2019 4th International Industrial Informatics and Computer Engineering Conference (IIICEC 2019)

Research on control strategy of battery charge and discharge circuit based on intelligent shutter

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Keywords: solar energy intelligent shutter; battery; intelligent shutter; charging and discharging

Abstract: the development of clean energy has been paid more and more attention by many countries, and photovoltaic power generation is being developed all over the world. Because the battery charge and discharge in the independent power generation system is relatively frequent, in order to prolong the battery life, reduce system failure, improve system stability and reduce the operation cost of power generation, it is necessary to manage the battery charge and discharge. In this paper, a solar energy intelligent shutter battery charge and discharge controller based on PWM control is designed. The system is mainly composed of MCU, voltage acquisition, charge control and discharge control.

Today, the global energy situation is tense and global warming is a serious threat to economic development. All countries in the world are looking for new energy alternative strategies to achieve sustainable development and gain an advantageous position in future development. Solar intelligent louver has become the focus of attention because of its remarkable advantages such as clean, renewable and safety. In particular, solar intelligent shutter photovoltaic power generation technology has been developed rapidly in recent years. Up to now, photovoltaic power generation technology has been extremely mature. There are two kinds of photovoltaic power generation technology: independent power generation system and distributed power generation system. Distributed generation system is mainly used in large-scale grid connected generation system. Independent power generation system is mainly for small users or small loads. Independent power generation system is more and more used in various fields because of its flexible application and strong adaptability.

The independent photovoltaic power generation system mainly consists of four parts: solar intelligent shutter battery board, controller, battery and DC load. The technical development of solar intelligent shutter battery and battery is relatively mature, and the performance requirements of the controller are different because of the different application occasions. For the general solar intelligent shutter battery, the requirements of the controller mainly focus on the management of battery charging and discharging, and the selection of charging and discharging at night and day On the other hand, through the management of the over charging and over discharging of the battery by the single-chip microcomputer, the life of the battery can be extended, so as to further improve the cost performance of the system. Based on this, an intelligent controller is designed.

1. System design scheme

In this design, stc15w4k60s4 μ pdip40 single chip microcomputer is used as the control center, and the voltage of battery and solar intelligent shutter battery is sampled by the combination of software and hardware. After the A / D conversion of the single-chip microcomputer, it is processed. The MCU output drives M0SFET through optocoupler to control the charge and discharge function of the system. The system can control the optimal charge and discharge of the battery. When the battery voltage is 14.5V + 0.5V, the solar intelligent shutter battery stops charging the battery. When the battery voltage is 10.5V + 0.5V, the battery stops discharging the load.

  DOI: 10.25236/iiicec.2019.073

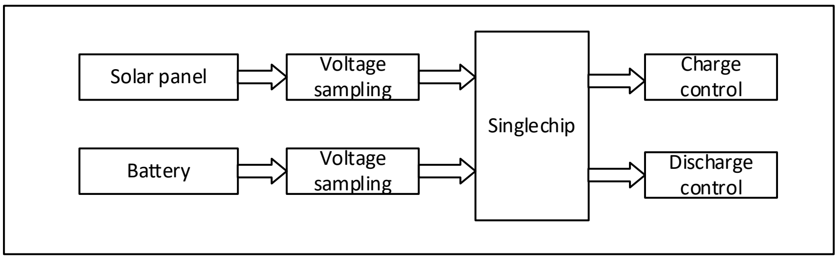

Figure 1 system design scheme

2. Hardware circuit design

The charge and discharge control circuit of the battery is shown in Figure 2. The charge control is mainly realized by Q1 control, and the discharge control is mainly realized by Q2 control. AD0 and AD1 are the voltage sampling output of solar intelligent shutter battery and battery respectively.

As shown in Figure 2, the voltage acquisition circuit (R1 and R2, R3 and R4) adopts the principle of two resistors in series to obtain the sampling voltage. The ratio of the two resistors is 10:1, and then they are connected in parallel at both ends of the solar intelligent shutter battery and the battery. The sampling voltage of the solar intelligent shutter battery and the battery is output by AD0 and AD1 respectively.

When the battery is fully charged, the voltage is about 15V, and the sampling voltage output through AD1 is about 1.36v. After sampling the battery voltage, the voltage fed into a / D is reduced to 0V ~ 3V, which greatly enhances the feasibility of a / D conversion.

