Application Number: 202321083946 **Total No. of Sheets: 2**

Applicants Name: Vishwakarma Institute of Information Technology **Sheet No. 1**

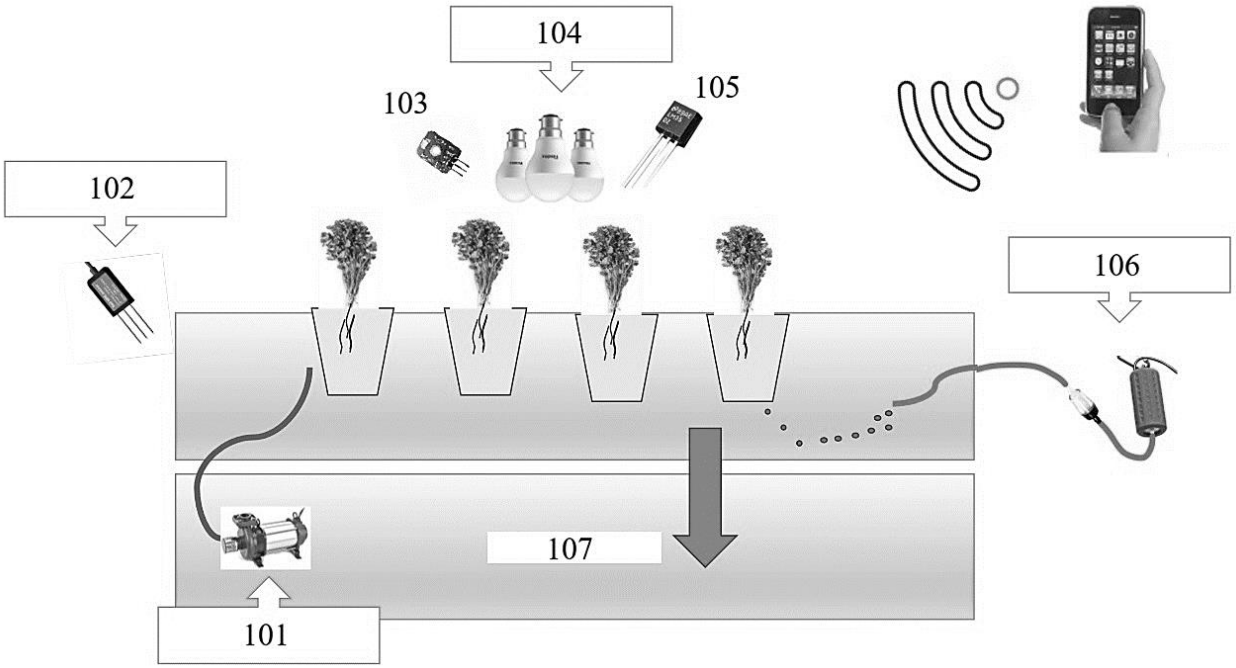


Figure 1

Date: 04/05/2024

Adv. Swapnil Jayantrao Gawande

Agent for the applicant [IN/PA 1587]

