Europaisches Patentamt
European Patent Office
Office européen des brevets

Espacenet

KR20150124305A AGRICULTURAL ROBOT

Applicants: LEE CHUL HEE [KR]

Inventors: LEE CHUL HEE [KR]

Classifications:

IPC ***A01D46/30; A01G13/10; B25J9/00;***

CPC **A01D46/30 (KR); A01G13/10 (KR); B25J9/00 (KR);**

Priorities: KR20140051049A 2014-04-28

Application: KR20140051049A·2014-04-28

Publication: KR20150124305A·2015-11-05

Published as: KR20150124305A

AGRICULTURAL ROBOT

Abstract

The present invention relates to an agricultural robot having a laser beam scanner to perform weed control, pest control, weeding out flowers, and cutting off sprouts and, more specifically, relates to an agricultural robot which can quickly perform work such as weed control, pest control, weeding out flowers, and cutting off sprouts by scanning a laser beam into an area of weed, pest, flowers, or sprouts after recognizing weed, crops, pest, flowers, or sprouts from a camera input image, does not pollute a human body and an environment, and can reduce a labor force.

KR20150124305A AGRICULTURAL ROBOT

Agricultural Robots {AGRICULTURAL ROBOT}

[0001] TECHNICAL FIELD The present invention relates to an agricultural robot, and more particularly, to an agricultural robot that scans a laser beam through a laser beam scanner to control weeds, pest control, flowering, or shoots.

[0002] Weeds and pests are one of the most important factors in reducing yield in agricultural systems. So weeds and pest control is the oldest task, which is also called agriculture itself. In addition, flowering and reddening (wetting) in crop cultivation is a very important way to produce fruit or vegetables with good marketability.

[0003] Conventionally, most of the weed control methods include cutting the weeds directly, spraying chemicals on the weeds, extracting the roots of the weeds and the like. , Spraying chemicals on pests, and burning diseased areas.

[0004] On the other hand, in recent years, when weed control using heat energy is known to be effective, weed control devices for burning weeds using burners, etc. have been developed, but this method is not selective and inaccurate. There is a problem.

[0005] In addition, the conventional flowering and netting work has been mainly dependent on the manual work, and a lot of manpower needs to be mobilized because there are many cases in which the flowering or tending work is performed all year or over a long time such as strawberries, tomatoes, bell peppers and cucumbers. There was a problem such as spreading various viruses or germs between crop individuals due to human hands or knives.

[0006] Therefore, to date, most of the weed control, pest control, flowering, or planting work is mainly dependent on manual or chemical spraying, and there is a shortage of rural manpower, pollution of human and environment, transmission of crops, and impairment of welfare of farmers. I have a problem.

[0007] Patent Registration No. 10-1374802 Registration Date 2014. 3. 4.

[0008] Accordingly, the present invention has been made to solve the above problems, by burning the weeds or pests or flowers or shoots in a non-contact by scanning the laser beam through a laser beam scanner without affecting the human body, soil and crops: It is an object of the present invention to provide an agricultural robot that can make weed control or pest control or flowering or sprouting faster by burning or ripening).

[0009] Hereinafter, the present invention will be described.

[0010] A laser beam generator for generating a laser beam; A laser beam scanner scanning a laser beam output from the laser beam generator; A camera for photographing weeds or crops; An image acquisition unit for acquiring an image of the weeds or crops from the camera; An image recognition unit for recognizing weeds or crops or pests or flowers or buds in the images acquired by the image acquisition unit; A target area detection unit for detecting a work target area by output information of the image recognition unit; A position adjusting device having at least one degree of freedom (DOF) to adjust positions of the camera and the laser beam scanner; It is composed of a main body for moving the position control device, weed control or pest control or weed control or budding by scanning the laser beam to the target area with the laser beam scanner based on the target area information detected by the target area detection unit Characterized in that.

[0011] The present invention minimizes the effects on the human body, soil and crops, and by quickly scanning the laser beam through a laser beam scanner to burn weeds or pests or flowers or buds in a non-contact manner, so that weed control or pest control or flowering or sprouting can be performed more quickly. You can achieve various effects.

