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Wireless Remote Water Meter Design of Automatic Meter Reading System

Zhu HengJun[1] and Zhu YiSheng[2]

Communication and electronic engineering College of Qiqihar University, Qiqihar ,China,160006
2. zsy15205512914@126.com

Abstract

By wireless communication through GPRS internet, a remote water metering system with low cost, accuracy and adaptable to complex environment was designed. In this paper, the analysis on the scheme confirmation, the development of management software was carried out, and the integrated design of the system based on GPRS was studied. The general planning and the technical requirements on the user's water consumption detecting system was also put forward, based on the S3C2440 chip.

Keywords*: Wireless communications; Remote reading water meter; GRPS; S3C2440*

1. Introduction

With the development of economy and urbanization progress, the city scale increases, and the number of residents water meter expands, either. As the result, the reading and charging problem of residents water meter becomes a big problem in city power supply enterprises. The traditional way for water metering in our country is reading by management staff on a regular basis. Meter reading by staff is not only time-consuming, timeliness and non-accuracy, but also has some problem, such as arrearage, mistakenly copy, loss copy, and long cycle [1].

Water metering technology is divided into auto water metering technology and remote metering technology by the degree of automation, which are both invented and developed rapidly in American in the mid-1980s. The remote metering technology is using pulse counting in water meter, and collecting the remote data by data traffic. And the monitor, manage and fault repair would be also controlled by the remote metering technology.

2. Overview

2.1. Mobile Communication Technology

In the early 1960s, the cellular mobile systems have been widely researched by many scientific research institutions, and the most representative achievements is the system based on large scale integrated phone technology and micro-processor technology in bell laboratories[3] .The wide usage of this technology had greatly changed the wireless world, which realized the popularity and development of the first generation of mobile telephone in the global scope.

The main improvement of the second generation of cellular mobile communication system is providing voice service while reducing the amount of data transmission at the same time, and the SMS application based on GPRS are widely popularize[7]. From the

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present situation of the wireless network, in addition to the main business of voice services, the need of large amounts data communication is increasingly mature. Building data communication service with high band-width and high quality is the important direction of the next generation. In the field of small amount data communication business, GPRS is an important option for it with a low cost, in which GSM and CDMA system the first choice[5]. Driving by more and more amounts of data applications, the developments of greater bandwidth EDGE technology and ETL technology have become the direction of the major mobile operators[6]. In the field of mobile communication network, China lags behind with South Korea, Japan, the United States and even Hong Kong.

In the days which called 2.5 generation of mobile communication system, the data transmission rate which would reach to hundreds of KB/s, is still not meet the needs of multimedia service completely[3]. Higher transmission rate and wider bandwidth of mobile communication technology are still the main research tasks of communications industry.

With the continuous development of communication technology, and higher demand of the high-speed mobile communication technology on the society, China's 3G network had achieved high coverage, and the 4G communication network coverage had also increased gradually, which would reach 100 MB/s ~ 200 MB/s expected, and the developing 5G communication technology would reach 1 GMB/s in theoretical[8].

2.2. The Embedded System

With the development of the microprocessor technology, the embedded system has become an important part of computer field. The embedded system is centered by application and on the basis of computer technology, the software and hardware could be tailored to suit the strict requirements of the application system, such as function, reliability, cost, volume, power consumption and so on. The characteristics of the system is smaller software code, higher automated and faster response speed, which especially suitable for the requirements of real-time and multitasking system[4]. The system usually consists of embedded microcontroller processor, peripheral hardware, embedded operating system and user's applications, which used to implement the control, monitoring or management function of the other devices.

Different to the PC system, the embedded systems includes two parts, which are hardware and software respectively. The hardware includes processor/microprocessors, memory, peripheral devices, I/O ports, graphics controller and so on[8]. The software includes the operating system software, which demands real-time and multitasking operating, and application programming. Application controls operation and behavior of the system, while the operating system controls the interaction between application program and hardware.

