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IoT based Hydroponic Farm

Nikita Bakhtar
V.E.S.I.T
2015nikita.bakhtar@ves.ac.in

Varsha Chhabria
V.E.S.I.T
2015varsha.chhabria@ves.ac.in

Iptisaam Chougle
V.E.S.I.T
2015iptisaam.chougle@ves.ac.in

Harsha Vidhrani
V.E.S.I.T
201harsha.vidhrani@ves.ac.in

Mrs. Rupali Hande
Professor
V.E.S.I.T
Rupali.Hande@ves.ac.in

Abstract- The effects of global warming make more difficult for planting in an uncontrolled environment. In the traditional farming method, farmers require fine quality of soil with natural mineral strengths. It also requires working cost for plowing and removal of weeds and also needs a large amount of space and water. In the case of seasonal plants, the yield does not satisfy the customer needs and the expectation of farmers in productivity. For these reasons, a farming method which needs lesser requirements in cost factor and also it easy to maintain and control the important factors such as light, water level temperature, and humidity throughout the year is needed. This proposed work presents a Hydroponic farming; the method of growing plants without making use of sunlight & soil. In this method, the plants are grown with their roots exposed to the mixture of minerals with water instead of underground soil. This method is a type of indoor agriculture style which is independent of weather, and it also avoids the cost of plowing and labor works. Watering and controlling of humidity is done with the help of a microcontroller Kit connected to Wireless sensor network with internet which senses the humidity, temperature and water level. With the help of this IoT technology, the real-time status of the plant's growth could be monitored by the authorized person from a remote location.

Keywords: Hydroponics, IoT, Sensors.

I. INTRODUCTION

The word "Hydroponic" defines as any means to grow plants via a medium that does not include the use of soil but involves inorganic nutrients or nutrient solution The system is a smart vertical farm in which plants will be grown in a vertical pipe using hydroponics and aquaponics technology. The temperature, humidity inside the system is continuously monitored using sensors. The liquid level inside the pipes is monitored using magnetic float switches and controlled using solenoid valves. The water supply to the system is from a central water tank, watering and controlling of humidity is done with the help of a microcontroller Kit connected to wireless sensor

network with internet which senses the humidity, temperature and water level.

A smart vertical farm module is used in which plants will be grown in vertical pipe stacks using hydroponics technology. The temperature, humidity inside the module is continuously monitored using sensors and feed into a microcontroller. The liquid level inside the pipes is monitored using magnetic float switches and controlled using solenoid valves. The research is basically on Smart Vertical form which monitors the changes in the environment, temperature, and humidity using sensors. In this Hydroponics system is used which means growing plants without soil with better results, especially in areas with space and environment unsuitable. Hydroponics is the upcoming technology that grows plants through minerals and water instead of natural soil. This system has no harmful effects on the environment or the quality on crops. Its main aim is to save water, improve the quality of crops avoiding the harmful effects of pesticides and factors affecting the quality of soil and save the land.

II. NEED

In the traditional farming method, farmers require fine quality of soil with natural mineral strengths.

It also requires working cost for plowing and removal of weeds and also needs a large amount of space and water. Hydroponic farming will be useful in a difficult environment as growing will take place in areas such as arid deserts. In such areas because of environment control growing can be made easy with the use of greenhouse farming or indoor plantation. The earth's population is assumed to increase by 9.6 billion by the year 2050 leading to a decrease in land available for food and produce production. With this population increase to feed the planet,we will need to develop alternative farming techniques. Since hydroponic growing techniques does not require soil it helps in areas where land is quickly being urbanized and cities are expanding at a rapid rate.The Usefulness of hydroponic in future space travel along with the many uses for hydroponic on earth will be seen . NASA is experimenting and researching with hydroponic because the soil suitable for supporting life in space is not found yet. In space soil would be a complex and unnecessary material to bring. Hydroponics will provide a good source of food for space travel and as well as through space it would allow us to grow plants in spaceships and uninhabitable land for long missions.

III. TYPES OF HYDROPONICS

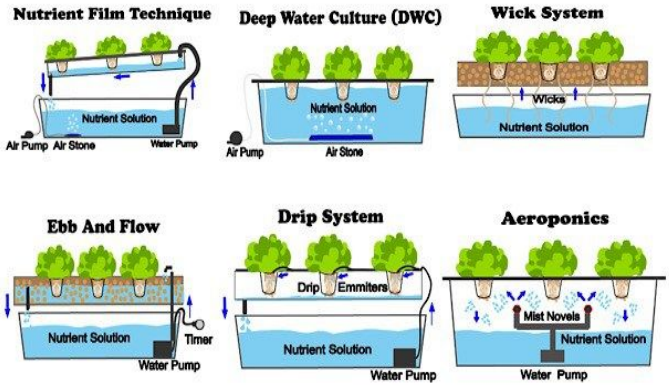

Fig.1 Types of Hydroponics(Image Source Google)

A. *Wick system*: The simplest technique compared to all the above is the wick system, as it does not consume electricity, use pumps or has any moving parts.

B. *Ebb and Flow (flood and drain)*: The plant roots are flooded with nutrient solution periodically.

C. *Deep water culture*: A reservoir acts as the container to store the nutrient solution. Oxygen, water and nutrient supply is provided by suspending the roots of the crops in this solution.

D. *Nutrient Film Technique(NFT)*: A structure similar to PVC pipes is

implemented in this technique. A series of plants are grown in series using this form of structure. The nutrient solution is inserted into the pipe like structure and then collected back into the reservoir through the other end, where a structure outlet is created for the solution to flow out.Thus, Recirculation is applied and at the same time, water conservation is proved from this method.