[0012] 1 is a view showing the agricultural robot and its weed control according to an embodiment of the present invention. 2 is a view showing the agricultural robot and its pest control according to an embodiment of the present invention. 3 is a view showing an agricultural robot according to an embodiment of the present invention. 4 is a diagram illustrating a laser beam scanner and a laser beam generator according to an embodiment of the present invention. 5 is a diagram illustrating a delta robot scanner and a laser beam generator according to another embodiment of the present invention. 6 is a diagram illustrating a laser beam scanner, a camera, and a scanning surface according to an embodiment of the present invention. 7 is a diagram illustrating a delta robot scanner, a camera, and a scan surface according to another embodiment of the present invention. 8 is a view showing a state in which the position adjusting device according to an embodiment of the present invention replaced by a multi-joint robot. 9 is a view showing an agricultural robot according to another embodiment of the present invention. 10 is a block diagram showing an internal control apparatus of the agricultural robot according to an embodiment of the present invention. 11 is a flowchart showing a flowchart of the agricultural robot according to an embodiment of the present invention. 12 is an explanatory view of the flowering or shodling operation of the agricultural robot according to an embodiment of the present invention. 13 is a view showing an agricultural robot according to another embodiment of the present invention.

[0013] Hereinafter, an embodiment of the present invention will be described in detail with reference to the accompanying drawings. However, the crops, fruit cultivation methods, dimensions, materials, shapes, and relative arrangements of the components described in this embodiment are not intended to limit the scope of the present invention thereto unless there is a specific description. It is only an illustrative example.

[0014] 1 is a view showing an agricultural robot and its weed control according to an embodiment of the present invention, Figure 2 is a view showing an agricultural robot and its pest control according to an embodiment of the present invention, Figure 3, 4 is a diagram illustrating an agricultural robot according to an embodiment of the present invention, and FIG. 4 is a diagram illustrating a laser beam scanner and a laser beam generator according to an embodiment of the present invention, and FIG. 5 is another embodiment of the present invention. FIG. 6 is a diagram illustrating a delta robot scanner and a laser beam generator according to an embodiment, and FIG. 6 is a diagram illustrating a laser beam scanner, a camera, and a scanning surface according to an embodiment of the present invention, and FIG. 7 is another view of the present invention. FIG. 8 is a view illustrating a delta robot scanner, a camera, and a scan surface according to an embodiment, and FIG. 8 is a view showing a state in which a position adjusting device according to an embodiment of the present invention is replaced by a multi-joint robot, and FIG. 9 is , Of the present invention 10 is a diagram illustrating an agricultural robot according to another embodiment, and FIG. 10 is a block diagram illustrating an internal control apparatus of an agricultural robot according to an embodiment of the present invention, and FIG. 11 is according to an embodiment of the present invention. 12 is a flowchart illustrating a flowchart of an agricultural robot, and FIG. 12 is a diagram illustrating a flower bud or chawing operation of the agricultural robot according to an embodiment of the present invention, and FIG. 13 is an agricultural robot according to another embodiment of the present invention. Figure is shown.

[0015] 1 and 2, the agricultural robot 10 of the present invention is

[0016] The end effector 200 formed of the camera 220 and the laser beam scanner 210 and the end effector 200 freely in horizontal, vertical, depth, pitch, yaw, roll, and the like. The body 100 is composed of a position control device 400 and a body 100 of six degrees of freedom (6DOF) to move, the plantation to grow the crop 510, the body 100 is moved, Crops 510, leaves 515, flowers 520, shoots 540, weeds 500, pests 551, pest eggs 552, diseased fruits 553 in the image input from the camera 220), The diseased leaf 554, and the like, and then the laser beam (3) for the target area 258 of the weed 500 or the pests 551, 552, 553, 554, the flower 520, and the shoot 540. 251) can be used to control weeds, pest control, flowering or mowing.

[0017] 1 to 11, the agricultural robot 10 of the present invention is

[0018] A laser beam generator 250 for generating a laser beam 251;

[0019] A laser beam scanner (210) for scanning the laser beam (251) output from the laser beam generator (250);

[0020] A camera 220 for photographing the weeds 500 or crops 510;

[0021] An image acquisition unit (910) for acquiring an image of the weed (500) or crop (510) from the camera (220);

[0022] Image recognition unit 920 for recognizing the weeds 500 or crops 510 or pests (551, 552, 553, 554) or flowers 520 or shoots 540 in the image acquired by the image acquisition unit 910 Wow;

[0023] A target area detector 930 for detecting a work target area 258 using the output information of the image recognition unit 920;

[0024] A positioning device (400) having at least one or more degrees of freedom to adjust the position of the camera (220) and the laser beam scanner (210);

[0025] Consists of the main body 100 for moving the position adjusting device 400.