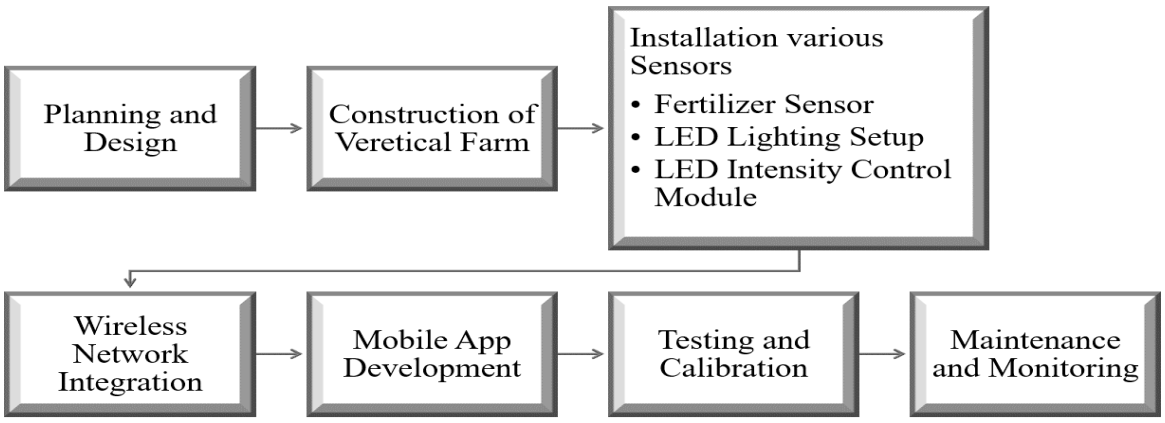


Figure 2

Date:04/05/2024

Adv. Swapnil Jayantrao Gawande

Agent for the applicant [IN/PA 1587]

Application Number: **Total No. of Sheets: 2**

Applicants Name: Vishwakarma Institute of Information Technology **Sheet No. 1**

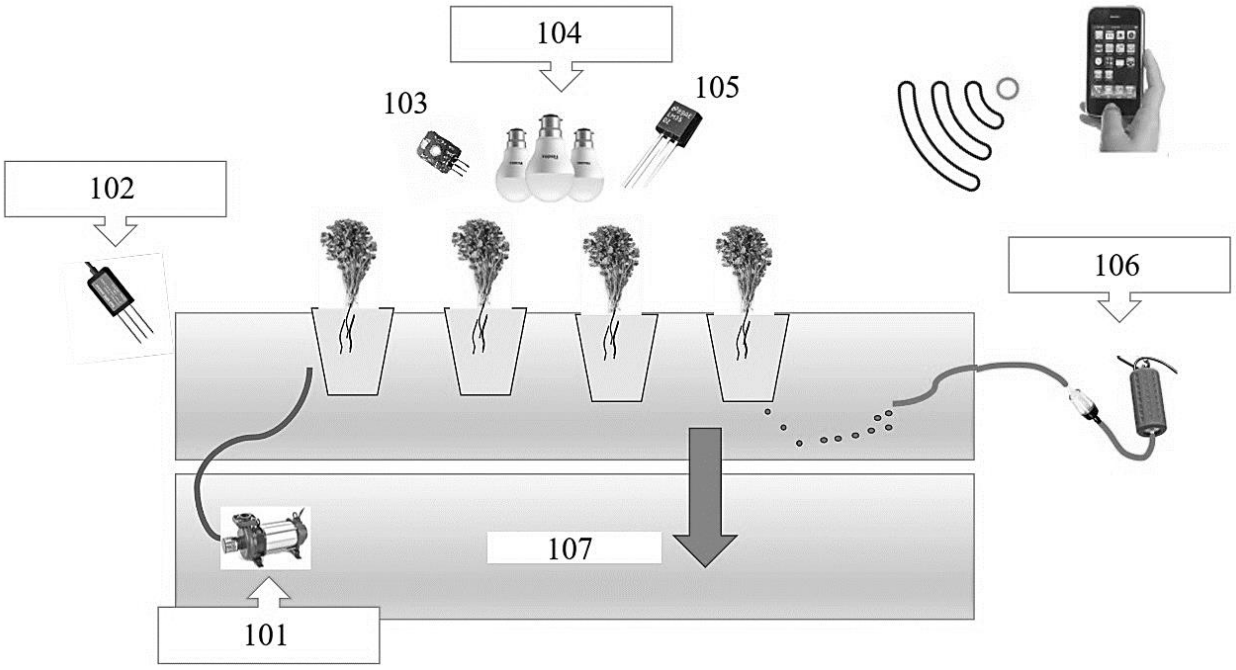


Figure 1

Date:08/12/2023

Adv. Swapnil Jayantrao Gawande

Agent for the applicant [IN/PA 1587]