The core of the embedded system is the embedded microprocessor. The embedded operating system generally refers to the kernel or micro kernel of operating system, which is the soul of an embedded system. The appearance of the embedded operating system had greatly increased the efficiency, reduced the total workload, and enhanced the portability. For the embedded system, the application can run without the operating system on a chip directly. But in order to manage multi-tasks scheduling, and the resources, function and expert database functions interface of the system reasonable, the development platform for the embedded operating system should be choose, which would ensure the execution of a program, reliability, real-time, the software quality. A good EOS (Embedded Operating System) is the key to the success of the embedded system with the most basic function of the general operating System, such as task scheduling, synchronization mechanism, interrupt handling, file functions, and so on.

3. The Design of the Remote Water Metering System

3.1. Integral Idea

The design of the remote water metering system in this paper is mainly refer to the remote reading system and communication module of remote water, electricity, gas, which is widely used. The basic working principle is that the water flow generated the flow meter metering signal, then the conversion unit coverts the signal to the display unit, where could identify, measure, calculate, and display the measuring frequency and time, as well as the user's water usage information. After real-time detection, the detected data is stored in memory, and send the data to the monitoring center regularly through text messages sent. Finally, water supply company validate and statistical analyze these data.

3.2. Overall Architecture

The used automatic water consumption measuring instrument in the experiment would measure the instantaneous water only when the water consumption is used by internal combustion. For the user who isn't suitable for the water consumption measurement by noise, the condition and flow's rule can solve this. Through the user's hosts and other auxiliary machineries in the flow sensor, the output voltage or pulse signal which is generated when water get through the flow sensor, could correspond to the signal collection and calculation of the flow value.

