Monitoring system design of the public energy-saving charging device

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Abstract. Aiming at the problem that when people go out and the mobile phone is dead, but there is no place to charge for phone, this thesis presents a monitoring system of energy-saving charging device at Bus Station. There are two mainly parts in this design, one is the use of solar panels installed on the roof of the Bus Station generates electricity, Electricity can be output to the storage battery through the automatic voltage drop module[1-2] in the form of electric current. The stored electric energy can be easily recharged by the mobile phone charging plug, It can facilitate the user that is out or his/her mobile phone is in the low-power state to replenish the power in time. The other part is the real-time monitoring System, when the control center sends a request to the detection module in order to uploading voltage and position data instructions through the PC or cell phone, the detection module can reply through the SIM800C SMS or through the serial port to the PC upload monitoring data, the control center staff can timely understand the charging system’s faulty and can locate the point of failure through the return of information, It is convenient for technicians to make accurate maintenance.

1. Introduction
Nowadays, the mobile phone has become a powerful tool integrating the functions of call, entertainment, Internet, shopping, reading and so on, Meanwhile, the concept of environmental protection has become the mainstream in today's society, but the energy-saving charging facilities for mobile phones in outdoor has seriously lagged behind. So, adhering to the concept of energy conservation, environmental protection, low-carbon life and serving the public life, this paper designed the charging energy saving device for rechargeable mobile phone users at low electric charge at the bus stop. In order to guarantee the normal work of the device, the energy-saving equipment monitoring system also was designed to ensure bus station energy-saving work charging device for personnel in a timely manner.

2. The system Overall design
The overall design block diagram of the public energy-saving charging service and monitoring system is shown in Figure 1. The system is mainly composed of solar panel, dc-dc module, battery, Rose stabilizers module, IAP microcontroller, SIM800C module, mobile phone and PC monitor interface. The solar panel converts the light energy into electric energy, which is used for variable voltage through DC-DC module to make it reach the rated charging value of the battery. The stabilizing part makes the
output voltage more stable, which facilitates storage of the battery. Rose stabilized circuit module boosts and stabilizes the output voltage of the battery, and charges the mobile phone users who need to charge. IAP microcontroller collects the actual voltage of the battery, proceeds AD conversion, converts the battery Analog voltage into Digital quantity, connects SIM800C through serial communication module, IAP microcomputer sends the detected data to the mobile of the maintenance staff or upper computer of the control center, and administrators can observe in PC monitor screen measurements, once fault occurs, convenient maintenance personnel for repair, the paper focus on this paper, the design of the Figure 1 box part implementation mechanism and function.

![Figure 1. The system overall design](image)

3. System hardware design
AP15F2K61S2[3], the newly released IAP microcontroller with simulation function, is adopted as the microprocessor to complete the voltage acquisition and data process tasks of the charging device. In this paper, it contains almost all the unit modules in data collection and control, which can work as long as it is connected with VCC (+5V) and GND. It doesn't need to buy an additional downloader, just connect the TXD and RXD terminals, and it can download and simulate the ISP.

3.1. The system acquisition module

![Figure 2. The voltage acquisition module](image)
Whether the energy-saving charging device can work properly is one of the issues that this monitoring system pays most attention to. The fault of this charging device is mainly reflected in two aspects through analysis: one is the charging battery voltage lower than +5V, another is the charging terminal without voltage due to the fault of the charging line. In Figure 2, it can use the six ADC port (P1.0 - P1.5) to detect the charging device voltage condition on chip IAP15F2K61S2, if the bus station need the more charging ports, you can use multiple switch extended charging ports, such as you can choose AD623 to put an ADC port extend to four charging ports, if you choose more channel selector, charging ports can be extended more.

3.2. The information transmission module

Along with the development of mobile communication technology, GSM network has become a very mature wireless communication network, has been gradually used in monitoring field, SIM800C[4] is used to finish interaction between system and Maintenance personnel with the AT command control. The SIM800C connection IAP15F2K61S2 was shown in Figure 3, SIM800C will detect the state of voltage of the charging device and it can be sent to the phone of the maintenance staff to Convenient the maintenance staff understand timely working condition of the charging unit, of course, they also can send SMS commands to charging device to ask whether the charging device work normally. It can be seen that the information transmission part of this design is the information sending module and the message receiving module. The former includes the GSM sending module and the phone sending AT command, the latter includes the PC receiving interface or mobile phone.

3.3. The upper receiver module

In order to ensure that the voltage information of the charging device collected by the IAP15F2K61S2 can be transmitted to the PC through the serial port to realize the wireless transmission and data control, the chip connection mode shown in Figure 4 must be adopted.

SIM800C is responsible for the wireless transmission of information and the voltage value of the public energy saving charging device is transmitted to the upper computer for display through the CH340G chip in Figure 4. The CH340G chip is the transfer chip of the USB bus to the serial port. As the serial port is rarely configured on the laptop at present, so the CH340G chip is used to map the USB port to the serial port in this design. In order to ensure the normal use of the system, it is necessary to
make the following Settings in Figure 4, to connect the RXD pin of CH340G with the pull-up resistance of about 300 ohms; to connect diode to the CH340G TXD pin, this can avoid CH340G supply current to the Single chip microcomputers, it can lead to problem that the program can not download.

4. Design and test of upper computer monitor module
The upper computer detection module [5] is written by Visual Basic. The monitoring interface of the upper computer in this design is shown in Figure 5. The voltage information of the public energy-saving charging device can be displayed in real time through it. In Figure 5 No.1 to No.4, respectively represent the voltage value of the charging port of the four-way mobile phone, and there is the circuit fault of the No. 3 and no. 4 without voltage value, which requires maintenance personnel to check and repair in time. Table 1 shows the comparison and analysis between the display voltage value of the upper computer and the measured voltage value of the charging circuit.

Table 1. Comparison and analysis between the display voltage value and the measured voltage value of the charging circuit

| Charging terminal number | The upper display voltage(V) | Measured voltage(V) | Data analysis          |
|-------------------------|-----------------------------|---------------------|------------------------|
| No.1                    | 4.98                        | 4.98                | Charging the phone     |
| No.2                    | 3.96                        | 3.96                | Solar battery are recharging |
| No.3                    | 0                           | 0                   | Circuit fault, need to be repaired |
| No.4                    | 0                           | 0                   | Circuit fault, need to be repaired |

5. Mobile monitoring module test
The maintenance personnel can send SMS(as agreed in the program text content) at any time to ask work of charging device, as shown in Figure 6, when the staff sends word "read" string using a mobile phone to the energy saving on the GSM module, the mobile phone receives the voltage of the charging device as shown in Figure 5, the maintenance personnel not only easy to locate the position of the
charging terminals but also convenient to judge the charging device is working correctly by returning area number and voltage value, the voltage values being charged at the charging terminal of the mobile phone that are shown in Figure 5. The measured voltage values of the charging circuit and the data received by the mobile phone show that there is no error between them, and real-time display is achieved.

![Figure 5. The results of mobile test](image)

6. Conclusion
The public energy saving charging device mainly uses solar energy to generate electricity, which greatly saves power generation cost, and solves the problem of power generation difficulty, and at the same time protects the environment and saves resources. The system knows whether the charging device fails through SMS. In addition, the monitoring of the upper computer can reduce the operating error and improve the operating efficiency of the system. The system makes the mobile phones easy to charge, has strong public welfare, and improves people's quality of life to a certain extent, which is the great significance for promotion.

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