Plant Cultivation Device in Intelligent Agricultural Greenhouse

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Abstract This paper mainly introduces the design and research of plant cultivation device in intelligent agricultural greenhouse. The device can automatically ventilate and control the temperature when the carbon dioxide content is insufficient. At the same time, the light color can be selected according to the plant properties, and the light and dark time can be controlled to provide a suitable growth environment for plants, which makes up for the shortcomings of the existing ordinary greenhouse. With China's strong support for agriculture, automatic agriculture is developing rapidly, and has a broad market prospect.

Key words Automatic agriculture, Automatic timing switch, Carbon dioxide controller, Transparent glass, Electromagnetic relay

1 Introduction

With the development and progress of China's agriculture, greenhouse is becoming more and more popular in China, but there are many shortcomings in ordinary greenhouse. If the carbon dioxide content is not controlled properly, and the temperature and humidity are not suitable, the photosynthesis of vegetables will be insufficient, resulting in poor cultivation effect. In this project, an automatic agricultural greenhouse cultivation device which combines single-chip microcomputer circuit and machinery is designed.

The device can automatically ventilate and control the temperature when the carbon dioxide content is insufficient. At the same time, it can select the required light color according to the properties of plants and control the light and dark time, so as to provide a suitable growth environment for plants and make up for the shortcomings of existing ordinary greenhouses. It can effectively improve the growth efficiency of vegetables and reduce labor costs.

2 Overall structure

The device consists of a series of devices, such as automatic timing switch, light selecting glass, carbon dioxide controller, copper resistance constant-current source temperature measurement circuit and electromagnetic relay. It can automatically ventilate and control the temperature when the carbon dioxide content is insufficient. The overall block diagram of the system is shown in Fig. 1.

3 Hardware design

3.1 AC timing switch controller The controller of AC timing switch is shown in Fig. 2. The controller is mainly composed of buck rectifier, monostable timing and AC solid state relay. When AN is pressed, the 3-pin of AE2596 is set to high level, so that the AC output of AC solid state relay is turned on, the load is turned on, the timing starts, and the longest timing time can be adjusted by adjusting RP1[1].

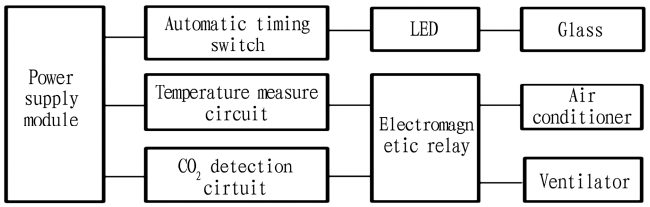

Fig. 1 Hardware structure of plant cultivation device in intelligent agricultural greenhouse

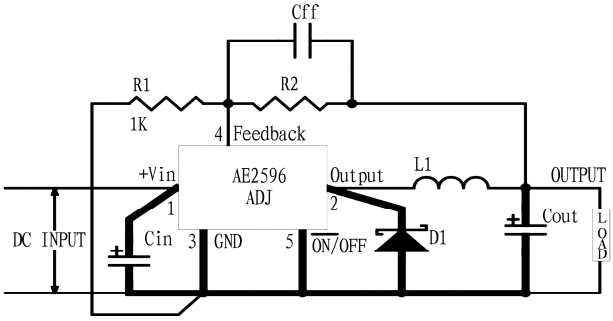

Fig. 2 Timing switch controller of plant cultivation device in intelligent agricultural greenhouse

3.2 Carbon dioxide concentration detection The carbon dioxide concentration meter includes single chip microcomputer, carbon dioxide sensor, electromagnetic relay, and ventilation and alarm equipment.

At present, the main methods to detect carbon dioxide in the market are chemical method, electrochemical method, gas chromatography, volumetric titration, *etc.* These methods generally have the problems of high price, poor universality, and low measurement accuracy. The sensor method has the advantages of safety, reliability, fast direct reading and continuous monitoring. Carbon dioxide sensors mainly include solid electrolyte type, barium titanate composite oxide capacitance type, conductivity change

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type, thick film type and so on. These sensors have some disadvantages, such as poor gas selectivity, being prone to false alarm, need for frequent calibration and short service life[2].

The infrared absorption type carbon dioxide sensor used in this device has the characteristics of high sensitivity, fast response time, good selectivity and strong anti-interference ability. The whole circuit design is simple, easy to use, fast and direct in reading and low in price[3] (Fig. 3).

