Design and Implementation of Internet of Things Planting System Based on esp32 MCU

Cuiying Ji , Yizhun Peng*

College of Electronic Information and Automation,Tianjin University of Science and Technology, Tianjin, China
*E-mail: *pengyizhun@tust.edu.cn*
www.tust.edu.cn

Abstract

Agriculture is the country's fundamental industry, but there is still a lot of hard work because of climate pests. It is the development direction of agriculture to integrate traditional agriculture into modern Internet of Things technology and realize visualization and digital management of agricultural production. This study combined modern information technology and used esp32 as the master to design and produce a plant planting system model for the Internet of Things.This research product uses a variety of sensors, Monitor the essential elements required for crop growth, including temperature, humidity, nutrient solution, soil moisture, etc.In the process of crop growth, automatic irrigation, nutrient solution supplement, ventilation cooling, light and other operations, greatly reduce the intensity of manual labor.

Keywords: Internet of Things; Soilless culture, Remote control, Automatic control

1. Introduction

With the rapid development of science and technology, mobile communication is changing from people to people to things, and then to things. The interconnection of everything has become an inevitable trend of mobile communication development.[1] This Internet of Things technology came into being. And it is considered to be the third wave of the world information industry after the computer and Internet industries. The Internet of Things technology is a new technology that senses and identifies external user information through various sensors, connects any object to the network according to the agreed protocol, analyzes and transmits information, and at the same time combines Internet technology to realize intelligent cognition, transmission, management and regulation of users.[2] The rest of this article is organized as follows. The rest of the article is organized in order. The second section introduces the hardware facilities of this design product. The third section introduces the overall structure of the system. Section IV introduces the overall content summary.

2. Main control board

In this design, ESP-WROOM-32 is selected as the main control board, which integrates traditional Bluetooth, low-power Bluetooth and Wi Fi, and has a wide range of applications: Wi Fi supports a wide range

of communication connections, and also supports direct connection to the Internet through a router; Bluetooth can

To enable users to connect mobile phones or broadcast BLE Beacon for signal detection. The data transmission rate supported by ESP-WROOM-32 is up to 150Mbps. After passing through the power amplifier, the output power can reach 22dBm, enabling a wide range of wireless communication. Therefore, this chip has leading technical specifications, and has excellent performance in terms of high integration, wireless transmission distance, power consumption and network connectivity.[3] The design of theMain control board is shown in Fig.1 .

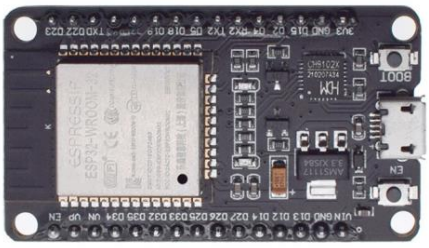


Fig.1.The design of the Main control board

2.1. Camera module

The right camera module is ESP32-CAM. It is a small size camera that can be released by Anson and is equipped with an OV2640 camera. The size is only 27x40.5x4.5mm. The main frequency is up to 240MHZ. It has a built-in 520KB SRAM and an external 8MB PSRAM. The board contains flash and has a TF card interface (which can be used to save pictures taken). It can fully display videos in real time on the web page or app.[4] ESP32-CAM is shown in the Fig.2.

Fig.2. ESP32-CAM

2.2. Water sensor

The water sensor is a simple and cost-effective water level Sensor. Its working principle is to determine the water level by measuring its Water volume through a series of exposed parallel wire traces. The conversion from water volume to analog signal can be easily completed, and the output analog value can be directly read by the esp32 development board to achieve the effect of real-time monitoringThe Water sensor is shown in Fig.3.

Fig.3. Water sensor

2.3. Temperature and humidity sensor

The temperature and humidity sensor adopts DTH11, which is a temperature and humidity composite sensor with calibrated digital signal output. It applies special digital module acquisition technology and temperature and humidity sensing technology to ensure that the product has reliability and excellent long-term stability, low cost, relative humidity and temperature measurement, fast response, strong anti-interference ability, long signal transmission distance, digital signal output, and accurate calibration.It has the following characteristics:

- Humidity measurement range: 20% ~ 95%.
- Humidity error: -5% ~ +5%
- Temperature measurement range:0 ºC ~ 50 ºC
- Temperature error:-2 ºC ~ 2 ºC
- working voltage:3.3V~5V

The design of the main control chip is shown in Fig.4.

Fig.4. Temperature and humidity sensor

2.4 Display module

0.96 inch oled display screen is selected, and IIC communication protocol is adopted. Voltage stabilizing circuit design。

2.5 Photoresistor module

In automatic mode, XH-M131 photoresistor module is selected to turn on and off the fill light, which can be regarded as a combination of relay and photoresistor Its working principle is that when the photosensitive detector detects that the light becomes bright, the switch automatically closes, the load works, and the blue light of the working indicator lights up; When the light is dim, the relay will be disconnected, the load will stop working, and the working indicator will go out. The design of the Photoresistor module is shown in Fig.5.

Fig.5. Photoresistor module

2.6 Electronic switch

The hardware electronic switch of this design product uses a relay. This component can be connected and disconnected through the control of high and low levels. That is to say, I can easily control whether the circuit is connected or not by just using the pin for high and low levels. Very simple and convenient Fig.6.

