

Water well SCADA system based on GPRS

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Abstract. This article describes the application of GPRS technology on water well control monitoring system, and system components, communication protocols and control software design is analyzed, the successful application of the system improves the efficiency of the water control monitoring.

Keywords: GPRS. SCADA. Communication protocol. Control monitoring

1. Introduction

There are twenty one water wells distributing within a radius of 90 square kilometers in Lingxi water plant . The control of water wells still stays in a manual state .The taking、 transporting and supplying of water can't be coordinated, the level of automation ,the control accuracy and stability is lower ; water plant operators can't keep informed of the specific operating parameters and all kinds of accident information (information accident of equipment operation、 vandalism theft etc .) in time .The water patrol officers had a intensive labor to carry out inspections and operations to twenty wells everyday and even through can't dispatch the water wells in time . The company's water supplying centre can't keep informed of the operating conditions of the Lingxi water plant and the water wells outside .In response to above conditions , water well SCADA system is designed to realize the remote sensing and control of Lingxi water plant network system .This system adopts distributed architecture ,effectively achieves the remote monitoring and management of twenty wells using the GPRS data transmission .

2. Telemetry and remote control network lingxi water plant subsystem

GPRS is a packet switching technology on top of GSM network , above it, TCP/IP network protocol can be loaded and data can be transmitted by virtue of overage advantage of GSM mobile network. The technology of industrial data transmission based on GPRS has got widespread attention and recognition in the industry .The remote control system for wells combines the computer and exclusive controller for water wells together . Deep wells and water plant central station uses the GPRS communication to monitor , setting up water resources well dedicated controller and GPRS DTU in each deep well. System control cabinet for wells is arranged in the water center station, the centralized monitoring for well system、 the alarming for abnormal working condition 、 the treatment for emergency and chain protection can be realized in the operator station.

Lingxi water plant remote sensing and remote control network mainly monitor specific operating parameters for water wells , providing evidence for the management's dispatch and regulation. The system adopts three layer construction as is shown in fig.1. Introductions for specific functions are as follows:

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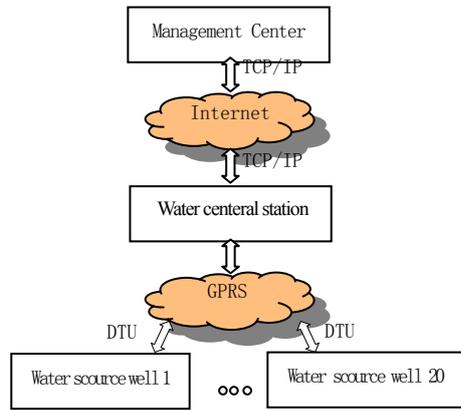


Fig.1 System structure

a) Control part for scene one-off water well

The 20 water wells in the field are the basic part of the whole system. Served as a field-level control unit ,it performs the collection and display of the operating data for each well and collect data of water wellhead pressure, flow, voltage and current through DTU to intelligent remote terminal . These data can be sent to the water central station by intelligent remote terminal in a active or passive way . At the same time the 20 water wells accept control instructions from water central station.

b) Water central station

Laying in the middle layer of the system , it is the core of the system. The first function of it includes accepting information management work for each well data’s reception, storage ,display, request and report printouts ,conducting monitor center warning for special situations and easily making access to real-time and historical data through client software ;the second function is to receive instructions from management center. Complete monitoring of scene water source wells through comprehensive analysis of the data .Meanwhile ,submit the meta-analysis data to the company management center.

c) Company management center

The highest level of the system ,in the application layer, using B/S structure. Mainly receives the transmitted data from water central station and can view working condition of any well or whole wells anytime and anywhere . Analyzing and sorting these data and then make macro-management and decisions.Then gives dispatching command to the water plant central station .Out of the needs of information security and scientific management ,it provides access account of water wells data for these departments or individuals who have access requirement^[1]

Water management center is the control centre of the SCADA , connecting with water supply center in Ethernet communication .The water supply centre and water wells adopts H7710 GPRS DTU communication , constituting a point to multiple point transmission.

3. The realize of remote communication technology

The real-time data collection and send of field pressure ,flow, voltage and current are all completed by intelligent remote terminal unit RTU-2600.Corresponding flow meters 、 pressure sensors 、 voltage transformers and current transformers are put in the scene to connect with the RTU-2600 analog acquisition interface, which is to collect working data .The data is packed after being collected to RTU-2600 and is sent to remote water wells monitoring center server by H7710 and GPRS wireless communications network. The monitor center server must use an independent IP address to WAP so that measurement and control terminal can accurately transmit data to the specific IP. The sever has water wells monitoring software and database which can store、 analysis and display received data.

Make real-time collection and analysis for running data(units of current, voltage) of each one-off water well to control the start and stop of the one-off water wells .Each one-off water sub site should upload a variety of operating data regularly and make pre-processing and alarm processing(such as the water pressure over the upper limit ,the water pressure over the lower limit , the unit current too large, the voltage too

high ,lacking phase in unit etc.) for presupposed limiting value and running conditions, which makes one-off water wells more stable ,more liable and more secure. The working frequency band of wireless data transmission is generally in the UHF or VHF band , the transmit power is between 300~19200bps, which covers tens of kilometers .We adopt hour Shenzhen hongdian H7710 GPRS DTU to finish wireless data transmission ,which meets industrial standards, optimized design of electromagnetic compatibility and with superior reliability; H7710 GPRS DTU embedded PPP, TCP / IP, DDP and other protocols, enabling a transparent data communication from the user device to a remote data center ; supporting dynamic IP address data center DNS domain name addressing ; supporting fixed IP address data center ;point to point and the center to multi-point transmission and transmission delay is generally less than one second; a separation of CPU and wireless core module design which has high extensibility; embedding standard protocol PPP, TCP / IP; embedding unique protocol DDP ,TDP and AT+; always on-line mode and a variety of trigger online mode; billing according to the data flow; data and SMS are mutual backup and can freely switch; support multiple communication.

