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Research Article

A Design and Implementation of Family Potted Plant Maintenance System

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ABSTRACT

This device is designed for the phenomenon that people often ignore the potted plants at home and lead to the death of potted plants. The intelligent flowerpot can make potted plants survive and grow better without supervision. It is a smart home product based on Internet of things technology. STM32 single chip microcomputer is used to collect the data of temperature sensor, humidity sensor, soil humidity sensor, harmful gas sensor, photosensitive sensor and other sensors, and it is used with intelligent tracking system composed of four DC motors, automatic irrigation system and mobile phone app; Through machine learning, potted plants can adapt to a variety of potted plants, so as to achieve the purpose of potted cultivation, beautification and improvement of living environment. Aiming at the disadvantages of artificial cultivation and potted plants in traditional family life, the maintenance of scientific intelligence is realized. We designed this smart flowerpot. This flowerpot not only solves the problem of life, but also adds green to the homes of those who have no time or ability to raise flowers, even the disabled.

1. Introduction

On the one hand, it can play a very good decorative role, beautify the home environment, cultivate sentiment, and increase the indoor elegant atmosphere; The second aspec t is that some green plants can absorb indoor harmful gas es, clean the air and create a good indoor ecological envir onment.Therefore, this paper designed a kind of intelligent flowerpot which can be placed at home and take care of potted plants independently [1], [2], [3], [4]. Users can not only not take care of the potted plants, but also know the situation of potted plants at any time [5]. Due to the rapid development of Internet of things technology, multiple intelligent flowerpots are used together, which increases the efficiency of flowerpots. Multiple intelligent flowerpots work together, forming a family plant ecosystem.

2. Embedded hardware system design

2.1. *Overall structure of flowerpot hardware*

When the signal of each sensor changes, the MCU will give instructions to the motion system shown in Fig. 1.

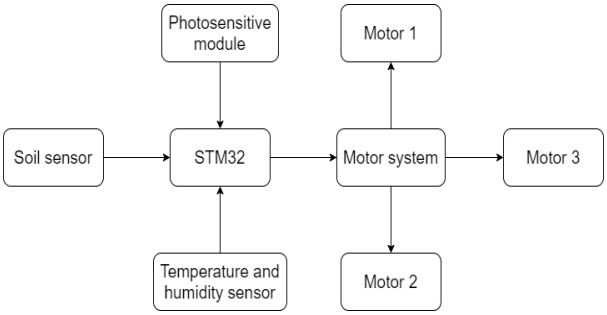

Fig.1. Hardware block diagram

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2.2. *Main control chip*

The core microcontroller of the embedded hardware system is STM32F767IGT6 chip shown in Fig. 2, and the core is arm cortex-m3, which is introduced by STMicroelectronics.

The system clock frequency is 72mhz， Two 12 bit ADC controllers, 7-channel DMA controller, seven I0 ports, three 16 bit timers, each timer has up to four channels and incremental encoder inputs for input capture / output comparison / PWM or pulse counting, a 16 bit PWM advanced control timer with dead time control and emergency brake, two I2C interfaces, three USART interfaces, two SPI interfaces (18m bit / s), can interface (2.0B active), USB2.0 full speed interface. Compared with other MCU, it has high performance, low cost and low power consumption, which can fully meet the system requirements.

Fig.2. STM32F767IGT6 chip

2.3. *Main components and sensors*

2.3.1 Bluetooth serial communication module

Bluetooth technology is a wireless technology standard, which can realize short distance data exchange between fi xed equipment, mobile equipment and building personal area network (using 2.4-

2.485ghz ISM Band UHF radio wave). Bluetooth technol ogy has radio frequency characteristics, adopts TDMA str ucture and network multi-

level structure, applies frequency hopping technology and wireless technology in technology, and has the advantag es of high transmission efficiency and high security, so it is applied in all walks of life. The module is used to realiz e the communication between the embedded device and t he mobile client.

The Bluetooth hc06 sown in Fig. 3 is a master-slave Bluetooth serial port module. In short, when the Bluetooth device and Bluetooth device are paired and connected successfully, we can ignore the internal communication protocol of Bluetooth and directly use Bluetooth as a serial port. When a connection is established, two devices share a channel, that is, the same serial port. One device sends data to the channel, and the other device can receive the data in the channel.

