SMART FARMING USINGAUTOMATIC AEROPONICS SYSTEM

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Abstract:Many cities over India are now becoming smart cities to achieve well developed status. In process of this development and urbanization there is lack of space and food in cities where we require the concept of smart farming. To fulfil the growing need of food we are developing this smart farming project using aeroponics technique, and our main objective is to make the aeroponics techniqueautomatic plus making the setup universal for multiple vegetable crops. In this automatic aeroponics system water and nutrition is fed to crops as per periodic cycle inside roots section. Temperature, humidity, pH and level of nutrition solution in reservoir are monitored. In absence of sunlight artificial light will be provided for photosynthesis.Overall automated system helps to reduce human efforts and increase the growth rate of plants.

Keywords:Smart Farming, Aeroponics, Monitoring and Controlling, Humidity, Growth rate of Plants.

I. INTRODUCTION

In India human population is increasing, thereby increasing the requirement of food daily. It becomes difficult for farmers to grow more crops at faster harvest rates with traditional farming methods which is not possible due to lack of fertile land fields. Majority of the farmers utilize major land fields to produce major crops like wheat, corn and alike, due to which there is less production of vegetable food due to which there is lack in meeting the daily food demands. To overcome the situation advance techniques of farming must be utilized. The aeroponics is one of advance technique of farming to get faster growth rate of plants. And our aim of this project is to monitor & control parameters of aeroponic system using controller to fasten the growth of plants & enhance the performance of system.

1.AeroponicsTechnique

Aeroponics is a new soilless technology in which the plant roots are suspended in mid-air and solution of water along with essential nutrients are sprayed on the roots at fixed interval of time. [1] The plants are grown in vitro in an enclosed chamber. This ensures maximum aeration to the roots thereby resulting in faster growth of the plants.This technique maximizes the oxygen availability at the root section, which results in faster growing of the vegetables.

2.Technology Developed Till Date

The research on such advance techniques with less water were first developed in 1920 by botanist who used aeroponics to study plants root structure in 1990's, study and refinement of such techniques took off after NASA funded a project by a small aeroponics operation. Further in such technique a network of specially designed PVC pipes are used as growing setups for plants known as nutrient film technique(NFT).[2] In other structure dip water culture (DWC) utilized containers filled with nutrient solution to grow plants. Such a system requires constant monitoring and maintenance, this makes the existing systems very intricate and not user friendly. These systems are too bulky and poorly designed thereby making the system inefficient. Herein is a combined effort to meet the technological development and to overcome the above mentioned complexities; by increasing quality of production and bringing about efficiency in growth of plant capacity.

3.Automatic AeroponicsSystem

To optimize the resources consumption and for the better working of the technique it is necessary to continuously monitor the technique. Because of a system failure or improper functioning may cause the loss of vegetable crop.The aeroponics system requires continuous monitoring of the setup by a skilled person, so to avoid this continuous human work and to improve the systems efficiency different controller are used which boost the production by controlling the different parameters which affects plants growth[3]In this technique one needs to monitor temperature and humidity inside the roots section. And as this technique is completely indoor system one needs to also monitor the light received by the plant for the photosynthesis process. So to improve the overall efficiency of the system and reduce the labour cost and to prevent the crop loss the aeroponics technique is made automatic.

II.METHODOLOGY OF THE SYSTEM

In this project of automatic aeroponics system, we are going to improve the performance of the system by monitoring and controlling the parameters like Temperature, Humidity, Light intensity, pH, Level, etc.

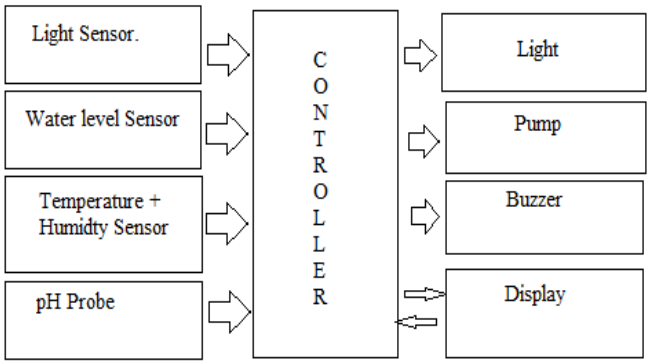

FIG.1 BLOCK DIAGRAM

1. Nutrition feed cycle control

The Nutrition solution is provided to the roots of plants via mister heads. The nutrition supply is provided in specific time cycle to avoid overwatering and continuous running of pump. The time cycle of ON and OFF of feed supply is achieved using switching of feed pump through controller and relay as per user provided time cycle.

