPRS is implemented by adding SGSN and GGSN new network nodes in the GSM network structure. Due to the addition of these two network nodes, the corresponding new interface needs to be added. Fig.3 illustrates the GPRS logical architecture. The GPRS network is a very complex system, and the following is an analysis of two entities that are concerned in the design of this article.



----Signaling interface
——Signalling and transport interfaces

Figure 3 The logical structure of GPRS backbone

The GPRS support node GSN is the most important network node in the GPRS network, including the functionality required to support GPRS. GSN has a mobile routing management capability that connects various types of data networks and can be connected to the GPRS register. GSN can complete data transfer and format conversion between mobile and various data networks. GSN is an independent device that resembles a router, and is integrated with MSC in GSM. Multiple GSN is allowed in a GSM network. There are two types of GSN: SGSN and GGSN. SGSN is the node that provides the business for the mobile terminal (MS). In activating the GPRS business, SGSN established a mobility management environment that included information about mobility and security aspects of the mobile terminal (MS). The main purpose of SGSN is to record the current location information of the mobile platform and to send and receive mobile packet data between the mobile and SGSN. GGSN is connected to the group data network by configuring a PDP address. It stores the routing information of the GPRS business users belonging to the node, and USES the information to send PDU to the current business access point of MS, known as SGSN, using tunnel technology. GGSN can query the user's current address information from the HLR through the Gc interface.

GGSN is primarily a gateway function that can be connected to a number of different data networks, such as ISDN and LAN. In addition, GGSN is also known as the GPRS router. GGSN can convert the GPRS packet packet from the GSM network to a remote TCP/IP or other network. The functions of SGSN and GGSN can be implemented both by a physical node and by different physical nodes. They all have IP routing capabilities and can be linked to IP routers. When SGSN and GGSN are located in different PLMN, they are connected through the Gp interface. SGSN can send location information to MSC/VLR through any Gs interface, and can receive calls from MSC/VLR via the Gs interface.

B. Process Analysis of GPRS Network for GPRS

The GPRS terminal designed in this paper collects and monitors the data collection from the RS232 serial port. The data is then uploaded to the server. Data transfer from the user terminal to the server: GPRS wireless terminal reads live device data from the user terminal through a serial port. The data is processed by GPRS terminal and sent to GPRS service support node (SGSN) by GPRS group data. SGSN communicates with the GPRS gateway support node (GGSN), which handles the grouping data and sends it back to the server on the Internet. GPRS backbone networks include GPRS service support junction (SGSN) and GPRS gateway support (GGSN). SGSN USES the base station subsystem (BSS) to complete the control of the mobile desk (MS), and locate MS by communicating with the register (HLR). SGSN and GGSN are connected via the IP backbone network in GPRS, where SGSN is between MS and GGSN and delivers data to MS and corresponding GGSN. GGSN is responsible for routing and encapsulation between GPRS and external data networks. GPRS network transport data mainly USES GPRS service support junction (SGSN) and GPRS gateway support junction (GGSN). Using GPRS network transfer data, you can view it as three processes, namely the

connection process, the data transfer process, and the termination process.

C. GPRS Terminal Communication Design

The GPRS module in this system USES the link layer PPP protocol for communication. The GPRS module communicates before the communication, then links the link to the TCP/UDP application transfer call. The process of data transfer by the network protocol stack is really a process of data encapsulation and data unmarshalling. When sending data, according to the application layer (user data) a (UDP) transport layer, network layer data link layer (PPP), a physical layer (serial) order data encapsulation: and when receiving data, decapsulation in reverse order. The implementation of the upper function needs to be applied to the underlying function, and the underlying function is to serve the upper function.