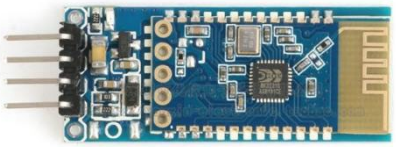

Fig.3. Hc06 Bluetooth serial communication module

2.3.2 Photosensitive module

The photosensitive resistance module is the most sensitive to the ambient light, which is generally used to detect the brightness of the ambient light and trigger the microcontroller or relay module. When the brightness of the ambient light fails to reach the set threshold, the do terminal outputs the high level. When the brightness of the external environment light exceeds the set threshold value, the do terminal outputs the low-level do The output end can be directly connected with the single-chip microcomputer, through which the high and low-level level can be detected, so as to detect the change of the light brightness of the environment; the analog output Ao of the small board can be connected with the ad module, and the more accurate value of the ambient light intensity can be obtained through AD conversion shown in Fig. 4.

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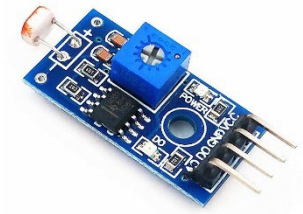

Fig.4.The motor drive module

2.3.3 Soil moisture sensor

Soil moisture sensor shown in Fig. 5 is a kind of sensor that we use to detect the moisture content in the soil. This sensor is composed of two detectors with two probes. The two probes enter into the soil and release electric current. According to the resistance value of the soil, the soil water content can be judged. When there is more water in the soil, the conductivity of the soil will be better, so the conductive current value will be larger. Therefore, the measured resistance value will be smaller, so it can be concluded that the soil contains more water. Similarly, when the soil is drier, the conductivity of the soil will be smaller than when it is wetter. Therefore, when the soil moisture content is small, the current that the soil can conduct is smaller, so

the greater resistance can be measured. Thus, the result with lower water content can be obtained.

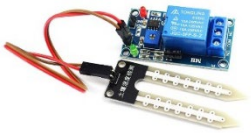

Fig.5. Soil moisture sensor

2.3.4 Integrated temperature and humidity sensor

The integrated temperature shown in Fig. 6 and humidity sensor uses digital integrated sensor as probe and digital processing circuit to convert the temperature and relative humidity in the environment into corresponding standard analog signal, 4-20mA, 0-5V or 0-10V. The temperature and humidity integrated analog sensor can transform the change of temperature and humidity value into the change of current / voltage value at the same time, and can be directly connected with various standard analog input secondary instruments.

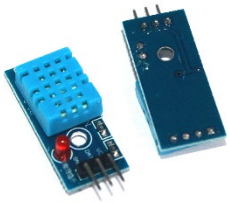

Fig.6. Integrated temperature and humidity sensor

3. Software design

STM32 microcontroller judges the growth environment of potted plants by reading the change of the level value of each sensor connecting pin. Each sensor detects the external environment in real time and transmits the collected signals to the single chip microcomputer. The Bluetooth module is connected with the mobile phone Bluetooth, and receives the information sent by the mobile phone Bluetooth for corresponding operation. The user's operation information can be transmitted to the flowerpot through WiFi shown in Fig. 7.

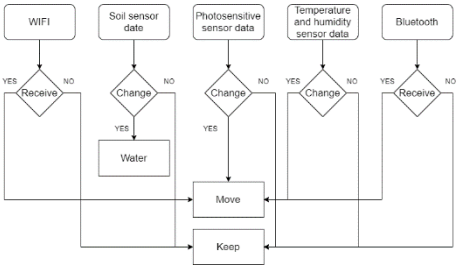

Fig.7. Software design flow chart

4. Testing and conclusion

4.1. *Test plan*

The seeds of Yushu are put into the intelligent flowerpot for planting test. After adding appropriate amount of water, fertilizer and other nutrients, they are planted on a windowsill with stable and appropriate light conditions, and the flowerpot is allowed to carry out intelligent cultivation for one month shown in Fig. 8.

Fig.8. Autonomic growth test

4.2. *Test results*

A month later, when we looked at the flowerpot again, it was incredible that it had sprouted and was very strong. We extracted and analyzed the nutrients, water and other components of Yushu seeds, and evaluated and compared the germination degree and health of the seeds. We found that the growth of Yushu shown in Fig. 9 ingly good.

Fig.9. Self growth test results

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