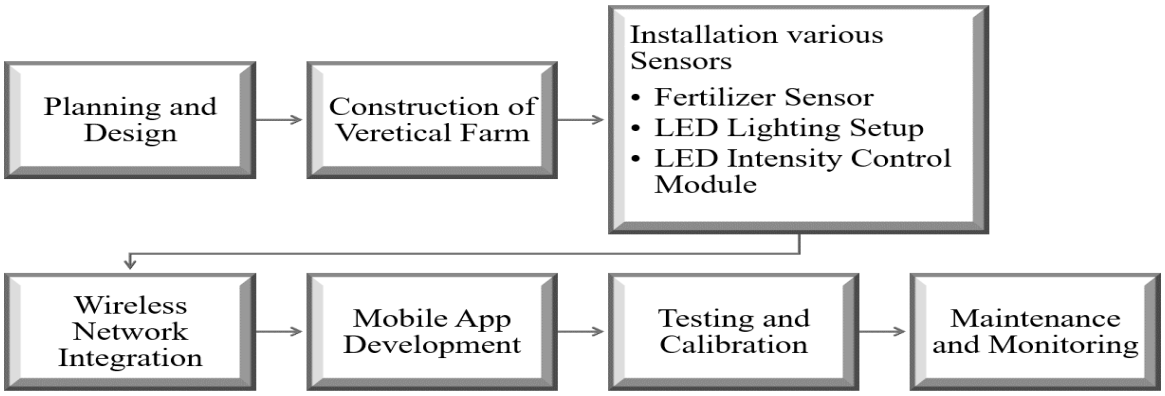


Figure 2

Date:08/12/2023

Adv. Swapnil Jayantrao Gawande

Agent for the applicant [IN/PA 1587]

FORM 2

THE PATENT ACT 1970

(39 OF 1970)

AND

The patent rules, 2003

COMPLETE SPECIFICATION

(See section 10: rule 13)

TITLE OF INVENTION

A SENSOR BASED CONTROL SYSTEM FOR SOILLESS VERTICAL FARMING

APPLICANT (S)

Name	Nationality	Address
Vishwakarma Institute of Information Technology	Indian	Survey No. 3/4, Kondhwa (Budruk), Pune, Maharashtra, India - 411048

PREAMBLE TO THE DESCRIPTION

COMPLETE

Following specification particularly describes the invention and the manner in which it is to be performed.

DESCRIPTION

TECHNICAL FIELD OF INVENTION

The present invention is related to the field of electronic engineering. More specifically, it relates to a sensor based control system for soilless vertical farming.

BACKGROUND OF THE INVENTION

The background information herein below relates to the present disclosure but is not necessarily prior art.

Hydroponic system is a principal circular component of vertical farming. It includes a multitier system with Light emitting diodes (LEDs), Heating or Air conditioning units, light, temperature and airflow environments with a controlled unit. The system described in uses the Internet of Things, vertical and zone-based agricultural production, and artificial photosynthesis. For better system analysis and monitoring, the time fluctuations in the data from each sensor are displayed graphically. To monitor and record the values of numerous factors such as humidity, temperature, soil moisture and sunlight of the natural environment, their study offers a simple and straightforward microcontroller-based circuit system. The construction of a web application enables continuous monitoring of the sensor data in relation to a threshold. ARM controllers, sensors and GSM technologies are used to build an automatic monitoring and alarm system. The water irrigation system and controlling the light intensity of grow lights are both remote controlled systems. The proposed approach focuses primarily on metropolitan areas where there are more commercial structures and less land available for agriculture.

