

# **INTELLIGENTLY CONTROLLED INDOOR PLANTATION SYSTEM IN THE CONTEXT OF AN LED PLANT GROWTH LIGHT**

## Field of the Invention

5       The present invention relates to an intelligently controlled indoor plantation system in the context of an LED plant growth light.

## Descriptions of the Related Art

10       With the improvement of people's living standards and the continuous occurrences of environmental pollution problems and food safety problems, organic foods are becoming more and more popular. However, due to the environmental pollution and the limitations of climate conditions, organic plants cultivated by traditional agricultural production methods are becoming less and less organic. Meanwhile, because of the growing population, the plantation cycles as well as the production yields are receiving more and more attention.

15       Greenhouses can provide optimal growth conditions for crops within a long period of time and protect crops from harsh climate conditions outside the greenhouses, and thus can achieve purposes such as adjusting the harvesting time of the crops, promoting the growth and development of the crops, controlling and preventing pests and diseases and increasing the production yields and quality. Greenhouse plantation brings great conveniences to  
20       people's life, it has become very popular and widely used rapidly. Environmental factors such as temperature, humidity, light intensity, and carbon dioxide concentration in the

plantation environment have a great influence on crop production.

With the development of science and technologies, greenhouse plantation system becomes mechanized and intelligent gradually. In conventional plantation systems, fluorescent lamps and incandescent bulbs are often used as light sources to emit light on plants in order to cultivate the plants. However, as compared to the conventional light sources such as the incandescent bulbs, the fluorescent lamps and the high pressure sodium lamps, LED lights not only allow the user to freely choose only light rays of wavelengths necessary for growth of the plants, but also emit no thermal radiation in the luminescent spectrum thereof. Thereby, LED lights are a kind of efficient light source for plants and are beneficial to plant cultivation.

However, for conventional plantation systems, the light intensity, temperature, carbon dioxide concentration, moisture, and nutrient liquid still cannot be modulated intelligently to achieve the purpose of energy conservation, environment protection and intelligent plantation.

### **SUMMARY OF THE INVENTION**

Accordingly, the primary objective of the present invention is to provide an intelligently controlled indoor plantation system in the context of an LED growth light so as to meet the demands of energy conservation and environment protection as well as intelligent plantation.

An intelligently controlled indoor plantation system in the context of an LED growth light comprises a growth rotating module, a plant growth chamber module, an LED light

source module, a water supplying module, an energy supplying module, and a central controlling module; wherein the growth rotating module uses a steel structure as a supporting frame and is installed perpendicular to the ground, the water supplying module is disposed under the growth rotating module, and the plant growth chamber module is installed on the growth rotating module; and the central controlling module is configured to monitor and/or adjust the plant growth environment in the plant growth chamber module in real time.

In an embodiment, the system further comprises an energy supplying module and a central controlling module. In an embodiment, the system further comprises a user terminal.

The central controlling module is configured to monitor and/or adjust the plant growth environment in the plant growth chamber module in real time.

The growth rotating module comprises a large-scale chain driving mechanism, and a plurality of plant growth chamber modules are installed to be suspended from the large-scale chain driving mechanism uniformly; and two sides of the large-scale chain driving mechanism are capable of moving in an upward direction and a downward direction synchronously to drive the plurality of plant growth chamber modules to move between different heights.

In an embodiment, a drawer-type plantation plate is disposed at the bottom of the plant growth chamber module and is withdrawable from the inside of the plant growth chamber.

In an embodiment, water is automatically supplied or sprayed to the plant growth chamber module by the water supplying module when the plant growth chamber module is rotated to the bottom layer.

In an embodiment, each of the plant growth chamber modules is provided with an LED light source module; and an arcuate reflector is disposed at the top of the LED light.

In an embodiment, a plurality of pores are uniformly distributed at the bottom of the plant growth chamber module so that water penetrates into the plant growth chamber through the pores; and a hydrophilic material is disposed above the pores to absorb the water.

In an embodiment, the plant growth chamber module is provided with a wireless transmission module for wirelessly transmitting signals collected by a sensor to the central controlling module in real time, and the humidity, the temperature and the concentration of carbon dioxide are adjusted by the central controlling module so as to monitor the plant growth environment in real time.

