A Survey On Automation In Vegetable Farming

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***Abstract-*. Agriculture is in major phase of change around the world and dealing with serious problems. Due to fast growing population it would be a difficult task to supply food to all. *A* simple, inexpensive method of crop cultivation without the need of soil is effective – the technology is known as Cyberponics. In the system, plant cultivates under complete control conditions in the growth chamber by providing a small mist of the nutrient solution .The nutrient mist is ejected through atomization nozzles on a periodical basis. The roots are allowed to dangle freely and openly in the air. However, the nutrient richwater deliver with atomization nozzles. The nozzles create a fine spray mist of different droplet size at intermittently or continuously. This review concludes that Aeroponics system is considered the best plant growing method for food security and sustainable development. The system has shown some promising returns in various countries and recommended as the most efficient, useful, significant, economical and convenient plant growing system then soil and other soil-less methods.**

Keywords - Cyberponics, Atomization Nozzles, Nutrient mist, Soilless

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I INTRODUCTION

One of the greatest challenges of today is to end hunger and poverty while making agriculture and food systems sustainable. However, providing clean and fresh food for next generation is our main concerns especially for growing global population. The world food production is rising faster than population and per capita consumption increase. Studies reported that in 2050, the world population expects to surpass ten billion people, 34% higher than now. In 2050, additional 60% to 70% global food production will need to feed the more urban and larger population.The scarcity of water is the most important and crucial issue to perform agriculture activities. The problems include minimum crop production with high population: (i) Highly dependent on climatic conditions and poor growing season due to starving in different parts of the world, (ii) Higher demand for biofuels could further influence on inputs, prices of farm produce, land, water, and endanger a global food security.

II RELATED WORKS

In the paper titled, Soil-less culture in modern agriculture by 'Amrita Sengupta and Hirak Banerjee',explains the need of soil-less cultivation of crops.Soil is usually the most available growing medium for plants. It provides anchorage, nutrients, air, water, etc. for successful plant growth. However, soils do pose serious limitations for plant growth too, at times. Soil-less culture mainly refers to the techniques of 'Hydroponics' and 'Aeroponics'. Hydroponics is a method of growing plants using mineral nutrient solutions, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or mineral wool. It is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution. This system helps to face the challenges of climate change and also helps in production system management for efficient utilization of natural resources and mitigating malnutrition.

In the paper titled, Use of aeroponics technique for potato (Solanumtuberosum) minitubers production in Kenya by 'M. W. Mbiyu, J. Muthoni, J. Kabira, G. Elmar, C. Muchira, P. Pwaipwai, J. Ngaruiya, S. Otienoand, J. Onditi' describes aeoponics method.Aeroponics is a plant culture technique in which mechanically supported plant roots are either continuously or periodically misted with nutrient solution. The international union of soil-less culture defines aeroponics "as a system where roots are continuously or discontinuously in an environment saturated with fine drops (a mist or aerosol) of nutrient solution" .

The basic principle of aeroponics is to grow plants in a closed or semiclosed environment by spraying the plant's roots witha nutrient-rich solution. Ideally, the environment should be kept free from pests and diseases so that the plants may grow healthier and quicker than plants grown in a soil medium. This soilless cultivation of plant can also be utilized for successful production of crops like as salad, corn i.e. baby corn, red chilies, tomatoes etc.

In the paper titled,A review on scope and potentiality of vertical farming in India by ‘Anil Kumar, Rajkumari Asha Devi, Pedada Sindhusha and Mishael R Marak ‘explains vertical farming.The vertical farming allows merging the other sophisticated growing techniques to a single system to get higher productivity. The techniques viz. hydroponics and controlled environment conditions can be used to grow crops based on a common principle of vertical farming.

These methods can be incorporated together or can be used solely to grow cops in vertical structures. The vertical farming can be carried out in a small structure to large sky scrapers. Vertical farming involves growing of crops vertically in controlled atmosphere using technology like LED lighting, heating, ventilation and air-conditioning systems, sensors and smart software, drones, mobile apps to maintain total control over the environment. It is also pressing need to grow more & more crops in a sustainable way to provide food to everyone and vertical farming and hydroponics are one of best alternatives to be integrated.