2. Temperature and Humidity monitoring

The monitoring of the temperature and humidity of root chamber is an important task, because it affectother parameters such as the pressure, the level, and ultimatelythe growth of plants. A temperature and humidity sensor is installed inside the root chamber which continuously measures the temperature and humidity and shows it on display.

3. Nutrition reservoir level control

The level of nutrition solution in reservoir has to be maintained at the specific level to avoid drying of roots and also to avoid the dry running of pump.The level is monitored using two float switches, one for high level indication and another for low level indication.

4. Artificial light control

Plants require the specific light for the photosynthesis process. So we are using the artificial light which provides the light of required spectrum, which increases the growth rate of plant. For vegetable crops we require the light in spectrum range of 600-640 nm.

5. pH Monitoring:

pH electrode measures hydrogen ion (H+) activity and produces an electrical potential. The modern pH electrode is a combination electrode composed of two main parts;a glass electrode and a reference electrode.pH is determined by measuring the voltage difference between these two electrodes. [4]

III. AEROPONICS SETUP

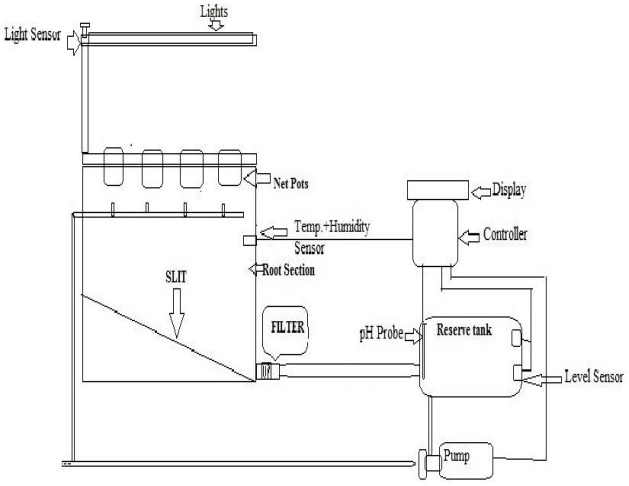

FIG.2 SETUP OF AEROPONICS SYSTEM

To make the aeroponic system setup universal, we have to make enclosure in such a way that roots section of the plants is kept in closed container with enough space for roots to grow freely. Roots section chamber should have to be isolated from sunlight to avoid formation of algae and fungus.The container should bear the weight of the heavy vegetable crops. The stem and upper section of plants should be at outer side of container with firm support to the stem. Make sure that the roots section gets proper mist of nutrition water solution for faster growth. Use net pots to provide support for roots inside the chamber.
Install one tilted slit at the bottom of the container and a filter for drainage and filtering of the nutrition solution returning to the reservoir.This solution can be recycled for reuse again in roots section.

IV. IMPLEMENTATION

Components

The systemmainly consists of temperature sensor, humidity sensor, light sensor,float switch, pH electrode, diaphragm pump, misting nozzles which is responsible for generating mist ofnutrition solution in roots chamber and buzzer which functions as an indicator for low water level in reservoir and these components are interfaced to the controller. Temperature and humidity sensor is a composite sensor contains a calibrated signal output of the temperature and humidity. The sensor includes a resistive sense of wet components and NTC temperature measurement devices, and connected with a high-performance controller. [5]The Diaphragm pumpis a positive displacement pump which has a combination of the reciprocating action to pump the nutrition solution. And the pump is operated via relay module to controller. The Diaphragm pump have good suction lift capability, some are low pressure pumps with low flow rates, others are capable of higher flow rates, dependent on the effective working diameter of the diaphragm and its stroke length. They can handle slurries with a relatively high amount of grit and solid content. Also it is suitable for discharge pressure of more than 100 psi. [6]

Plants Arrangement

Plants in an aeroponics system have to be arranged properly so that the roots of one plant suspended inmid-air in growing chamber cannot interfere with other plants roots. The spacing between two plantsshould have to be at least 2inches. Use net pots to provide support for roots. The stem of plant can be supported by using sponge or similar material to keep it steady.

