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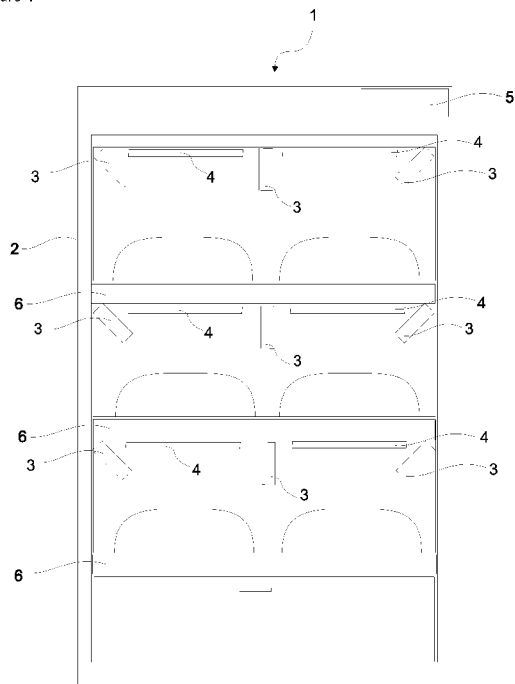
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(54) Title: AN AUTONOMOUS PLANT CULTIVATION CABINET

Figure 1



(57) Abstract: The present invention relates to a plant cultivation cabinet (1) that comprises a cabinet (2) wherein the plants are placed; one or more than one light source (4) that is arranged in the cabinet (2) and that illuminates the interior of the cabinet (2); at least one camera (3) that monitors the interior of the cabinet (2), and a control unit (5) that processes the images captured by the camera (3) when the light intensity is above a certain value, and evaluates and processes the images captured by the camera (3) when the light intensity is below a certain level together with the images captured when the light intensity is above a certain value. Thereby, the quality of the images captured by means of the cameras (3) when the light intensity in the cabinet (2) is below a certain value is enabled to be improved without adversely affecting the growth of the plants.



Description**AN AUTONOMOUS PLANT CULTIVATION CABINET**

- [0001] The present invention relates to a plant cultivation cabinet that autonomously performs all the functions necessary for growing plants and that can be remotely controlled and monitored.
- [0002] In plant cultivation cabinets, the growth of plants is monitored by means of cameras. By using cameras, images of the plants can be automatically recorded at predetermined time intervals and an image can be taken when desired by means of a mobile application. By creating a time lapse video using the images captured at predetermined time intervals, the user is allowed to view the growth of the plant in a video. Furthermore, the user is allowed to view the interior of the cabin when needed by providing real-time images. Under well-lit conditions, e.g. during daytime, the quality of the images taken by the cameras does not pose any problems. However, the need for turning on the illumination means in the plant cultivation cabinet at night adversely affects the growth of the plants in the cabinet. Turning the lights off degrades the quality of the images of the interior of the cabinet.
- [0003] In the state of the art United States Patent Application No. US2016371830, an autonomous plant cultivation system is disclosed, wherein by means of the camera that captures the images of the plants, the current life cycle stage of the plants is determined and the illumination thereof is controlled accordingly.
- [0004] Another state of the art embodiment is disclosed in United States Patent Application No. US2017118450. In this document, an image processing method is disclosed wherein an image is created by combining the images captured by two separate cameras.
- [0005] The aim of the present invention is the realization of a plant cultivation cabinet wherein the quality of the images captured at low illumination levels is improved.
- [0006] The plant cultivation cabinet realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof comprises a cabinet wherein the plants are placed; one or more

than one light source that is arranged in the cabinet and that illuminates the interior of the cabinet; at least one camera that monitors the interior of the cabinet, and a control unit that processes the images captured by the camera, that controls the light source, wherein the images captured by the camera are saved in the control unit if the light intensity is above a certain value and the images captured by the camera when the light intensity is below a certain level are evaluated and processed together with the images captured when the light intensity is above a certain value.

