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Design and Implementation of an Intelligent Irrigation System

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Abstract

This paper mainly studies a kind of intelligent irrigation system, that is, the design and manufacture of soil moisture detection circuit. The core part of the circuit is composed of single-chip microcomputer AT89C52 and ADC0832. The data collected by the humidity sensor is used as the input analog signal to select the humidity sensor and A/D conversion. The internal circuit includes humidity collection, A/D conversion, single-chip microcomputer decoding display and other functions. Insert the humidity sensor in the soil to return the current humidity value to the microcontroller and display it on the nixie tube. Compared with the set upper and lower humidity values, the motor circuit will start automatic watering if it is lower than the lower humidity limit value, and the motor circuit will stop watering if it is higher than the upper and lower humidity limit value. If it is between the upper and lower humidity limit values, you can decide whether to start manual watering according to your wishes. The initial upper and lower humidity values can be realized through the button circuit, Increase or decrease the original humidity value according to the actual water demand of flowers. The manual part is poured by turning off the power supply of the single chip computer and supplying power from the peripheral circuit.

Keywords

AT89C52, ADC0832, temperature sensor, A/D transition.

1. Introduction

With the development of society, people's quality of life is getting higher and higher. Micro spray technology is an advanced technology in recent years. Its core technology is to assemble the irrigation facilities of the model. The water flows through the pipe system at a certain speed from a special nozzle and then disperses into small water droplets and falls into the air of plants and flowers. The system has the characteristics of low water consumption and small impact on irrigation of dense planting areas, small leaves and tender plants[1-10]. As people's life is getting better, the quality is getting higher and the pace of life is getting faster and faster, people want to find peace in the fast pace, so automatic irrigation equipment came into being. The type of automatic watering equipment sold on the market is single, but the price is also very high, and most functions can only be set with a regular watering time, so it is difficult to automatically and timely water potted plants, and the cost performance is low. Therefore, we design an automatic watering system for potted plants that integrates soil moisture detection, automatic watering and automatic water supply from water storage tanks. Let people water automatically and timely when they have no time[10-13].

2. Design scheme

The system is mainly composed of single-chip microcomputer control circuit, digital tube drive circuit, key circuit, humidity sensing circuit, power supply circuit and motor control circuit. After pressing the power key, the humidity sensing circuit is simulated by ADC0832 and two

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point positioners and sent to the microcontroller. The detected soil temperature and humidity value is displayed on the nixie tube drive circuit through the I/O port of the microcontroller. The current humidity value displayed on the nixie tube is compared with the set value. If it is lower than the lower limit value, the motor circuit will work, and the automatic watering program will start running, and the automatic watering will start. If it is higher than the upper limit value, the single-chip microcomputer sends a control signal to control the motor circuit and stop watering. If it is set in the manual watering system, the soil temperature and humidity value can be detected and displayed on the LCD screen. You can decide whether to water or not, so as to achieve the purpose of real-time monitoring of soil moisture and temperature.

The main chip in this design is AT89C52, which has the following characteristics: 8-bit, low voltage, and 89C52 high-performance CMOS. The read-only flash memory contained in it is 8kbytes, repeatable rewritable and 256bytes RAM. It also has nonvolatile storage technology and a general 8-bit CPU on the chip. AT89C52 single chip microcomputer has 32 bidirectional input or output (I/O) ports, 3 16-bit programmable timing counters, 2 bidirectional serial communication ports and 2 read-write port lines in its 40 pins. P1 is a complete 8-bit bidirectional I/O port. Dynamic design technology is still used in the single chip computer, so it can reach a wide operating frequency range, ranging from 0 MHz to 24 MHz. The operating frequency can reach 0MHZ, which means that it has the function of sleep power saving. In this mode, the on-chip RAM will be closed and stop working, that is, there will be no clock oscillation, and it can continue working only when it is awakened. There are many ways to wake up, such as timing/counter serial port, etc.

In this design, the main temperature sensing chip is ADC0832. The chip has an 8-channel multiplexer, which is based on the fact that after the address code signal latch is decoded, 8 analog input signals are selected for analog-to-digital conversion. In analog circuits, analog-to-digital converters are digital quantities. It is an analog voltage and current signal. It can also be the force acting on the contact surface of two objects, the degree of heat and cold, the degree of atmospheric dryness, the position change of objects and the sound signal. However, before A/D conversion, the input signals to the A/D converter need to be converted into voltage signals by different sensors.