In an embodiment, the energy supplying module of the plantation system comprises a solar power supplying module and a battery module.

In an embodiment, the system further comprises a user terminal in the form of a mobile phone or a computer, which is adapted to be connected to the central controlling module in a wired or wireless manner; and the user may examine the plant growth conditions through the mobile terminal or the PC terminal and may monitor/adjust operating conditions of the system through the terminal to meet the growth requirements of different plants.

**The present invention has the following advantages:**

(1) Transition of the agricultural production from mechanization to intelligentization can be achieved and the productivity can be greatly enhanced. The indoor plantation manner can control the pests and diseases without using pesticides, so the plants can become more

organic. The three-dimensional plantation can increase the plantation density and thus greatly increase the production yield.

(2) The side surface of the growth rotating module 4 is strip-shaped, and the side surface of the supporting frame and the bottom surface of the base are also strip-shaped. Such system occupies a small area, and thus saves the land area and greatly increases the land utilization rate.

(3) The system has its own plant growth light adjusting system and does not need the sunlight, and thus can achieve an indoor large-scale plantation. This type of plantation is not affected by the environment and the climate conditions, provides a steady production yield and can be used for large-scale plantation. The unique plant growth light system can greatly shorten the growth cycle of the plants and thus reduce the cultivation time.

(4) The growth rotating system converts the plant growth process into a kind of automatic pipeline work. This can increase the energy utilization rate and the production and plantation efficiency. During the whole growth cycle, different schemes are chosen for different seeds that are planted and no human operation and intervention is needed before the harvesting.

(5) The plant production can be monitored wirelessly and remotely, which can reduce human control and operation and truly achieve the intelligent remote control. The plant growth can be monitored through a mobile terminal or a PC terminal.

(6) The system is powered by the solar energy and thus is green and environmental friendly. The LED growth light having specific wavelengths according to the present

invention is more energy-saving and environmental friendly than similar conventional special illumination lamps that emit red light or blue light.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

5        The attached drawings are described herein to provide a further understanding of the present invention and constitute a part of this application. The illustrative embodiments of the present invention and the description thereof are only intended to illustrate rather than to improperly limit the present invention. In the attached drawings:

**FIG. 1** is a front view of a plantation system;

10       **FIG. 2** is a partially enlarged view of the plantation system;

**FIG. 3** is a side view of the plantation system;

**FIG. 4** is a schematic perspective view of the plantation system; and

**FIG. 5** is a schematic structural view of a wireless remote control network of the plantation system.

### **DESCRIPTION OF THE PREFERRED EMBODIMENT**

Hereinbelow, the technical solutions of the embodiments of the present invention will be clearly and fully described with reference to the attached drawings illustrating the embodiments of the present invention.

20       An intelligently controlled indoor plantation system in the context of an LED plant growth light is shown in **FIGs. 1, 2 and 3**.

The intelligently controlled indoor plantation system in the context of an LED plant growth light comprises a growth rotating module 4, a plant growth chamber module 2, an LED light source module 1, a water supplying module 5, an energy supplying module and a central controlling module; wherein the growth rotating module 4 uses a steel structure as a supporting frame and is installed perpendicular to the ground, the water supplying module 5 is disposed under the growth rotating module 4, and the plant growth chamber module 2 is installed on the growth rotating module 4.

In an embodiment, the system comprises a base, a growth rotating module 4, a plant growth chamber module 2, an LED light source module 1, and a water supplying module 5. The growth rotating module 4 has a strip-shaped side surface and is installed on the base and perpendicular to the ground, and a separate water supplying module 5 is disposed under the growth rotating module 4. The plant growth chamber module 2 is installed to be suspended from the growth rotating module 4.

In an embodiment, the system further comprises an energy supplying module and a central controlling module. In an embodiment, the system further comprises a user terminal.

The central controlling module can monitor and/or adjust the plant growth environment in the plant growth chamber module.

The growth rotating chamber module 4 comprises a large-scale chain driving mechanism 6, and the plant growth chamber module 2 is installed to be suspended from a shaft of one of the chains at two sides of the driving mechanism; and the chains at the two sides of the large-scale chain driving mechanism can move in one direction synchronously to

drive the plurality of plant growth chamber modules **2** on the chained frame to move between different heights.