- [0007] In an embodiment of the present invention, the control unit records the images captured by the camera when the light source is turned on and evaluates and processes the images captured when the light source is turned off together with the images captured when the light source is turned on. In this embodiment, the light source is turned on during the daytime and turned off during nighttime.
- [0008] In another embodiment of the present invention, the control unit comprises a multiplier that is used for processing the images obtained when the light intensity is below a certain value. The multiplier can be a coefficient specified by the produced or can be a function. The multiplier defines the correlation between the images captured when the light intensity is above and below a certain value.
- [0009] In another embodiment of the present invention, the plant cultivation cabinet comprises one or more than one rack whereon the plants are placed. In this embodiment, at least one camera is arranged between each two racks. Furthermore, one or more than one light source may be arranged between each two racks.
- [0010] In an embodiment of the present invention, the plant cultivation cabinet comprises the camera that can detect different wavelengths. For example, said wavelengths can be visible spectrum, infrared etc.
- [0011] In another embodiment of the present invention, the surface texture analyses of the plants under different lighting conditions, color values in different color spaces (such as RGB, HSV, YUV, etc.) and morphological characteristics can be used as the multiplier.
- [0012] In another embodiment of the present invention, the camera and the

control unit can transmit data to the outer environment and can be remotely controlled via wired or wireless connection.

[0013] By means of the present invention, high quality images of the plants in the plant cultivation cabinet are enabled to be captured without adversely affecting the growth of the plants.

[0014] The model embodiments relating to a plant cultivation cabinet realized in order to attain the aim of the present invention are illustrated in the attached figures, where:

[0015] Figure 1 - is the front view of the plant cultivation cabinet of the present invention. The elements in the figures are numbered as follows:

1. Plant cultivation cabinet
2. Cabinet
3. Camera
4. Light source
5. Control unit
6. Rack

[0016] The plant cultivation cabinet (1) comprises a cabinet (2) wherein the plants are placed; one or more than one light source (4) that is arranged in the cabinet (2) and that illuminates the interior of the cabinet (2); at least one camera (3) that monitors the interior of the cabinet (2), and a control unit (5) that processes the images captured by the camera (3) when the light intensity is above a certain value, and evaluates and processes the images captured by the camera (3) when the light intensity is below a certain level together with the images captured when the light intensity is above a certain value. Thus, the quality of the images captured by means of the cameras (3) when the light intensity in the cabinet (2) is below a certain value is enabled to be improved without adversely affecting the growth of the plants.

[0017] In another embodiment of the present invention, the control unit (5) also controls the light source (4). In this embodiment, the images captured by the camera (3) when the light source (4) is turned on are directly processed, and the images captured by the camera (3) when the light source (4) is turned off are evaluated and processed together with the

images captured when the light source (4) is turned on. In this embodiment, the light source (4) is turned on during the daytime and turned off during night time.

[0018] In an embodiment of the present invention, the plant cultivation cabinet (1) comprises the control unit (5) that processes data obtained by multiplying the images captured when the light intensity is below a certain value by a coefficient. Said multiplier can be a coefficient specified by the producer or can be a function. The coefficient defines the correlation between the images captured when the light intensity is above and below a certain value. For example, in this embodiment of the present invention, when, in the control unit (5), each pixel in the images captured when the light intensity is above a certain value is defined as $Y(i, j)$ and each pixel in the images captured when the light intensity is below a certain value is defined as $D(i, j)$, the function defined for each pixel is defined as $T(i, j)$. Here, the correlation therebetween is as given below:

[0019] $Y(i, j) = T(i, j) \times D(i, j)$

[0020] $T(i, j)$ can be the same function for some and all pixels or a different function for each pixel. Thus, the images captured by the camera (3) when the light intensity is below a certain value are processed using a coefficient and together with the images captured when the light intensity is above a certain value and the quality of the images captured when the light intensity is below a certain value is improved to match the quality of the images taken when the light intensity is above a certain value.