[0026] Referring to the agricultural robot 10 according to the present invention in the configuration as described above,

[0027] A main body 100 having a moving device 980 and a control device 900;

[0028] A position adjusting device (400) installed at one end of the main body (100) and having at least one or more degrees of freedom to move freely according to the position of the weed (500) or the crop;

[0029] A laser beam scanner 210 having a laser beam generator 250 attached to an upper end of the position adjusting device 400 and outputting a laser beam 251 and scanning a laser beam output from the laser beam generator 250. It is provided with a camera 220 for photographing the weeds or crops, and provided with the illumination 230 required for the camera 220 and provided with a spray nozzle 240 for spraying air or liquid (medical liquid and pollen mixture) The end effector 200 is formed.

[0030] Preferably, the number of the camera 220 is one camera when the distance between the camera 220 and the subject (weed or crop) is kept within a predetermined range, the distance between the camera 220 and the subject In the environment where the depth of the image (Z-axis: distance between the camera and the subject) information is needed or the position and posture of the main body 100 and the end effector 200 must be adjusted by themselves, it is not constant. (Such as a stereo camera).

[0031] Preferably, the position adjusting device 400 in the present invention is configured as 6 degrees of freedom (6DOF) delta robot, but the present invention is not limited thereto. The positioning device 400 is an actuator having at least one or more degrees of freedom, such as horizontal, vertical, depth, pitch, yaw, roll, Cartesian robot, delta Robot, articulated robot, pan-tilt, etc. (see FIGS. 3 and 8).

[0032] Preferably, the mobile device 980 according to an embodiment of the present invention, a method using a rail (rail) or a line tracer (line tracer), a method for traveling along a path previously stored in a remote server, autonomous driving method, etc. The main body 100 may be moved in various forms.

[0033] Preferably, the air spray of the injection nozzle 240 is used to help moisturize the pollen to reach the pistil by causing the wind, or to move the location of the weeds and crops by the force of the wind, the liquid spray It is used when using chemicals, pollen mixtures or firefighters.

[0034] Preferably, the weed control using the laser beam in the present invention, after recognizing the weeds to learn or burn a predetermined target area 258 of the stem close to the ground so as not to function as a plant stem.

[0035] Preferably, the pest control using the laser beam in the present invention, after recognizing the pest or pest eggs attached to the crops to learn or control the predetermined target area 258 of the body of the pest or pest eggs.

[0036] Preferably, the pathogen control using the laser beam in the present invention, after recognizing the distribution area of the germs, learn or burn the distribution area as a target area to control.

[0037] Preferably, the flower bud using the laser beam in the present invention, after recognizing the flower 520 in the crop, ripen or burn a predetermined target area 258 according to a preset condition so that the flower 520 no longer functions. Do not let it. Here, the flower 520 includes flower buds. For example, referring to FIG. 12, after obtaining the number of flowers recognized as flowers, only a proper number of flowers are left according to a preset condition, and the remaining flowers are burned and sieved.

[0038] Preferably, the netting using the laser beam in the present invention, after recognizing the newly sprouting sprout 540 at the contact point where the stem and leaves of the crop branch, learn the predetermined target area 258 according to a preset condition. Or burn to burn.

[0039] Preferably, the preset condition may be subject to target conditions, number, interval, etc. according to the crops and varieties.

[0040] Referring to FIG. 4, the laser beam scanner 210 provided in the end effector 200 includes an X-axis mirror 212 and a Y-axis mirror 214 that reflect the laser beam, and the X-axis mirror. An X-axis mirror motor 211 and a Y-axis mirror motor 213 for rotating the 212 and the Y-axis mirror 214, respectively.

[0041] In addition, the laser beam generator 250 for generating the laser beam is installed at one end of the laser beam scanner 210 inside the end effector 200.

[0042] Referring to FIG. 6, the laser beam 251 output from the laser beam generator 250 is scanned while being reflected through the X-axis mirror 212 and the Y-axis mirror 214 of the laser beam scanner 210. The surface 255 may be output in various shapes such as lines, areas, and dots, and according to the output intensity of the laser beam generator 250, cutting, marking, burning, and optically cutting metal, stone, wood, and fiber with a laser beam. It can be used for a variety of tasks in the agricultural field.

[0043] Preferably, the laser beam generator 250 may output the laser beam generator 250 by adjusting the intensity and focus of the laser beam 251 according to the signal of the control device 900.

