Design of Solar Energy Automatic Tracking System Based on STC89C52

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Abstract. This paper designs a solar energy automatic tracking system based on STC89C52. The photoelectric sensor collects the sunlight signal. After A/D conversion, the collected signal is sent to STC89C52. After data comparison, MCU sends out control signals. The step motor is used to control the level and pitch angle of the solar panel, so that it always faces the direction of sunlight, and realizes the sunlight tracking. The hardware design includes the minimum system of STC89C52 MCU, sunlight signal acquisition circuit, A/D conversion circuit, key circuit, motor drive circuit, etc. The software is written in C language, including main program, data acquisition subroutine, key reading subroutine, data comparison subroutine, etc. Through physical production and operation debugging, the design function is normal.

1. Introduction
Solar energy is a kind of clean energy. At present, solar panels are widely used for photovoltaic power generation. Because of fixed direction, the traditional solar panels can't track the changes of sunlight, so the photoelectric conversion efficiency is low. Therefore, the design of a solar energy automatic tracking system has a good application value. In this paper, a solar energy automatic tracking system based on MCU is proposed. The system can use photoelectric sensor to collect light signals. The MCU compares and analyses the signals. The step motor can automatically track the movement of sunlight; ensure that the solar panel to receive more sunlight, so as to improve the utilization of solar energy.

The main work of this paper includes:
① Determine the overall design scheme of the system;
② Hardware design and software design of the system;
③ Production and operation of the physical object.

2. Overall design scheme of the system
The overall design scheme of the system is shown in Figure 1.
3. System hardware design
The hardware design includes the minimum system of STC89C52 MCU, sunlight signal acquisition circuit, A/D conversion circuit, key circuit, stepping motor drive circuit, indicating circuit, etc.

3.1. Minimum system of MCU
The minimum system of MCU includes STC89C52, clock circuit and reset circuit, as shown in Fig.2. The crystal frequency is 12 MHz and VCC is +5V.

3.2. Sunlight signal acquisition and A/D conversion circuit
The circuit is shown in Figure 3. Four photoresistors are selected for sunlight signal acquisition, and they are installed symmetrically to collect sunlight in four directions of the solar panel. After photoelectric conversion, the four light signals are converted into voltage signals, which are sent to PCF8591 A/D converter and converted into digital signals.

Figure 1. Overall design scheme of the system

Figure 2. Circuit of the minimum system of MCU
3.3. **Key circuit**

The circuit is shown in Figure 4, with 5 buttons in total. Key K4 is used to switch the manual control or automatic tracking mode; key K3, key K5, key K2 and key K6 are used to control the upper, lower, left and right directions respectively (manual control mode).

3.4. **Stepping motor drive circuit**

The circuit is shown in Figure 5. The ULN2803 driver chip is used to drive the four phase stepping motor to rotate. The two stepping motors respectively control the level and pitch of the solar panel, so as to track the sunlight.
3.5. *Indicating circuit*

The circuit is shown in Figure 6. Two LED lights indicate that the current mode is manual control mode or automatic tracking mode.

4. *System software design*

The software is written in C language, mainly including main program, data acquisition subroutine, key reading subroutine, data comparison subroutine, etc.

The main program flow chart is shown in Figure 7. First, initialize (timers T0 and PCF8591), then collect the data, read the key value, judge whether it is the automatic tracking mode (if yes, compare the data; if not, enter the manual control mode), and finally generate the control signal to drive the stepping motor.
5. Production and operation of physical object

The finished physical object is shown in Figure 8. Power on operation, press K4 key, switch to automatic tracking mode, and the LED indicator light is on, and the solar panel will rotate in the direction of sunlight. This indicates that the device is tracking successfully, as shown in Figure 9.

6. Conclusion

On the basis of the overall design scheme, this paper designs the hardware and software respectively. The hardware design includes the minimum system of STC89C52 MCU, sunlight signal acquisition circuit, A/D conversion circuit, key circuit, stepping motor drive circuit, etc. The software is written in C language, including main program, data acquisition subroutine, key reading subroutine, data comparison subroutine, etc. Through the physical production and operation debugging, the design function is normal, has some values of reference and application.
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