[0021] In another embodiment of the present invention, the plant cultivation cabinet (1) comprises one or more than one rack (6) whereon the plants are placed. In this embodiment, at least one camera (3) is arranged between each two racks (6). Furthermore, one or more than one light source (4) is arranged between each two racks (6).

[0022] In an embodiment of the present invention, the plant cultivation cabinet (1) comprises the camera (3) that can detect different wavelengths. For example, said wavelengths can be visible spectrum, infrared etc.

[0023] In another embodiment of the present invention, the surface texture analyses of the plants under different lighting conditions, color values in

different color spaces (such as RGB, HSV, YUV, etc.) and morphological characteristics can be used as the coefficient.

[0024] In another embodiment of the present invention, the camera (3) and the control unit (5) transmit data to the outer environment and are remotely controlled via wired or wireless connection.

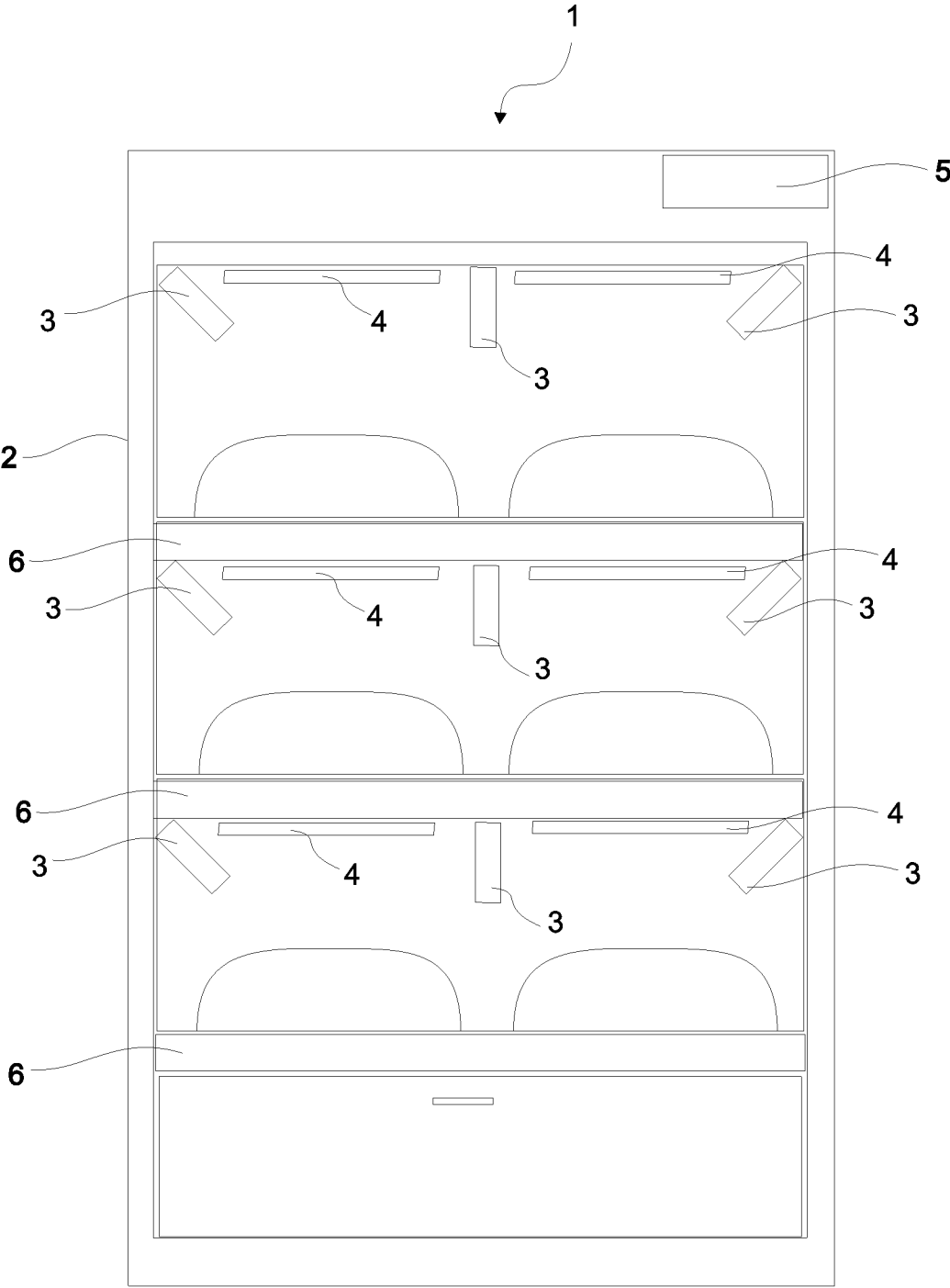
[0025] By means of the present invention, when the light intensity is low, high quality images of the plants in the plant cultivation cabinet (1) are enabled to be captured without adversely affecting the growth of the plants.