Focusing on hydroponic systems, the research study proposes Vertical Hydroponics Farming Test-Bed in Qatar. There are many different types of hydroponic systems, from deep-flow aeroponic systems to wick systems, drip systems and nutrient systems. These systems are currently being developed to solve technical,

difficulty and crop impact problems. Power consumption is continuously monitored by a power meter module, making the system more energy efficient and highly expandable. The vertical Nutrient Film Technique (NFT) hydroponic system used in this research offered the most advantages over the other systems, claimed by researchers. The vertical NFT system contains 4 tubes distributed on 3 shelves and each tube has 9 holes for plant growing. This system was used to grow tomatoes, strawberries, mint, coriander, cucumbers, peppers, lettuce and tomatoes from stalks in an indoor area. The IoT platform allows data extraction in a CSV file, which can be helpful in creating machine learning algorithms, while at the same time the system can generate a large amount of data suitable for training classical and deep learning algorithms in order to improve the performance of the automated control system.

The colour sensors for detection of fertilizer requirement for a smart farm are implemented in the study. that uses sensors such as LDR sensors, temperature sensors, humidity sensors and wind speed sensors, among others. The RGB values of the leaf are determined using a colour sensor in this research, which helps to determine the exact amount of fertilizer is determined using the pallet number instead of averaging two pallet numbers. The colour sensor not only helps with fertilizer dosage, but also determines whether a leaf is diseased. For continuous monitoring of the temperature around the farm and for irrigation, for any change in soil moisture, a temperature sensor and a soil moisture sensor are connected. With the help of the soil moisture sensor, the moisture content in the soil is determined and the water supply is carried out depending on the specified threshold value. The temperature is continuously monitored with an analogue temperature sensor.

INA202211075551 discloses the Internet of Things (IoT) is becoming more and more popular as new technologies are introduced, not just in industries but also in agriculture. Agriculture is essential to the development of human civilization, and as the population grows, it becomes more important to boost production while reducing costs, time requirements, and labour inputs. In order to meet those needs, the IoT idea is used. Agriculture as it is practiced today requires a lot of manual labour. Farmers found it challenging to keep tabs on field conditions at all times and from any

location. As a result, utilizing IoT technology, the parameters related to agriculture, such as temperature, humidity, rain, moisture, etc., are gathered with the use of sensors and quickly communicated to the farmers. To increase agricultural productivity, the suggested farm system integrates IoT, Raspberry Pi, and sensors. Thingspeak.com provides a live online information feed. With the use of these mobile devices, farmers in this system are able to monitor and manage all aspects of farming, from pre-farming to post-farming, and receive advice around-the-clock. Animal detection gives the current system an added benefit by spotting its presence and issuing a warning. The presence of animals interfering with human life and the environment in residential areas is growing. It is practical to use this technique to protect both human and animal life.

US11195015B2 related to an agricultural method includes providing a positive air pressure chamber to prevent outside contaminants from entering the chamber; growing crops in a plurality of cells in the chamber, each cell having multi-grow benches or levels, each cell further having connectors to vertical hoists for vertical movements in the chamber; maintaining pre-set temperature, humidity, carbon dioxide, watering and lighting levels to achieve predetermined plant growth; using motorized transport rails to deliver benches for operations including seeding, harvesting, grow media recovery, and bench wash; dispensing seeds in the cell with a mechanical seeder coupled to the transport rails; growing the crops with computer controlled nutrients, light and air level; and harvesting the crops and delivering the harvested crop at a selected outlet of the chamber.

OBJECTIVE OF THE INVENTION

The primary objective of the present invention is to provide asensor-based control system for soilless vertical farming.

Another object of the present invention is to make precise monitoring and control of environmental parameters such as temperature, humidity, light intensity, and nutrient content possible by IOT-based sensors.

Yet another object of the present invention is to provide a continuously monitored and analysedthe crop stress, disease, or nutrient deficiencies is facilitated, allowing for faster intervention and increased crop production.

Yet another object of the present is to provide effective water management enable real-time monitoring of soil moisture, enabling accurate irrigation techniques.

SUMMARY OF THE INVENTION

Accordinglythe following invention providesa sensor based control system for soilless vertical farming. The soilless vertical farming has revolutionized modern agriculture by offering an innovative and sustainable approach to growing crops in limited spaces. This synopsis outlines a cutting-edge farming system that utilizes advanced sensor-based control mechanisms to optimize the application of fertilizers, water, and light in vertical farming setups.