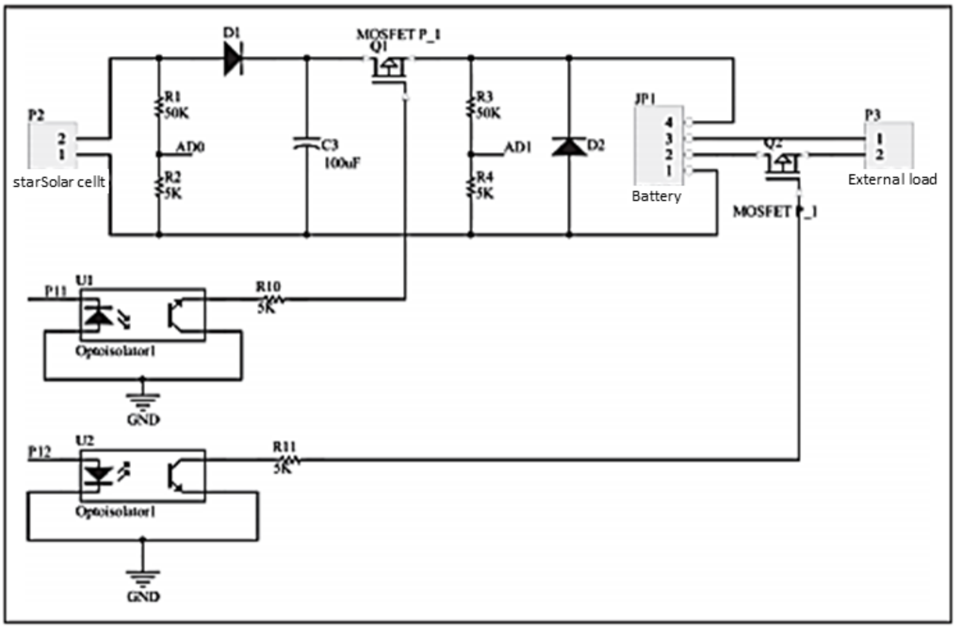

Figure 2 charge and discharge control circuit

The charge discharge circuit is composed of charge diode D1, filter capacitor C3, continuous current diode D2, MOSFET QL, MOSFET Q2, etc. Diode D1 is to prevent reverse charging. When the voltage of the battery is higher than that of the solar intelligent shutter battery in cloudy days or at night, D1 will take effect.

The PWM control principle is used to control the battery charging. The p-channel MOSFET is selected as the switch control device in the design. A photoelectric coupling device is added between the msofet and the control terminal of the single-chip microcomputer. The main purpose is to isolate the charging circuit from the single-chip microcomputer, improve the safety and stability of the point, and avoid voltage crosstalk damaging the single-chip microcomputer.

When p12 end is sent to low voltage level, the light-emitting diode inside the optocoupler will not turn off. At this time, because the phototransistor inside the optocoupler fails to receive the light signal, it will also turn off, which is equivalent to the switch "off", Q1 will turn off, and it will not be charged. When p12 is high voltage level, the light-emitting diode inside the optocoupler will turn on, and the phototransistor inside the optocoupler will receive the light signal It is in on state, which is equivalent to the switch "closing", making MOSEFT form on circuit, Q1 is on, and solar intelligent shutter battery charges the battery. Changing the duty cycle of PWM signal can control the effective charging time of the battery and achieve the purpose of reasonable charging. As the discharging principle of battery is similar to charging, it will not be repeated here.

3. Software design

The signal of AD0 and AD1 is used to determine whether the solar intelligent louver battery and battery are connected to the circuit. When there is no connection, the voltage acquisition output is 0. If one of the signals is detected as 0, no charge control is performed. When both signals have voltage, the battery starts to charge when there is no load connected, and it will be in floating charge state and infinite cycle after full charge. When the load is connected, switch to the discharge state through the change-over switch to control the discharge, but stop the discharge when the battery voltage drops to the set lower limit or the midway load is pulled out. The charging control program flow chart is shown in Figure 3. The charge and discharge control is similar. This paper only describes the software design of the charge control part