[0044] In addition, the camera 220 installed to face the scanning surface 255 of the laser beam scanner 210 may transmit an image signal including weeds or crops to the image acquisition unit 910 of the control device 900. Transmit (see Fig. 10).

[0045] Preferably, the laser beam generator 250 according to an embodiment of the present invention is installed at one end of the laser beam scanner 210, but the present invention is not limited thereto. When the output capacity of the laser beam generator 250 is large, the laser beam generator 250 is installed in the main body 100, and in this case, the laser beam is provided through a mirror or an optical fiber so that the laser beam can be input at a predetermined position of the laser beam scanner 210. The path of is derived.

[0046] Preferably, the present invention scans the laser beam 251 to the scan surface 255 with the laser beam scanner 210 formed by a galvano-scanner, but the present invention is not limited thereto. Instead of the laser beam scanner 210, a delta robot scanner 310 formed of a delta robot may be used, and another type of scanner formed of a rectangular coordinate robot or an articulated robot may be used as a specific position of the scan surface 255. End effects 200 and 300 scanning the laser beam 251 may be formed (see FIGS. 5, 7, and 9).

[0047] The control device 900 of the agricultural robot 10 according to an embodiment of the present invention with reference to Figure 10, the image acquisition unit for acquiring an image including weeds or crops from at least one of the camera 220 (910 and the pests 551, 552, 553, 554, flowers 520, shoots 540, or weeds 510 included in the crop 510 from the images acquired by the image acquisition unit 910, The image recognition unit 920 for calculating the state and number of the weeds 500 or pests (551, 552, 553, 554), flowers 520, shoots 540, and the like, and the image recognition unit 920 The target area detection unit 930 for detecting the work target area 258 from the calculated information, the camera 220 coordinates and the laser beam scanner 210 coordinates are calibrated, and the target area detection unit 930 is calibrated. One embodiment of the present

invention, such as a calibration unit 940 for providing correction information, the laser beam scanner 210 and the moving device 980 It controls the overall operation according to the controller and is configured (950) for inputting and outputting a signal to the outside.

[0048] Preferably, the image recognizing unit 920 may include calculating correlation and depth information using information classified and recognized from each image when the image is an image acquired from the plurality of cameras 220. .

[0049] Preferably, the input / output device 960 functions as an operation command, various sensor inputs, and data transmission and reception through a network.

[0050] Preferably, when weeds or pests occur as a result of image recognition, the information is transmitted to the manager, and according to a preset condition, the laser beam may be scanned and controlled, or chemical liquid spraying using the spray nozzle 240 may be performed.

[0051] 11 with reference to the flowchart of the agricultural robot 10 according to an embodiment of the present invention,

[0052] First, in step S10 it is determined whether there is a job start command. Work start command methods include a method that the operator inputs to the input and output device 960 of the control device 900, a method based on predetermined information, and a method by remote control. If the judgment is denied, the process repeats step S10 until there is a command to start work, and if it is positive, moves to the next.

[0053] In the next step S20, the image acquisition unit 910 acquires an image from the camera 220 input signal and transfers the image to the image recognition unit 920.

[0054] In the next step S30, the image recognition unit 920 extracts, recognizes and labels the areas of weeds, crops, pests, flowers, buds, etc. in the image, and transfers them to the target area detection unit 930.

[0055] Preferably, the image recognition result includes a classification value, area information, correlation, state information, labeling, and the like.

[0056] Preferably, the image recognition conditions depend on the variety of crops and the working environment and are set and selected in advance.

[0057] Preferably, the crops are classified and recognized as leaves, stems, flowers, fruits, shoots, and planting distances of the crops, compared to previously input crop information.

[0058] Preferably, the weed is classified as a weed that recognizes a plant that has emerged from a predetermined planting distance between crops or differs from previously inputted crop information.

[0059] Preferably, the pest recognizes objects attached to the foliar, stem, and branch of the crop by pre-input pest information.

[0060] Preferably, the bacterium is recognized by comparing the surface of the crop leaves, stems, branches, etc. with the normal state of the crop and classifying the previously input germ information when abnormalities are found.

[0061] Preferably, image recognition for weeds or pests may be performed by an image recognition technique using an artificial neural network.

[0062] Preferably, the pattern recognition information for the weeds or pests or flowers or buds may be constructed through supervised learning or unsupervised learning with previously input weeds or pests.

