Design and Application of Automatic Meter Reading System For Anti Stealing Electricity

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Abstract. Based on the high-speed development of computer technology, VLSI and communication technology, this paper studies an anti stealing wireless meter reading system which can improve the power supply enterprise's anti stealing ability and collect, count and analyze the power consumption of large users timely, effectively and accurately, and analyze the characteristics and components of the system design to meet the market demand. The system studied in this paper is mainly used for power supply enterprises to control power stealing for large users.

Keywords: Anti stealing power, GPRS wireless communication, System design.

1. Introduction
The automatic meter reading system based on GPRS wireless communication has the ability of anti stealing electricity, and sends the alarm information to the monitoring center in real time; on the other hand, the terminal power data is collected and sent to the monitoring center for data processing through GPRS modern transmission and communication technology. This paper mainly analyzes the selection of key hardware components and software platform.

2. Design principles and steps of automatic meter reading system against stealing electricity
(1) System design principles
In order to safely, accurately, reliably, advanced, intelligent, practical, economical and reasonable design of the integrated collection system of anti stealing wireless remote alarm and meter reading, the following design principles shall be observed in the design process:
1) Accuracy
   Necessary measures should be taken to ensure the accuracy of data in system data acquisition, transmission, storage and calculation.
2) System reliability
   This mainly includes the following aspects:
   ○ Reliable system design
   ○ Strong and not easily damaged structure
   ○ Reliable circuit hardware design
   ○ Reliable anti-interference software design
   ○ Fault design of self protection, self inspection and self diagnosis system
Reasonable selection of components and parameters

The practicability of the system includes many links, such as product design and development, production and sales, application site and so on.

Feasible system production, assembly requirements, debugging, testing convenience.

Feasible system sales, high cost performance requirements, better than similar systems at home and abroad.

Feasible system application, can work in various field working conditions, high reliability, simple practical operation, convenient maintenance.

Developability

It supports and dynamically extends various meter protocols.

From the integrated system of residents anti stealing electricity to large user system and substation monitoring system.

The expansion of system processing capacity.

System scheme design steps

The design of anti stealing wireless meter reading system should first be familiar with the electric energy meter and the corresponding principle of electric energy measurement, the principle of stealing electricity and anti stealing electricity, and on this basis, through the study of the existing scheme, the design scheme of the system is determined. The specific steps are as follows:

1) Selection of electric energy meter: according to the current situation of civil electric energy meter and the development trend of electric energy meter, select a widely used and good market prospect electric energy meter for automatic meter reading research.

2) Determine the anti stealing scheme: from the working principle of the electric energy meter to study the way of stealing electricity, so as to determine the corresponding anti stealing measures for all kinds of electricity stealing behaviors.

3) Selection of system communication scheme: the communication channel scheme of the integrated anti stealing system refers to the upper communication channel scheme between the monitoring center and the system terminal collector.

4) Design system terminal: according to the requirements, select the corresponding controller, communication module, etc. to complete the design and development of the system terminal.

5) Choose software development platform: the software of this system is divided into two parts: terminal collector program and monitoring center software. Among them, the collector side program can be written in C, assembly and other languages.

Analysis of the overall architecture of anti stealing automatic meter reading system

The whole system is composed of collector, GPRS module, GPRS wireless mobile network channel, SIM card, multi-function meter, etc.

1) Collector. The collector mainly completes the functions of anti stealing, power stealing signal acquisition, meter parameter setting and power reading. The collector uses 12 current transformers and 3 voltage transformers to complete the anti stealing function.

2) Modular GPRS. The remote module of wireless data communication adopts GPRS module with built-in TCP/IP protocol processing function, and supports short message receiving and sending mode and GPRS data transmission mode at the same time (Figure 1).

3) GPRS mobile network wireless channel. The data transmission between the monitoring center and the collector is completed by GPRS communication network. The monitoring center and the collector address each other through IP, and the data communication can be conducted only after the connection is established (Fig. 1).

4) User identification card. The user's identification card, or SIM card, stores the user's data, key and authentication method, which can be used by GSM system to identify the user. To connect to GPRS network, the SIM card must have GPRS service.
5) Multi function meter. The electric energy meter involved in this system refers to an all electronic multi-functional electric energy meter with RS-485 output interface.

![Figure 1. GPRS network reference model.](image1)

(2) System architecture analysis
There are two levels of anti meter reading system. The lowest level is the anti stealing data acquisition unit, which consists of the collector and GPRS module; the data receiving and processing unit is the highest level, which is composed of PC monitoring center connected with Internet and GSM short message transceiver. Collector - the core device of the system is composed of anti stealing circuit, power stealing signal and power data acquisition controller module, GPRS module embedded with TCP/IP protocol. The overall framework of the system is shown in Figure 2.

