

TITLE OF INVENTION

A VERTICAL FARMING ASSEMBLY AND A METHOD OF LOADING SEEDLINGS ONTO THE SAME

BACKGROUND OF THE INVENTION

5 A. Field of The Invention

The present invention relates to farming tower assembly, and a method for loading seedlings onto the farming tower assembly using robots, and in particular, a farming tower with multiple levels for hydroponic farming. The disclosed assembly and method are applicable for more general application in the fields of agriculture.

10 B. Description of Prior Art

Vertical farming is an evolving technique for cultivation of crops through artificial control of influential environmental factors. These systems of cultivation can vary in size, ranging from a household appliance to a 10,000 square-meter warehouse, or to a multi-hectare greenhouse.

15 Vertical farming systems are typically equipped with a general selection of actuators and sensors to monitor and control the environment, as well as preparing of seedling for cultivation on the vertical farming assembly. In big scale vertical farming assembly, AI gadgets are essential in order to increase and/or to facilitate mass production. It is essential that the method of vertical farming be low cost of operation and provides
20 consistent, year-round production for a wide range of crops, and for any location with a flat floor to allowing moveable robot in handling seedling uploading and for transporting of the seedling to a cultivation location of the vertical farming assembly.

There is a need at present for large scale production of food and biomass both to supply emerging food and energy markets and to offset impacts to food supplies and
25 land usage created by the increasing usage of traditional food sources as fuel and the increasing global populations placing pressures on food, water, fuel stocks, land and other resources. Prior inventions had addressed portions of the needs for automated or high-density production of crops for food and biomass, but had not addressed the optimal characteristics claimed here.

U.S. Pat. No. 6,508,033 described a multi-story vertical platform arrangement, it in effect was describing an expensive construction methodology which for many crops would prove not to be cost effective and would force an extensive use of artificial light to reach interior spaces between levels. Rather than a multi-story, frame-floor-and-ceiling approach, a towered framework approach is indicated which mimics other, proven natural forms for the photosynthetic absorption of light such as the geometry of a pine forest or a tropical rainforest canopy.

U.S. Pat. No. 6,508,033 was also more adapted for the production of annuals in that each time a plant was harvested, it was completely replanted. Perennial grasses and other perennials can be clipped at the end of a full growth cycle, leaving the roots intact and will re-grow new shoots which can be harvested at the end of the next growing cycle. There is a need for a system that allows re-harvesting of perennials, and other similar crops. U.S. Pat. No. 6,508,033 arranged the plants in groups of many plants at the same stage of growth which would have the effect of increasing in-process inventory and therefore tie-up working capital.

U.S. Pat. No. 6,508,033 discloses sequenced seedlings on a planar conveyance with a fixed ceiling height suitable for mature plants, and a generalized three axis and multi-zone robotic arrangement for cultivation.

US Patent Publication No. 20110120002 discloses continuous-loop conveyor, towering upon vertical framework, which allows potted perennial plants and other plants to be transported throughout all stages of maturity in a manner which substantially multiplies yield per acre, allows production to proceed in both natural and artificial light, allows production and harvesting to be automated, and allows production to proceed in conditions which are favorable to plants but unfavorable to humans.

BRIEF SUMMARY OF THE INVENTION

A main object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly having a plurality of shelves comprising the steps of:

- i. positioning the trackless robot at a completed cultivation plant location within an area where the vertical farming assembly is located;
- ii. automatically moving of the trackless robot to auto retrieve a plurality of trays with completed cultivation plant from the shelves of the vertical farming assembly;
- 5 iii. transporting the trays with completed cultivation plants from the completed cultivation plant location to a harvesting area;
- iv. auto-loading of the retrieved trays from the shelves onto a conveyor belt of a conveyor system for further processing;
- v. moving the trackless robot from the harvesting area to a seedling area where a
- 10 plurality of seedlings on trays are ready for cultivation in the cultivation plant location of the vertical farming assembly;
- vi. auto loading of the trays containing the seedlings to the trackless robot;
- vii. moving the trackless robot from the seedling area to the cultivation plant location to deliver the trays of seedlings onto the shelves of the vertical farming
- 15 assembly; and
- viii. uploading the trays onto the shelves by pushing the trays to a plurality of cultivation racks mounted onto a roller conveyor positioned on the shelves.