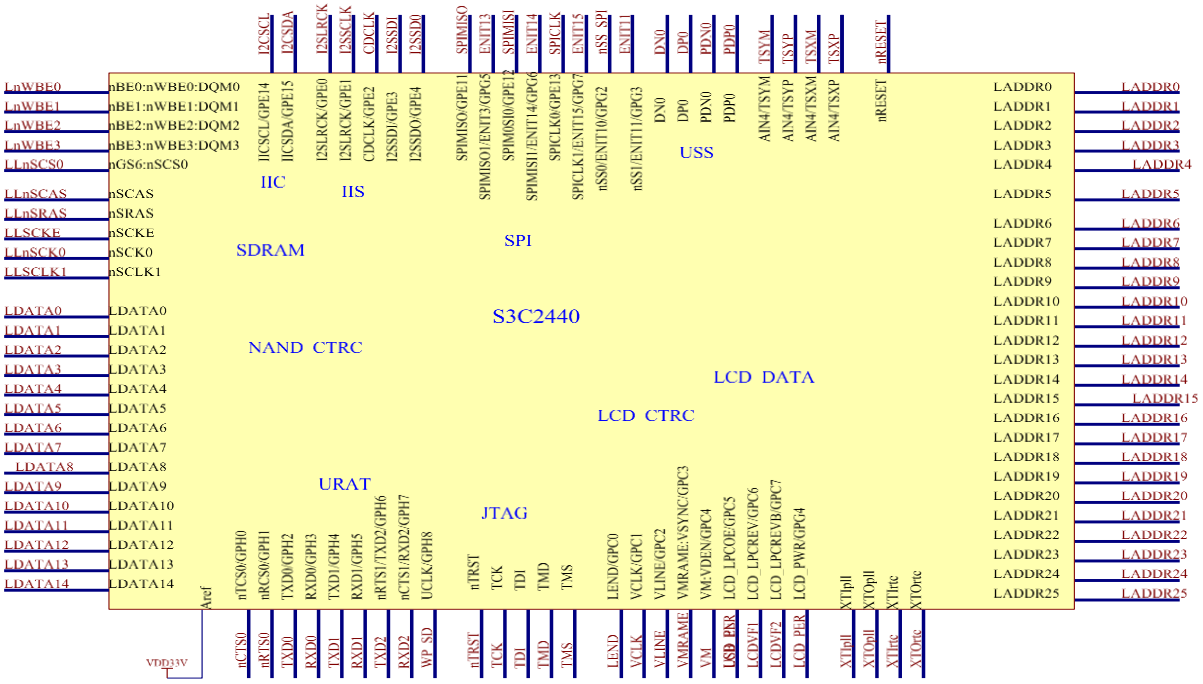

Figure 1. S3C2440 SCM Module Diagram

In Figure 1 ,the output of the power supply circuit is connected to the Aref of the S3C2440 in the minimum system, providing the power supply voltage of the 3.3V. Address pins of the system LADDR0~LADDR25, and two pieces of memory chip address pins are connected in parallel, S3C2440 LDATA0~LDATA15 pin is in parallel with the two pieces of memory chips, forming 32-bit wide data transmission channel. Instructions for the processor can execute driven clock signal, the clock of the system can be divided into real-time clock and the main system clock, real-time clock can consists of the external crystal oscillator circuit via the pin XTOrtc, XTIrtc provides the desired clock

signal, 12Mhz external crystal oscillator circuit to generate clock signal can be through a pin XTIpll, XTOpll, then multiplication and division, provides the main system clock frequency. The reset signal is achieved by pin nRESET to the low level of CPU.

4. Design of Major Module

4.1. Power Circuit Design

Power supply system is relatively simple, using direct external 5V voltage as the power input, this design uses LIM117 buck chip, the chip can produce the whole system needs two voltage :3.3V, 1.8V.

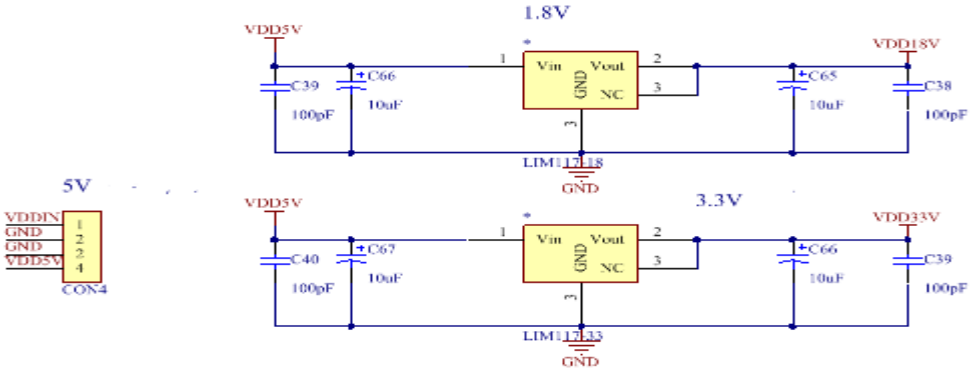

Figure 2. Power Circuit

LCD module and a storage circuit requires a 3.3V voltage, 1.8V kernel provides working voltage, S3C2440 I / O voltage is 3.3V, but the design was not is for handheld mobile devices, the system does not have improved power management circuitry. The power of the whole system is controlled by the hardware, the software is unable to realize the switch machine. Power circuit is shown in figure 2.

4.2. The Process Design of the GPRS Working on ARM Module

GPRS module can complete the GSM short message sending and receiving, data and voice communication and so on. This module is mainly used in the collector and remote PC users GPRS data transmission using mobile communication services, complete the user water meter data remote transmission and the whole system remote monitoring.

GPRS module communicate with the serial port of S3C2440 , GPRS module serial port work level is the same as the S3C2440 serial port, so it is not necessary to use the level conversion circuit. Connecting the two modules of the corresponding serial port with DuPont line, so as to realize the data communication between GPRS module and ARM. In Figure 3, the serial port of the module is connected to the RXD1 pin of the S3C2440 chip, the serial data receiving end GTM_RXD0 is connected with the TXD1 chip of the S3C2440.