The proposed system employs a combination of precision sensors and sophisticated algorithms to monitor crucial environmental variables in real-time. These sensors are strategically placed throughout the vertical farm to continuously measure essential parameters such as temperature, humidity, pH levels, nutrient content, and light intensity.

The data collected by these sensors is fed into an intelligent control system, capable of making data-driven decisions and adjustments to optimize crop growth. The system's primary objectives are to ensure precise delivery of nutrients, water, and light to each individual plant, maximizing yield and resource efficiency while minimizing waste. Equipment are Vertical Farming Equipment like shelves, racks, Plant reservoir for plant support,Nutrient Pump, Air Pump(106), LED Bulbs(104), Sensors (Fertilizer Sensor(102), Temperature Sensor(105), UV Sensor, Light Intensity Sensor(104), Arduino), Wires, power convertor etc.

BRIEF DESCRIPTION OF DRAWING

This invention is described by way of example with reference to the following drawing where,

Figure 1of sheet 1 illustrated the proposed sensor-based control system for soilless vertical farming.

Where,

101 denotes a sensor-controlled submersible pump.
102 denotes the fertilizer sensor.
103 denotes an ultraviolet sensor.
104 denotes a sensor-controlled LED or varying intensity.
105 denotes the temperature sensor.
106 denotes an air pump.
107 denotes a nutrient solution.

Figure 2 of sheet 2 illustrated the block diagram of proposed invention.

DETAILED DESCRIPTION OF THE INVENTION

As used in the description herein and throughout the claims that follow, the meaning of “a,” “an,” and “the” includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of “in” includes “in” and “on” unless the context clearly dictates otherwise.

The present invention is related a sensor-based control system for soilless vertical farming. Vertical farming is a promising approach to address the challenges of traditional agriculture by maximizing food production in limited space and reducing the environmental impact. Due to the lack of natural soil in soilless vertical farming systems, precise management of key elements such as fertilizer, water and light is required to maximize crop development and yield. In order to increase the effectiveness and sustainability of soilless vertical farming, the invention is on the

implementation of sensor-based control systems. Real-time monitoring of important factors such as nutrient levels, soil moisture, water quality and light intensity is made possible by integrating sensors into vertical farming systems. Using intelligent control algorithms, the fertilizing, watering and light conditions can be dynamically changed and optimized depending on the plant requirements by collecting correct data from the sensors.

Error! Reference source not found. shows step-by-step methodology to create a soilless vertical farming system integrated with a fertilizer sensor, LED lighting, LED intensity control module, and wireless network connectivity to connect with a mobile device for remote monitoring and control.

Planning and Design:

- Determine the available space and select an appropriate location for your vertical farm.
- Decide on the number of vertical tiers and the size of each tier based on your requirements and available resources.
- Design the layout of the tiers, considering factors like accessibility, lighting, and irrigation system placement.

Construction of Vertical Farming System:

- Build or acquire the vertical farming structure, ensuring it is sturdy, well-supported, and capable of handling the weight of plants and equipment.
- Install shelves or racks on each tier to hold the growing containers.
- Set up the irrigation system, including pipes, pumps, and drip emitters or misters, to deliver water and nutrients to the plants.

The proposed vertical form system is based on Hydroponic System. Hydroponic systems refer to soilless cultivation systems that provide plants with essential nutrients and water directly through a nutrient-rich solution, typically consisting of a balanced mixture of mineral salts dissolved in water. In hydroponics, the plant roots are supported by an inert medium or substrate, such as rockwool,

perlite, or coconut coir, which holds the plants in place while allowing for the exchange of oxygen and nutrient uptake.