Fig.6. Photoresistor module

2.4 Other components

The fan is a small 5V power supply fan, the water pump is a submersible small water pump with a built-in brush motor, The 3.3V power supply LED lamp board, power supply part are No. 5 battery and 2596 voltage reduction module.

3. System framework

The Internet of Things technology is an important part of modern information technology. The Internet of Things realizes the fast and accurate connection between things.[5] As a new generation of information technology, the Internet of Things still takes the network as the core link to extend and expand user information through the network. Second, the Internet of Things realizes the transmission, communication and exchange of information between goods through the network. The Internet of Things is widely used in various fields through the combination of sensing technology, identification equipment and ordinary computer network technology, impacting the traditional operation mode. Taking traditional agriculture as an example, planting, management and harvesting are carried out manually, while the Internet of Things technology uses sensors, the Internet and the application layer to achieve user intelligence, information management and application.[6]

3.1. The Internet of Things. Basic framework

The Internet of Things is composed of three layers: the perception layer, the network layer and the application layer. The sensing layer consists of temperature and humidity sensors, cameras and other identification information terminals. The perception layer is an extremely important part of the development of the Internet of Things, and an important carrier and way to identify and collect external information. Therefore, the perception layer is called the eye of the Internet of Things. The network layer is responsible for transmitting the information acquired by the perception layer to the application layer through the network, which is the core part of the Internet of Things technology. Similar to the brain and central system of higher animals, the network layer is responsible for analyzing and processing information, and transmitting the information to the application layer; Then the application layer reacts. The application layer is the Internet of Things connected to the user control terminal, responsible for information regulation and management.[7]

3.2. System framework design of this product

The Internet of Things planting system for soilless culture designed in this study can enable the plant growth process to automatically supply nutrient solution, supply light, open ventilation settings, real-time monitoring, etc. according to the compiled work program. This design is divided into two modes, one is intelligent mode, the other is manual mode.[8]

In the intelligent mode, various sensors in the system conduct all-weather and uninterrupted real-time monitoring, make intelligent judgments based on real-time data and control models, and make corresponding adjustments according to actual needs, so as to achieve a better environment for plant growth in an unmanned environment. Realize small-scale agricultural automation. In the other manual mode, the plant growth can be monitored remotely and in real time, and some adjustments can be made according to the real-time data, such as nutrient solution supply, ventilation, etc. The manual mode is built on the basis of the intelligent mode, which means that we are generally in the intelligent mode. The manual mode is set for the failure of the intelligent mode due to uncertain factors.

The system integrates sensor, automatic monitoring, automatic control, communication, calculation and other technologies with expert system to realize automatic monitoring and control of temperature, humidity, nutrient solution and other factors in the strawberry soilless cultivation greenhouse.

4. Conclusion

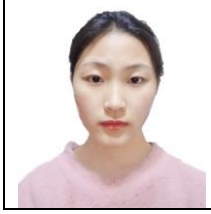
In this paper, the design and implementation of the internet of things planting system based on esp32 master microprocessor are described and the basic working principle is designed. The framework of the system is also designed in detail. In the next stage, we will be committed to detailed system design on this basis.

References

1. Ye Yun. Research on the Application of Internet of Things Technology in the Age of Big Data [J]. Industrial Innovation Research, 2022 (22): 76-78
2. Huang Lili. Application Analysis of Internet of Things Technology in Smart Home [J]. Digital Technology and Application, 2022,40 (09): 39-41. DOI: 10.19695/j.cnki.cn12-1369.2022.09.12
3. Liu Qing, Yan Jinkui. Design and implementation of environmental monitoring system for vegetable greenhouses based on ESP32 [J]. Industrial Control Computer, 2021,34 (09): 137-138+140
4. Cui Jintao, Tong Ruidong. Design of visual tracking robot based on ESP32 and MQTT protocol [J]. Journal of Liaoning Teachers' College (Natural Science Edition), 2021,23 (04): 67-71
5. Lin Ning, Zhang Liang. Application of Internet of Things Technology in Soilless Cultivation [J]. Computer Knowledge and Technology, 2015,11 (25): 153-155. DOI: 10.14004/j.cnki.ckt.2015.2504
6. Zhou Zijun, Liu Xiaobo, Ye Zhichan, Li Huaiyuan, Yang Haijun. Research on the application of the Internet of Things cultivation mode of elevated strawberry [J]. Agricultural Science and Technology Communication, 2021 (04): 169-171
7. Huang Lili. Application Analysis of Internet of Things Technology in Smart Home [J]. Digital Technology and Application, 2022,40 (09): 39-41. DOI: 10.19695/j.cnki.cn12-1369.2022.09.12
8. Lei Yan, Wei Congqi. Design of intelligent agricultural environmental monitoring system based on Internet of Things technology [J]. Electronic Technology and Software Engineering, 2022 (18): 246-249

Authors Introduction

Ms. Cuiying JI



She is an undergraduate of Tianjin University of science and technology, her research field is Intelligent manufacturing.

Dr. Yizhun Peng

He is an Associate Professor in Tianjin University of Science &Technology. He recevived a doctor's degree in control theory and control engineering from the Institute of Automation,Chinese Academy of Science,in 2006.His research field is intelligent robot and intelligent control.