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Automatic Embedded Wireless Control System Based on GPRS

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Abstract: This paper describes a designed GPRS-based wireless control system, highlights the signal acquisition and processing as well as remote data transmission software design and implementation. GPRS-based wireless control system mainly consists of auto sampler software, signal sampling and processing system, wireless data transmission module. In wireless data transmitting section installed in the field tester supports serial data transmission on wireless data transmission module, the establishment of the monitoring server in the indoor, field test data can be timely sent to the server. The detector shows performance index through a lot of testing. Test results show a high degree of automatic detector for unattended remote areas in a variety of harmful ions under conditions of dynamic monitoring. *Copyright © 2013 IFSA.*

Keywords: Wireless communication, Server, Data acquisition, Data transmission.

1. Introduction

As the continued growth of China's population, GDP, consumption of resources, energy demand is growing rapidly [1]. In the case of substantial energy consumption, rapid economic growth, pollution emission intensity, the grim situation of environmental pollution, situation has not been fundamentally reversed [2]. In addition, the pollution caused by the reduced total water intensifies has led to the increasing of water pollution, the increasing of water pollution has led to a further significant supply and demand of water resources. Not only by the daily consumption of water polluted, more affected by toxic ion contamination. Unscientific production and manufacturing processes, water and land developed a lot and survival of excess water is diverted to human life and a large number of factories, making the process of social and economic development needs of the water environment and the current reality of the water environment increasingly acute contradictions between [3]. Therefore, real-time monitoring of the concentration of heavy metals in drinking water for human production and life has its significance [4].

Most of the current detection of ions in water using offline checking, that is, after the water off-site testing, which means the disadvantage that the sample in the collection, transportation, testing and other contamination of the process is more serious, which affect the accuracy of test results, and the cycle of entire test is very long [5]. The world's most advanced test mode is automatic real-time monitoring to the water element content of measurement site, by means of real-time network to response the changes of the contents of trace elements in water. The biggest advantage in this way is the ability to obtain a continuous record to the change of the content of trace elements in water [6]. Compared with the

traditional test instrument, this instrument is simple operated, low cost, targeted, high testing accuracy, high degree of automation, enabling to provide supervision information for unmanned and wireless remote control , so that make it possible to on-site real-time monitoring of harmful ions in drinking water [7].

This design of GPRS-based wireless control system is divided into hardware and software design, including data capture–processing and algorithm; automatic control software system; system integration and human-machine interface software; wireless communications monitoring module and other software and hardware architecture. Test data is first stored in the hard disk of field test instrument, then use the wireless data transmission module to send the data and the results to a central server, testers can be valid in a lab environment to download and test data for further analysis. Testers can also be based on actual needs, remote boot the analyzer at a specified time, wait until the test is completed and then the data will be automatically transferred to the server. The instrument has a simple, low-cost, targeted, high testing accuracy, high degree of automation, making it possible to provide supervision information for unmanned and wireless remote control, so it is possible to on-site real-time monitoring of harmful ions in drinking water.

2. Automatic Wireless Control System

2.1. Database Technology

Database technology is a large amount of important data storage and database technology is derived from some mathematical models stored, it is specified for a number of elements of the various applications, and contains a small data redundancy. Database technology produced in the late 1960s, is the advanced technology of data scheduling [8]. Test data is first stored in the hard disk of field test instrument, then use the wireless data transmission module to send the data and the results to a central server, testers can be valid in a lab environment to download and test data for further analysis. Testers can also be based on actual needs, remote boot the analyzer at a specified time, wait until the test is completed and then the data will be automatically transferred to the server. The wireless network topology of the entire testing process is shown in Fig. 1.

2.2. The Progress of Automatic Wireless Control System Based on GPRS

Water pollution problems have been attracted more and more attention in the world, as well as drinking substandard water for a long time can lead to many diseases. The rapid development of wireless communications provides a good development platform for detecting harmful ions in potable water. Using GPRS technology, GPRS-based wireless embedded control system achieve a true on-line monitoring and unattended. After a number of experiments, even if communication signals is poor, the GPRS-based wireless embedded control system can also achieve a stable remote boot and data transfer. Data transfer schematic shown in Fig. 2.