The growth rotating module **4** comprises a large chain driving mechanism **6**, and the plurality of plant growth chamber modules **2** are installed to be suspended from the large-scale chain driving mechanism uniformly; and the two sides of the large-scale chain driving mechanism can move in an upward direction and a downward direction synchronously to drive the plurality of plant growth chamber modules **2** to move between different heights.

The plurality of growth rotating modules **4** move along with the large-scale chain driving mechanism **6** synchronously in one direction, and the moving speed thereof is controlled as needed so that the growth rotating modules **4** can stop at different heights. For crops having different growth cycles, different rotation periods may be used, e.g., rotation periods of 24 hours, 16 hours, 12 hours and 8 hours.

In an embodiment, the growth rotating module **4** uses a steel structure as a supporting frame to guarantee the stability of the rotation of the plants, and the large-scale chain driving mechanism **6** is used as a rotating section to guarantee the stability of the driving.

In an embodiment, the powering section of the growth rotating module **4** is a servo motor, and a driver board of the servo motor is provided with a wireless transmission module which can wirelessly receive data transmitted from the central controlling module to control the rotating speed and the stop position of the motor according to the data instructions. The wireless transmission module wirelessly transmits signals collected by a sensor to the central

controlling module in real time, and the central controlling module adjusts the humidity, the temperature and the concentration of carbon dioxide to monitor the plant growth environment in real time.

In an embodiment, a drawer-type plantation plate **3** is disposed at the bottom of the plant growth chamber module **2** and is withdrawable from the inside of the plant growth chamber **2**. The whole layer of the plantation plate **3** can be withdrawn to be replaced with a new one, so that the time of harvesting vegetables can be greatly reduced. In an embodiment, the plantation plate **3** has a certain depth so as to reserve water.

Water is automatically supplied or sprayed to each of the plant growth chamber modules **2** by the water supplying module **5** when the plant growth chamber module **2** is rotated to the bottom of the rotating module **4**. In an embodiment, the water supplying module **5** is made of an environment-friendly stainless steel material through seamless welding so that the plants can not only be normally supplied with water but also stay organic because the environment-friendly material will not cause secondary pollution to the plants.

The plant growth chamber module **2** is used for growing plants, and is designed according to the plant gravity to ensure a consistent growth direction of the plants. A plurality of pores are uniformly distributed at the bottom of the plant growth chamber module so that water can penetrate into the plant growth chamber through the pores; and a hydrophilic material disposed above the pores can absorb the water and keep the water for a certain period of time so that the plants can absorb the water therefrom. In an embodiment, the plants to be grown in the plant growth chamber module **2** can be changed freely so that

the plants can be harvested and planted separately.

In an embodiment, each of the plant growth chamber modules 2 is provided with an LED light source module 1. In an embodiment, a separate LED light source module 1 is disposed at the top of each of the plant growth chamber modules 2. In an embodiment, an arcuate reflector is disposed at the top of the LED light to increase the utilization rate of light rays.

In an embodiment, a high-performance LED plant growth light is used as the light source. An aluminum enclosure is used for the LED plant growth light to facilitate heat dissipation. An enclosure made of a high-quality aluminum material or other heat dissipating materials provides an excellent heat dissipating effect, so a long service life of the light can be guaranteed and the maintenance cost thereof can be reduced. A transparent cover of the plant growth light is made of a flame-resistant PC material having a high light transmittance, so as to guarantee a maximum luminous efficiency and the safety of using the plant growth light. The lamp bead of the LED plant growth light consists of a single-color LED having a high luminous efficiency and emitting light rays of a special wavelength, such as red light rays having a wavelength of 650~660 nm, blue light rays having a wavelength of 440~450 nm and white light rays having a full wavelength range. Adjustment may be made to obtain white light rays, red light rays and blue light rays of different intensities respectively depending on different properties of the plants. Various combinations of light rays of different colors can be obtained through adjustment to meet different demands of plants for light rays. A PWM dimming driving power source having a high efficiency is used as the

power source of the plant growth light, and is used in combination with a wireless transmission controlling module. In addition, because the dimming system is located right above the plants, the irradiation distance is short and the light loss is small. Therefore, the power is minimized and the luminous efficiency is maximized. The wavelength and intensity of the light rays emitted by the plant growth light can be adjusted according to the growth cycles of the plants. Light radiations of different color ratios are provided during the different production cycles of plants to provide plants with light radiations of different wavelengths and intensities to meet the growth requirements of the plants. The whole dimming system automatically adjusts the light rays according to the properties of the growth cycles of the plants. In addition, the dimming system can further switch on and off the plant growth light according to the growth cycles of the plants to optimize the utilization of resources.

