

# Design of non-contact IC card intelligent water meter

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**Abstract.** The non-contact IC card intelligence water meter is a new type of automated water meter system. It has a very good prospect of application. This thesis take the high-performance embedded microprocessor as the core, and use the technology of Radio Frequency Identification (RFID), proceeded the designs of non-contact IC card intelligence water meter system.

## 1 Design of intelligent water meter system with contactless IC card

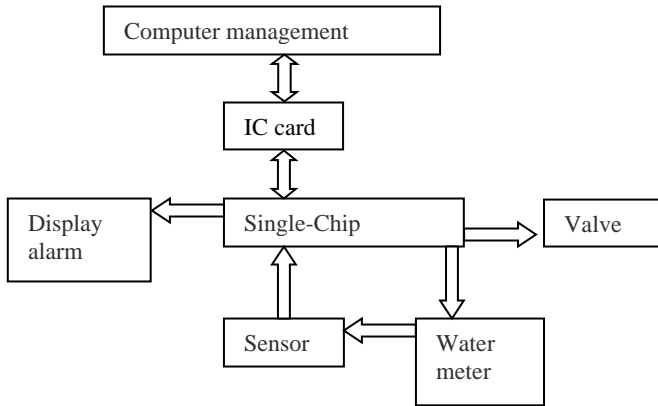
### 1.1 Structure of intelligent water meter system with contactless IC card

Intelligent water meter system with contactless IC card consists of three parts: water meter, information carrier IC card and water station computer information management system.[1] The system structure is shown in Figure 1.

The computer information management system of water supply companies is composed of PC and water information database system. The information carrier adopts non-contact IC card, and the water meter is non-contact IC card intelligent water meter. Users go to the water supply company to apply for IC card and pre order water quantity. The non-contact IC card water meter reads the IC card water quantity information and controls the valve circuit to open the solenoid valve for water supply. In the process of water use, the water flow impacts the rotation of the impeller and drives the gear equipped with two magnets to rotate, resulting in the closure of the dry reed and the conduction of the circuit. The electronic part will control the liquid crystal display according to the pulse signal generated by the on-off of the dry reed and decrease by a certain amount. When the water is used up, the single chip microcomputer will send a signal to the valve driving circuit, and the valve will be closed immediately. When the IC card that bought the water is inserted into the water meter, the electronic part will read the data, and then the signal will be given to the valve driving circuit, the solenoid valve will be opened, and the user can use water.

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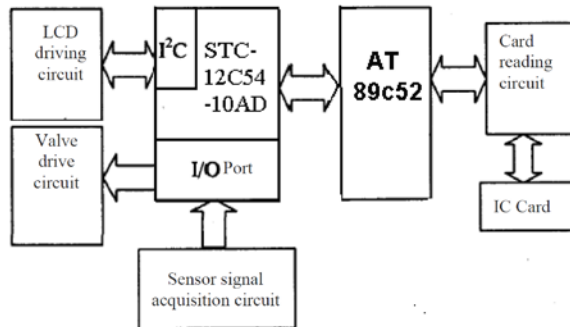
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**Fig. 1.** Structure of intelligent water meter system with contactless IC card.

### 1.2 Hardware system design of intelligent water meter system with contactless IC card

The system takes STC12C5410AD series 1T 8051 single chip microcomputer as the core, controls the LCD display driving circuit through I2C interface, controls the valve driving circuit through general I / O port, and collects water volume. The interface and function of card reader unit are complex. Therefore, the card reader circuit is composed based on AT89C52 single chip microcomputer. STC12C5410AD and AT89C52 are connected in RS232 communication mode.[2] The hardware system structure diagram is shown in Figure 2.



**Fig. 2.** Hardware system diagram of intelligent water meter system with contactless IC card.

### 1.3 Software system design of intelligent water meter system with contactless IC card

Intelligent water meter system with contactless IC card can realize the following functions[3]:

- (1) Ensure that the water management department effectively manages the user's water meter, and the water meter can enter the working state only with two authentication cards (administrator card and business card).
- (2) The user holds the IC card to the tap water management department to pre order a certain amount of water, then inserts the IC card into the water meter card reader, controls

the solenoid valve to open, and the water meter is in working state before the user can use water.

