Design of the Solar Energy Watering Robot

Li Yang and Yin Tianguang

***Abstract*—Watering robots powered by solar panels, the robot automatically detect the soil moisture. When the soil moisture not conducive to plant growth, the robot automatically along designated routes to watering flower, until to satisfy the appropriate soil moisture, stop watering and return to the starting point. Experiments show that, the automatic watering robot has the advantages of simple operation and convenient use, satisfied the automation and intelligent of modern life.**

***Index Terms*—Watering robot, soil testing, infrared signal, solar energy.**

I. Introduction

With the consumption level and living quality have improved, home gardening market was very popular, Many office workers were indoor planting flowers and grass to adorn life. But because of the accelerated pace of life, Growing flowers is easier than working in the garden problems exposed. The most important question is gardening watering problems, sometimes because of a business trip, busy and other reasons untimely watering, resulting in water shortages and dry flowers. Research shows that, more than 80% of the flowers death is due to untimely watering [1]. In the existing energy structure, the main energy is oil, natural gas, coal and other fossil fuels, which are non-renewable energy sources. These sources are very limited [2]. As new type energy, solar energy is undoubtedly an environmentally friendly, green energy, but also a huge amount of renewable energy. This design of solar energy automatic watering robot can realize automatic watering as needed to ensure the healthy growth of plants.

II. Design Principles

Solar energy Automatic Watering Robot，powered by solar energy panels, placed soil moisture detection device in the soil. When detecting the soil needs watering, infrared emission device will give a signal to distant solar energy robots. With the signal, the robot will start immediately and accurately reach pots position to watering the flowers through the pump. Soil moisture detection continues while watering, when detecting soil moisture achieve the required, the robot will stop water supply, and return to the starting position.

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III. Circuit Design

Solar energy automatic watering robot using single chip as the control core, the circuit mainly include soil moisture detection circuit, battery protection circuit, power supply circuit, infrared transmitting and receiving circuit, driver circuit, infrared patrol line circuit, ultrasonic ranging circuit and pressure detection circuit.

A. Storage Battery Protection Circuit Design

Battery protection circuit (Fig. 1), use the solar panels charge the battery, achieve to prevent battery overcharge and over discharge function. When the battery voltage reaches 13.5V, VZ2 breakdown conduction, B point potential is positive, VT3 is reverse-blocking, and VD1 is turned on, and trigger V4 conduction. C3 positive charges by the charge through V3 applied to the V4 cathode, V3 instantaneous plus reverse voltage cut-off turn off the charging voltage source. Meanwhile the charge indicator lamp LED3 stops light, and the voltage normal indicator lamp LED2 is normal light. When the battery voltage is lower than or equal to 13 V, VZ2 cutoff, VT3 forward conduction, the current through C3 trigger V3 conduction, charging circuit and connected, at the same time, C3 was also charged.

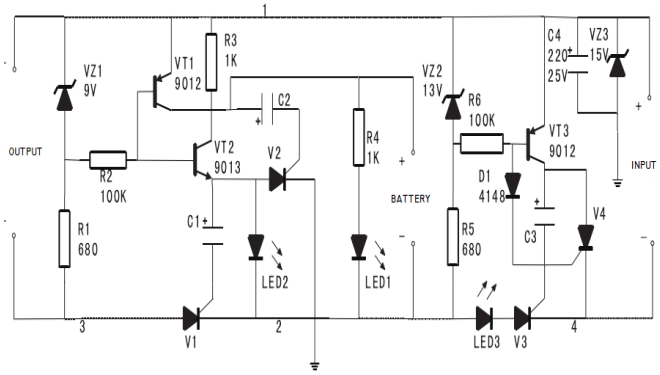

Fig. 1. Storage battery protection circuit diagram.

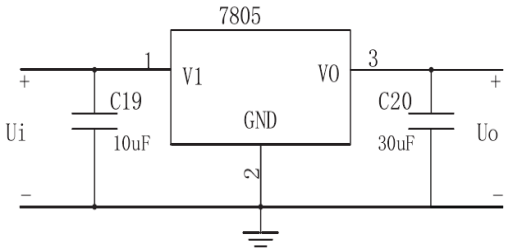

Fig. 2. Regulated power supply circuit diagram.

B. Regulated Power Supply Circuit Design

Regulated power supply circuit (Fig. 2), use of integrated regulator 7805. Ui is the input voltage provided by the battery, Uo is the output voltage, and C19and C20 respectively for the

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input and output filters capacitor. 5 V output is positive DC voltage to provide power to other circuits. The output is 5V DC voltages, provide power for other circuits.