In an embodiment, each of the plant growth chamber modules 2 is provided with a temperature sensor, a humidity sensor, and a carbon dioxide concentration sensor. In an embodiment, each of the plant growth chamber modules 2 is provided with a wireless transmission module for wirelessly transmitting humidity signals collected by the humidity sensor to the central controlling module in real time, and the central controlling module monitors/adjusts the plant growth environment in real time. In an embodiment, each of the plant growth chamber modules 2 may further be provided with a carbon dioxide supplying module and a heating module, which are connected to the central controlling module via the wireless transmission module to control the temperature and the concentration of carbon

dioxide in each of the plant growth chamber modules **2** according to the growth conditions required by different crops. The concentration of carbon dioxide is adjusted as follows: the carbon dioxide concentration data collected by the carbon dioxide concentration sensor is transmitted by the wireless transmission module to the central controlling module in real time so that the central controlling module makes a comparison according to the plant growth data, and if the carbon dioxide concentration is lower than a preset value, an appropriate amount of carbon dioxide will be released by the central controlling module to balance the concentration of carbon dioxide.

In an embodiment, the temperature sensor and the carbon dioxide concentration sensor are both provided with a wireless transmission module for transmitting the monitored data to the central controlling module in real time. This eliminates the need of laying wires, so the cost of wiring and maintenance is reduced and remote intelligent control can be achieved. In an embodiment, the wireless transmission controlling module uses the advanced Zigbee or Jennet IP communication protocols, and the control applications are compatible with the Android or the IOS mobile phone system. The application programs can be set into different modes depending on different plants to control the on and off times and the dimming for plant growth. Thus, the intelligent remote wireless transmission control can be truly achieved.

In an embodiment, the energy supplying module of the plantation system may comprise a solar power supplying module and a battery module. The solar power supplying module and a battery module are disposed outside the greenhouse and are connected to the growth

rotating module 4, the central controlling module, the water supplying module 5, the LED light source module 1, and the plant growth chamber module 2 of the plantation system to supply power to the system so that the environmental protection effect can be achieved.

Each of the water supplying modules is provided with a pH meter for testing the pH value of nutrient liquid or water. Because different plants need different pH conditions, the pH value of the nutrient liquid or water for growing each kind of plant can be tested by the central controlling module according to the pH conditions needed by the plant; and the central controlling module can also control the intensity and color ratios of the light rays emitted by the plant growth light and adjust the temperature and the humidity simultaneously.

In an embodiment, the central controlling module compares the humidity data according to the water demands of the plants in different growth cycles. If the plants need to be supplied with water, the plantation chambers will be moved to above the water supplying system, and the water supplying module 5 will start supplying water. The hydrophilic material in the plant growth chambers then absorbs water; and when the humidity sensed by the humidity sensor meets the growth requirements of the plants, the water supplying module stops supplying water and the plant growth chambers return to the original place. Therefore, it is unnecessary for the user to manually examine the conditions of the soil and to water the plants. The data of the central controlling module is downloaded into the gateway and the programs can be modified by the user in a self-defined manner; and if the programs are altered by one of the users, then the application programs of all the users are altered simultaneously in real time. Furthermore, the central controlling module further collects

data such as the temperature, humidity, carbon dioxide concentration and so on, makes data comparisons, and analyzes the data and send out a wireless instruction in real time to control the corresponding mechanisms and make adjustments. The central controlling module monitors the growth data of the plants in real time and then transmits the growth data to the user to notify the user of the status of the plants in the growth cycles and to call the user's attention to make settings and execute operations, and this is the core part of the system. The central data processing system generates different instructions according to different plants to control operations of other systems; and the user can also make adjustments in real time according to data practically monitored.