Another main object of the present invention is to provide a vertical farming assembly comprising

- 20 a plurality of vertical frames and horizontal frames forming into rack structure with a plurality of shelves;
- a plurality of rollers forming into a conveyor system for holding a plurality of trays containing seedlings;
- a lighting system being formed on each shelf for the cultivation of seedling; and
- 25 a trackless robot which navigates within the cultivation area and harvesting area to deliver matured plants and to upload the trays onto the shelves of the vertical farming assembly.

Yet still a further object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly, wherein the vertical farming assembly comprises a plurality of layers with horizontally arranged rail to hold a plurality of trays containing seedlings delivered by the trackless robot.

- 5 Another object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly, wherein the conveyor system includes a plurality of rollers which allow the trays to move on the rollers, and the vertical farming assembly is equipped with hydroponic LED grow light or the like.

- 10 Still an object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly, wherein the LED grow light is configured to provide photosynthetically active radiation to the seedling on the tray of the shelves of the vertical farming assembly, and the plurality of the shelves are environmentally controlled site with regulated air quality to ensure healthy growth of plants.

- 15 Still another object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly, wherein the trackless robot is freely navigating throughout the seedling area, cultivation area and the harvesting area of the vertical farming assembly.

- 20 Another object of the present invention is to provide a method of loading seedling by a trackless robot for a vertical farming assembly, wherein the trackless robot is freely moving from one location to a second location within the cultivation area of the vertical farming assembly.

Yet still another object of the present invention is to provide a vertical farming assembly further comprising

- 25 a cultivation area; and

a seedling area which is next to the harvesting area, thereby

the trackless robot is allowed to navigate from the cultivation area to the seedling area or the harvesting area, or vice versa.

Still yet another object of the present invention is to provide a vertical farming assembly, wherein the trackless robot performs a plurality of tasks pertinent to loading of seedlings and harvesting of matured plants and the assembly is constructed at a low cost to be mass-produced and mass-arrayed facilitating trackless robot or the like
5 for seedlings loading and harvesting of crops.

Yet a further object of the present invention is to provide a vertical farming assembly, wherein the lighting system allows the growing day and growing season for plants to be extended and the shelves allow planting perennial crops, and the multiple level of the assembly is configured to facilitate growth of organic crops.

10 Another object of the present invention is to provide a vertical farming assembly, wherein the robot or the like is freely to navigate throughout the farming assembly.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

A fuller understanding of the nature and objects of the present invention will become
15 apparent upon consideration of the following detailed description, taken in connection with the accompanying drawings, wherein:

FIG. 1 shows an overall vertical farming assembly with a trackless robot in a cultivation area according to the embodiment of the present invention.

FIG. 2 shows a plurality of shelves of the vertical farming assembly of the present
20 invention, wherein matured plants on the shelves of the farming assembly is shown.

FIG. 3 is a schematic view showing the location of the cultivation area, the harvesting area of the vertical farming assembly in accordance with the present invention.

FIG. 4 is a perspective view showing auto loading of retrieved trays by a trackless robot onto a conveyor system in accordance with the present invention.

25 FIG. 5 is a schematic view showing the movement of trackless robot within the cultivation area from the harvesting area to the seedling area in accordance with the present invention.

FIG. 6 is a schematic view illustrating the loading of seedling from seedling tray to the trackless robot in accordance with the present invention.

FIG. 7 is a schematic view illustrating the moving of a trackless robot from the seeding area with seedling tray to the shelves of the vertical farming assembly at the cultivation
5 area in accordance with the present invention.