Claims

1. A plant cultivation cabinet (1) **comprising** a cabinet (2) wherein the plants are placed; one or more than one light source (4) that is arranged in the cabinet (2) and that illuminates the interior of the cabinet (2), and at least one camera (3) that monitors the interior of the cabinet (2) **characterized by** a control unit (5)
 - that processes the images captured by the camera (3) when the light intensity is above a certain value, and
 - processes the images captured by the camera (3) when the light intensity is below a certain level together with the images captured when the light intensity is above a certain value.
2. A plant cultivation cabinet (1) as in Claim 1, **characterized by** the control unit (5) that directly processes the images captured by the camera (3) when the light source (4) is turned on and processes the images captured by the camera (3) when the light source (4) is turned off together with the images captured when the light source (4) is turned on.
3. A plant cultivation cabinet (1) as in Claim 1 and 2, **characterized by** the light source (4) that is turned on during the daytime and turned off during the nighttime.
4. A plant cultivation cabinet (1) as in any one of the above claims, **characterized by** the control unit (5) that processes data obtained by multiplying the images taken when the light intensity is below a certain value by a coefficient.
5. A plant cultivation cabinet (1) as in any one of the above claims, **characterized by** one or more than one rack (6) whereon the plants are placed.
6. A plant cultivation cabinet (1) as in Claim 5, **characterized by** at least one camera (3) arranged between each two racks (6).
7. A plant cultivation cabinet (1) as in Claim 5 and 6, **characterized by** one or more than one light source (4) arranged between each two racks (6).
8. A plant cultivation cabinet (1) as in any one of the above claims, **characterized by** the camera (3) that can detect different wavelengths.
9. A plant cultivation cabinet (1) as in Claim 4, **characterized by** the control unit (5) that uses the surface texture analyses of the plants under different lighting conditions, color values in different color spaces (such as RGB, HSV and YUV) and morphological characteristics as the coefficient.

10. A plant cultivation cabinet (1) as in any one of the above claims, **characterized** by the camera (3) and the control unit (5) that transmit data to the outer environment and that can be remotely controlled via wired or wireless connection.

Figure 1



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/069879

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A01G9/00 A01G9/20
 ADD. A01G31/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 A01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2017/103922 A1 (EROLL 15 LTD [IL]) 22 June 2017 (2017-06-22)	1-3,5-8, 10
Y	page 1, paragraph 1; figures 1-5 page 6, paragraph 1 - page 8, paragraph 1 page 12, paragraph 3 - page 13, paragraph 3	4,9
X	US 2017/071143 A1 (NEWSAM HERBERT [US]) 16 March 2017 (2017-03-16) paragraphs [0027] - [0030]; figure 3	1-3,5-8, 10
A	WO 2013/002548 A2 (CHOI WON YEONG [KR]) 3 January 2013 (2013-01-03) abstract; figure 1	1-10
Y	US 2015/281593 A1 (SLABY JIRI [US] ET AL) 1 October 2015 (2015-10-01)	4,9
A	abstract; figure 3	1-3



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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