Automated Hydroponics Based Vertical Farming System

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Abstract - **Agriculture is the most important sector of Indian Economy. Indian agriculture sector accounts for 18 per cent of India's gross domestic product (GDP) and provides service to 50% of the countries workforce. India is the world's largest producer of pulses, rice, wheat, spices and spice products. India has many areas to choose for business such as dairy, meat, poultry, fisheries and food grains etc. India has arose as the second largest producer of fruits and vegetables in the world. In India, dependency on agricultural yield and geographic conditions contribute majors to underdevelopment and poverty. These problems can be overcome by using alternate farming methods and new technologies. Farming technics like hydroponics, aeroponics and aquaponics provide large agricultural yields as well as fertilizer free crops with less water usage. These technics can be implemented in areas with scarce water supply. Along with these farming technics, vertical farming can be used to generate more yields in less area. Vertical farming greatly reduces the required farming area. To further improve these methods an automated system can be used to control the various processes that are required when using these farming methods. These automation reduces the human intervention as well increase the growth rate of the crops. Analyzing enormous amount of data can be done by accessing and linking various devices with the help of Internet of Things (IoT).**

Key Words: Hydroponics, Farming, Agriculture, Soil, Automated

1. INTRODUCTION

Agriculture is deliberated as the dynamic piece of life for the human kind as it is the central source of sustenance grains. It plays crucial part in the progress of country's economy and enhancement. It furthermore gives huge trade openings to the general population. Improvement in agricultural section is vital for the improvement of economic state of the country. Unfortunately, abundant agriculturists still use the orthodox policies of cultivation which brings about low yield of harvests. Wherever automation had been used and human beings had been replaced by means of automatic tools, the produce has been increased and less work required. Therefore there is requirement to realize and utilize current innovation in the agriculture to upturn the yield of crop. Use of automation technology means the utilization of sensors and transducers to gather the information from various environmental conditions and recreate the atmosphere more suitable for the plant growth as well send the whole system processes to the user. The collected data gives information about various environmental factors affecting plant growth.

There are number of diverse factors that affect the proficiency to overwhelming mark. These factors include assault of bugs when product is at the phase of gathering. Indeed, even after gathering, ranchers likewise confront issues away of collected trim and some more. In this way, so as to give answers for all such issues, it is important to create coordinated framework which will deal with all components influencing the efficiency in each stage.

2. Hydroponics

Generally soil is seen as a primary medium for growing crops. This reduces the arable area across the country to support proper fertilized soil to be able to cultivate crops. This limits farming to specific areas. Hydroponics works on the principle of cultivation of crops on water completely. Thus there is no need for soil to be used. This provides limitless possibilities as to how the crops can be grown. Hydroponics system works on the principle of water used as the primary medium of growth .The essential nutrients required by the crops are provided by mixing the nutrient solutions in the water which is then circulated to the crops. Use of Hydroponics as greatly reduces the water requirement for cultivation as most of the water is reused whereas in soil cultivation water usage is inefficient. The benefit of hydroponics is that you can avoid numerous problems that affect growth in plants such as insects and soil-borne diseases that can harm your yield. This means insecticides can be avoided. And the user has more control over the nutrients that nourish the crops. It is easier to vary the nutrients that the plant receives at various steps in the life cycle to ensure ideal growth.
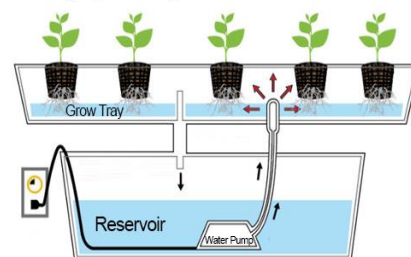
Fig -2: Hydroponics System

B) Aeroponics

Aeroponics is a method of growing vegetation without soil and with very tiny water. It's a very effective and proficient method of growing an extensive variety of vegetation. By means of this technique means you can produce upright as well as parallel, thus it can be a great method of saving space.

With aeroponics, vegetation is placed into horizontal boards, in such an approach that top, crown, bottom and roots are put off in the air. In this approach the top can grow skyward in addition to the roots sinking lacking need of soil at all. The cultivators nourish the vegetation by means of spraying them scheduled basis by a fine mist of a nutrient-rich, water-mix

Solution. As the entire structure is sealed off, you save water since the nutrient mixture is entirely salvaged inside the aeroponics systems design.
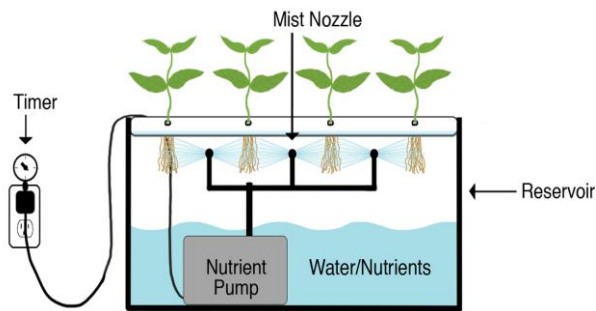

Fig -2: Aeroponics System

C) Aquaponics

Aquaponics is a method of cultivation that conglomerates nurturing fish in tanks (recirculating aquaculture) along with soilless plant culture (hydroponics). In aquaponics, the nutrient-rich water from nurturing fish delivers a natural nourishment used for the vegetation and the vegetation aid to cleanse the water for the fish. Aquaponics can be used to sustainably nurture fresh fish and vegetables for a household, to nourish a rural community or to produce revenue in a money-making agribusiness venture, year 'round, in any climate.