![Figure 2. Overall physical model of the system.](image2)

When the collector receives the meter reading command sent by the monitoring center, it will establish instant communication with the meter through the bus according to the relevant
wireless communication and data transmission products, including telemetry and remote control. GPRS wireless communication is a communication module with superior performance compared to G18. G18 and G20 (Motorola) have integrated IP / TCP protocol, but the price of G20 is higher than that of G18. Ericsson GR47 series, wavecom products, Motorola G20 and G18 series, etc., also have high performance and strong applicability, which completely solves the cost problem and negotiation bottleneck of GPRS wireless communication and data transmission modules.

4. Scheme analysis of automatic meter reading system against stealing electricity

From the overall structure of the system, we can see that the integrated acquisition system of anti-theft wireless remote alarm and meter reading is composed of collector, GPRS module, GPRS wireless mobile network channel, SIM card, multi-functional meter, monitoring center and other parts. It is a system combining hardware and software. The following from the hardware, software two aspects of the system design.

(1) Analysis of system hardware scheme

According to the system structure diagram in Figure 3, the hardware scheme design of the system mainly includes the selection of electric energy meter, acquisition controller and wireless communication module. The final scheme design and characteristics of each part will be introduced in detail.

**Figure 3. System structure diagram.**

1) Selection of acquisition controller

The specific functional characteristics of pic18f6620 are as follows:

- High performance RISC CPU
- The maximum pull current / current is 25mA
- Up to 4KB data storage
- Up to 10 MIPS execution speed
- 16 for wide instruction, 8-bit wide data channel
- 3 external interrupt pins
- 8 × 8 single cycle hardware multiplier
- 4 timers
- Master synchronous serial communication (MSSP) with two working modes: SPI / I2C

2) Selection of wireless communication module

Up to now, GPRS data transmission modules are widely used in industrial systems, including Sony / Ericsson Gr47 series, wavecom products, Motorola G20 and G18 series, etc. The following is a comparison of these products: G18 and G20 (Motorola): G20 has integrated IP / TCP protocol, but the price is higher than that of G18; G18 is a GPRS communication module with superior performance and strong applicability, which completely solves the cost problem and negotiation bottleneck of GPRS wireless communication and data transmission terminal. Therefore, the application of GPRS in wireless communication and data transmission products, including telemetry and remote control...
system, monitoring system, GPS / GSM satellite navigation, GPRS wireless internet access, SMS center and so on, has been obtained.

GR47 of Sony / Ericsson company: GR47 is launched by Sony / Ericsson company. It is embedded with GSM / GPRS module of TCP / IP protocol, which can support voice, data, fax and other functions. Compared with other wireless modems, its biggest advantage is that it has the function of TCP / IP protocol stack and the openness of internal CPU resources, which greatly shortens the development cycle of GPRS products. At the same time, the wide operating temperature range from -30℃ to +75℃ enables GR47 to meet the application requirements of most customers.

(2) Analysis of system software scheme
The monitoring center software is a power information management system running on the meter reading host
1) It has the function of automatically monitoring the host's IP address;
2) It can indicate the working state of monitoring center software;
3) It can display the status of data acquisition terminal, including operation status, ID number, installation address, registration date, etc;
4) It can query the status of data acquisition terminal, whether someone steals electricity and whether the communication is normal;
5) It has the function of setting blacklist users (suspected objects of stealing electricity);
6) It can copy the data of electric energy meter at any time and display it in real time, including ID number, sending time, meter data, etc;
7) It can read and write the data of electric energy meter regularly and display it in real time, including ID number, sending time, meter data, etc;
8) It has the function of automatically saving the received information;
9) The user's permission can be set according to the user's requirements;
10) It has the function of alarming after receiving the electric larceny signal; At present, there are many software development tools on the market, such as visual basic, Visual C + +, Visual C # and Delphi. Through analysis and comparison, C#, with the advantages of simple, modern, object-oriented, safe, compatible and flexible, provides the best environment for users to quickly design their own software.

5. Conclusions
Based on the principle of system design, according to the principle of electric energy meter and corresponding electric energy measurement, the principle of stealing electricity and anti stealing electricity, this paper gives the scheme design steps and the overall structure of the system, and concludes that the system is composed of collector, GPRS module, GPRS wireless mobile network channel, SIM card, multi-functional meter, monitoring center, etc. Finally, the specific scheme of the system is analyzed from two aspects of hardware and software, including the selection of watt hour meter, acquisition controller, wireless communication module and monitoring center software platform. With the emergence of various high-tech means of electricity theft, we should constantly improve the means of electricity theft. With the development of network, information and control technology, automatic meter reading technology will be further improved, and become the mainstream of society, and will be widely used in China.

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