

Design of automatic spraying machine based on internet of things technology

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Abstract. In order to realize large-area automatic spraying of fruits and vegetables and improve the ability of intelligent spraying device to select the target of key diseases and pests, a new automatic target spraying device for fruits and vegetables is designed based on the Internet of things and intelligent monitoring technology. The new automatic spraying machine can be combined with the real-time monitoring data of diseases and pests, and the infrared scanning technology can be used to accurately spray the target and selectively spray the fruits and vegetables automatically. The single chip microcomputer is used to realize the automatic control of the whole system, and the real-time control can be combined with the mobile terminal software of the mobile phone. The device meets the needs of modern agriculture for pesticide spraying, has a wide range of applications in real life, and has significant practical significance.

Keywords: Automatic spraying machine, Internet of things technology, Real-time monitoring.

1 Introduction

With the proposal of smart agriculture and precision agriculture, agricultural production puts forward higher requirements for the intelligent and precision level of farmland operation. In recent years, the Internet of things has been more and more widely used in agricultural control and automatic production, such as disease and pest detection and diagnosis, distributed data collection and real-time environment detection. It can intelligently analyze factors such as soil temperature, humidity and light demand, and improve the intelligence and automation level of agricultural equipment by means of remote monitoring and information release, so as to realize the fine development of agriculture. At present, there is not much research on automatic spraying devices in China, and it is rare to use the Internet of things and real-time monitoring of diseases and pests to study spraying devices. The introduction of this technology into the design and research of fruit and vegetable spraying devices can bring great technological changes for the implementation of automatic and accurate spraying, improving the safety of personnel in

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the spraying process, reducing the degree of environmental pollution. It is of great significance to improve the spraying efficiency.

2 Design of spraying facilities

In order to realize the large-scale operation of fruit and vegetable spraying, the automatic spraying device must be used. The knapsack sprayer can no longer complete the field operation, which does great harm to personnel and the use efficiency of pesticides is low. The use of suspension sprayer can effectively change this situation. The suspended sprayer is refitted with a tractor, so that the spraying area is increased and the spraying effect is effectively improved; However, the device is only suitable for large plot operation, not suitable for orchards or greenhouses. It has weak adaptability and low degree of automation. It is not suitable for spraying in orchards or greenhouses such as fruits and vegetables. Now, UAV technology is mature and used in many fields. The use of multi rotor UAV technology in agricultural production has unique advantages in pesticide spraying, such as low altitude, fixed point directional spraying, release of manpower, high efficiency, low maintenance cost, especially vortex generated by rotor, which can better spray pesticide spray on crops and improve the efficiency of pesticides in pest control. Based on the concept of this device, an automatic spraying device based on Internet of things and real-time monitoring is designed. The overall framework is shown in Figure 1.

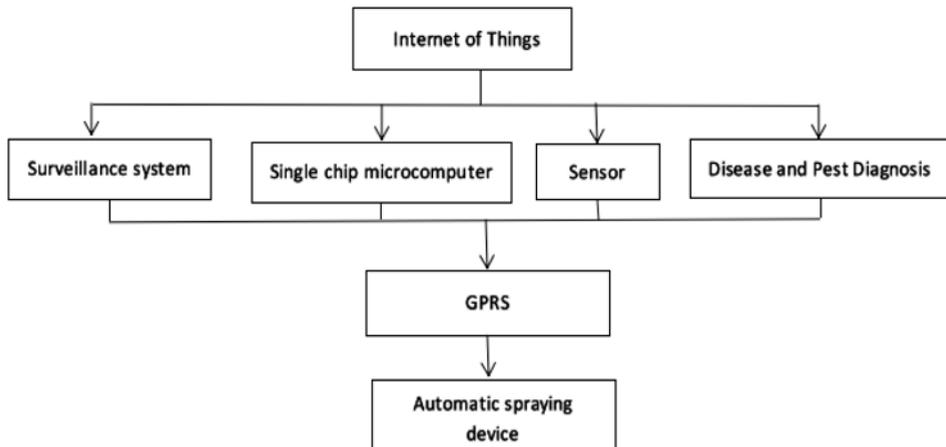


Fig. 1. Automatic spraying device based on Internet of things.

The role of Internet of things in the design of automatic spraying device is mainly to detect the environment of orchard or greenhouse and realize real-time monitoring. Among them, environmental parameters mainly include light, temperature and humidity, and video monitoring is mainly to monitor the pest status of fruit trees in real time. When the video monitoring finds that the disease and insect pests of fruit trees in a certain area are serious and it is necessary to spray medicine in the area, the location is sent to the single chip microcomputer by GPRS network communication. After the single chip microcomputer confirms the location, the fruit trees are accurately located by infrared scanning. When working, firstly, the pest area is measured through the real-time monitoring of the Internet of things, and the single chip microcomputer is used to process the data to obtain the target area of fruits and vegetables with serious pests; If the target is identified, the sprayer moves. After reaching the designated place, the target area is sprayed by the solenoid valve. The spraying amount can be controlled by the solenoid valve, so as to realize the full-automatic control of the spraying process.