3. Hardware description

The design is based on AT89C52 as the core controller, including digital tube drive circuit, key circuit, humidity sensing circuit, and motor control circuit. The whole circuit is to insert the humidity sensor into the soil, and the detected humidity value is returned to the single chip computer in a certain way. The single chip computer makes feedback on the returned humidity value, so as to realize the intelligent control of the repeater, and display the returned value on the digital tube to complete the operation control of the whole system.

The design circuit uses a digital tube. When the humidity sensor is inserted into the soil, the digital tube will display the current humidity value, and people can freely set the original upper and lower humidity values. The humidity sensor sends the sensed humidity value to the single-chip microcomputer, and then the single-chip microcomputer control circuit analyzes the humidity value, and displays the current humidity value on the digital tube. With the watering process, the soil humidity value will also change. At this time, the microcontroller will make corresponding control and display the current humidity value on the digital tube. As for the choice of display, because most of the words are suitable for growing outdoors with sunlight, the light outside is relatively strong, which requires high display requirements. The nixie tube display is relatively clean and more suitable for sunny days. Although the energy consumption of the nixie tube is higher than that of the LCD display, the nixie tube is the best choice for the design of the watering system.

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The key circuit divides the working mode of the whole circuit into automatic watering and manual watering. There are three keys in this design, from right to left are the setting key, the humidity plus key, and the humidity minus key. When the power key is pressed and the setting key 1 is pressed, the nixie tube will display the set maximum value. Combine the plus and minus keys to adjust the maximum value to the appropriate value. Press the power key and press the setting key 2 at the same time, and the nixie tube will display the set minimum value. Combined with the plus and minus keys, adjust the minimum value to the appropriate value. If the displayed humidity value is between the upper and lower limits, press the humidity decrease key once, and the machine will work in the manual watering mode. Press the humidity decrease key once, and the manual watering can be stopped.

The humidity sensing circuit is mainly composed of humidity sensors. When the button loop is in automatic sprinkling mode, we need to set a value that meets the humidity requirements. When the humidity sensor detects the humidity value, it will be sent to the SCM for timely analysis and processing. If the detected value is less than the set value, the motor circuit works to realize the watering function; If the detected value is greater than or equal to the set value, the motor circuit is closed and the watering function is closed. When the manual watering mode is selected for the key circuit, it is not necessary for the single-chip computer to analyze the detected humidity value. The single-chip computer controls the motor circuit according to the key to realize the watering function.

The motor control circuit is mainly composed of relay and motor. Relay is an electrical control device. If the change of the input quantity meets the requirements, the electrical output circuit will make a predetermined change of the control quantity. There is a close relationship between the control system and the controlled system. It is generally used in automatic control circuits, It is actually a small current to control the operation of the large current automatic switch ". Therefore, the current and water flow can be automatically adjusted in the circuit, which has a great guarantee for the safety of the entire circuit, and it is very convenient to change the circuit. The relay acts as the pump switch to control the water output of the pump. With the help of the motor, it can fully realize the timed and quantitative water delivery. According to the humidity value displayed on the digital tube, it can determine how much water to pour.

In the general circuit diagram, the whole design includes single-chip control circuit, digital tube drive circuit, key circuit, humidity sensing circuit, motor control circuit and power supply circui

4. Software description

The software flow of the intelligent irrigation system designed in this paper mainly includes two parts, one is to realize the main flow of automatic irrigation, and the other is to design the sub-flow of manual watering. The main process shows the whole automatic watering process. After turning on the power, perform system initialization, set the initial humidity value, insert the humidity sensor into the potted plant, display the humidity value of the current potted plant on the nixie tube, press the key, and select whether to irrigate or not according to the comparison between the current humidity value and the initial humidity value. Finally, the microcontroller indicates whether the motor works.

The manual watering subroutine works when the current humidity value is between the upper and lower limits of the initial humidity value, then the automatic irrigation program does not work. If people want to irrigate, they can press the key and select the manual irrigation subroutine to achieve the irrigation function.