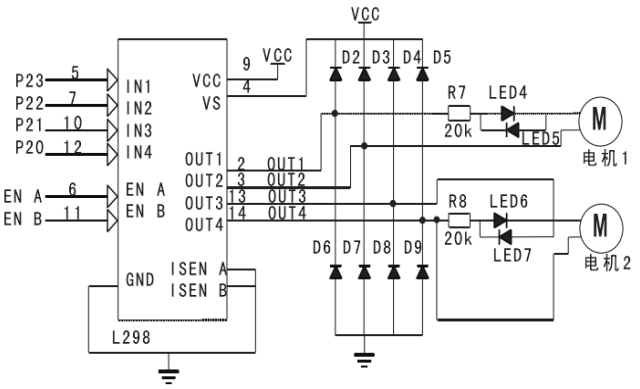

Fig. 3. Motor drive circuit diagram.

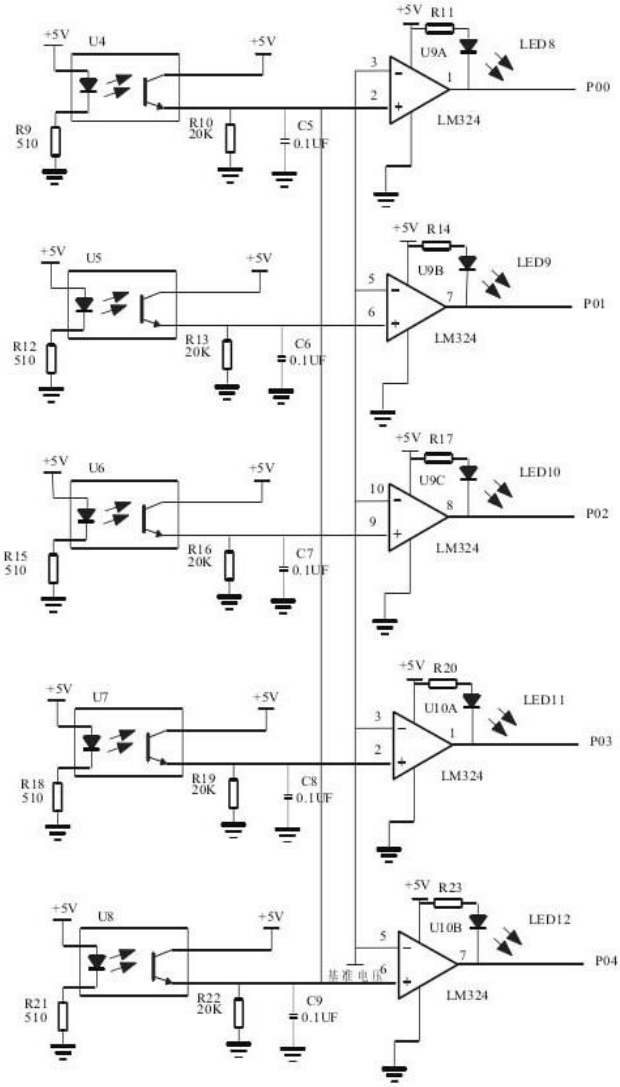

Fig. 4. Patrol line diagram.

C. Motor Drive Circuit Design

Motor drive circuit is using L298N driver chip. In Fig. 3, IN1 to IN4 are control input signal ports, when the input signal terminal IN1 connected high electrical level input terminal, IN2 connected low electrical level, motor M1 forward rotation; Signal terminal IN1 connected low electrical level, IN2 connected high electrical lever, motor M1 reversal. When the input signal terminal IN3 connected high electrical and IN4 connected low electrical, motor M2 forward rotation; signal terminal IN3 connected low electrical and IN4 connected high electrical, motor M2 reversal.

D. Patrol Line Circuit Design

The circuit (Fig. 4) adopts the integrated infrared emission receiving tube, use infrared transmitting tube and receiving tube compactly mounted together, designed by the principle of infrared absorbed for different colors. Most of the emitted infrared lights were absorbed by black line, when the infrared transmitting tube and the receiving tube in the black line position. That is, most of the emitted infrared lights was reflected and received by the receiving tube, when there is no reflected light and infrared emitting tube and receiving tub is not in the black line position. The circuit has five ways infrared emitting tube and receiving tube, the middle way is mainly to ensure that the robot can move forward along the path, next two ways mainly to realize correct when robot deviate from the route, thus ensuring robot back to the route. The outer two ways is mainly to ensure the robot realize turn at the intersection according to the route.

