

Intelligent selling-water management system based on embedded devices and wireless network

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Abstract. A kind of intelligent selling-water management system combined embedded devices and wireless networks is discussed at length in this paper. The system consists of three parts which are water level detecting terminal installed on water dispenser, the server used for summarizing data and scheduling installed on the company side and application of mobile client. The embedded device captures the user's residual water and then the data will be transmitted to the server application which is connected to a database, it stores and analyzes the receiving data subsequently. The application of mobile client acts as an interface to concern the delivery information between user and delivery man and a platform to communicate mutually. The overall system implements the function that the selling-water company delivers water intelligently in terms of users under different network environments.

Introduction

With the rapid development of the electronic and communication technology, people's life style has a huge change. In the process of life style information, people have been constantly searching for a more convenient, quick and intelligent way of life. Today, however, pure water companies adopts this way that "when users don't have water, users will call the water companies, and then the water companies will send water to users according to registry information". Real-time performance of this traditional way is poor, and users may be on the phone for a long time, water companies will send the water to users, besides users' address information will be informed every time, pure water companies also need to register users' information, which is very troublesome and inefficient for users and companies. Due to the situation above, and we combine with the current situation of the current cost of embedded devices fallen sharply and the growth of the network communication coverage, this paper proposes a smart sell water management system based on wireless network [1], aiming to improve the work efficiency of the water company and make people's life more convenient.

The Overall Structure And Function Of System

The system is mainly composed of three parts; water level detection terminal of the users water, the server used data aggregation and scheduling server in water company and program of mobile users application. The water level detection terminal takes the STM32 as the main controller [2], and monitors the water level of the user through the ultrasonic module (HC-SR04). When water level has reached the warning level (water is not enough, and it need to buy water), The server receives request signal through WIFI network or mobile network and users the signal to confirm the customer's location. The company will remind staffs to send water to users according to the situation. In order to check out easily, the company storages related information. At the same time it will inform the users generally time of sending water though the wireless network. The server provide network access interface for mobile user application, The client application program will

provide users and staff members with different functional interfaces according to different account types, and users and staff will receive different information from the server. As shown in Fig 1.

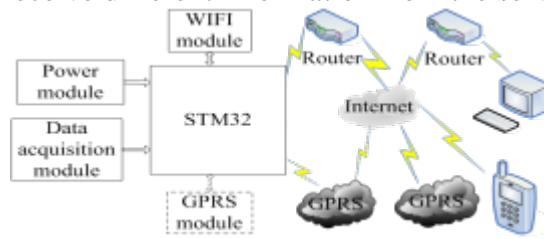


Fig 1 System overall structure

System has the following features: First, It can real-time and accurately detected remaining water of the user on the server side, and set according to the distribution of liquid level, come true intelligent distribution request, water company staff will send water after receiving the request of water; Second, water company can query all customers information through the server database, then the company can reasonable arrangements staff for different area in different periods, it can reduce water excessive or insufficient from a certain extent and it will also save water cost; Third, provide account management functions, pure water company can analyze, process and print for information of database, convenient company accounts management; Fourthly, provide mobile client application, the user can not only get user information database on the PC server, the administrator also get their own water listing information through this APP. At the same time the APP and water personnel provide communication platform.

Hardware Design

Water level detection system consists of a terminal, the selling-water management center server and mobile terminals, composed of two parts later using the PC and mobile phone, without hardware design. This introduces the water level detection terminal hardware design, which consists of a controller module, the water level detection module and wireless transmission module, as shown in Figure 2.