5. Physical commissioning

The physical design of the intelligent irrigation system is shown in Figure 1.

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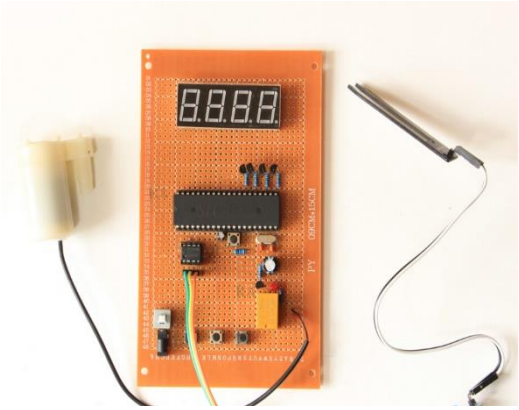

Figure 1 The physical design

"J1" is used as an external power input port, and the input voltage is 9V-12V, either DC or AC power. "J2" is used as the humidity value up key and the manual watering on key. When the power is connected and the system is initialized, the upper limit of humidity can be adjusted. When the current humidity value is between the upper and lower limit of humidity, this key acts as the manual watering on key. "J3" is used as the humidity value down key and the manual watering off key. When the power is connected and the system is initialized, the lower limit value of humidity can be adjusted. When the current humidity value is between the upper and lower limit values of humidity, this key acts as the manual watering off key. When it is started, the manual watering program ends. "J4" is the automatic watering selection key. Press this button to start the automatic watering program. When the humidity value of potted flowers is less than the lower limit of humidity, the program will automatically drive the motor to realize watering. The physical key is shown in Figure 2.

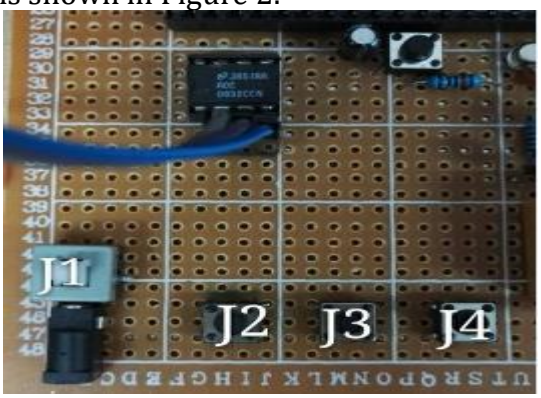

Figure 2 Physical button diagram

Insert the humidity sensor into the soil of the plant, press the J1 key, and the humidity value will be displayed on the nixie tube. Press the J4 key to open the humidity setting switch. Press J3 to set the lower limit of humidity. When the humidity is lower than the set lower limit, the motor will automatically start pumping irrigation; Press J2 to set the upper limit value of humidity. When the humidity reaches the set upper limit value, the motor will stop pumping water. At this time, press J4 again to exit the setting, automatically detect the soil humidity, and then automatically water the function. If the displayed humidity value is between the set upper and lower values, press the J2 key to enter the manual setting mode. When the humidity value is greater than the set upper limit value, the manual mode will also stop pumping. Press the J3 key to manually close the watering.

6. Conclusion

fter several months of continuous efforts and struggle, the thesis was finally completed. Although there are many difficulties, they have been successfully solved. The design is divided

into hardware and software. The hardware includes power supply circuit, key circuit, single-chip control circuit, digital tube drive circuit, humidity sensing circuit and motor control circuit; The software part mainly completes the compilation of the main program, initialization program, key processing program, and motor control program of the single chip computer. Due to the relative lack of knowledge, the idea at the beginning was not very clear, and it was difficult at the beginning. Later, I browsed some online documents, and slowly produced some ideas. At first, I set up the main framework, which is very important and is the backbone of the paper. Then complete each module step by step according to the framework, and the overall thesis is completed smoothly. Finally, it also realizes the function of intelligent watering. In the process of physical production, there are many problems. We should consider the electrical property between components and try to reduce the interference between components. The technical requirements for welding are relatively high. A little carelessness will lead to the place of desoldering and missing welding, which leads to the physical can not realize the corresponding function, so we should be very careful when welding.

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