The ability to precisely control fertilizer levels and concentrations, pH, and climatic factors such as temperature, humidity, and lighting are among the key features of hydroponic systems. These systems use a variety of methods including drip irrigation, aeroponics, deep water culture, and nutrient film technology to deliver the nutrient solution to the roots. Because water and nutrients are recycled, hydroponics allows for the most efficient use of resources while minimizing waste and negative environmental impact.

Installation of Fertilizer Sensor:

a. Choose a suitable fertilizer sensor that can measure nutrient levels in the water or growing medium.
b. Install the sensor in the irrigation system at an appropriate location to capture accurate readings.
c. Connect the sensor to a microcontroller or data acquisition device for data collection and processing.

LED Lighting Setup:

a. Select high-quality LED grow lights suitable for your crop's specific lighting requirements.
b. Install LED lights on each tier of the vertical farm, ensuring even coverage and proper positioning to optimize plant growth.
c. Connect the LED lights to a power source and consider using timers or programmable controllers for automated lighting schedules.

LED Intensity Control Module:

a. Acquire or develop an LED intensity control module that can regulate the brightness and spectrum of the LED lights.
b. Install the control module in a convenient location, preferably near the vertical farming system's control center.

c. Connect the LED lights to the control module and configure the settings according to the crop's growth stages and lighting requirements.

Wireless Network Integration:

a. Choose a reliable wireless network technology, such as Wi-Fi or Bluetooth, for connecting the vertical farming system to a mobile device.
b. Set up a wireless network router or access point within range of the vertical farm's control center.
c. Configure the network settings and establish a connection between the control center and the mobile device(s) using the appropriate wireless protocol.

Mobile App Development:

a. Design and develop a mobile application compatible with the wireless network technology chosen in the previous step.
b. Implement features in the app to receive real-time data from the fertilizer sensor, control LED intensity, and monitor other relevant parameters.
c. Ensure the app provides a user-friendly interface for managing the vertical farm remotely and accessing vital information.

Testing and Calibration:

a. Conduct thorough testing of the entire system, including the fertilizer sensor, LED lights, intensity control module, wireless network, and mobile app.
b. Calibrate the fertilizer sensor to ensure accurate readings and adjust the LED intensity settings based on plant response and growth requirements.
c. Make any necessary adjustments or refinements to optimize the system's performance and reliability.

Maintenance and Monitoring:

a. Establish a regular maintenance schedule to check and clean the irrigation system, LED lights, and control modules.
b. Monitor the fertilizer sensor readings and make necessary adjustments to maintain optimal nutrient levels.

c. Continuously monitor the wireless network connectivity and troubleshoot any issues that arise.
d. Regularly update the mobile app to enhance functionality and address any bugs or security vulnerabilities.

Working of the proposed invention:

The vertical farm system is meticulously designed from the ground up, starting with a thorough assessment of the available space to determine the most suitable location. Once the space is identified, careful consideration is given to the number of vertical tiers needed and the size of each tier, ensuring they align with the requirements and available resources. This planning phase also involves designing the layout of the tiers, taking into account factors such as accessibility, lighting, and the placement of the irrigation system to maximize efficiency.

Following the planning and design stage, the construction phase commences with the creation of a sturdy structure capable of supporting the weight of both plants and equipment. This includes the installation of shelves or racks on each tier to hold the growing containers securely in place. Additionally, the irrigation system is set up, incorporating pipes, pumps, and drip emitters or misters to deliver water and essential nutrients directly to the plants' roots.

Integral to this hydroponic system is the integration of a fertilizer sensor, which plays a crucial role in monitoring nutrient levels in the water or growing medium. The sensor is carefully installed within the irrigation system at an optimal location to ensure accurate readings. This data is then collected and processed using a microcontroller or data acquisition device, providing valuable insights into the health and nutrient status of the plants.

In conjunction with nutrient monitoring, LED lighting is strategically installed on each tier to provide the necessary illumination for optimal plant growth. High-quality LED grow lights are selected based on the specific lighting requirements of

the crops being cultivated. These lights are connected to a power source and may be controlled using timers or programmable controllers to establish automated lighting schedules that mimic natural daylight cycles.

