

A New Remote Meter Reading System with Four Meters in One Network

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Abstract

With the development of electron and computer, automatic meter reading system (AMRS) has a possibility to be put into reality. Especially for the well-to-do uptown, the Construct Department of China has demanded to realize integrate management of water meter, kilowatt-hour meter and gas meter step by step, gradually to realize automatic meter reading, measuring and charging with computer. This paper aims at the existing problems, such as independent charging for the above meters, bad real- timing measuring data, low efficiency, inaccuracy and so on. Thus, an automatic meter reading system of water electricity, gas, and calorie is designed. The strong point of this system is: low cost, precise measuring, stable working, and easy to install and maintain. AMRS realized the remote meter reading of water, electricity, gas and heat. It solved the problems of independent charging, manual data processing, and complicated charging. It will boost the automatic meter reading efficiently and has an enormous application prospect.

Keywords

Automatic Meter Reading System, Multi Energy, Design of Collector and Concentrator.

1. Introduction

With the deepening reform of water supply, power supply, gas supply and heating system, public utilities have developed rapidly. Water, electricity, gas and heating have entered the market as commodities[1]. Nowadays, a special person needs to be sent to read meters for every residential building. It is not only cumbersome to copy data, but also difficult to collect statistics[2-3]. What's more, the energy consumption data of each energy-consuming unit can not be statistically analyzed. So the energy loss link can not be judged and handled timely and effectively, and the energy consumption of the system is high. More importantly, it is impossible to provide timely and accurate data for billing, line loss control, power consumption analysis, marketing forecasting, and even macro-decision-making[4-6]. Only by updating the mode of meter reading and adopting the management means of remote centralized meter reading system is the way to solve the problems of energy accounting and charging.

The construction of multi-meter integrated system can further enhance the ability of power grid to accept multiple energy sources[7-8]. It not only realize rational distribution of energy consumption and promote efficient utilization of clean energy, but also construct a safe and efficient modern energy system. Multi energy use is generally based on advanced measurement infrastructure (AMI), which is also known as smart meter infrastructure (SMI), is a complete system including hardware and software[9-12]. It uses two-way communication system and intelligent electricity meter which can record user's detailed load information to obtain a variety of measurement values with time scale, such as power consumption, power demand, voltage, current, etc. in time or real time. At present, the research and application are generally focused on the technology and implementation of multi table integration, and extensive and in-depth research work has been carried out at the technical level[13-

15]. However, there are not many researches on how to integrate the business models of different industries and how to make good use of the collected user data, etc. This paper proposes a win-win business model of electricity, water, gas and heat enterprises based on multi energy data analysis by studying the business model and promotion prospect of multi energy data collection on the user side. So that the multi energy data collection on the user side can bring new consumption mode and business growth point to the State Grid and the society.

2. System overall design

2.1 Design of energy consumption measurement method of remote transmission base meter

The system mainly uses MCU as the CPU substation to sample the energy consumption information of water, electricity, gas and heating. The energy consumption is directly copied from the multi-user electronic energy meter. The system can be equipped with 16 concentrators, each concentrator can be equipped with 16 collectors, each collector can be equipped with up to 112 base meters and a multi-user electronic energy meter. The system adopts distributed structure, and a typical distributed measurement and control system is composed of upper management computer.

Set the inductive switch K at the corresponding position of a certain word wheel, which is a contact switch with self-protection function. Set two inductive components A and B with different characteristics on the word wheel. When in use, the word wheel rotates. When a turns to the position of K, K is sensed to be in the "on" position by A. After A turns away, K remains in the "on" state until B turns to K and is sensed "off". After B turns away, K is still in the "off" state until a turns again. In turn, a square wave pulse signal is generated to realize "on, off and on" in strict accordance with the energy consumption of the base meter. In this way, the system can collect these pulse signals and calculate the corresponding energy consumption of users.

2.2 Communication standard

RS-485 standard bus is a serial interface standard of balanced transmission mode. It allows multiple transmitters in the circuit and one transmitter to drive multiple load devices. The load device can be a combination unit of passive transmitter, receiver or transceiver. The common line circuit structure of RS-485 is that both ends of a pair of balanced transmission are equipped with terminal resistors. Its transmitter, receiver and combined transceiver can be hung at any position on the balanced transmission line. In data transmission, multiple drivers and receivers can share the same transmission line in multiple applications. The signal transmission of RS-485 communication interface uses the voltage difference between the two lines to represent the logic "1" or "0", because the transmitting end needs two transmission lines, and the receiving end only needs two transmission lines, so the RS-485 receiving and transmitting end only need two lines to complete the signal transmission. The characteristics of RS-485 standard bus are: strong anti-interference ability, high transmission rate and long transmission distance. When using twisted pair and without modem, it can transmit 1200 meters at the transmission rate of 100ksp, and 1500 meters or more at the rate of 9600 bsp.