Addition of Nutrientsin Water

The essential plant nutrients include carbon, oxygen and hydrogen which are absorbed from the air,whereas other mineral nutrients are obtained from the growing medium. Plant needs mineral nutrientsuch as nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), and sulphur (S), magnesium (Mg). [7]. The amount of nutrients provided to roots in aeroponics should be proper as per requirement of plants. Because the excess amount of nutrients can harm the roots.

V. RESULTS

As compared with other techniques automatic aeroponics system will give better results with good quality of vegetablecrops. Automatic controlling and monitoring helps to keep the level of humidity and temperature at constant level using a nutrition water solution feed cycle. The timely spray of nutrition water in root section chamber keeps the humidity at constant value and also the temperature of the roots section is under the safe limit at constant value as compared to outside temperature.FIG.3 shows the graph of monitored temperature and relative humidity of roots section chamber for 24 hours, where the roots of the plants grow in constant humidity and safe temperature as compared to surrounding temperature and humidity. The humidity is at 95% and temperature is at 20 °C.

FIG.3 GRAPH OF TEMPERATURE AND HUMIDITY vs. TIME

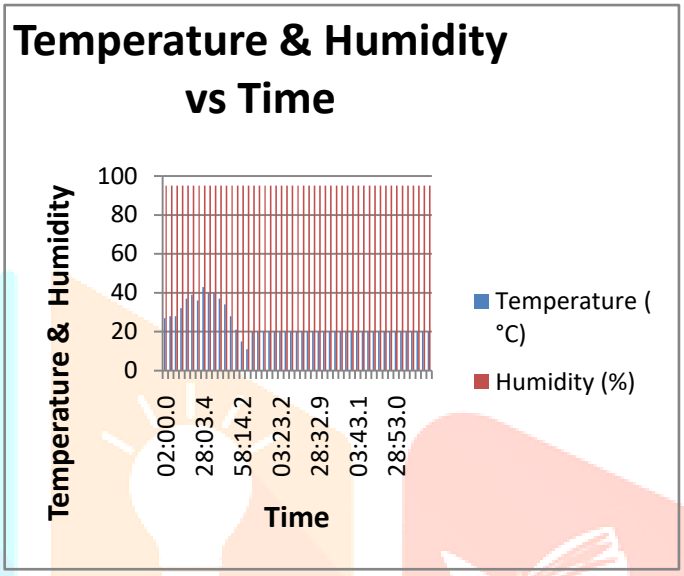

FIG.4 PLANTS GROWN IN AEROPONICS SYSTEM

VI.ADVANTAGES

- The system is fully automated thereby ensuring minimum human interference and manual errors.
- The system ensures vegetation of any type depending upon the requisites of user.
- The system protects the plants from all kinds of insects, fungus which can infect the vegetation.
- The system ensures minimum wastage of water.
- The system is eco- friendly since it does not create any type of pollution and harm the environment.
- The said system is user friendly, light weight.

VII. APPLICATION

One of the importanceof the system is its ability to provide perfect environment which ensures bettergrowth of plants. Automating the aeroponics system will reduce efforts of user and maximize theperformance of system and the universal setup allows the user to cultivate different vegetables crops. This system is also beneficial in the regions where traditional farming of vegetables is difficult. The automatic aeroponics system becomes lifesaving technique to grow vegetable crops in unfertile terrain such as deserts, some parts of hilly areaswhere water resources are less.

VIII. CONCLUSION

The automatic aeroponics system is a smart technology to grow vegetable crops in less water and withoutusing soil. The automation handles the technical monitoring and controlling of the parameters related to plants growth. This makes the system user friendly and easy to use with the less human efforts.As compared to outside atmosphere the indoor system keeps the setup environment in favourable conditions to the plant growth such as temperature, humidity, light conditions. This system can become lifesaving in areas where water and good soil is not available in large quantity such as desert land in Africa, in many parts of Asia where water and land fields are less.

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