FIG. 8 is a schematic view illustrating the tray with matured seedling being pushed onto the rack on the shelf of the cultivation area with roller conveyor system of the vertical farming system of the present invention.

10 **DETAILED DESCRIPTION OF THE INVENTION**

The following detailed description is of the best currently contemplated modes of carrying out exemplary embodiments of the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the
15 appended claims.

Referring to FIGs. 1 - 8, broadly, there is shown a vertical farming assembly (100) comprising

a plurality of vertical frames (110) and horizontal frames (120) forming into rack structure (130) with a plurality of shelves (140);

20 a plurality of rollers (150) forming into a conveyor system (160) for holding a plurality of trays (170) containing seedlings (171);

a lighting system (180) being formed on each shelf (140) for the cultivation of seedling (150); and

a trackless robot (12) which navigates within a cultivation area or zone (14) and
25 harvesting area (50) to deliver matured plants and to upload the trays (170) onto the shelves (140) of the vertical farming assembly (100).

Referring to FIG. 1, there is shown an overall vertical farming assembly (100) with a trackless robot (12) in a cultivation area or zone (14) according to the embodiment of

the present invention. The cultivation area or zone (14) is a site where the vertical farming assembly (100) is located. The cultivation area or zone (14) is provided with the trackless robot (12) which performs the delivery of matured plants to a harvesting area. The trackless robot (12) moves freely in the cultivation area (14).

5 FIG. 2 shows a plurality of shelves (140) of the vertical farming assembly (100) of the present invention, wherein a completed cultivation plant on the shelves (140) of the farming assembly (100) is shown. The completed cultivation plants on the shelves (140) are being retrieved automatically by the trackless robot (12) and are then transferred out from the cultivation area (14) to a harvesting area (not shown), in
10 accordance with the present invention.

In accordance with the present invention, there is also provided a method of loading seedling by a trackless robot (12) for a vertical farming assembly (100) having a plurality of shelves (140) comprising the steps of:

- i. positioning the trackless robot (12) at a matured plant location within an area
15 where the vertical farming assembly (100) is located;
- ii. automatically moving of the trackless robot (12) to auto retrieve a plurality of trays (170) with matured plant from the shelves (140) of the vertical farming assembly (100);
- iii. transporting the trays (170) with matured plants from the matured plant location
20 to a harvesting area (50);
- iv. auto-loading of the retrieved trays (170) from the shelves (140) onto a conveyor belt (161) of a conveyor system (160) for further processing;
- v. moving the trackless robot (12) from the harvesting area (50) to a seedling room (52) where a plurality of seedlings (171) on the trays (170) are ready for cultivation in
25 the cultivation area or zone (14) of the vertical farming assembly (100);
- vi. auto loading of the trays (170) containing the seedlings (171) to the trackless robot (12);
- vii. moving the trackless robot (12) from the seedling room (52) to the cultivation area (14) to deliver the trays of seedlings (171) onto the shelves (140) of the vertical
30 farming assembly (100); and

viii. uploading the trays (170) onto the shelves (140) by pushing the trays (170) to a plurality of cultivation racks mounted onto a roller conveyor (161) of the conveyor system (160) positioned on the shelves (140).

In accordance with the preferred embodiment, the cultivation area (140) includes the seedling area (52) which is next to the harvesting area (50), thereby

the trackless robot (12) is allowed to navigate from the cultivation area (140) to the seedling area (52) or the harvesting area (50), or vice versa.

As shown in FIG. 1, the vertical farming assembly (100) comprises a plurality of layers with horizontally arranged rail to hold a plurality of trays (170) containing seedlings (171) delivered by the trackless robot 12), and a conveyor system 160) (shown in FIG. 4) includes a plurality of rollers (150) which allow the trays (170) to move on the rollers (150). In the preferred embodiment, the vertical farming assembly (100) is equipped with hydroponic LED grow light or the like. Further, the LED grow light is of a LED Full Spectrum grow Light.