To further enhance the efficiency and management of the vertical farming system, wireless network integration is implemented. This allows for seamless communication between the system and a mobile device, facilitating real-time data monitoring and system management. A dedicated mobile application is developed to interface with the system, providing users with the ability to remotely monitor nutrient levels, adjust LED lighting intensity, and access other relevant parameters.

Soilless vertical farming, also known as vertical farming or hydroponics, is an innovative approach to farming that involves growing crops in vertically stacked layers without using soil. This method has gained popularity due to its numerous benefits and the need for sustainable and efficient food production. The reasons behind soilless vertical farming can be understood from the following points:

Land use: Arable land is becoming increasingly scarce due to increasing urbanization and a growing world population. By using vertical space instead of horizontal land, soilless vertical farming offers a method that allows crops to be grown in urban areas or in sites with limited space.

High Yield: By using vertical space, vertical farming increases the productivity of the land. To increase planting density and total crop production per unit area, crops are grown in stacked layers called towers. This high-yield method relieves conventional agriculture and helps to cover the increasing need for food

Water Efficiency: Circulating water systems are used in soilless vertical farming techniques such as hydroponics, which use much less water than traditional soil-based farming. These systems efficiently transport water to plant roots, reducing water loss through evaporation or runoff. This water-saving feature is essential, especially in areas with water scarcity.

Controlled environment: By using vertical farming, a controlled environment for crop development can be created. In order to optimize plant development and increase yield, factors such as light, temperature, humidity and nutrient levels can be precisely controlled. With this management, crop production can take place all year round without being dependent on the weather.

Reduced pesticide use: Pest and disease control is improved in a controlled environment, reducing the need for chemical pesticides. To control pests biologically, vertical farming systems often use integrated pest management strategies such as beneficial insects or physical barriers. This strategy promotes organic and chemical-free farming methods.

Freshness and Local Production: Locating vertical farms closer to urban centers can shorten the supply chain and reduce transportation costs. Because of this close proximity, consumers may receive fresh, locally grown produce that enhances flavour and nutritional content while reducing the carbon footprint of long-distance transportation.

The preferred embodiment of present invention consisting of a sensor-controlled submersible pump (101) connected to the nutrient solution reservoir (107) for precise delivery of nutrient solutions based on feedback from the fertilizer sensor (102), a fertilizer sensor (102) integrated into the irrigation system and connected to a microcontroller and data acquisition device for real-time monitoring of nutrient levels, an ultraviolet sensor (103) connected to the microcontroller and data acquisition device for monitoring UV radiation levels affecting plant growth, a sensor-controlled LED lighting system (104) with varying intensity, connected to the microcontroller and data acquisition device, for optimizing light conditions based on data from the temperature sensor (105) and ultraviolet sensor (103), a temperature sensor (105) connected to the microcontroller and data acquisition device for monitoring ambient temperature within the vertical farming environment, and an air pump (106)

connected to the nutrient solution reservoir (107) and sensor-controlled submersible pump (101) for aerating the nutrient solution and maintaining optimal oxygen levels.

While various embodiments of the present disclosure have been illustrated and described herein, it will be clear that the disclosure is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions, and equivalents will be apparent to those skilled in the art, without departing from the spirit and scope of the disclosure, as described in the claims.

I/We Claim:

1. A sensor based control system for soilless vertical farming, comprising of:

a sensor-controlled submersible pump (101) connected to the nutrient solution reservoir (107) for precise delivery of nutrient solutions based on feedback from the fertilizer sensor (102);

a fertilizer sensor (102) integrated into the irrigation system and connected to a microcontroller and data acquisition device for real-time monitoring of nutrient levels;

an ultraviolet sensor (103) connected to the microcontroller and data acquisition device for monitoring UV radiation levels affecting plant growth;

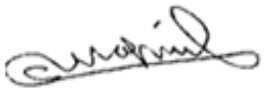
a sensor-controlled LED lighting system (104) with varying intensity, connected to the microcontroller and data acquisition device, for optimizing light conditions based on data from the temperature sensor (105) and ultraviolet sensor (103);

a temperature sensor (105) connected to the microcontroller and data acquisition device for monitoring ambient temperature within the vertical farming environment, and;

an air pump (106) connected to the nutrient solution reservoir (107) and sensor-controlled submersible pump (101) for aerating the nutrient solution and maintaining optimal oxygen levels.

