An Overall Design Method of Intelligent Remote Water Meter Remote Reading System

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Abstract

This paper presents the design and implementation of sensor, wireless data communication and M-BUS communication. In view of the advantages and disadvantages of the existing intelligent water meter reading system, a targeted solution is proposed. The infrared reflective sensor is designed for the dry-type magnetic water meter. The intelligent water meter is designed by M-BUS protocol, infrared data transmission technology and ultra-low power embedded system. At the same time, the hardware circuit and embedded system software of M-BUS host are designed and implemented. This design takes into account the requirements of function and cost. And it improves the accuracy and real-time of data collection, which has a broad market prospects.

Keywords

Intelligent Remote Water Meter, M-BUS Concentrator, Hardware Design, Software Design.

1. Introduction

In order to alleviate the water crisis, the whole country has carried out the transformation of water network and implemented the policy of "one household, one meter". After the implementation of the policy of "one household one meter", the crisis of water resources has been greatly alleviated. However, with the development of urban construction, the land shortage makes the building construction tend to develop high-rise buildings, and then the original form of manual meter reading is adopted[1-3]. The first increases the workload, the second increases the difficulty of water meter reading, and the original form of water meter reading still cannot complete the water quantity in time and accurately Copy and read the water fee. According to the construction requirements of smart water in smart city, the original extensive management needs to be skillfully advanced to the refined management, and the modern technology needs to be used to improve the management level and the original water supply management mode[4-5]. Another advantage of using the intelligent water meter is that the user's real-time data collection fees can be more refined, fees can be more reasonable and reasonable distribution of water resources, which provides a powerful technical means for the realization of step water price.

Intelligent water meter remote collection and reading system is a frontier research field which involves interdisciplinary and highly knowledge intensive integration[6-8]. The research on the remote collection and reading system of intelligent water meter is not only conducive to the emancipation of human beings, but also to the collection of user's water volume information, the transmission of remote data to the network and upload to the server, and the final feedback to the user and water management department, so as to realize the standardization of water fee measurement and improve the management level and information disclosure level of the government. In the research of intelligent water meter remote reading system, it is of great significance to solve the practical problems by multi-disciplinary technology theories such as sensor technology, embedded computer technology and wireless communication technology[9-10].

2. Intelligent Remote Water Meter Remote Reading System

2.1 Demand analysis of intelligent remote water meter remote reading system

At present, the intelligent meter reading system has been booming. And there are many kinds of meter reading methods which can be divided into two categories[11]. The mobile meter reading system and the community network type bill meter system, the mobile meter reading system has simple installation, high reliability, and is suitable for the community with far building spacing and low real-time requirements, but the cost is also high, and the use of GSM network requires high server[12-14]. The network meter reading system can avoid the above disadvantages, but its real-time performance is not as high as the mobile meter reading system. However, the two methods are used in different regions according to different needs, and realize the network management of data. There are many kinds of communication methods in communication, such as 485 bus communication, M-BUS communication and CAN bus communication, which have different advantages and disadvantages in different situations.

The intelligent remote water meter reading system based on M-BUS bus realizes the following functions as required:

(1) Intelligent water meter

Data acquisition function: the water quantity information detection function is completed for the dry-type magnetic water meter, and the forward and reverse rotation detection of the water meter is realized.

Data statistics function: the intelligent water meter will process and process the collected data, such as flow, flow rate, fault statistics and time statistics.

Battery power alarm function: the intelligent water meter needs to have battery power detection function. When the battery power is lower than a certain value, the administrator will be informed to replace the battery through the M-BUS communication server software to realize the battery power alarm function.

Low power design: in use battery power supply, it can work normally for more than 9 years.

Convenient for on-site construction and later maintenance: for on-site installation, it shall be convenient for debugging and manual reading of product maintenance and water quantity by after-sales personnel in later period.

(2) M-BUS concentrator

Compatible with intelligent water meters of multiple water meter manufacturers: the load characteristics of M-BUS slave devices of intelligent water meters in the market are different. Through the new M-BUS host circuit design to adapt to the different M-BUS slave devices, the intelligent water meters of multiple water meter manufacturers can be read.

Load detection function: M-BUS concentrator can carry load which depends on the capacity of power supply and the static consumption of M-BUS slave equipment. By detecting the bus, it can prevent overload and bus short circuit, and realize power cut-off and audible and visual alarm functions.

External communication interface: M-BUS concentrator adapts to different requirements, different communication protocols and different use modes. External communication and configuration ports are required for users.

Overload recovery function: when the bus is overloaded and wrong, the bus can recover automatically.

2.2 The overall design of the intelligent remote water meter reading system based on M-BUS

This paper mainly focuses on the design of M-BUS intelligent remote water meter and M-BUS concentrator in the M-BUS intelligent remote water meter reading system. A remote data collection and reading system of intelligent water meter includes bottom data terminal products, middle data collection and reading system and upper data system management system. This paper mainly deals with the hardware design of the bottom data terminal products and the middle concentrator, but not the upper computer data management system.