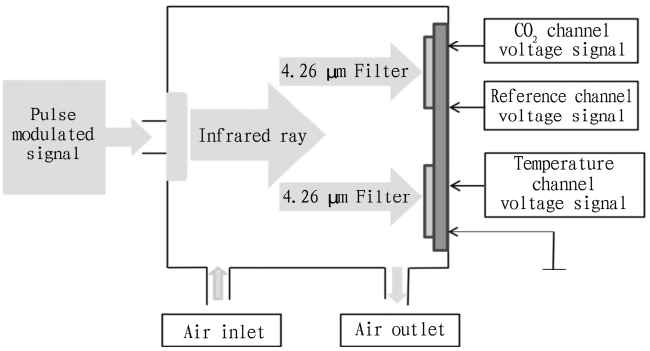

Fig. 3 Carbon dioxide concentration measurement of plant cultivation device in intelligent agricultural greenhouse

3.3 Copper resistance constant-current source temperature measuring circuit In the constant-current source temperature measurement circuit, copper thermal resistance is used as temperature sensor, which converts the temperature change into the change of resistance value. It can reach the sensitivity of 3.618 mv per centigrade in the range of 0 – 100 ℃, which is more than 50 times that of thermocouple.

3.4 Transparent glass When the composite light is vertically illuminated into the glass, the bevel causes the light to disperse. The refractive index of different color light is different, and the size of ∠1 is controlled, so that the light with large refractive index can be totally reflected, and the light with small refractive index can be refracted.

As shown in Fig. 4a, when ∠1 is 40.88°, blue light and purple light will be totally reflected; and because ∠2 = ∠4, blue light and purple light will be totally reflected again and emitted vertically. As shown in Fig. 4b, when ∠1 is 41.23°, red light and orange light will be refracted, and the light of other colors will be reflected back.

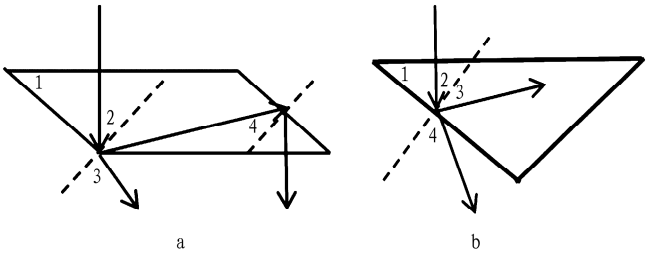

Fig. 4 Transparent glass of plant cultivation device in intelligent agricultural greenhouse

4 Software design

The power supply is connected with a plurality of control circuits. The fill light is controlled by an automatic timing switch. At this time, the copper resistance constant-current source temperature measurement circuit and carbon dioxide detection circuit will control the air conditioner to adjust the temperature and humidity of the greenhouse through the relay (Fig. 5).

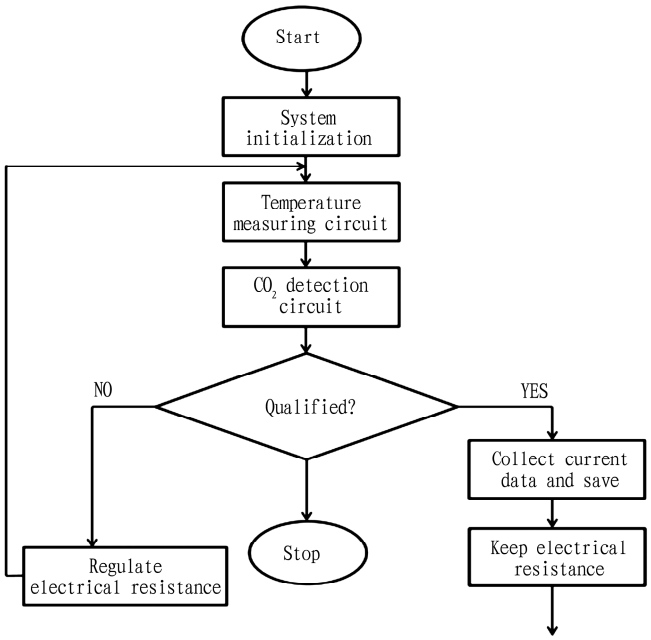

Fig. 5 Flow chart of temperature and carbon dioxide of plant cultivation device in intelligent agricultural greenhouse

5 Conclusions

The intelligent agricultural greenhouse cultivation device makes up for the deficiency of the existing ordinary greenhouses in the market. It can automatically ventilate and control the temperature when the carbon dioxide content is insufficient. At the same time, it can select the required light color according to the plant properties, and control the light and dark time, so as to automatically provide the most scientific and suitable growth environment for vegetables. The intelligent agricultural greenhouse cultivation device can effectively improve the growth efficiency of vegetables, and reduce labor costs, and has a good market prospect.

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