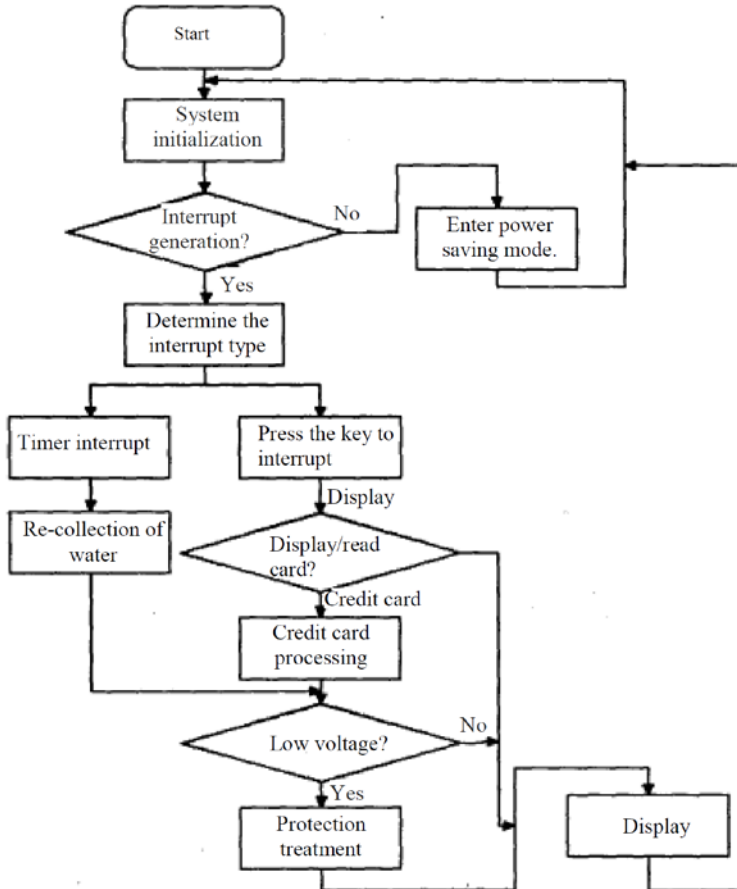
(3) In the process of water use, the water meter will save the “total water consumption”, “remaining water consumption” and other information to the flash RAM area in time, so that important information can be recovered in case of power failure and abnormal conditions.

(4) The water meter is equipped with anti-disassembly and anti-magnetism devices. In case of damage accidents (such as private dismantling of water meter and strong magnetic interference), the water meter will close the solenoid valve. The solenoid valve can only be opened with the IC card specially used by the water management department.

(5) The water meter is also equipped with a voltage detection device. When the voltage drops to a certain value, the water meter will save useful information and close the solenoid valve at the same time. After replacing the battery, the water meter will automatically restore useful information and work again.

(6) The LCD will display the information icons of the above situations for users and management departments to query.

The main program flow chart of the software system is shown in Figure 3.



**Fig. 3.** Main program flow chart of the system.

## **2 Key technology design of intelligent water meter system with contactless IC card**

### **2.1 Low power design of the system**

The power consumption of a single chip microcomputer system is affected by many factors. It mainly depends on the technical indicators of the system, the selection of chips and components, and the working mode of the system.[4] The system uses STC12C5410AD single chip microcomputer as the core control and integrated serial LCD circuit. It has the advantages of high reliability, low power consumption and less occupation of system port resources. The isolation / control unit is composed of varistor, optocoupler and relay, which is mainly used to control the action of solenoid valve and eliminate the disturbance to the system caused by peak voltage fluctuation caused by the action of solenoid valve; In the process of hardware and circuit design, the following measures are mainly adopted to realize the low power consumption of single chip microcomputer system: ①The system adopts full CMOS hardware design; ②The single-chip microcomputer of the system adopts STC12C5410AD single-chip microcomputer which can run when power is off and can interrupt and wake up; ③The selection of sensors, solenoid valves and discrete devices supports low-power design; ④The system circuit design supports low-power operation and power management; ⑤The system adopts low voltage, low frequency and maximum static design.

### **2.2 Anti shake design of water meter**

During the operation of water meter, due to the uneven pressure of water in the pipeline, the pipeline and water meter will vibrate. At present, almost all domestic intelligent water meters use magnets and magnetic sensors. The vibration of the water meter causes the shaking of the magnet; Due to the jitter of the magnet, it causes multiple sampling and counting of the magnetic sensor, resulting in the inconsistency between the electronic count and the word wheel count. For this problem, the hysteresis comparator technology is used to make the magnetic sensor into a special hysteresis device.

### **2.3 Design of automatic data error correction**

The data of the electricity meter running on the power line will be disturbed and disordered due to the interference environment for many years. It can be said that occasional data confusion is an incurable disease for IC card meter design and manufacturers.

The technical measures are as like as two peas: increasing the capacity of solid state memory, and storing all the data in different places at the same time (multiple storage technologies). When reading data, it reads from multiple locations simultaneously, and then analyses the data read. As long as three of them are the same, the data is considered to be effective (data voting technology). At the same time, error correction processing is carried out for the wrong data (automatic error correction technology).

### **2.4 Design of improving memory life**

The service life of solid-state memory is theoretically 1 million times, and the actual service life is about 700000 times. When the memory is used for the first 100000 times, the data work is the most reliable, and then there will be occasional abnormalities, that is to say, the

memory is the most reliable in its youth. Therefore, in the design of data storage, the space of each storage unit should be controlled within 100000 times, and the maximum storage times should not exceed 100000 times. When a memory pointer is used for more than 100000 times, the pointer will automatically turn to the next new memory, which effectively reduces the use times of the storage unit and improves the data reliability.

## References

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