"Green Fruit" - Intelligent Traceable Agricultural Product Production and Marketing Platform Based on Blockchain Technology

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Abstract

The production process of agricultural products has been greatly improved and optimised through the intelligent agricultural greenhouse system. Using intelligent irrigation, measuring CO2, IoT and other technologies, it creates a greenhouse intelligent control system that is simple to operate, highly automated and intelligent. In addition, using the double combination of front-end architecture and applets, it can record all the growth process, perfectly integrating the intelligent mode + big data application. Create a tailor-made ID for agricultural products. Under our design, we break the traditional automation mode, which is more conducive to understanding the whole growth process of agricultural products.

Keywords: Internet of Things; automation; big data application; intelligent agriculture.

1. Introduction

The aim of the paper is to discuss the many advantages brought by the traceable smart greenhouse model in terms of agricultural production, food safety and market competitiveness, as well as the initial system modelling and related technologies established [1].

From the perspective of food safety and security By integrating product traceability technologies, it is possible to trace the entire process of agricultural products from planting and growing to harvesting, processing and marketing. This helps to monitor potential sources of contamination, diseases or other risk factors, and to identify and deal with problems in a timely manner, thereby improving food safety. Automated control allows real-time monitoring of environmental parameters in the greenhouse, such as temperature, humidity and light, which can precisely control the growing conditions of crops. Through meticulous data recording, farmers can optimise planting strategies to improve the quality and yield of their produce. The increased resource efficiency enables smart greenhouse technology to enable precise irrigation and fertiliser application, as well as efficient energy use. This helps to reduce water wastage, fertiliser use and energy expenditure, and improve the sustainability of agricultural production. The Internet of Things (IoT) in this plays an extremely crucial role and offers many opportunities for innovation and efficiency gains in agricultural production. It can deliver real-time metrics of various parameters in the model to the network and feedback to the user's mobile phone. The user can observe the crop growth at any time. So, IoT can monitor various environmental parameters in the greenhouse in real time, such as temperature, humidity, light, soil moisture, and so on. This real-time monitoring enables farmers to understand the growth of their crops more accurately and quickly adjust the conditions of the greenhouse to optimise the production environment. When problems arise, such as disease, pest infestation or other production challenges, the traceability system can quickly pinpoint the source of the problem. This helps farmers take quick action to minimise losses and maintain continuity of production [2].

Each crop can be identified with its own identity card. Smart greenhouses generate large amounts of data through sensors and monitoring systems, which can be used for data storage. Farmers can make more informed decisions based on actual environmental and production data, and buyers can learn about their growth.

The rest of the paper is organised as follows. Section 2 presents the structure and principles of the system model. Part III presents the feasibility study of the system model. Part IV gives the physical pictures of the constructed model and the verification process to finalise the correctness of the designed. Part V summarises the main points of the paper [3].

2. Introduction to the system model

Intelligent greenhouse control system is a scientific system for intelligent management of greenhouses.

Environmental data is collected through the corresponding sensor equipment. Then, through various commands set by the system, the management work is completed automatically.

At the same time, the data collected by the sensors will be analysed and the results will be fed back to the farmers. Under the guidance of agricultural experts, the yield is increased and the quality is improved. In the whole system, QCA9531 gateway module is used as the core component, and the core programme is burned into it. At the same time, all kinds of sensors, rolling shutters, fans, water valve controllers, cameras and other hardware devices will be accessed. When the power is to be turned on, it can be run and controlled automatically according to the programme. The use of sensors to obtain environmental data, when detected more than the threshold value of the fruits and vegetables, will start the corresponding actuator.

2.1 CO2 Sensor

Carbon dioxide (CO_2) sensor is composed of LED-PR measuring unit, LED driving circuit, LDO power supply, photoelectric signal processing circuit, temperature measuring circuit and microprocessor, which is shown in Fig. 1 below.