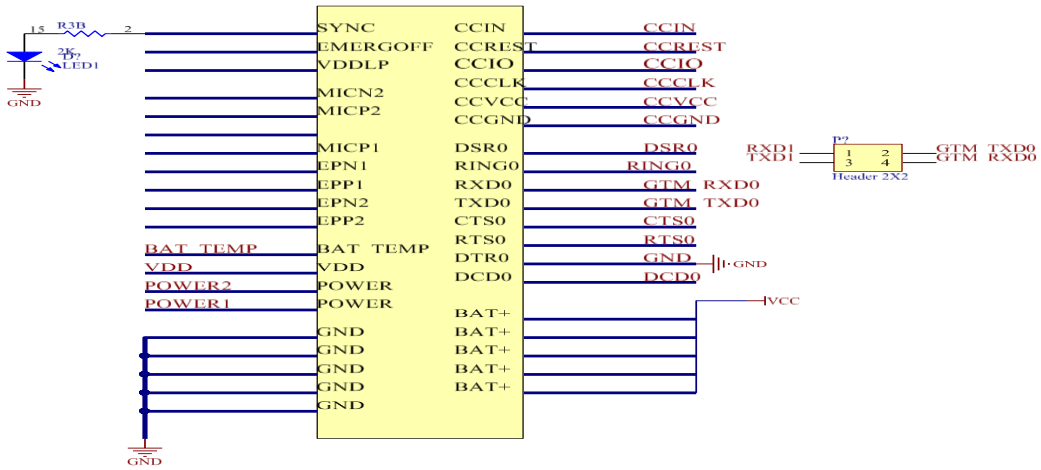

Figure 3. The Connection Circuit of Serial Port

4.3. The Extent Design of Program Memory

The system of S3C2440 can be adopted by the convenient debugging. With the support of a large number of application interface, debugging could be realized in flexible way, with the help of programmable memory devices, more complex system deployment could be implemented, and with the aid of circuits design, the reliability of in-site information protection and the application system scenarios which represent the complex system is higher.

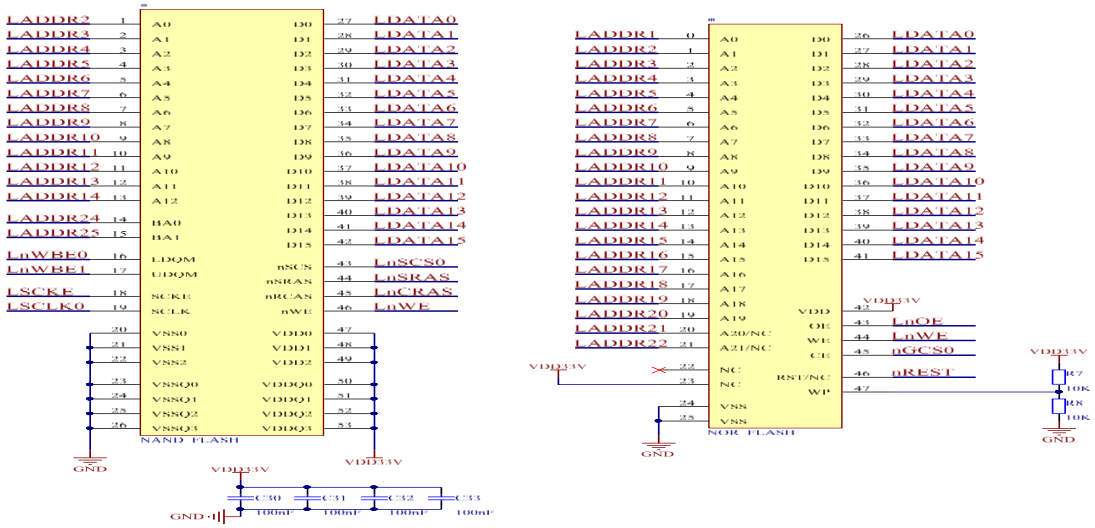

Figure 4 . The Memory Circuit

The FLASH in S3C2440 chip does not have enough storage space, S3C2440 can not store a large amount of data, so it is necessary to expand the SDRAM interface to store data. The design uses two pieces of peripheral interface connected to a 32m bytes total 64M byte size of static memory chip (model: HY57V561620FTP as collector storage module, sufficient to meet the design requirements, in order to improve the speed of data access can they are connected in a formation of 32 bit wide data bus width; because it is then, the use of the nGCS6 as two memory chip chip select pin.