E. *Drip system***:** In a drip system, the nutrient solution is dripped onto the roots of plants to keep them moist.

F. *Aeroponics***:** This is very similar to the Nutrient Film Technique. The difference is that, instead of using a recirculation method, it is replaced by sprinklers. They do the task of sprinkling the root zone of the plant with nutrient solution.

IV. METHODOLOGY

- Collection of equipment
- Building the outer frame
- Automation using various hardware components
- The Functionality of the controllers into separate components-

A. *pHarmBot*: Used to maintain nutrient level maintenance and pH level maintenance.

B. *hydroBot***:** It is a control system for automation of hydroponics farm.

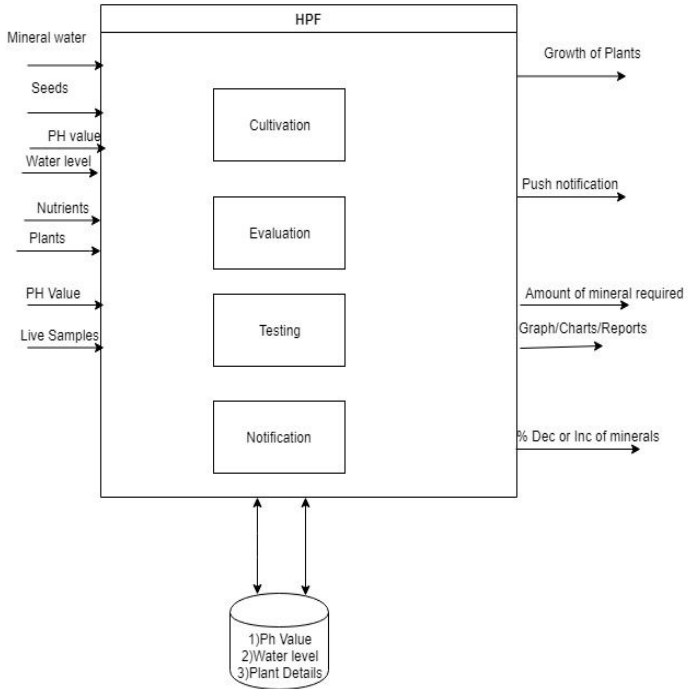

Fig.2: Block Diagram of System

The input given to the cultivation block will be mineral water, seeds, nutrients. The output expected from cultivation is the growth of the plant(spinach). The input for the evaluation and testing block will be the value of the water level and the pH value of the spinach. The accurate and required pH-value and the water level will be stored in the database. The real-time value and the required value will be compared and accordingly if the values don't match, a notification will be sent to the user along with the required amount of nutrient value. The system will generate a graph/report of plant growth from time to time.
Managing the pH values and nutrient concentrations within acceptable ranges is essential for successful hydroponics.

Tools to be used for managing hydroponic solutions :

- *pH meter* :A tool that uses an electric current to find the concentration of hydrogen ions in water-based solutions.
- *Litmus paper*: Litmus paper is a member of chemical indicators. Litmus paper changes color when exposed to an acidic or basic solution.
- *Electrical Conductivity Sensors*: A tool which measures electrical conductivity in a solution.

Hardware Requirements:

- *Arduino Uno R3*: A basic sensor monitoring application for hydroponics should be able to get the most critical information needed to grow a crop successfully. The parameters we would want to monitor to achieve this goal would be pH and electrical conductivity and carbon dioxide concentration. We can achieve all these goals at a reduced cost with the help of an Arduino microcontroller.

Fig 3: Arduino

- *Raspberry Pi 3 Model B:* This small brilliant device gives us the flexibility of controlling the system with the programming languages of our choice.
- *BreadBoard*: It is used for various connections or to turn on/off LED.
- *Waterflow Sensor Counter Meter(1-60L/Min,DC 5-24V)*: It consists of a water rotor, a hall-effect sensor and a plastic valve body. When water flows through the rotor, rotor circulates and the speed of it changes with a different rate of flow.
- *DC 12V Electric Solenoid Valve*: It is controlled by an electromagnet. If we put pressurized water in a solenoid valve, water will be blocked. If you supply the magnet with the expected current /voltage, the valve will open and the water will flow.
- *620 GPH Submersible Pump*: This pump transports 900 gallons of water per hour through an 1-inch pipe to optimally deliver water and nutrients to plant's roots.
- *2 Channel Relay Module Shield for Arduino*: It can control one electrical device for e.g Submersible Water Pump.
- *Arduino Conductivity Sensor*: This should be installed in the water reservoir that will be used to supply the plants growth medium.
- *Analog PH Meter Kit*: This test kit is the most popular method to check pH. This test kit works by adding a few drops of a pH-sensitive dye to a small amount of the nutrient solution and then comparing the color of the resulting liquid with a color chart.
- *12V DC Peristaltic Dosing Pump:* Automatic dosing systems are the

alternative solution, they both monitor water chemistry and respond to those measurements by dosing the system.

V. CONCLUSIONS

Today, hydroponics is an established branch of farming. Progress has been on large scale and results obtained in various countries in the world have proved that this technology is thoroughly practical and has very definite advantages over conventional methods of crop production. Soil-less cultivation and vertical hydroponics can be used in places where the gardening is not possible. Thus not only is it a smart approach but one which has proved of great benefit to humanity.

People living in crowded city streets, without gardens, can grow fresh vegetables and fruits in household gardens or in small discarded containers. By means of hydroponics, a regular and abundant supply of fresh greens vegetables, fruits can be produced in poor production areas and clean areas can be made productive at relatively low cost.

FUTURE SCOPE

More different types of vegetables can also be grown rather than green leafy vegetables, by adding the different nutrients and different pH values. Different reports can be generated for different types of vegetables and along with pH value and water level the temperature, humidity can also be checked and notifications for the same will be sent to the user of the system. Pesticides and Insecticides control can also be done.

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