Fig. 1. Sample sensors

Firstly, a suitable location should be chosen to install the CO_2 sensor. The location should be chosen to represent the average CO_2 concentration of the plant growing area in the greenhouse. The sensor is usually installed in a hanging position to ensure that it can accurately measure atmospheric CO_2. before use, the CO_2 sensor needs to be calibrated to ensure the accuracy of its measurement. Calibration can be carried out by using a standard gas with a known CO_2 concentration, according to the model number of the sensor and the guidelines provided by the manufacturer. Then, connect to the monitoring system. CO_2 sensors are usually connected to the monitoring or control system of a smart greenhouse. This can be achieved through a wired or wireless connection. The sensor sends real-time measured CO_2 concentration data to the monitoring system, enabling the farmer to remotely monitor and manage CO_2 levels in the greenhouse. The farmer can set thresholds based on plant growth requirements and optimal CO_2 concentration ranges. Once the measured CO_2 concentration exceeds or falls below the set threshold, the system triggers appropriate control measures, such as adjusting the ventilation system or CO_2 supply unit.

The CO2 sensor monitors the CO2 concentration in the greenhouse in real time and transmits the data to the monitoring system. These data are usually recorded and archived for future analysis and reference, as shown in Fig. 2 below.

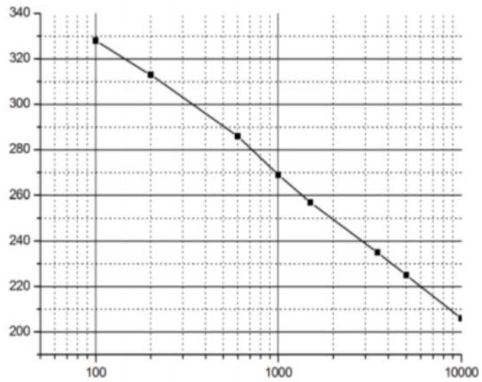

Fig. 2 Sensor characteristic curve

The Y-coordinate represents the output signal, with a maximum value close to 330mV; the X-coordinate represents the concentration of CO2, with a minimum value close to 210ppm.

2.2 temperature detector

Temperature detection is very important for greenhouse intelligent control system. As shown in Fig. 3, the temperature sensor is used to collect the surrounding environmental factors, read the temperature data, and through the signal processing function, the peripheral devices, as shown in Fig 4, respond accordingly and transmit the temperature data wirelessly to the cloud platform. When the temperature is higher than the preset temperature e, the MCU drives a relay to control the fan rotation to reduce the temperature. When the temperature is lower than the preset temperature, the MCU drives the relay to control the collector to heat up [14].

Fig. 3 Temperature sensor DHT11

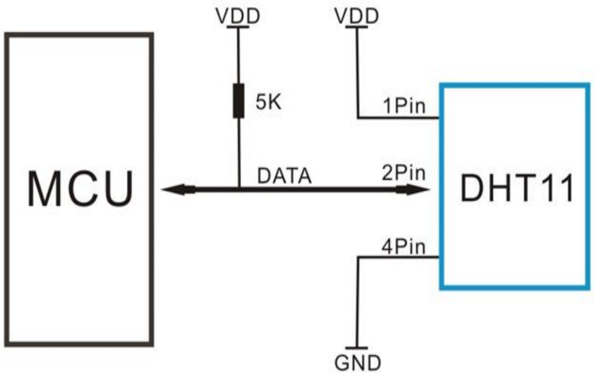

Fig. 4 Typical Circuit Applications

2.3 Soil moisture sensors and automatic irrigation systems

The soil moisture sensor is chosen to be installed per $1m^2$ of soil by selecting the LM393 soil moisture sensor, as shown in Fig. 5, based on the needs of the crop and the layout of the greenhouse. Typically, the sensor is buried near the root system of the plant to ensure that it can accurately measure the moisture in the soil. Soil moisture sensors usually require a power supply (Eq. (1)). The corresponding values for Equation I are shown in Table 1. Sensors usually use low-power electronic components that can be powered by batteries or other suitable power sources. Then connected to the monitoring system: The soil moisture sensor is connected to the monitoring system of the shed. Real-time soil moisture values are fed back to the platform to provide numerical feedback for subsequent soil rehydration. The premise is to set threshold values for soil moisture based on crop needs and optimal growing conditions. These thresholds will be used in the irrigation system [4].