E. Soil Testing Circuit Design

Soil testing circuit design (Fig. 5) is designed based on the different soil moisture have different conductive ability [3]. Adjustable resistor R25 or probe spacing can change the measurement sensitivity, to realize the detection of soil moisture. Determine the voltage at point A, when the need of watering (VL) and full of water (VH). Design window comparator according to the voltage, to achieve output high electrical level when Va < VL.

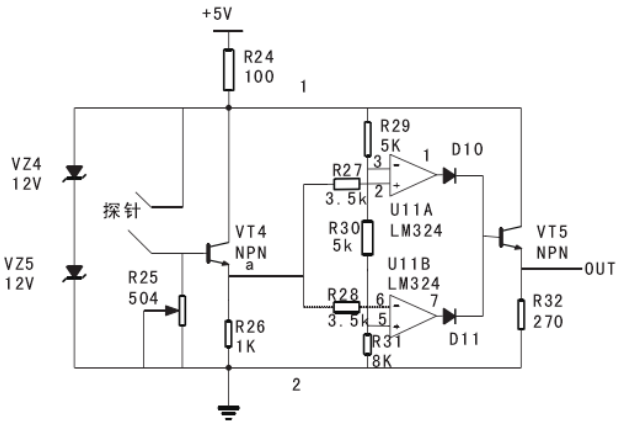

Fig. 5. Soil testing circuit diagram.

F. Ultrasonic Transmitter Circuit Design

SCM P1.0 port to control the ultrasonic transmitting circuit work (Fig. 6), transistors Q2, Q3 component strong feedback type oscillator, the tiny change of Q2 collector output voltage feedback to Q3 of the base through the ultrasonic transmitting probe, After Q3 amplification and applied to Q2 base is further amplified, after several cycles to form an oscillation circuit. The probe feedback Q2 output to Q3 base, While will be oscillator frequency stability on its own natural frequency, used as a stable frequency components. Ultrasonic transmitter probe both ends for 40

kHz square wave, pushing ultrasound probe generate 40 kHz ultrasound.

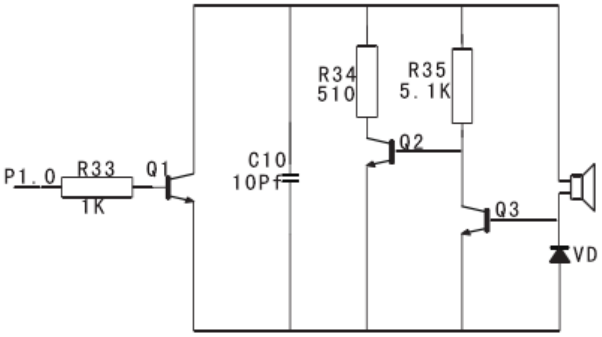

Fig. 6. Ultrasonic transmitter circuit diagram.

G. Ultrasonic Receiving Circuit Design

Ultrasonic receiving circuit includes a low pass filter circuit, amplifier circuit, the comparator shaping circuit (Fig. 7). First, the capacitor C11 filtering the residual DC voltage that may exist, and then amplifying circuit for weak ultrasonic echo signal amplification, and through the band-pass filter circuit to remove interference signals, amplifying and filtering circuit using high speed Precision Operational Amplifier TL082, Finally using a comparator the shaping circuits.

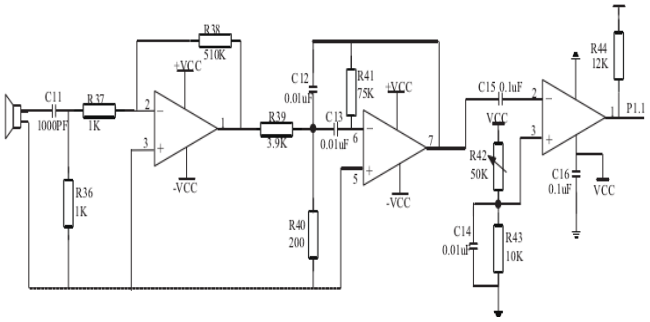

Fig. 7. Ultrasonic receiving circuit diagram.