D) Vertical Farming

With the use of Hydroponics new ways of area utilization is possible. One of them is vertical farming. In vertical farming the crops are stacked on top of one another to reduce the area requirement. This is greatly useful in areas where area is a problem. This also is useful in agricultural cultivation in urban areas as well as in closed spaces like warehouses. Controlled environments are used when growing crops in closed spaces such as buildings or warehouses.

II. METHODOLOGY

The entire structure is comprised of 3 main modules: sensors, data analytics, and web interface. Hardware consists of a hydroponics farm assembled with a sensor grid for the purpose of monitoring and controlling the system. The sensor network is comprised of five different sensors that control different parameters needed for plant growth namely humidity, pH level, Water level, light intensity.

A. CONSTRUCTING THE SYSTEM STRUCTURE

Even though the plants in hydroponic system do not require soil to grow but they require a support to help them grow. There are various techniques that can be used for providing the base such as Rockwool, clay pellets or nutrient film. In this structure we will be using the Rockwool and clay pellets to provide the support base. The clay pellets will be placed in a porous container along with the seed. A water base will be provided which will receive the circulating water which is enriched with nutrients. The growing containers will be placed in the water base as sown in figure 4. The nutrient rich water will be stored in container placed at the bottom of the structure. An oxygen pump will ensure that the water is oxygenated along with a sensor network to check pH and water level. The water pump will circulate the water across the system.

Fig. 4: Farm model

B. Sensor network

The sensor network consists of four different sensors humidity, water level, light, pH sensor. This sensors are connected to a microcontroller which performs the task of analyzing the data and performing tasks based on that data.
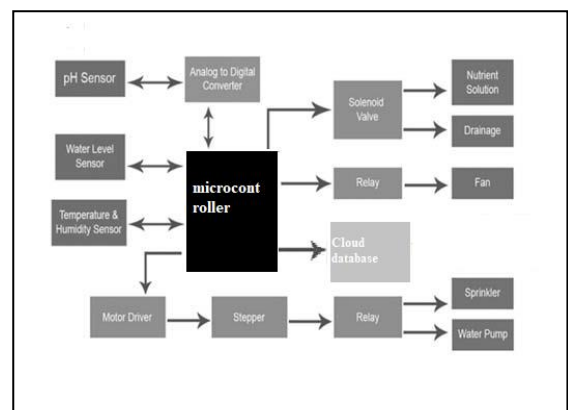

Fig. 5: System Block Diagram

C. Automatic Climate Control

The microcontroller takes into consideration all the sensor modules initializes them and starts the automation process by gathering input data from the sensors this data is then processed to generate an appropriate response corresponding to the plant type. If the light sensor detects enough light in the system then the leds are turned off to save energy. The microcontroller activates the pump at scheduled times to ensure nutrient rich water reaches the plants and the water stays oxygenated. The ph. sensor monitors the pH of the solution in the primary tank periodically to ensure that the ph. level of the water is within specified range. If the ph. level exceeds the recommended range the microcontroller turns the solenoid valve to let fresh water in to balance out the ph. The system also monitors the humidity levels. As with modern technologies it is possible to grow seasonal crops at any time irrespective of the location. Suppose a plant only grows in humid climate the system adjusts the system to generate the specific or suitable climate for the plant to grow. The humidity sensor monitors the humidity and if humidity level is high the controller activates the fans to control the temperature. Fans are also used to maintain a specific temperature for the plants.

3. CONCLUSIONS

Hydroponic nurturing offers countless principal ideas when differentiated using regular cultivation. Principle point of attention is that crops can be grown in locations with unproductive land. Hydroponically grown plants are a lot resistant to water with a high salt contains. Additional benefit integrates not having insects, rodents, and contaminations. Hydroponic farming has lot of advantages for growing appropriate plants which leads towards rise in produce of farm by means of appropriate quantity of nutrient, light, water and in fit temperature environments. This can be easily done by using a microcontroller based automation system which is easy to implement and requires less intervention. The system is also easy to deploy and maintain as well as scalable. The se=system also updates the server with information about the system periodically hence all the information is available to the user and the system can also be controlled with the web environment which makes the user interaction with machine more friendly.

ACKNOWLEDGEMENT

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