Fig. 5 LM393 Soil moisture sensors

$$Q(t) = \int_0^t I(\tau) d_\tau + Q_0$$

(Battery power at time t) (1)

Table 1 symbols denote meaning

Q(t)	Battery power at time t
$I(\tau)$	Current as a function of time
τ	integral variable
Q_0	Initial battery charge

The design of the automatic irrigation system is a multi-level, multi-component project as shown in Fig. 6 need to receive the sent data from the soil moisture sensor to determine whether irrigation is required. By setting a default upper and lower threshold of normal humidity (±3%) in the software. When the soil moisture is lower than the set lower threshold, the pump is activated to deliver water to the underground pipeline and spray it out to drench and moisten the soil to achieve the effect of irrigation. At the same time, the soil moisture sensor continuously checks whether the humidity has risen above the middle of the upper and lower thresholds, and if it meets the requirements, it stops the delivery; if it does not meet the requirements, it continues to cycle the process until it reaches the normal humidity range (Fig. 7).

```
 if(sensor=="shadowing"){
   digitalWrite(IN1,HIGH);
   digitalWrite(IN2,LOW);
   analogWrite(ENA,100);
   delay(1000);
   digitalWrite(IN1,LOW);
   digitalWrite(IN2,LOW);
   analogWrite(ENA,255);
   delay(100);
   return true;
   }
 if(sensor=="pump"){
   digitalWrite(PUMP,LOW);
   delay(500);
   return true;
 }
 return false;
}
```

Fig. 6 Embedded part of the code

```
/*****************get DHT11 *****************/
int h=(int)dht.readHumidity();
delay(150);
/*************************/
digitalWrite(MH_power, HIGH);
delay(10);
float s = analogRead(MH_A0);
float s1 = map(s0, 0, 1023, 255, 0);
delay(150);
/********************************/
uint16_t l=BH1750();
delay(150);
uint16_t DHT11=400;
if(SGP30(t,h)){
  co2=SGP30(t,h);
}
```

Fig. 7 Get DHT11 code

3. System feasibility study

The application of IoT technology in smart agriculture has enabled real-time monitoring and control of parameters in the greenhouses, providing a high degree of environmental control and visibility. This helps farmers to understand the situation in the greenhouse in real time and take necessary measures to meet the needs of the crop and improve yield and quality.

The traceability system provides a reliable guarantee of the quality and safety of agricultural products through QR codes and database technology [5]. Consumers can easily access detailed information about the products, which builds trust and improves their market competitiveness.

The high degree of automation of the greenhouse system makes it very easy and convenient for farmers to operate. Monitoring of environmental parameters, water and nutrient supply in the greenhouse can be automated through automatic control systems. This reduces the dependence on a lot of manpower and farmers can focus more on monitoring and managing the system rather than having to physically work in the greenhouses for long hours.

By accurately monitoring and controlling environmental conditions, the system is expected to significantly improve the yield and quality of produce. Because the growing environment in the greenhouse can be finely tuned, crops can be optimised for optimal light, temperature and humidity conditions at different stages of growth, leading to increased yields and improved product quality.

4. Physical pictures and verification process

The model is now completed in terms of technology development, with hardware models, WeChat small programmes, traceability systems [6], e-commerce website development. website, and in the future it will enter the data interaction stage and improve the audience universality test [7], which are shown in Fig. 8, Fig. 9 and Fig. 10.