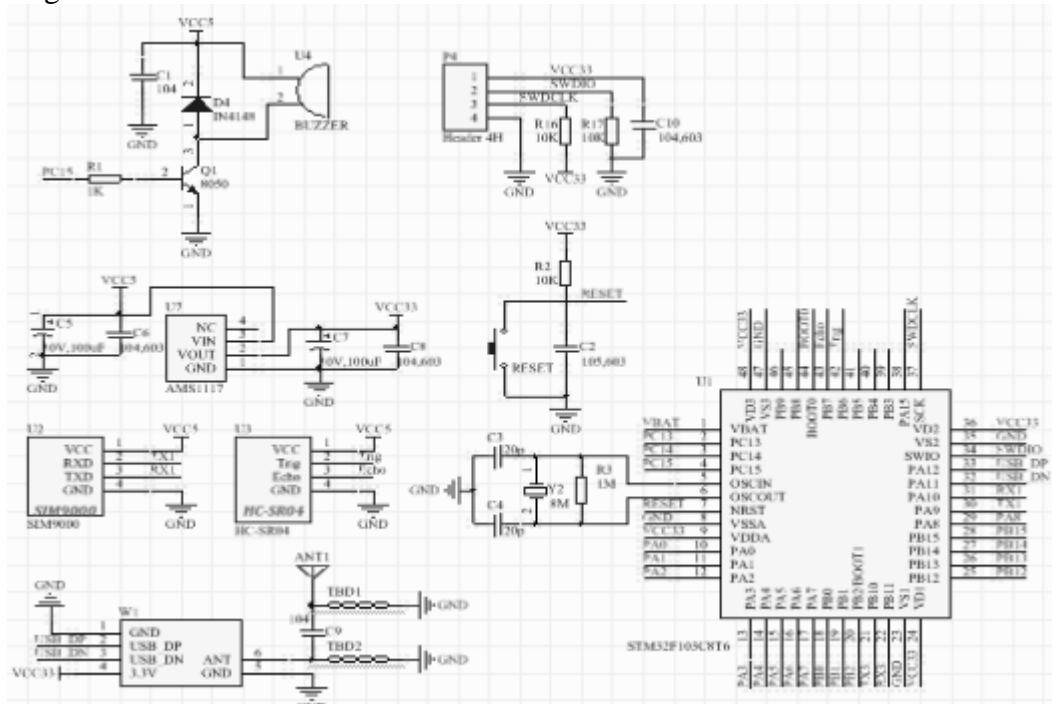


Fig 2 each module schematic

The main controller module. The main control chip select STM32F103C8T6, STM32F103C8T6 belong enhanced STM32 series, it uses high-performance ARM® Cortex™ -M3 32-bit RISC core. Rich interface chip contains two 12-bit ADC, 3 general-purpose 16-bit timers and a PWM timer, also includes standard and advanced communication interfaces: it has two I2C interface and SPI

interfaces, three USART interfaces, a USB interface and a CAN interface [3].

level data acquisition module. User terminal level data acquisition module selects the ultrasonic module (HC-SR04). HC-SR04 stable, measure the distance range of up to 450cm, accuracy up to 0.2cm, low power consumption, it can meet the needs of the system level measurement. HC-SR04 trigger control signal input pin TRIG and ECHO, ECHO signal pins are connected STM32F103C8T6 the PA1 and PA2, shown in Figure 2.

The measurement principle: (1) Ranging adopts the IO port TRIG trigger, to the least 10us high signal; (2) module automatically sends eight 40kHz square wave and automatically detect whether a signal return; (3) the signal return by ECHO IO port outputs a high level, high duration is ultrasonic time from launch to return. Test distance = (high level time * sound velocity (340M / S)) / 2.

Remote data transmission module. The user terminal network environment factors is considered, we can adopt the two different ways to meet different customers under the network environment of the function of remote data transmission. The one way: user can use the WIFI module in the home or office with WIFI network environment. After through the STM32 set the WIFI module, it can access to the Internet network by the router, and then the data acquisition module data collected after the STM32 treatment are sent to the server through the Internet network. The enough using existing network environment build the remote data transmission channel. We get the job done by a WIFI module. The second way: the current mobile network cover almost all urban and rural living areas, GPRS module achieve remote data transmission without WIFI network environment and it makes up for the customers that do not WIFI network environment. GPRS module choose SIM900 wireless module, it can come true data transmission with low consumption. STM32 communicate through AT commands with SIM9000 module. GPRS network communication in two ways provided to users with two network interfaces, it meets different users under the network environment the use of desire. SIM900 wireless module communicates with the main control module through the serial port, WIFI module communications STM32F103C8T6 and though the USB interface, as shown in Figure 2.