4.4. Reset Circuit

The design of the minimum system using professional MAX811 chip. The chip can produce a low level of CPU reset required.

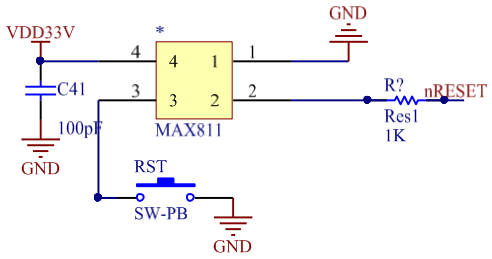

Figure 5 . Reset Circuit

4.5. The Clock Circuit

Clock circuit is one of the most important circuits in the electronic system. Because the execution of the processor instruction needs the clock model to drive. The reliable clock circuit is the premise of the system running smoothly.

The main system clock source from an external crystal oscillator (XTIPLL) or an external clock (EXTCLK). Through the 12Mhz clock signal generated by the external crystal or an internal oscillator programming control, can provide the required frequency for different peripherals.

Internal real time clock (RTC) clock signal can be external 32.768KHz crystal oscillator circuit, or by the master clock programming. In order to ensure the accuracy of the RTC clock signal, recommended by using an external crystal oscillator circuit. The design of the main system clock signal provided by the external clock oscillator circuit of external 12MHz.

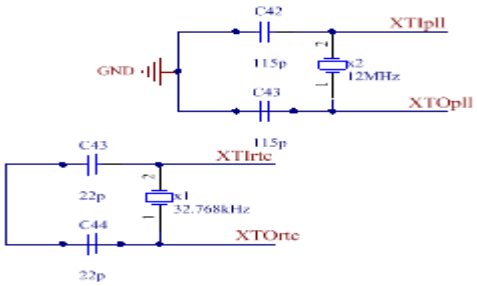

Figure 6. The Clock Circuit

System after power on, the external crystal OSC began to provide a clock signal, when an external crystal is directly used as system clock fclk, system operation for a period of time can through code is set to start the MPLL and MPLL needs to start a locking time (LockTime). This is because the MPLL output frequency is not stable, during which fclk stop output stops the CPU, after LockTime clock stable output, the CPU work in the new set of frequencies, then can through set fclk, hclk and PCLK frequency ratio to generate different bus need different frequency. The clock circuit is shown in figure 6.

5. System Testing

The data processing module includes message handling function and data handling function. When a message is coming, the message handling function will dispatch, and then turn to data handling function when the message is received completely.