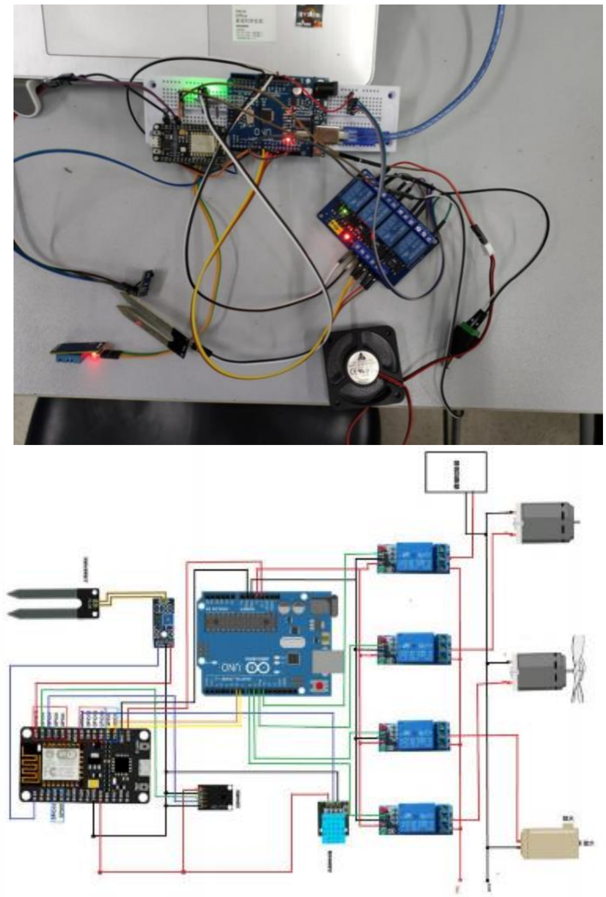

Fig. 8 on-site demonstration

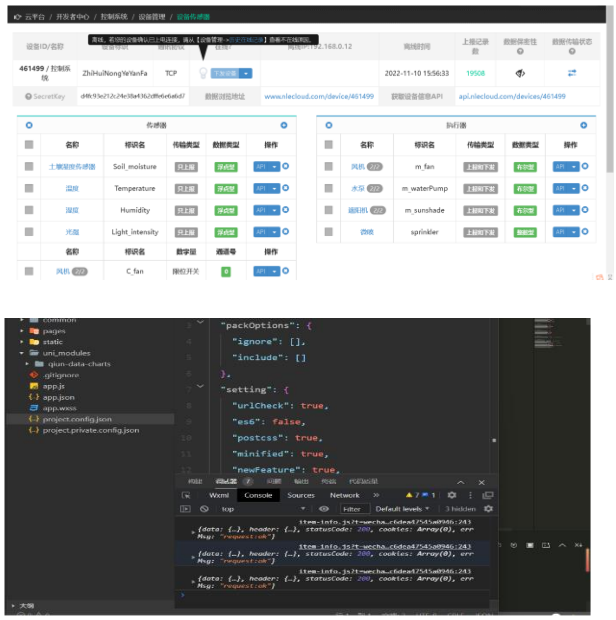

Fig. 9 Cloud Platform Home

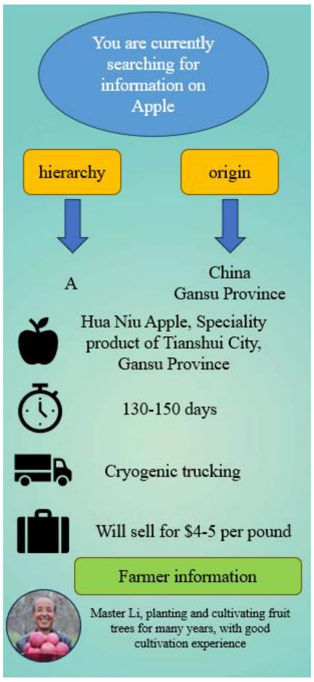

Fig. 10 Crop "ID"

5. Synthesis

The paper mainly describes the growing of crops in smart greenhouses under the fully automated mode. "Traceable Smart Greenhouse" is a modern agricultural production system that uses advanced technology and Internet of Things (IoT) to improve the efficiency of agricultural production and realise precise agricultural management. Including: intelligent sensor technology, Internet of Things, automation control, precise fertiliser application and water management. It improves the efficiency, quality and sustainability of agricultural production, while ensuring product quality through a traceability system to provide consumers with safer, traceable agricultural products [8].

6. References

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Authors Introduction

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Hold a positive and serious attitude towards work, have a strong sense of responsibility, be sincere, meticulous, optimistic, and stable, have a good team spirit, can quickly adapt to the work environment, and can continuously learn and improve oneself in practical work, and do their job well.