III METHODOLOGY

The goal of our project is to create a fully automated aeroponics and greenhouse system that will reduce the need for human interference to the maximum possible extent. Two different chambers will be developed one for the shoot system and the other for the root system. This is done to ensure that the climatic conditions of the root system and shoot system are completely independent of each other.

The shoot chamber will host a light sensor, temperature sensor, humidity sensor, air pressure sensor, gas sensor and an ultrasonic range finder along with two air pumps to regulate the air pressure within the chamber. A temperature regulator, made using thermoelectric coolers, will be connected to the shoot chamber to regulate the temperature of the chamber.

The regulator will consist of a cooler and a heater. The cooler will reduce the temperature of the chamber if the temperature of the system increases above the optimum value. The heater will increase the temperature of the chamber if the temperature drops below the optimum value. An array of white LED lights will be fixed to the zenith of the chamber and the brightness of these lights will be controlled according to the optimum light intensity different plants require for photosynthesis. An ultrasonic range finder will monitor the growth of the plant.

A gas chamber will regulate the amount of carbon dioxide and oxygen present within the root chamber. Plants require oxygen for respiration and carbon dioxide for photosynthesis. The optimum length of time a plant needs to be exposed to light for efficient food production differs from plant to plant and the composition of the air in the shoot chamber needs to be regulated to suit both respiration and photosynthesis. The gas chamber will consist of an oxygen chamber and a carbon dioxide chamber and gases from these chambers will be delivered to the shoot chamber through the use of air pumps.

A humidifier will regulate the humidity level of the shoot chamber to match the requirement of the plant. An ultrasonic atomizer will be placed inside a reservoir of water to produce mist and the mist will be pumped into the shoot chamber through an air pump to increase the humidity of the chamber. To reduce the humidity within the chamber the air pump that is used to regulate the air pressure within the chamber can be used. The cooler can also liquify the moisture to reduce the humidity within the chamber.

The root chamber will have its own temperature regulator which will regulate the temperature of it in the same way the temperature of the shoot chamber is regulated. The oxygen chamber of the gas chamber will also be connected to the root chamber through an air pump to regulate the oxygen level in the root chamber. Similar to the shoot chamber, the root chamber will also contain a pair of air pumps which will be used to regulate the air pressure within the root chamber. The humidifier will also be connected to the root chamber to regulate the humidity level of the root chamber. A nutrient chamber will be constructed which will consist of the nutrient, pH Up liquid and pH down liquid. A reservoir will be placed on the floor of the root chamber and water, nutrients, pH up liquid and pH down liquid will be supplied through solenoid valves. A couple of mixers in the reservoir will ensure that the composition of the nutrient solution within the reservoir stays consistent.

A pH sensor and an EC sensor will monitor the pH and EC level of the solution and according to the needs water, nutrients, and pH up and down liquids will be delivered to the nutrient solution. An ultrasonic range finder will monitor the water level of the reservoir and the reservoir will be replenished if the solution drops below a certain level.A beehive bottle will be immersed in the nutrient solution and an ultrasonic atomizer will be placed inside it. When the atomizer produces mist, the mist will be constrained within the bottle and the mist will be sprayed at the root using an air pump.The specific objectives of this project involve accomplishing goals which are specific to system and which would greatly improve the system from those that are already available.

Hence, the objective is to develop an aeroponic and greenhouse system that can both monitor and regulate the interior environment, and send the collected data over an internet connection to a server which would process the data and display it to the user through a web interface, which will also be used to allow the user to control the aeroponic system.