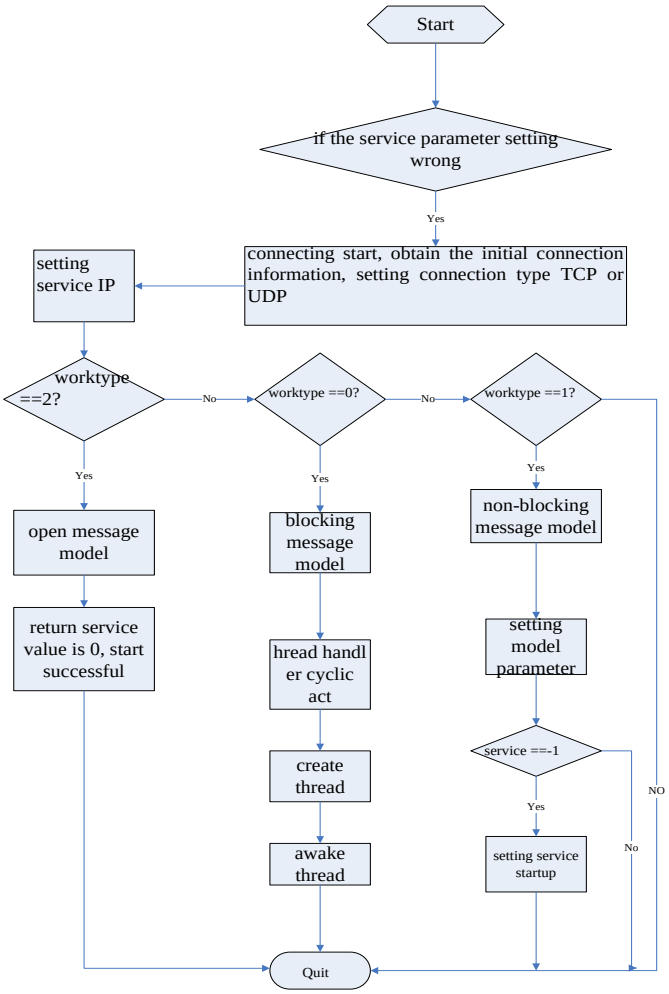

Figure 7. Service Start Module

When starts, the system will self-inspect firstly, if there exists bug, the system will quit. If not, the connection will be built, and the initial message will be obtained. And then the IP of the server will be set. When the model is message model, the serve connecting is open, and the return value from service variate is 0. If the message model is blocking model, the thread handler will be cyclic act, and the related thread will be built to awake the blocking thread. If the message model is the non-blocking model, the parameter will be reset. Finally, judging whether service value is 0. If it is, the service starts. If it is not, exit program, as the following picture shown.

When in the message handling function, the system will clear the user's information to get ready for new data, and inquiry whether response the message. If responding the message, the system will turn to the message reading-handle process, if not, the system is quit. After reading message, if the message is null, the system's register list will refresh and wait for new message. If the message has the data, the system will turn to the data handling function. The process is as follows:

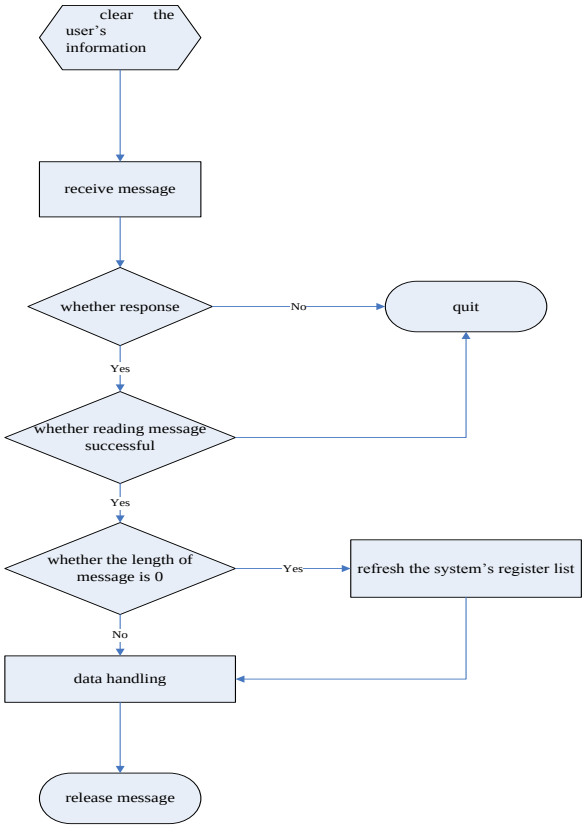

Figure 8 . Processing Flow Chart of Message Module

When the message is received, the data manipulation function will be invoked, and then the data will be handled in different ways, such as proceeded to register, or parameter setting, due to the different data type. The process is as follows:

The system should get some user's information, such as ID, time and data length, due to the data which the system receives is the user's data package. And then the system judges whether it needs to check the data. If it is, the data will be written in Textbox for check, and if it isn't, the data will be written in the database.

6. Conclusion

In this paper, wireless meter reading system combines with GPRS technology which is widely used in the wireless communication technology ,and embedded technology,.So it has a safe and reliable, the advantages of strong processing ability , it has been verified by several times, this system can well meet the requirements of water supply department of wireless meter reading, and has a certain practical value.

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Authors

ZHU HengJun
Profile: Male, Master, Professor, Research interests:Signal Detection and Information processing,Communication System Design.

ZHU YiSheng
Profile: Male, Master Graduate Student, Research interests: Embedded Technology .