2.3 System design

Because RS-485 has the above advantages, it can support one-to-many point communication, which is convenient for networking, and the communication distance can also meet the design requirements of the system; moreover, the requirements for real-time of the four meter networked remote meter reading system are not high, and the reading of energy consumption is not frequent, generally only once a month. So the system chooses the half duplex RS-485 communication standard.

In order to increase the reliability of the whole remote transmission system, the collector and concentrator are adopted in this paper between various base tables and upper management microcomputers. The overall distribution structure of the system is shown in Figure 1 below. The data between the upper computer and the concentrator can be transmitted through the RS-485 bus, and the collector can collect the pulse information of the user's various remote energy consumption meters through the shielded twisted pair, convert and store it; the collector can directly receive the user's electricity information through the RS-485 interface on the DF type electricity meter, or through

the infrared interface on the collector, use the special infrared interface The meter reading device reads all kinds of energy consumption information of the collector.

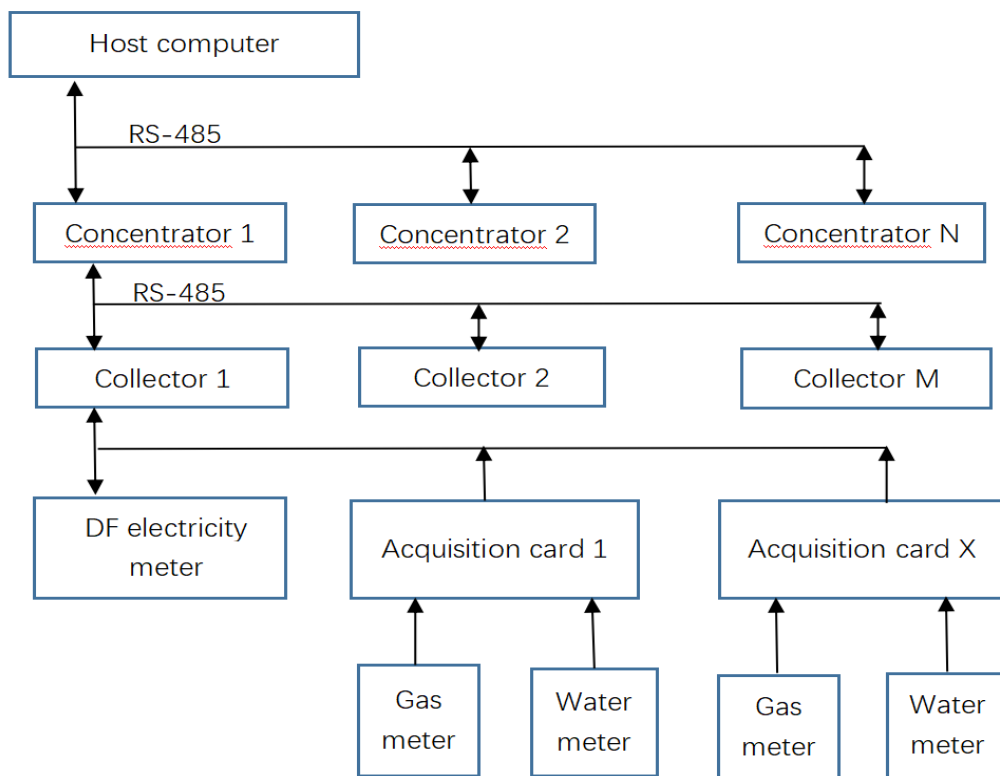


Fig.1 The overall schematic diagram of AMIRS

3. Design of collector and concentrator

(1) CPU selection of collector

AT89552 combines multi-functional 8-bit CPU and flash memory in a single chip, and has large internal RAM capacity. It also has static logic, can work at low to zero frequency, and supports two power-saving modes: idle and power down. These excellent performances provide a high flexibility and low price technical scheme for most embedded control systems, so this system chooses at89552 as the CPU of data collector.

(2) The design of pulse data acquisition circuit

Each collector needs to collect 112 channels of pulse signals (7 cards, x16 households / card). If they are all sent to the CPU through the Po port, obviously, all the samples at one time need to be divided into 14 times (14xs channels). Therefore, three state data input buffer is needed to isolate these 14 groups of signals. The commonly used data input buffer can be divided into one-way and two-way. In the application of this system, only one-way pulse information is available, so one-way buffer can be selected. In this system, the cheap 74HC244 is selected as the data input buffer.