VI. SYSTEM SOFTWARE DESIGN

Linux, as an open source operating system, has unique advantages and extensive applications. Linux is highly flexible and can be tailored to suit a variety of application requirements. Linux was originally designed for desktop applications general-purpose operating system, not only inherited the characteristics of the Unix, including virtual memory mechanism, process support and user management, etc.; And many aspects exceed Unix, becoming the first choice for embedded development and the mainstream of the market in terms of open source, free, stable, etc. In addition, Linux is a portable cross-platform operating system that supports a wide range of different architecture processors. Linux can run whether it is a CISC, RISC, 32-bit, or 64-bit processor. The development of embedded Linux on the ARM platform is a bottom-up, step-by-step process, and of course some work can be done in parallel, typically with the following steps:

1) install and set up development tools on the host machine and set up a cross compilation environment;

Install the Bootloader on the target board.

3) configure and compile the kernel;

4) install and run the kernel by Bootloader;

5) device driver development;

6) prepare the contents of the root file system;

7) install the target root file system;

8) develop and run applications;

9) system integration.

This article USES the desktop Linux system RedHatLinux9.0 as the host development environment and communicates with the target board via the serial line and the network line. The host machine running terminal emulation program as the target board console (the console), and through the Ethernet transmission files and programs, in the form of a virtual terminal display target program running on the host. In this development mode, including the Bootloader, the kernel, the root file system, and the application are stored in the NANDFlash of the target board.

Using the terminal emulator minicom on Linux, you need to configure it properly before using it for the first time. Run minicom-s, select "Serialportsetup" under the Configuration menu, and select "Savesetupasdf1" to save the exit. Ethernet connections are used to download images of the kernel and root file system; After running embedded Linux on the target board, you can implement Linux's powerful network communication capabilities between the host and the target board. For example, you can mount a Shared directory and run the target program through NFS (network file system). You can also use TFTP (TrivialFileTransferProtocol) to transfer files and programs.

VII. CONCLUSION

Due to distribution is more dispersed, the monitoring stations of sin number, for the needs of multi-level management of water resources, a variety of information demand of modern sin district water resources management makes hydrologic monitoring system of the workload increased significantly, although general water automatic monitoring system to solve the traditional manual monitoring cycle is long, the disadvantages of low efficiency, small range but is common in the aspect of hydrologic data transmission investment costs, maintenance difficulties, easy to cause hydrologic data of the leaders, false positives, misstatement or omission, difficult to meet the practical requirements. To solve above problems, this article in to the area of informationization construction of sin based on the analysis of the basic content and characteristics of flood area based on ARM and GPRS hydrologic monitoring system for the overall structure of short message. To compile flood zones to monitor computer communication and data management software. The water conservancy information monitoring system is designed based on ARM and GPRS short information. Characteristics of this system is based on a wide coverage of the GSM short message service provided mobile communication public network transmission hydrologic data, without networking, suitable for actual, system operation cost is low, the data transmission reliable and rapid. In addition, the system is simple, intensive, and has good mobility.

REFERENCES

[1] Aacek, Szymensky. Embedded Internet Technology in Process Control Device.IEEE, 2002, 6(3):77-82.

[2] ARM Limited,ARM920T(Rev 1)Technical Reference Manual,2000.

[3] Wookey,Tak-Shing,Aleph One,Porting the Linux Kernel to a New ARM Platform,Guide to ARMLinux for Developers,2002：52-59.

[4] TC35 Cellular Engine Hardware Interface Description[S],Siemens Inc,2002.369.

[5] AT Command Set Siemens cellular engines V03.10[S].Siemens Inc,2002.284.

[6] Samsung Electronics Co. Ltd S3C2410X 32-Bit RISC Microprocessor User's Manual(Revision 1.2),2003.

[7] ARM Limited.ARM9TDMI Data Sheet. ARM Limited, 2002:34-36.

[8] Frank Vahid and Tony Givargis. Embedded System Design: A Unified Hardware/Software Approach. University of California: Department of Computer Science and Engineering, 2006:57-60.

[9] Samsung Electronics Inc. S3C2410X Data Sheet. Samsung Electronics Inc, 2003:4-45.

[10] Siemens Mobile. MC35 Hardware Interface Description. Siemens Mobile, 2004:13-16.

[11] Karim,Yaghmour.Buliding Embedded Linux Systems,2003.