2. The sensor based control system for soilless vertical farming as claimed in claim 1 wherein a wireless network module to connect with a mobile device for remote monitoring and control.

Date:04/05/2024



Adv. Swapnil Jayantrao Gawande

Agent for the applicant [IN/PA 1587]

ABSTRACT

A SENSOR BASED CONTROL SYSTEM FOR SOILLESS VERTICAL FARMING

The present invention is related a sensor based control system for soilless vertical farming. in order to increase the effectiveness and sustainability of soilless vertical farming, the invention is on the implementation of sensor-based control systems. a sensor-controlled submersible pump (101) for precise nutrient delivery, a fertilizer sensor (102) monitoring nutrient levels, an ultraviolet sensor (103) gauging UV radiation, a sensor-controlled LED lighting system (104) adjusting intensity based on data from the temperature sensor (105) and ultraviolet sensor, and an air pump (106) aerating the nutrient solution. connected to a microcontroller, these components allow real-time monitoring and control. real-time monitoring of important factors such as nutrient levels, soil moisture, water quality and light intensity is made possible by integrating sensors. Using intelligent control algorithms, the fertilizing, watering and light conditions can be dynamically changed and optimized depending on the plant requirements by collecting correct data from the sensors.

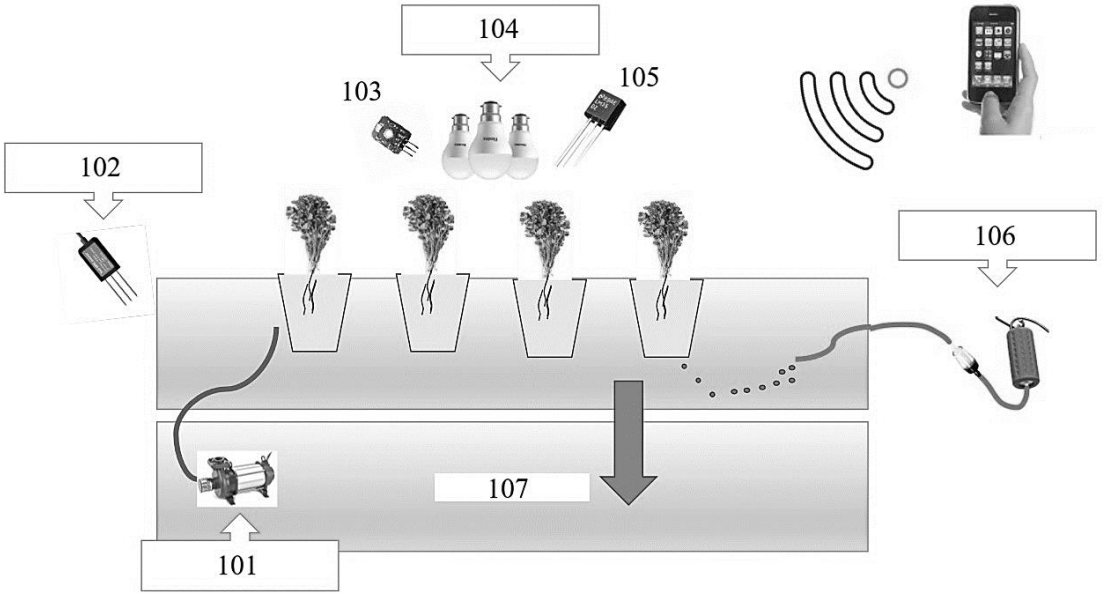


Figure 1