(3) Design of storage circuit of collector

Due to the possibility of power failure in the system, measures must be taken and data protection scheme must be designed. Here, we can choose 6264 memory plus backup battery, or use EZPROM in X5045. However, when the storage speed is not the main contradiction, the serial EZPROM has more advantages in price, power consumption and volume, while X5045 itself is a serial EZPROM with only 512 bytes, which can not meet the storage demand of the collector.

(4) Design of communication circuit of collector

The collector needs to communicate with the concentrator and DF multi-user watt hour meter in time, so it needs to design the communication circuit of the collector. The signal in the communication should be isolated by the photoelectric combiner. The main function of the photoelectric combiner is to protect the sudden change of the communication line voltage and prevent the external interference from entering the collector. In the system, SN75LBC184, which conforms to RS-485 communication standard, is selected for level conversion, and TLP521 is selected as optoelectronic coupling device.

(5) The design of power circuit of collector

The power supply of the collector includes three 5V main power supplies and backup power supplies generated by alternating current. The backup power supply replaces the 5V main power supply of the main board of the collector when the mains power is cut off. It supplies power to the CPU, memory 24lc16b and remote transmission base meter of the collector, so as to ensure that the collector can continue to carry out normal pulse collection when the mains power is cut off and ensure the correctness of data collection of the system. The backup power supply shall be designed to ensure the continuous working time of the collector is not less than 48 hours, and can be charged automatically, and can be started in time in case of power failure.

(6) Selection of concentrator CPU

The concentrator also uses a single-chip microcomputer to record and process the pulse that the collector collects and reflects the user's energy consumption information from the field, and completes the communication with the upper computer PC and the collector according to the needs. Because AT89552 combines multi-functional 8-bit CPU and flash memory in a single chip, and has large internal RAM capacity, it provides a high flexibility and low price technical scheme for most embedded control systems. In order to ensure the universality and consistency of the system, on the premise of meeting the requirements of the system and adapting to the development of the meter reading system in the direction of intelligence, the CPU of the concentrator is also selected as the 8-bit CMOS microcontroller AT89552, which is low power consumption and high cost performance.

(7) Design of concentrator communication circuit

The communication circuit of concentrator is mainly responsible for data communication with collector and upper computer. On the one hand, the concentrator shall record and store all kinds of energy consumption information (such as energy consumption information of water, electricity, gas, heating, etc.) stored in n collectors (n max. 16) under the concentrator, so as to further transmit energy consumption data to the upper computer and report the working conditions of each collector and its backup power supply, etc. according to the needs; on the other hand, the concentrator shall also be responsible for transmitting the upper computer to the collector All kinds of commands from the collector play the role of bridge and link to transmit information and commands. Therefore, the working principle of the communication circuit of the concentrator is exactly the same as that of the collector.

(8) The design of 5V main power circuit of concentrator

The power design of the concentrator is simpler than that of the collector. It does not need to collect the energy consumption pulse. Its main function is to communicate with the collector and PC in time. Because the communication between the concentrator and PC is only once a month, and the collector has considered the backup power supply for the power failure or power failure in the measurement field, the power design of the concentrator does not need to consider the backup power supply. Therefore, the power supply design only includes three groups of 5V main power supply: one group supplies power to the concentrator CPU and its peripheral interface circuit, and the other two groups of DC 5V output supplies power to the chip used for communication isolation. The design schematic diagram of the main power supply of the concentrator 5V is exactly the same as that of the collector.

4. Conclusion

The remote meter reading system with four meter network is a comprehensive development project integrating digital circuit, digital communication, computer software and database technology. This system is designed for the data collection of the remote base meter. According to the actual working environment of the remote base meter, the development status of the property management in the community and the weakness of the existing meter reading system, based on the starting point of reducing the system cost, increasing the capacity of the system and enhancing the working reliability of the system, a set of economic, practical and easy to promote four meter in one remote transmission system is designed. It breaks the traditional manual recording mode of energy consumption such as water, electricity, gas and heating. It makes use of computer and network technology to change the traditional manual meter reading into computer automatic meter reading. It overcomes the disadvantages and shortcomings of low property management level, long working cycle, low efficiency, easy to cause disputes, and individual meter reading and settlement of water, electricity, gas and heating, which not only improves the efficiency of meter reading The work efficiency has greatly reduced the cost of management and operation, and the improvement of meter reading efficiency has also provided abundant charging time and increased charging rate for water, electricity, gas, heating and other management departments to collect the energy consumption expenses of users in time. At the same time, the rich report management of the system has also improved the reliable and accurate basis for the transformation of power grid and other pipe networks, which has a very important application and promotion Value.

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