Working band: optional 850/1900MHz dual-band, GPRS/EDGE Class 10, encoding scheme: CS1 - CS4 , antenna interface:50 Ω /SMA-K (negative head), TTL/RS-232/RS-422/RS-485, Data rate: 300 ~ 57600bps ,voice interface : standard voice level output , the actual bandwidth of GPRS : 20-50Kb/s, actual bandwidth of EDGE : about 150 kb/s ,average communication currency : 105mA@+12VDC,average idle current: 15mA@+12VDC,working environment temperature : -40~+70°C.

Network communication protocol

Water center station and well groups adopts primary and the secondary communication which is similar to broadcasting . The sencondary machine never send commands or data initiatively ,all is controlled by the primary machine.Communication can't be conducted directly among secondary machines,it must be transferred by primary machine. Data communication baud rate is 9600b/s.Each controller has a unique address number which is the only difference between each controller. Eight data bits frame format, no parity, 1 stop bit. Data format adopts data packet form,which is as follows:

Start flag	source machine address	Destination machine address	data length	Data content	Testing sum	Stop bit
1 byte	1 byte	2 bytes	2 byte	N byte	2 byte	1 byte

Water Center station broadcasts its own address as required, all the wells listen to the radio and write down the broadcasted address. Compare the received address to their own addresses, communicate by primary and the secondary two-machine communication process if the address is same and isolate from the network temporarily if different. As is shown in Fig.2.

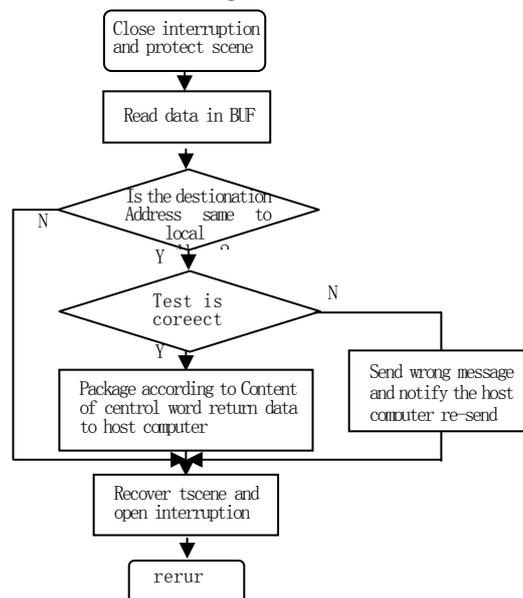


Fig.2 Communication flow chart

Table1 STYLE OF SENDING DATA

num	name	byte	note
1	Water well level	2B	liquid level sensor output signals
2	Output water pressure	2B	pressure sensor output signals
3	flow	2B	flow meter Output signals
4	Motor power	2B	
5	Power factor	2B	
6	Line frequency	2B	
7	Three-phase voltage	6B	
8	Three-phase current	6B	
9	KWh	1B	
10	Time signal	7B	Year-month-day-hour -minute-second
11	Motor start-stop	1bit	
12	Manual and automatic switch	1bit	
13	Terminal address	2B	GPRS node number

a) Communication subsystem design

Communication subsystem adopts socket communication, the monitoring center server and the monitoring terminal use client / server model . The main function of the communication subsystem in server-side is to create socket to monitor ,set up a connection when has terminal requests and receive data from the terminal. When conducting intercommunication, the server must be started first to enable the monitoring center server on line and receive all the information sent by GPRS-DTU in a specified port .This design uses the Microsoft Winsock Control SP6 version socket active which is a set of open ,multi-protocol network programming interface, the use of such control needs to register and be loaded in the applying program. This active provides related operating functions such as calling GetLocalIP () function to get the current host IP address and return. The socket makes communication become more reliable and convenient and it is easy to expand monitor nodes for system^[2].

4. The database subsystem design

The data control centre GPRS dispatching system software is the key to the whole system.It can send all kinds of commands , collect effective data detected by the DTU terminal in real time and write them to database, calculate,deal with ,statistics and analysis the database and finally display the dealing results in a table or graphic;

Dispatching center computer uses Windiows 2000 Server edition operating system, using DEPHPI 7.0 programming language and making communications link with GPRS through gprs_dll.dll, GPRS_SMM.dll, misc.dll etc.It accomplishes the management of remote sensing and remote control and a series of functions such as alarming,parameter setting ,operating mode setting ,time proofreading , reseting and selective calling. It can conduct automatic inspection , making telemetry or remote communication to all testing points for once in specified time , while the data displayed and stored in database;it can also conduct automatic inpection to selected points ,making dynamic inpection to a part of testing points in specified time.It provides a complete set of solution program for wed report making ,which combines the function of report making with web and windows applying program ,accomplishing the access、 analysis 、 report and share of data.

5. Conclusion

After the building of GPRS water well remote sensing and remote control network system, the scheduling of company water supplying station can not only acknowledge various operating parameters (such as pool water level, output pressure ,water flow, unit operating parameters ,etc) , accomplish the remote control of the motor start and stop, the remote reading of the state, the setting of the working parameters etc , but also it can keep informed of the operation of one-off water wells. Its timely and effectively dispatch of water supply resources ensure the company's normal water supply, providing basis for the enterprise information management.

6. References:

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