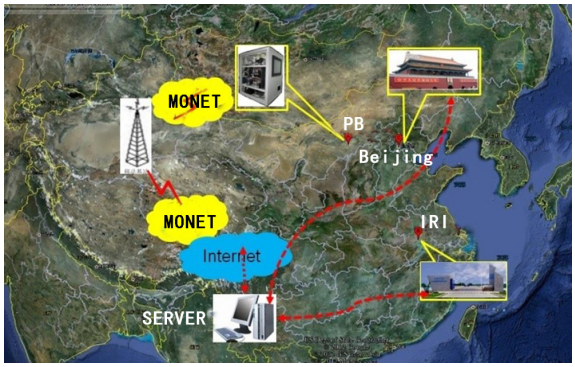

Fig. 1. The wireless network topology of the entire testing process.

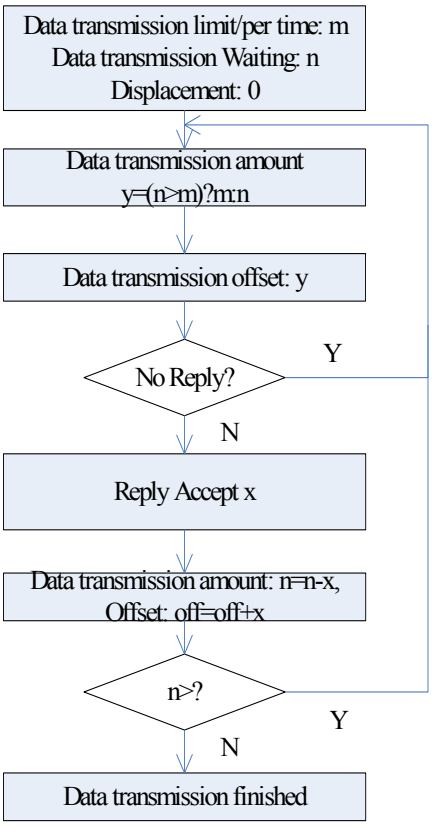

Fig. 2. Data transfer schematic.

Server-side remote control and real-time monitoring of user login screen shown in Fig. 3. After the user enters the corresponding web site, enter the correct user name, password and

verification code, we can access the remote control and real-time monitoring of the main interface. The main interface communications analyzer status indication (normal, abnormal), the analyzer's data transmission time, fluoride concentration and other information before and after treatment of drinking water. Researchers can click the Open button on the main interface, remote start field testing equipment, raw data can also be further click on the main interface to download. GPRS wireless network and the Internet using a wireless monitoring system to establish the true sense reaching remote start and monitoring.

Fig. 3. Server-side remote control and real-time monitoring of user login screen.

Using GPRS technology to achieve remote start monitoring instruments and testing is completed automatically send data to fully achieve unattended and remote wireless control. The test data is first stored in field test instrument in hard disk, after the use of wireless data transmission module of the data and the results are sent to the center server, test personnel can download the test data and make further analysis in a laboratory environment. Testers can also be based on actual needs, remote start at a specified time analyzer, wait until after the test is completed the data will be automatically transferred to the server.

3. The Realize of Wireless Control System

Rs232 is also called ETA-232-E, is an industry standard and its role is to ensure compatibility between the various plant products and released in 1962. American Electronics Industry Association also provides a universal serial interface specification EIARS232-C.Since RS232 is a single-ended signal transmission, so its relatively short transmission distance. It has common mode noise and other defects in transmission, so it can communicate within the generally applicable twenty meters. RS485 is followed by RS232, it can compensate for the low transmission speed, and transmission distance is short and other defects. RS485 has multi-point and two-way communications capabilities, the transmitter power and error protection mechanisms have also been effectively improved.