Power and buzzer module. SIM900 wireless module, ultrasonic modules and buzzer are used 5V power supply, 5V power supply to 3.3V by AMS1117 WIFI modules and it supply the main controller and power supply, as shown in FIG. Buzzer prompts the user is responsible for reminding the selling-water company to send water, PC15 pin is connected to the main controller, as shown in Fig 2.

The System Software Design

Figure 3 is the client software flow chart for data acquisition and remote transmission. The client software adopts the method of module multiplication, and the program is composed of the main program, the hardware initialization, the establishment of the network connection, the data acquisition and the water request module. The program starts with the peripheral hardware module initialization, and gets ready for the normal job. Then, we can set parameters according to the domain name server and its connection is established. After the connection, the data is collected and sent to the server. The sending data is unconditional, and the analysis and judgment of the data is conditional whether on the shortage of water and sending the water request.

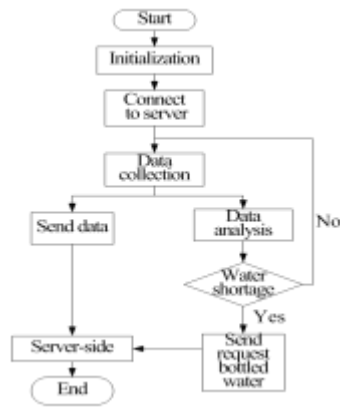


Fig3 client software design flow figure

The application on server consists of both background program and foreground program. The background program receives the data and stores it into the database continually and the foreground program is a MFC application in order to provide user interface.

In accordance with the principle of information security, when foreground starts running, an administrator landing interface pops up first which only allows rightful administrator to log in and thus avoids modification and disclosure of user information in database by others. The foreground provides management function about user information, account and water delivery. User information management function can inquire all information associated with the user according to single and the query result is displayed on an information sheet which can be referred to modify or delete user information. Accounts information of a specific time period can be reported and printed in account management function. For water delivery management function, the information of the user whose residual water is inadequate inquired from the database by region or related officials will be sent to mobile client application of the related officials. And then the water delivery can be arranged appropriately. The functional block diagram of foreground program on server application is shown in Figure 4.

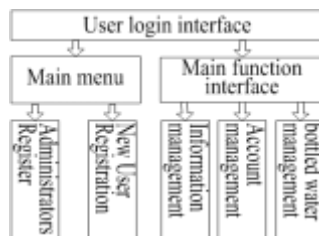


Fig 4 Server-side application foreground part of the function block diagram

Event-driven mode is employed in foreground program, which means that user operation determines the running process of the program.

The flow chart of background program is shown in Figure 5. Server monitors “socket client” triggered by client, namely user terminal, via a stream socket “socket server”. If the server detects a connection request from the client, a real connection will be established after three-way handshake. This real connection is a new stream socket and data can be transmitted between client and server through this connection. Figure 5 indicates the program running process of a single client requesting connection, establishing connection and transmitting data. When multiple clients request connections, the basic progress is the same. The original socket “socket client” continues to monitor requests from other clients [4]. In this case, if more clients request simultaneously, sever can conduct corresponding operation in their respective sockets for each request concurrently, which enables a real time monitoring of multiple clients.