[0063] Preferably, the image recognition unit 920 according to an embodiment of the present invention implements color images, gray images, and black and white image information alone or in parallel.

[0064] Next, in step S40, the target area detection unit 930 detects the target weed control or pest control or the flower weeding or swelling condition as the work target area 258.

[0065] Preferably, the designation of the target area 258 is a shape filled with the area for scanning the laser beam, and in the case of weeds, a predetermined area at the center of the stem portion of the weeds close to the ground, and in the case of a pest, the entire pest area extracted In the case of flowers, the flower pistil region, and in the case of new shoots, the budding region or the stem region attached to the shoots are designated as the target region 258 to work with (see FIGS. 1, 2, and 12).

[0066] In a next step S50, it is determined whether there is a work target area 258 detected by the target area detection unit 930. If it is negative, go to step S80 to execute, and if yes, go to the next step.

[0067] In the next step S60, the power is adjusted to the laser beam intensity suitable for the task.

[0068] Preferably, in this step, the laser beam may be scanned at a low intensity prior to the actual scanning operation to correct the position value for the work target region 258 in advance.

[0069] In the next step S70, the operation is completed by scanning the laser beam in a predetermined order for each target area 258 as the execution step of the job.

[0070] In the next step S80, the position adjusting device 400 is controlled to adjust the position of the end effector 200.

[0071] Preferably, if the horizontal, vertical, depth, pitch, yaw, roll, etc. of the position adjusting device 400 is properly controlled, it is possible to quickly adjust the portion too close or obstructed to the main body 100. You can work.

[0072] Preferably, referring to another embodiment of the present invention, the agricultural robot 10 of the present invention is horizontal, vertical even by changing the angle between the main body 100 and the leg 410 or the leg 410 node even in the ground without moving the ground. 6 degrees of freedom, depth, pitch, yaw, and roll, are provided to the end effector 200.

[0073] In the next step S90, it is determined whether there is a job end command, and if it is negative, the main body 100 is moved to the next work position (S100), and the above steps are repeatedly performed.

[0074] Preferably, in the body movement (S100), by using the wheel 180 or the leg 410 of the main body 100 to move the main body 100 to the desired location of the crop planting or planting stage (FIGS. 1, 2, See FIG. 13).

[0075] Preferably, the present invention is performed by the flow chart of Figure 11 but the present invention is not limited thereto. The order of the work may be performed differently according to the environment, cropping or worker setting.

[0076] Referring to FIG. 13, the agricultural robot 10 according to another embodiment of the present invention includes at least three legs 410 to move the camera 220 and the laser beam scanner 210 while moving the camera. And a body 100 providing at least three degrees of freedom to the laser beam scanner 210.

[0077] Preferably, the leg 410 may be operated by the main body moving step S100 or the end effect position adjusting device control step S80 (see FIG. 11).

[0078] Preferably, in another embodiment of the present invention, the end effector 200 and the main body 100 provided with the camera 220, the laser beam scanner 210 and the injection nozzle 240, respectively or It can be formed as a module of merging.

[0079] Preferably, the body 100 according to another embodiment of the present invention is formed with eight legs 410, but the present invention is not limited thereto. When at least three legs 410 are provided, six degrees of freedom may be provided to the end effector 200, but four or more legs 410 may be provided to maintain the balance of the main body 100.

[0080] Therefore, the agricultural robot according to the present invention can speed up weed control or pest control or flowering or sprouting by scanning the laser beam through a laser beam scanner to burn weeds or pests or flowers or shoots, Not only can it reduce costs, it can overcome various time and space constraints in work, prevent damage to crops, and reduce adverse effects on human body and environment.

[0081] * Detailed description of the major symbols in the drawings * 10: Agricultural robot 100: Main body 110: Battery 120: Body moving camera 121: Body moving light 180: Wheel 200: End effector 210: Laser beam scanner 211: X axis mirror motor 212: X-axis mirror 213: Y-axis mirror motor 미러 214: Y-axis mirror 220: Camera 230: Illumination 240: Injection nozzle 250: Laser beam generator 251: Laser beam 255: Scanning surface 258: Target area 300: End effector 310: Delta Robot Scanner 400: Positioner 410: Leg 500: Weed 501: Weed Stem 510: Crop 515: Leaf 520: Flower 540; New shoot 551: pest 552: pest eggs 553: diseased fruit 554: diseased leaf