Because Universal Serial communication is a common means of communication between the host computer and other hardware device, the Windows of Microsoft provides a variety of s application program to realize serial communication in operation system. The serial interface need to be initialized before use, once it completed, then it can be read and write. The declaration of read and write function as follows:

BOOL ReadComm (HANDLE Comm,
// the sentence of serial interface
LPVOID ComBuffer,
// set the byte number of the read data
WORD,
// the number of redirect to the type DWORD
LPDWORD NumberOfBytesRead,
// once repeat, parameters redirect to the structure OVERLAPPED, if operate at the same time, parameters is null
LPOVERLAPPED Overlapped);
BOOL WriteComm(HANDLE Comm,
// the sentence of serial interface
LPCVOID lpBuffer,
WORD NumberOfBytesToWrite,
// WORD number of bytes to write
LPDWORD NumberOfBytesWritten,
//once repeat, parameters redirect to the structure OVERLAPPED, if operate at the same time, parameters is null
LPOVERLAPPED lpOverlapped);

MSCOMM is serial programming ActiveX controls in Windows environment developed by Microsoft, with this control, programmers do not consume too much time to write complex application programming interface (API) functions, very easy to use. To achieve precise control of PC peristaltic pump is need to establish reasonable and perfect communication control protocol. External control interface DB15-2 is connected to a 485-B; DB15-3 is connected to a 485-A. The format of communication protocol frame is flathead (Frame) + address + length + pdua + fcsb. Which flathead is let E9H for the first frame, when in transmission, all contents after header, if there is E8H, place it by E8H, 00H. If there is E9H, place it by E8H, 01H. When Reception, will restore E8H to E8H, 00H, restore E9H to E8H, 01H. Address is an address of one byte, the range is 1~31; length represents the number of byres pdua; fcsb is XOR of address, length, application layer part of the encoded data of pdua as follows:

(1)Read operating parameters: RJ

Answer: RJ + Speed 2byte + full speed, running Reversible 1byte +

(2)Set the device address: WID + 1 byre in new address

Answer: WID

(3) To read the device address: RID

Answer: RID, addr is only the address of pump (1-30).Used to verify the correctness of the set address.

In the communication protocol, W, R, J, I, D corresponding to ASCII value 57H, 52H, 4AH, 49H, 44H; in the speed, high byte is former to low byte, the maximum speed of 50.0 rpm, i.e. 01F4H; full speed, in the start and stop the status byte, BIT0 indicate start and stop status bit, 1 means run, 0 means stop; BIT1 expressed full status bit, 1 run at full speed, 0 for normal operation; in the really reversed byte, BIT0 is positive counter status bit, 1 represents forward, 0 represents the reverse; address bit is defined as 1. For example, setting the peristaltic pump (address 02) is being transferred, the speed is 25 revolutions per minute, and the command is: E9 02 06 57 4A 00 FA 01 01 E3.

Syringe pump via RS-232 or two interfaces of RS-485 to communicate with the host computer, which supports two protocols, one is the OEM agreement, and another called the DT (terminal) protocol. OEM agreement provides enhanced error checking, which uses the checksum and serial number, OEM agreements as shown in Table 3.2. Among them, data STX is the header of each frame, ETX for the end of the frame, the checksum is terminated of the entire data block. Pump address is form 31H-3FH; serial number is a fixed value 31H; data blocks constituted by the commands and parameters, all are represented by ASCII, low in the post, high in the former, such as I1000: 5 bytes, represent 49 31 30 30 30. The checksum is the last character in the data string is the XOR of all data from STX to ETX (including STX, ETX).

Peristaltic pump' commonly interpreted control commands as follows: E9 01 06 57 4A 01 F4 01 01 EF, which E9H for the header, the first 01H indicating the address, 06H represents the length of pdu, 57H, 4AH respectively ASCII value of W, J, 01F4H said that running at full speed, in the second 01, if BIT0 bit is 1 represents run, if BIT1 is 0 indicates normal operation, in the third 01H, the BIT0 bit indicates the direction of rotation is clockwise, EF is the XOR of address, length and pdua. If you need to reverse peristaltic pump, make the BIT0 bit to 0 in the third 01H, and then recalculate XOR of addr, len and pdu. To stop the peristaltic pump , only to make the BIT0 bit to 0 at second 01H, and then recalculate the XOR of addr, len and pud.