The hardware components are:NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature

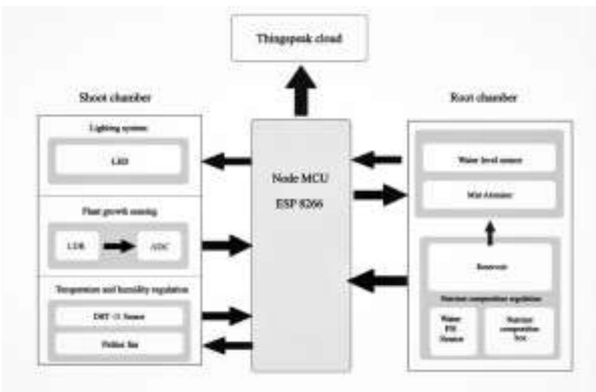

Fig 1: Block Diagram Of Cyberponics

The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form. For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. It is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.Ultrasonic sensor is used to measure the water level in the system. It is used to determine the distance to the water, it transmits a sound pulse that reflects from the surface of the water and measures the time it takes for the echo to return. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity and the ultrasonic sensor (or transducer) works on the same principles as a radar system. An ultrasonic sensor can convert electrical energy into acoustic waves and vice versa.

A pH meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as pH.It measures the difference in electrical potential between a pH electrode and a reference electrode.Total dissolved solids (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. TDS concentrations are often reported in parts per million (ppm) or milligram per Litre (mg/l).

Primary sources for TDS in receiving waters are agricultural runoff and residential (urban) runoff, clay-rich mountain waters, leaching of soil contamination, and point source water pollution discharge from industrial or sewage treatment plants.Water pump is used to control the inflow of water in the system and control of the water flow will be based on computation process from the SOC board based on other sensors .A humidity sensor senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity . A photoresistor (acronymed LDR for Light Decreasing Resistance, or light- dependent resistor, or photoconductive cell) is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits and light-activated and dark-activated switching circuits acting as a resistance semiconductor.

In the dark, a photoresistor can have a resistance as high as several megaohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The software requirements are:The Arduino integrated development environment (IDE The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java.

It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple oneclick mechanisms to compile and upload programs to an Arduino board.

It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.ThingSpeak has integrated support from the numericalcomputingsoftware MATLAB from Math Works, allowing ThingSpeak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks. Feature include sharing of data with public channel,collect data in private channel and does event schelding.

IV ADVANTAGES:

Delivers nutrients directly to the plant roots. Conserves water through runoff absorption into roots. Controls moisture for better plant growth.It Can be combined with hydroponics. . Reduce the risk of disease and pest infestation in a controlled environment. Produces higher quality food in a controlled environment. Roots are provided with better exposure to oxygen.

V DISADVANTAGES:

Aeroponics facilities require constant monitoring to be successful and also it is an expensive growing method to set up initially.Aeroponics is highly susceptible to power outages so we must have a certain level of technical knowledge and it requires regular disinfection of the root chamber.The equipment relies heavily on automatic systems.Only high-pressure systems are suitable for long-term growth projects.Aeroponics systems can be noisy in an enclosed environment.

VI APPLICATIONS

The chief feature of aeroponics is fast plant growth where plants grow fast because their roots have access to a lot of oxygen 24/7.In aeroponics, need to maintain is the root chamber (the container housing the roots) which needs regular disinfecting, and periodically, the reservoir and irrigation channels so maintenance of the system is easy and less need for nutrients and water where Aeroponic plants need less nutrients and water on average, because the nutrient absorption rate is higher, and plants usually respond to aeroponic systems by growing even more roots and requires little space where it will not acquire much space to start an aeroponics garden. Depending on the system, plants can be stacked up one on top of each other.

VII CONCLUSION

The main features of this automated aeroponics system is monitoring and regulating the essential factors needed for plant growth. User can control the operation of system with customized user settings. All the necessary factors that are essential/vital for the plant growth is monitored using this system and regulated automatically by using suitable mechanism, thus it takes off the additional burden from the plant grower.

Plant growth should be monitored frequently in order to identify any problem occurring with the plant. This is achieved by using taking regular photos of the plant through the web interface and the reading collected from ultrasonic sensor which helps to determine the height of the plant. The system has shown some promising returns in various countries and recommended as the most efficient, useful, significant, economical and convenient plant growing system then soil and other soil-less methods.

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