Figure 2-1 is the overall frame diagram of the intelligent remote water meter reading system based on the M-BUS bus, in which the intelligent water meter measures the water flow through the sensor, collects the user's water quantity information and stores it in the intelligent water meter. The intelligent water meter and concentrator communicate through M-BUS, and M-BUS communication obtains the internal water quantity information of the intelligent water meter through certain communication protocol. The system adopts M-BUS communication, which is a master-slave half duplex transmission bus designed for the special interface of consumer instruments. The slave station can only respond after the master station inquires, and can not upload information actively. The base station of the intelligent water meter network reads the information of the intelligent water meter remotely through the M-BUS concentrator, and processes and stores the data on this basis. According to the characteristics of M-BUS, the master communicates with the slave. Through the change of the level, the slave analyzes the voltage information of the master, the slave communicates with the master to send the current information, and the master analyzes the current information of the slave. The M-BUS bus can provide power for the slave, but when the bus is powered off, the slave can not continue to work. In order to maintain the long-term stability of the intelligent water meter, we provide a large capacity disposable battery for the intelligent water meter. When the M-BUS host is powered off, it can use the power supply of the intelligent water meter to ensure the stability of reading the water meter.

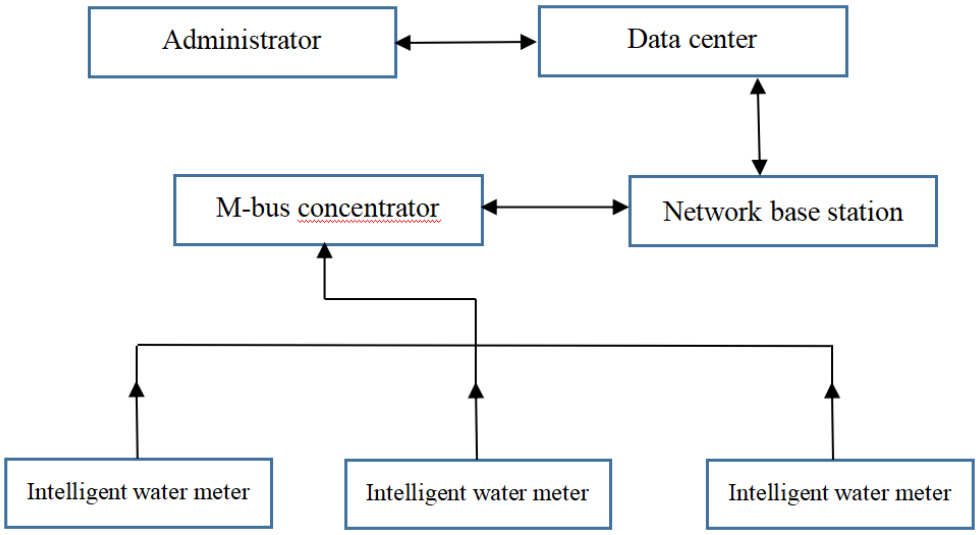

Figure 2-1 Schematic diagram of intelligent remote water meter reading system based on M-BUS bus

2.3 The overall design of hardware part of the system

2.3.1 The overall design of the hardware part of the intelligent water meter

According to the functional requirements, the hardware part of the intelligent water meter is mainly divided into MCU core module, infrared data communication module, M-BUS communication module, photoelectric detection module, external wake-up and LED status display module as shown in Figure 2-2.

Most of the time, MCU core module is in the state of low power consumption, through the photoelectric detection module for timed water flow detection. When the M-BUS concentrator collects data, the M-BUS communication module wakes up the MCU core to send data. In the field environment, when the installation personnel debug the equipment through the infrared handheld configuration device, first wake up the intelligent water meter from the outside, the indicator light flashes, and then the meter number, water quantity configuration and water meter information can be read through the infrared data communication module.