To control the injection pump, the first is to enter a fixed command 02 31 31 5A 52 03 09, 02H represents a beginning of a data, 31H indicates the address of the pump, and the second 31H is the value 31H, 5AH is the ASCII value of Z represents initialized the piston, 52H is the ASCII value of R represent execute the current command, 03H represents the end of a data, 09H represents XOR of all data from STX to ETX (including STX and ETX).

The syringe pump valve moves to the input position and extract arsenic standard solution and then discharged need to execute the command: 02 31 31 49 41 31 30 30 30 4F 41 30 52 03 64, which 02H represents a beginning of data, 31H indicates the address of the pump, the second 31H is a fixed value, 49H is the ASCII value of I represents move the value to output port position, 41H is the ASCII value of A indicates t move the piston to absolute position , 31H, 30H, 30H, 30H are ASCII value correspond to the character 1, 0, 0,0, 4FH is the ASCII value of O represents move the valve to the output port location, 41H is the ASCII value of A means that moves the piston to the absolute position , 30H is the ASCII value of the character 0, 52H is the ASCII value of R show execute the current command, 03H represents the end of a data, 64H represents XOR of all data form STX to ETX(including STX and ETX).

4. Wireless Data Transfer and Real-time Curve

IOCOMP control is a popular third-party drawing control, it has a powerful drawing function, according to the needs real-time rendering different line, different width, and different color curve. It mainly includes iPlot, iXYPlot and iScope drawing function, iPlot displays the function of control chart. iXYPlot' function is extended to iPlot' function. It is used when the X value is not always increase or decrease, when using it, we need to set some drawing characteristics and speed etc. iScope is a hardware-based digital to analog circuit affairs which directly to display, needing data acquisition card to transfer data to match it.

Control has a plurality of sub-object interfaces, such as channel, axes etc. Many important properties and methods will influence the functions of control, they distribute in the main interface of the control. For example, the printer configuration, context and preferences function all distribute in the main interface. The similarity of channel interface and the main interface is that they have the same file I/O function interface. File interface methods and properties of the main interface belong to all peripheral interfaces in the chart, but the interface method of peripheral interface files belonging to a specific interface. Analysis meter testing has shown a continuous curve in Fig. 4.

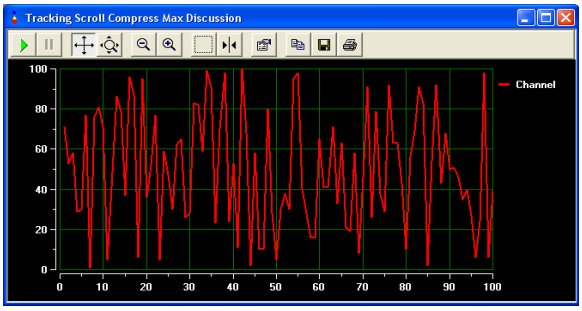

Fig. 4. Analysis meter testing has shown a continuous curve.

5. Conclusions

Real-time monitoring of the content of the harmful ions in drinking water has a great significance in environmental testing, clinical, food and is very important to people's life and health. GPRS-based wireless control system has a simple manipulation, low-cost, targeted, high precision, high degree of automatic while the merits can achieve unattended and remote wireless control, so that make harmful ions in drinking water of real-time monitoring of live fast as possible. The test data is first stored in field test instrument in hard disk, then use wireless data transmission module to send data and the results to the center server, the tester can download the test data and make further analysis in a laboratory environment. The tester can also according to actual needs, in the remote start analyzer specified time, after the testing data is automatically sent to the server.

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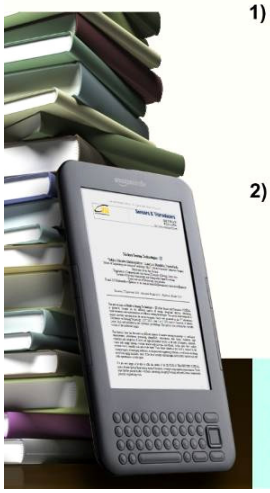

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