H. Pressure Sensor Circuit Design

Pressure sensor is using for detecting the level of the water tank. Send alarm signal when the tank water level falls below a certain value, Prompt people add water to the water tank. The buzzer will Send alarm signal when adding water to a certain level, suggesting that people stop adding water.

Pressure sensor circuit (Fig. 8) the pressure is converted into an electrical signal and amplification shaping by silicon pressure sensor. Because of the signal is weak, so through the LM358 formed two poles voltage after amplification by LM358 out from 7 feet. Change the Rp45 can adjust the reference voltage, the output of the circuit is zero when no pressure at sensor. R52 and R55 is the feedback resistor, capacitors C17 and C18 are filter capacitors, when the pressure sensor is subjected to pressure, when the pressure sensor under pressure, the electric bridge loses balance, 3 point and 4 point voltage is not equal, because 3 point voltage is fixed by Rp45, so the voltage difference will be output by 4 point, output pressure signal after the LM358 linear amplification [4].

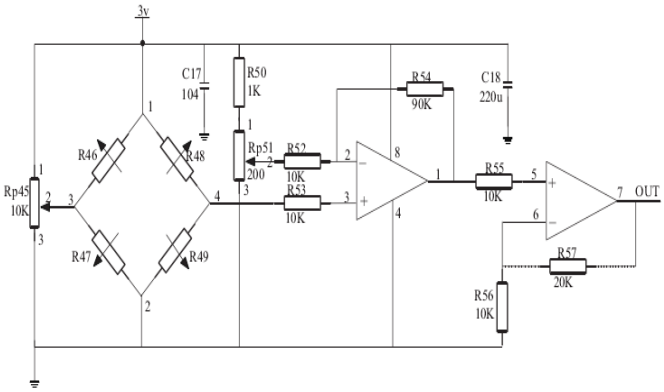

Fig. 8. Pressure sensor circuit diagram.

I. Infrared Communication Circuit Design

The infrared communication circuit (Fig. 9), promote the MOS tube turned on when P1.2 is high electrical level, LED13 infrared emission. When LED14 cannot received infrared signal, performance a high-impedance state, transistor Q5 off, P1.6 output high electrical level. When there is an infrared receiving, LED14 turned to the transistor base current is supplied, resulting in transistor Q5 saturated conduction , P1.6 output low electrical level [5].

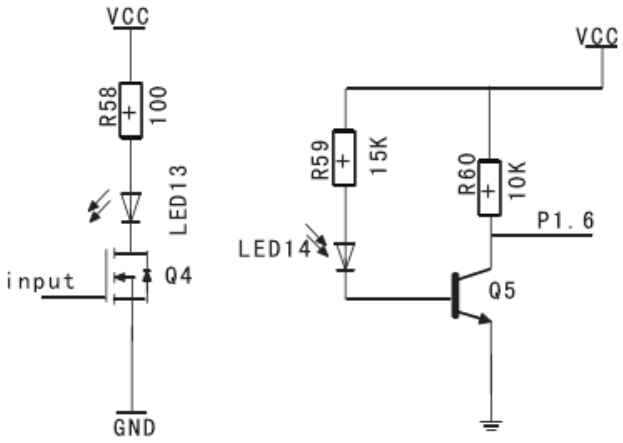

Fig. 9. Infrared communication circuit diagram.

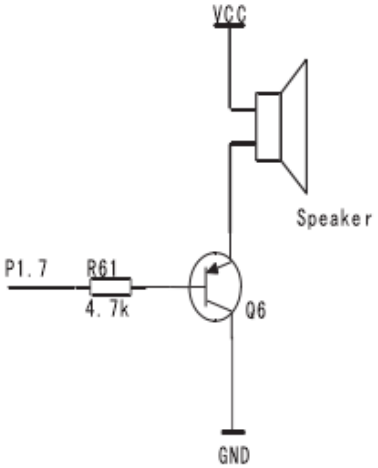

Fig. 10. Alarm circuit diagram.

J. Alarm Circuit Design

As shown in Fig. 10, buzzer sounds when the microcontroller P1.7 output low. The buzzer does not sound

when the microcontroller P1.7 output high. When the tank water level is too low, the MCU P1.7 output low, the buzzer will sound an alarm.

IV. Conclusions and Discussion

Based on the completion of the related hardware design, carried out some related experimental for solar automatic watering robot. The experiments display the process of watering flower. As can be seen from the experimental results, the present design is feasible.

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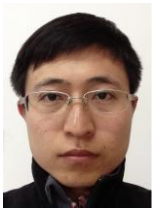

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