In the present invention, the LED grow light is configured to provide photosynthetically active radiation to the seedling on the tray of the shelves (140) of the vertical farming assembly (100), and the lighting system (180) allows the growing day and growing season for plants to be extended, and the multiple level of the assembly (100) is configured to facilitate growth of organic crops.

FIG. 3 is a schematic view showing the location of the cultivation area (14), the harvesting area (50) of the vertical farming assembly (100) in accordance with the present invention.

In accordance with the present invention, the cultivation area (14) is provided with a plurality of vertical farming assemblies where path is provided for the movement of the trackless robot (12). After matured plants are picked, the trackless robot (12) will deliver the plants to the harvesting area (50) located next to the end of the cultivation area (14). The trackless robot (12) takes down trays (170) from the shelves (140) of the vertical farming assemblies and delivers the trays (170) to the harvesting area (50), and the trackless robot (12) is freely to navigate throughout the farming assembly (100).

The plurality of the shelves (140) of the present invention are environmentally controlled site with regulated air quality to ensure healthy growth of plants, and the trackless robot (12) is freely navigating throughout the cultivation area (14) and the harvesting area (50) of the vertical farming assembly (100), and the trackless robot (12) is freely moving from one location to a second location within the cultivation area (14) of the vertical farming assembly (100).

FIG. 4 is a perspective view showing auto loading of retrieved trays (170) by the trackless robot (12) onto the conveyor system (160), located in the harvesting area (50), in accordance with the present invention. As shown in the figure, the trackless robot (12) is auto loading retrieved trays (170) to the conveyor system (160). The loading process is done automatically and orderly. In other words, the trackless robot (12) performs a plurality of tasks pertinent to loading of seedlings and harvesting of matured plants.

The vertical farming assembly (100) is provided with a plurality of shelves (140) which are allowed planting of perennial crops, and the assembly (100) is constructed at a low cost to be mass-produced and mass-arrayed facilitating trackless robot (12) or the like for seedlings (171) loading and harvesting of crops.

FIG. 5 is a schematic view showing the movement of trackless robot (12) within the cultivation area or zone (14) from the harvesting area (50) to the seedling area (52) in accordance with the present invention. The trackless robot (12) is able to move from a harvesting area (50) to a seeding area (52). The matured seedling (171) in the seedling area (52) is loaded to the trackless robot (12) to be delivered to the shelves (140) of the farming assembly (100).

FIG. 6 is a schematic view illustrating the loading of seedling (171) from seedling tray (170) to the trackless robot (12) in accordance with the present invention. The seedlings (171) on the tray (170) located on the shelves (140) of the seedling area (52) are loaded onto the trackless robot (12) and the trackless robot (12) will then deliver the trays (170) to the cultivation area (14) of the farming assembly (100).

FIG. 7 is a schematic view illustrating the moving of a trackless robot (12) from the seedling area (52) with seedling tray (170) to the shelves (140) of the vertical farming assembly (100) at the cultivation area (14) in accordance with the present invention.

The trackless robot (12) after collects the trays of seedlings (171) from the seeding area (52) moves to the cultivation zone or area (14) so as to send the matured seedling (171) on the trays (170) to the shelves (140) of the farming assembly (100). The trackless robot (12) moves from the seedling area (52) to the cultivation zone or area
5 (14) based on the instructions given to the trackless robot (12).

FIG. 8 is a schematic view illustrating the tray (170) with matured seedling (171) being pushed onto the shelves (140) of the cultivation area (14) with roller conveyor system (160) of the vertical farming system (100) of the present invention. The trays (170) delivered by the trackless robot (12) to the cultivation area (14) are loaded onto the
10 conveyor system (160) made of a plurality of simple rollers (150). The tray (170) is being loaded one after the another and being pushed one by one along the rollers (150) until the shelves (140) are fully packed with trays.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although exemplary embodiments of this invention have been
15 described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. This invention is defined by the following claims, with equivalents of the claims to be
20 included therein.