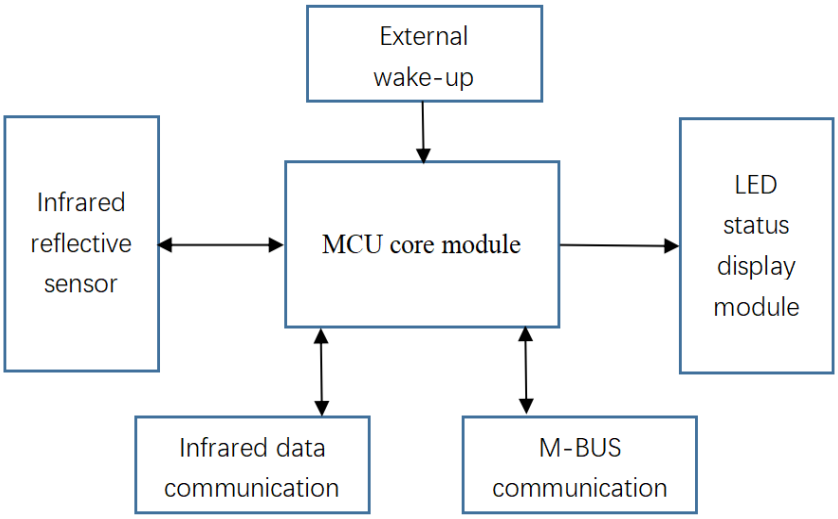

Figure 2-2 Overall framework of intelligent water meter hardware design

2.3.2 The hardware design of M-BUS concentrator

The functions of M-BUS concentrator are mainly divided into power module, MCU core module, overload detection module, M-BUS data sending and receiving module and status display module. As shown in Fig. 2-3, the M-BUS concentrator can not only collect and read the intelligent water meter remotely through the serial port of W external equipment, but also through the configuration mode. The core of M-BUS concentrator is also part of M-BUS data conversion module, MCU core module provides detection and control signals for M-BUS data conversion module, power module provides 37V, 20V, 12V, 5V and - 5V power for MCU core module and M-BUS data conversion module, overload detection module is M-BUS detection module Whether the bus current is overloaded or not provides protection and overload alarm for the M-BUS concentrator.

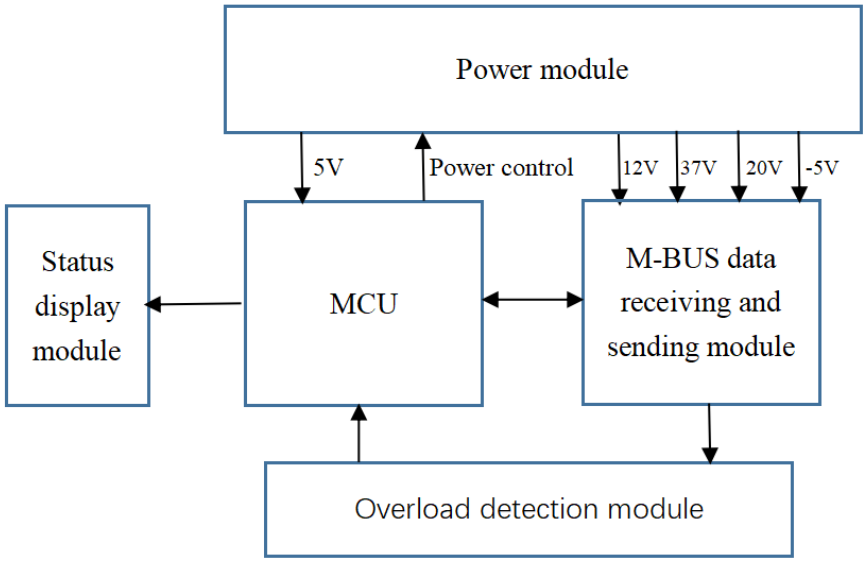

Figure 2-3 Overall framework of M-BUS concentrator hardware design

2.4 The overall design of software part of the system

2.4.1 The overall design of the software part of the intelligent water meter

According to the function division, the software design of the intelligent water meter can be divided into four functional modules, i.e. M-BUS communication software design, infrared communication software design, data storage design, water information detection, etc.

According to the requirement, the design of M-BUS communication software completes the data reading part of slave part of M-BUS communication protocol. The information management of intelligent water meter can be realized by infrared data communication, which can solve the problem of debugging and later maintenance on site. The programming workflow of the intelligent water meter is as follows: when the intelligent water meter is powered on, initialize the hardware, and check whether the meter number of the intelligent water meter is 0. If it is 0, the intelligent water meter is not configured and directly enters the low power state. After configuration, the infrared detection is carried out every 125ms, and the water volume and power on time are recorded cumulatively. When the complete infrared data gap is detected, the infrared data communication is carried out by triggering the interruption of the microcontroller through the external main yellow tube. Most of the time, the intelligent water meter is in a low-power state. After the water volume detection, M-BUS communication, infrared communication and battery power detection, it will enter a low-power state immediately. The power consumption can be greatly reduced by the duty cycle mode of operation.

2.4.2 The overall design of M-BUS concentrator software

The main function of M-BUS concentrator is realized by hardware, and the software of M-BUS is mainly responsible for the control function of hardware. M-BUS software design mainly realizes the function of load overload alarm and dynamic threshold setting. Firstly, the low level of overload alarm pin is detected, the MCU module is interrupted, the M-BUS bus power supply is cut off, and the power on detection is carried out again after a period of time. Secondly, the adjustment of dynamic threshold is that MCU gets the highest voltage of M-BUS signal after AD sampling and filtering, and sets and compares PWM values with different duty cycle to get M-BUS signal through hardware comparison circuit. At the same time, it supports the external setting of fixed threshold through the serial port.

3. Conclusion

This paper mainly completed the overall design of an intelligent remote water meter reading system. Firstly, the demand of intelligent water meter and M-BUS concentrator is analyzed according to the M-BUS intelligent remote water meter reading system. Then it introduces the overall design of the software and hardware of the intelligent remote water meter and M-BUS concentrator. This design provides a new method for water system.

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