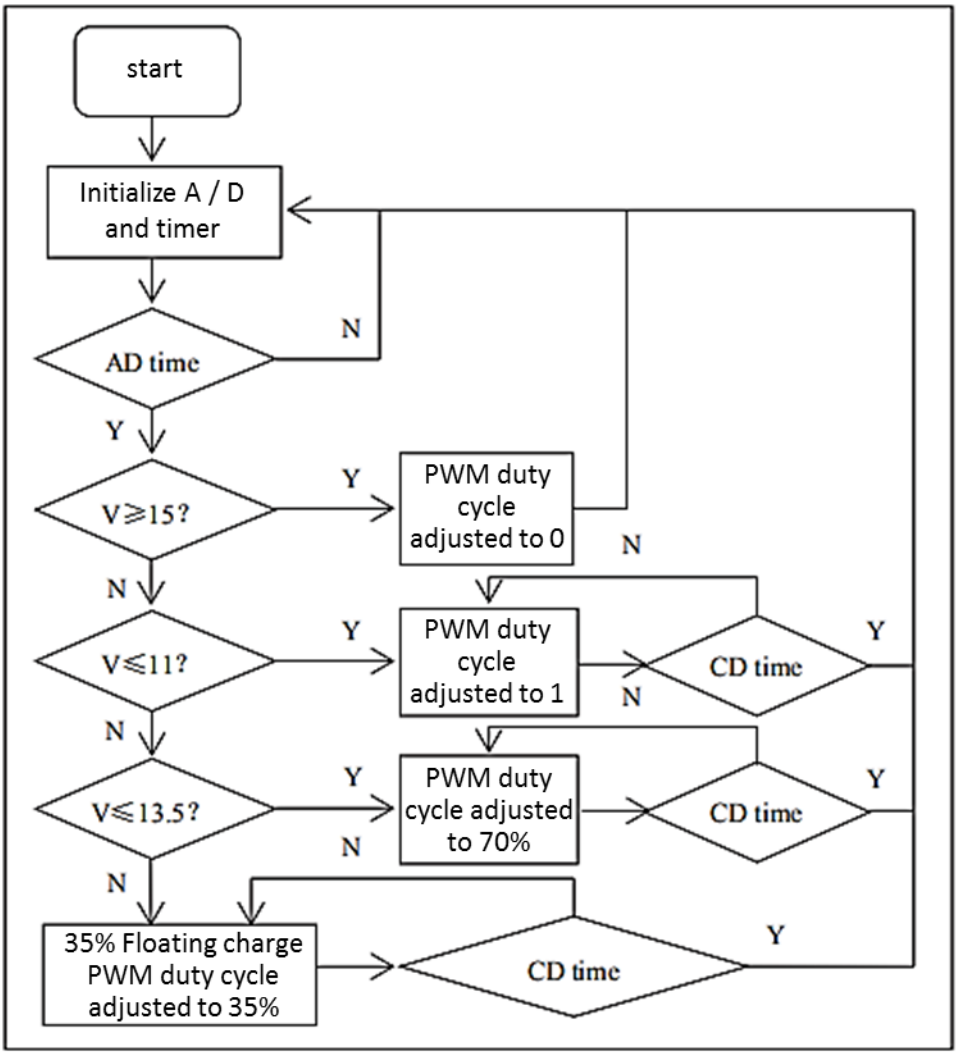

Figure 3 charging control procedure flow chart

Set the timer to interrupt once for 2S and 30s. After reaching the set time, the interrupt handler will enter the state judgment and adjust the duty cycle. Set the AD acquisition timing time to 2S, and carry out AD acquisition task all the time when the time is not reached. When the time is reached, carry out the next step to judge the current voltage of the battery. If the battery voltage is greater than 15V, adjust the PWM signal duty cycle to 0, and do not charge; if the battery voltage is lower than 15V, judge the battery voltage, if the battery voltage is lower than 11V When the voltage is between 11V and 13.5V, the duty cycle of PWM signal is adjusted to 1 for continuous charging; when the voltage is between 11V and 13.5V, the duty cycle of PWM signal is adjusted to 70% for charging; when the voltage is between 13.5V and 15V, the duty cycle of PWM signal is adjusted to 35% for floating charging. Charging time CD time

Set it to 60s, collect the voltage again every 60s, and then determine the charging state of the battery.

4. Conclusion

The system completes the design of charge and discharge control of battery. Stc15w4k60s4 μ pdip40 is selected as the single chip microcomputer to complete the voltage acquisition signal processing and the generation of PWM wave. MOSEFT tube is used in the charge and discharge part to control the charge and discharge. In order to prevent the battery current from pouring back, optocoupler is selected to isolate the single chip microcomputer and improve the safety and reliability of the controller. When charging, the duty cycle of PWM wave is changed according to the collected battery voltage to achieve fast charging and slow charging Purpose. After testing, the system has better charge and discharge control performance.

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