CLAIMS

1. A method of loading seedling by a trackless robot for a vertical farming assembly having a plurality of shelves comprising the steps of:
 - i. positioning the trackless robot at a completed cultivation plant location within an area where the vertical farming assembly is located;
 - ii. automatically moving of the trackless robot to auto retrieve a plurality of trays with completed cultivation plant from the shelves of the vertical farming assembly;
 - iii. transporting the trays with completed cultivation plants from the completed cultivation plant location to a harvesting area;
 - iv. auto-loading of the retrieved trays from the shelves onto a conveyor belt of a conveyor system for further processing;
 - v. moving the trackless robot from the harvesting area to a seedling area where a plurality of seedlings on trays are ready for cultivation in the cultivation plant location of the vertical farming assembly;
 - vi. auto loading of the trays containing the seedlings to the trackless robot;
 - vii. moving the trackless robot from the seedling area to the cultivation plant location to deliver the trays of seedlings onto the shelves of the vertical farming assembly; and
 - viii. uploading the trays onto the shelves by pushing the trays to a plurality of cultivation racks mounted onto a roller conveyor positioned on the shelves.
2. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the vertical farming assembly comprises a plurality of layers with horizontally arranged rail to hold a plurality of trays containing seedlings delivered by the trackless robot.
3. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the conveyor system includes a plurality of rollers which allow the trays to move on the rollers.

4. The method of loading seedlings by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the vertical farming assembly is equipped with hydroponic LED grow light.
- 5 5. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 4, wherein the LED grow light is of a LED Full Spectrum grow Light.
- 10 6. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 4, wherein the LED grow light is configured to provide photosynthetically active radiation to the seedling on the tray of the shelves of the vertical farming assembly.
- 15 7. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the plurality of the shelves are environmentally controlled site with regulated air quality to ensure healthy growth of plants.
- 20 8. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the trackless robot is freely navigating throughout the seedling area, cultivation area and the harvesting area of the vertical farming assembly.
- 25 9. The method of loading seedling by a trackless robot for a vertical farming assembly as set forth in Claim 1, wherein the trackless robot is freely moving from one location to a second location within the cultivation area of the vertical farming assembly.
- 30 10. A vertical farming assembly comprising
a plurality of vertical frames and horizontal frames forming into rack structure with a plurality of shelves;
a plurality of rollers forming into a conveyor system for holding a plurality of trays containing seedlings;

a lighting system being formed on each shelf for the cultivation of seedling;
and

a trackless robot which navigates within the cultivation area and harvesting area
to deliver completed cultivation plants and to upload the trays onto the shelves
of the vertical farming assembly.

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11. The vertical farming assembly as set forth in Claim 10, further comprising
a cultivation area; and
a seedling area which is next to the harvesting area, thereby
the trackless robot is allowed to navigate from the cultivation area to the
seedling area or the harvesting area, or vice versa.

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12. The vertical farming assembly as set forth in Claim 10, wherein the trackless
robot performs a plurality of tasks pertinent to loading of seedlings and
harvesting of matured plants.

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13. The vertical farming assembly as set forth in Claim 10, wherein the lighting
system allows the growing day and growing season for plants to be extended.

14. The vertical farming assembly as set forth in Claim 10, wherein the shelves
allow planting perennial crops.

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15. The vertical farming assembly as set forth in Claim 10, wherein the assembly
is constructed at a low cost to be mass-produced and mass-arrayed facilitating
trackless robot or the like for seedlings loading and harvesting of crops.

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16. The vertical farming assembly as set forth in Claim 10, wherein the robot or the
like is freely to navigate throughout the farming assembly.

17. The vertical farming assembly as set forth in Claim 10, wherein the multiple
level of the assembly is configured to facilitate growth of organic crops.

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