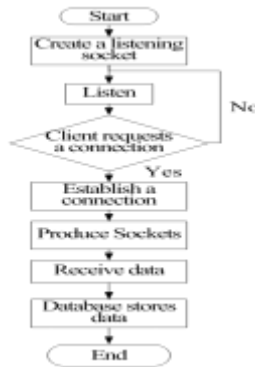


Fig5 Server-side application background function block diagram

Mobile client application design. Mobile client application is the same as the server foreground application, which is the event driven user interface application, and the program operation flow depends on the user operation decision.

Users download and run the mobile client application is a log-in interface, the program will judge the user's account type that is a common user or administrator. According to the different types of accounts, two different interfaces will be logged to: common user interface and administrator interface.

The common user interface includes five modules: (1) business processing; (2) the balance inquiry; (3) the information of the water supply; (4) the online service; (5) preferential activity.

System testing

By logging interface successfully logged in to the server in the foreground application, and go to the main menu interface, as Figure 6 .

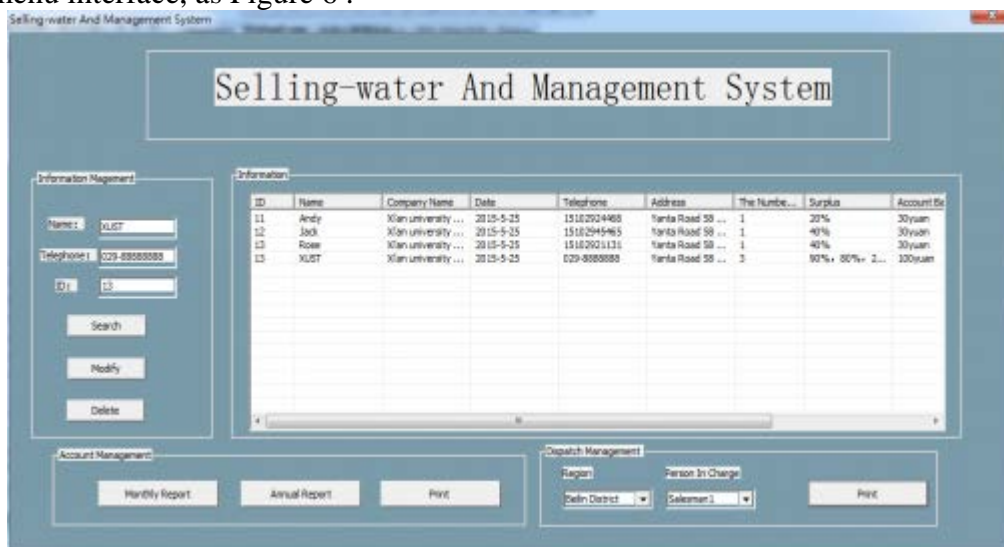


Figure 6 server-side foreground application main interface

Through the input part of the information in the above information managements and click the query button, all information queries to the corresponding user is shown in the table on the right. It can be achieved to change and delete user information. In the lower right corner of the two drop-down menu select the regions and responsible person, click the print button to print the relevant person in charge of sending water list and send the information to the relevant person in charge of the mobile client applications account, as shown in Figure 7.

Water Dispatch List				
NO	USER'S NAME	TELEPHONE	ADDRESS	USER TYPE
11	Andy	15102924468	Yanta Road 58 Communications Building 412	VIP
12	Jack	15102945465	Yanta Road 58 Communications Building 410	VIP
13	Rose	15102921131	Yanta Road 58 Communications Building 410	General User
13	XUST	029-8886888	Yanta Road 58 Communications Building 410	General User

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Fig 7 Selling-water list

Through this system, all other design tested have been able to achieve stable function, there was not program runaway phenomenon and data collection anomalies.

Conclusion

The design of the function of each module finished, we can choose the right solutions to meet the selling-water management in mind. At the same time it has to modify the very versatile and scalability, data collection instruments for special reading and other data, only need to replace client-related sensors and a small amount of server software will be able to meet other remote data collection capabilities. What we can study such a data acquisition, processing, analysis and management of the system is important for the development of intelligent.

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