In an embodiment, the user terminal may be a mobile phone or a computer, which is adapted to be connected to the central controlling module in a wireless or wired manner, as shown in **FIG. 5**.

The user may examine the plant growth conditions through the mobile terminal or the PC terminal and is also allowed to monitor/adjust operating conditions of the system through the terminal to meet the growth requirements of different plants. The user may use an intelligent mobile phone having an Android system or an IOS system and downloads different applications according to different operating systems. However, the instructions of different users are synchronized in real time; and if one of the users alters a program, the instructions of other users will be updated at the same time. The user may also use a PC terminal to monitor in real time, wherein a plurality of operating systems may be compatible in the PC terminal, and the Windows, the LINUX and the Mac OSX systems all can be

compatible with each other and can communicate with each other. . Through controlling via the wireless network or the Internet, instructions can be remotely transmitted to the central data processing system to monitor the growth process of the plants. Because the system is controlled through wireless transmission, the wiring problem of the system can be simplified and the remote intelligent control can be achieved. These mobile terminals can be compatible with a plurality of operating systems and a plurality of communication mechanisms. The user terminal comprises optimized and customized parameters for different plants at different stages. The user may also set corresponding schemes of temperature, light, humidity and carbon dioxide parameters according to different requirements.

The above disclosure is related to the preferred embodiments of the present invention and is not to limit the invention.. People skilled in this field may proceed with a variety of modifications and replacements based on the disclosures and suggestions of the invention as described without departing from the characteristics thereof. Nevertheless, although such modifications and replacements are not fully disclosed in the above descriptions, they have substantially been covered in the following claims as appended.

What is claimed is:

1. An intelligently controlled indoor plantation system in the context of an LED plant growth light, comprising (i) a growth rotating module, (ii) a plant growth chamber module, (iii) an LED growth light source module, (iv) a water supplying module, (v) an energy  
5 supplying module, and (vi) a central controlling module; wherein the growth rotating module uses a steel structure as a supporting frame and is installed perpendicular to the ground, the water supplying module is disposed under the growth rotating module, and the plant growth chamber module is installed on the growth rotating module, and the central controlling module is configured to monitor and/or adjust the plant growth environment in the plant  
10 growth chamber module in real time, wherein the plant growth chamber module having a plurality of pores uniformly distributed at the bottom thereof , allowing water to penetrate into the plant growth chamber through the pores having being disposed with a hydrophilic material thereabove, is provided with a wireless transmission module for wirelessly transmitting signals collected by a sensor to the central controlling muddle in real time, and  
15 the central controlling module is used to adjust the humidity, the temperature and the concentration of carbon dioxide and monitor in real time the plant growth environment.

2. The intelligently controlled indoor plantation system in the context of an LED plant growth light as claimed in claim 1, wherein the growth rotating module comprises a large-scale chain driving mechanism, and a plurality of plant growth chamber modules are installed to be suspended from the large-scale chain driving mechanism uniformly; and two  
5 sides of the large-scale chain driving mechanism are capable of moving in an upward direction and a downward direction synchronously to drive the plurality of plant growth chamber modules to move between different heights.

3. The intelligently controlled indoor plantation system in the context of an LED plant growth light as claimed in claim 2, wherein a drawer-type plantation plate is disposed at the  
10 bottom of the plant growth chamber module and is withdrawable from the inside of the plant growth chamber.

4. The intelligently controlled indoor plantation system in the context of an LED plant growth light as claimed in any of claims 1~3, wherein water is automatically supplied or sprayed to the plant growth chamber module by the water supplying module when the plant  
15 growth chamber module is rotated to the bottom of the rotating module.

5. The intelligently controlled indoor plantation system in the context of an LED plant growth light as claimed in claim 1, wherein the energy supplying module of the plantation system comprises a solar power supplying module and a battery module.

6. The intelligently controlled indoor plantation system in the context of an LED plant growth light as claimed in any of the claims 1-5, further comprising a user terminal in the form of a mobile phone or a computer, which is adapted to be connected to the central controlling module in a wireless or wired manner; whereas the user examines the plant growth  
5 conditions through the mobile phone terminal or the PC terminal and monitors/adjusts operating conditions of the system through the terminal to meet the growth requirements of different plants.