3 Intelligent control network and hardware design

In order to realize the automation and intelligent control of the spraying system, it is necessary to design the core controller of the spraying device. Its main function is to obtain the area with dense diseases and pests by connecting with the Internet of things, and then use infrared technology to locate the target area. The design adopts self-propelled spraying equipment, and the main spraying objects are fruits and vegetables. After the signal is processed in the single chip microcomputer, the control signal is sent to the executive end of the sprayer to control the opening and closing and flow of the solenoid valve, and focus on the application of drugs in the concentrated area of diseases and pests. The bottom layer uses sensor equipment to collect the pest status of fruits and vegetables, and then transmits the data to the remote host computer through node routing equipment and communication protocol. The communication between the host computer and routing equipment uses GPRS. The hardware part of the system consists of 8 modules, mainly including communication system module, infrared scanning module, clock circuit, power supply module, equipment reset module, interface test module, stepper motor control module, solenoid valve module and power supply module.

The infrared scanning equipment mainly scans the distance. Through the variable distance switch, the rated test distance can be adjusted from 0cm to 1000cm, which provides the parameters of fruit tree target recognition for the intelligent automatic spraying machine. The principle is that when the automatic spraying device receives the fruits and vegetables with serious diseases and pests through network communication, the infrared device is used to automatically locate and identify the fruit trees. Infrared scanning equipment uses infrared transmitting and receiving devices to measure the distance between fruits and vegetables. The signal is amplified by modulation and demodulation, and the automatic control function is realized by single chip microcomputer. The clock circuit of the automatic control process is shown in Figure 2. Automatic single chip microcomputer needs clock signal in automatic control, because when executing automatic control, the control system needs to be executed in strict sequence. The single chip microcomputer used in this design uses the way of internal clock generation, and uses xtal1 and xtal2 to bridge the crystal oscillator, C1 and C2 use 30pf capacitor for fine adjustment. The position of the single chip microcomputer and the clock circuit is the nearest, so as to avoid the interference of the external environment in the process of data acquisition and processing and ensure the stability of the system.

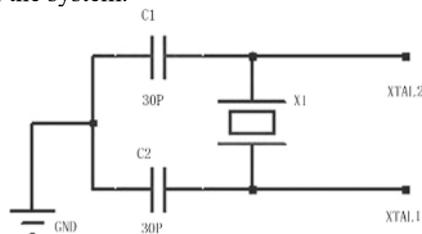


Fig. 2. Single chip clock circuit diagram of control system.

4 Software design

The software program design must meet various control requirements of UAV spraying, mainly including three parts: firstly, the communication relationship between UAV and remote controller needs to be considered, especially when various attitude control quantities change, UAV can respond in time. In case of abnormal communication, interrupt program is generally used to judge. After interrupt response, UAV can execute established

procedures and alarm; Secondly, the input signal acquisition can complete the confirmation of the remote control signal and transfer it to the main program for processing; Finally, the main program part initializes the functional modules such as data acquisition, data display, fuzzy algorithm processing and wireless communication after startup. When a control signal comes in, the corresponding control variable conversion pulse width data is obtained through PID algorithm, and the data is output to the register through DMA. Now mobile terminals are popular. You can use eclipse to develop Android applications to realize software programs. You can use mobile phones for real-time monitoring and automatic spraying control.

5 Conclusion

This paper designs an intelligent spraying machine based on Internet of things technology. The device uses the Internet of things technology to combine the automatic spraying device with the real-time monitoring system, establishes the wireless communication network of the device, uses the single chip microcomputer to complete the hardware design of the whole system, uses the infrared scanning device to realize the intelligent identification of the target of fruits and vegetables to be sprayed, and gives the software design of the system. The intelligent automatic spraying machine changes the traditional manual spraying method for a long time, effectively improves the safety of personnel in the spraying process, and is of great significance for improving the spraying efficiency and realizing accurate spraying.

References

1. Fang Y, Gu L and Zhang L 2017 Research on Automatic Spraying Machine Based on Intelligent Monitoring of Agricultural Pests and Diseases Based on Internet of Things *Journal of Agricultural Mechanization Research* **39** pp 224-227, 262.
2. Chen A 2015 Design of Pesticide Spraying Control System for UAV *Mechanical and Electrical Information* **15** pp 113, 115.
3. Zhang X, Fan J and Xu H 2019 Pesticide Spraying System for Fruit Trees Based on Internet of Things *Internet of Things Technologies* **9** pp 92-94, 96.
4. Li C, Yi Q and Liu H 2020 Greenhouse Sprayer Based on Internet of Things Technology *Electronic Technology and Software Engineering* **9** pp 115-117.
5. Meng S and Hao L 2019 Design and Experiment of Agricultural Intelligent Spray Control System Based on Fuzzy PID *Agricultural Engineering* **9** pp 36-38.
6. Bu Y and Jiao J 2021 Design and Modal Analysis of Pesticide Spray Device Based on ANSYS *Journal of Agricultural Mechanization Research* **43** pp 163-168, 173.
7. Zhou X 2011 Design of Online Measurement and Control System for Facility Agriculture Based on Internet of Things Technology *Journal of Taiyuan University of Science and Technology* **32** pp 182-185.
8. Ding G 2021 UAV Spraying and Fertilization Technology for Wheat in Huaibei Area *Agricultural Development and Equipments* **27** pp 35-36.
9. Guo Y 2020 Research of Precision Control System of Pesticide Spraying Based on Wireless Sensor Network *Journal of Agricultural Mechanization Research* **42** pp 134-137.
10. Zhao F and Jiang P 2019 Unmanned Aerial Vehicle Route Control System Based on Wireless Sensor Network *Journal of Agricultural Mechanization Research* **41** pp 226-229.