The Design of Concentrator Base the WIA Wireless Network
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**Abstract.** In connection with meter reading system of low-pressure line in the domestic. We propose a wireless meter reading which based on the network of GPRS and WIA. In this paper, we principal design the local wireless part of communication that works on downstream. It is able to read the data of meter by wireless network. It has advantage of real-time and low power consumption.

**Introduction**

At present, the existing energy meter automatic meter reading system in domestic. It mostly adopt RS485 cabling and narrow-band low-frequency power line carrier from energy meter or collector to concentrate \cite{1}. There are many problems in the past. For example, construction difficult and narrow bandwidth and the rate is too low, and bad real-time and cannot achieve the two-way fast communication. It is difficult to meet the requirements of the construction of the power supply enterprise that the power of information integration acquisition platform. It cannot meet the high-level management requirements that pre-paid and power failure and electric larceny too. To solve the above problems, this paper proposes meter reading system which based on GPRS and the WIA wireless network. The uplink communication uses GPRS wireless network communication and the downlink communication uses WIA wireless network. The WIA wireless network is a new clustering wireless sensor networks. It supports multi-hop transmission and effective coordination in each cluster imbalance in the load distribution \cite{2,3}. It has fast networking and low power consumption and real-time features. It solves the system unstable and unreliable and the transmission bandwidth and distance restricted in meter reading \cite{4,5}.The concentrator can collection information of power users accurate and timely.

**Wireless Meter Reading Overall Introduction**

Wireless automatic meter reading system consists of four components which are energy meter and collector and concentrator and management center. The block diagram of wireless meter reading is shown in Figure 1. The communication mainly using wireless in the system. It uses GPRS (General Packet Radio Service) between concentrator and management center. It uses WIA wireless network communication between meter terminal and concentrator. The management center uses meter reading software to read data of meter in real time or timing. It can understand electricity consumption information and be able to make the power load balance distribution of timely and effective. So it can analyze whether the phenomenon of stealing is existence.

**Local Wireless Hardware Design**

The concentrator is the device which can collect and deposit data of the terminals meter. It can exchange data with the management center. The concentrator plays a connecting role in the entire wireless meter reading system. It is bridge of the wireless meter reading system which plays a vital role in the stability of system.
A local wireless hardware configuration diagram is shown in Figure 2. It mainly includes a processor unit and RF unit and a storage unit and a power supply unit and an indicator unit and a communication interface and so on.

![Fig.1 Block Diagram of Wireless Meter Reading](image1)

![Fig.2 Wireless Hardware Structure Diagram](image2)

The processor uses STM32F103 chip which is produced by ST. The frequency can reach to 72 MHz which uses a 32-bit CPU. It has 128K bytes program memory and 20K bytes SRAM in internal. It has a lot of clock output modes and power management modes. It has three power saving modes which is sleep and stop and standby. A temperature sensor is embedded. It can analog sampling directly. It supports the debugging of two ways which is serial debugging and JTAG debugging. There are up to seven timers and nine communications interface in internal. For example, I2C and USART and SPI and USB interface.

The RF unit uses Si4432 processor which is produced by Silicon Labs. The receiver sensitivity can up to negative 118. The maximum output power can reach to 20dBm. The receive current is 18.5mA and the send current is 27mA when the output power is 11dBm. The transmit data ratio from 1 to 128kbps and work voltage from 1.8V to 3.6V. It supports digital RSSI and Auto frequency calibration. It communicates with the processor through the SPI interface and connects antenna by UPG2214TB-E4-A RF switch. The RF circuit schematic is shown in Figure 3.

The memory circuit schematic is shown in Figure 4. This design uses two AT24C1024BN-SH25-B-8S1. It has storage capacity of 1024 bytes. It supports 1.8V and 2.5V operating voltage mode. It communicates with the processor through the I2C interface which has two lines. The fastest clock rate can reach up to 1MHz. It has hardware write protection and software write protection function which can be written 1000000.

![Fig.3 RF Circuit Schematics](image3)

![Fig. 4 Storage Circuit Diagram](image4)

The schematic of the power supply circuit Is shown in Figure 5. The system power supply is 3.3V. The power has two input selection, one is 3.3V which can output current 150mA. The other is 12V which can supply current 400mA. The 12V power must be transformed 3.3V which can be used for system.

The indicator schematic is shown in Figure 6. The LED1 is the power indicator which is red. It is turn on when the system works normally. The LED2 is network status indicator which is green. The LED2 flashes when the system network is working properly. The pin PB8 controls RF modules receive data indicator and the pin PB9 controls RF modules send data indicator. The red flash indicates the module receives data work properly. The green light flash indicates the module send data work properly.
Local Wireless Software Design

Local wireless part uses WIA wireless network communications. The terminal meter can be communicate with concentrator through single-hop or multi-hop. The concentrator and terminal meter compose of a star topology network. Software flow chart is shown in Figure 7. In order to improve the reliability and timeliness of the meter reading network. This design uses HPCR (high-performance clustering routing algorithm) algorithm [2]. The algorithm can establish a number of non-inferiority paths. It can make multi-path routing and congestion control and energy balance and path update combination. It improves the reliability and timeliness of clustering routing algorithm effectively and maintains high energy efficiency.

![Software Flow Chart](image)

**Fig.7 Software Flow Chart**

Conclusion

The concentrator is designed which analyzes the characteristics of energy information collection structure and the site environmental complexity and functional diversity. The STM32F103 chips and large-capacity flash memory is used in this paper which makes the concentrator work more flexible. This article proposes meter reading plan which base on the GPRS and WIA wireless network. Introducing the hardware and software of concentrator. It is compared with the low-pressure narrowband carrier communication that has higher reliability and better stability and security and Large data capacity. It has a feature of two-way full-duplex fast communication. The communication distance can up to 2 km when in the case of good communication environment. It meets the need of modern wireless meter reading because it has good anti-interference and resistance to multipath fading.

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