ISSN No:-2456-2165

Hydroponics Plant Monitoring System using IoT: A Review

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Abstract:- For more production in farming, many farmers use more fertilizers and pesticides. All these chemical fertilizers are harmful to human health. So organic farming will be necessary nowadays. Hydroponic farming is one of the organic farming. Inside hydroponic no fertilizers and pesticides are sprinkled on plants by farmers. Our paper describes about closed-loop hydroponic system. Closed loop hydroponic means all parameters that are required for hydroponic farming are controlled and monitored automatically with the help of IoT. Here NodeMCU serves as the central control unit of our system which controls all parameters system.

Keywords:- *Hydroponics Iot, NFT, TDS, Thing Speak, Etc.*

I. INTRODUCTION

Nowadays every sector is growing, development in the agriculture sector is also the most important part. So, innovation and new experiments are expected in agriculture. Because 68% of the Indian population depends on agriculture for their livelihood. India has a great history of farming techniques, and many innovations in the field of agriculture have been made in India.

Hydroponics plant monitoring system using IoT is a low labour cost system. Hydroponics is a system in which plants or vegetables are cultivated without soil. Inside Hydroponic instead of soil, water is used for cultivating plants. With the help of water only it is not possible to grow plants, so inside water all nutrients are provided which are required to grow plants. Hydroponic is derived from the Greek word, hydro, which means water, and ponos means work. The main objectives of the hydroponic system include growing vegetables with minimal use of water and controlling the environment for better growth of vegetables.

As the population increases the problem of land and food also increases. Then the hydroponic system is a solution to the problem of land and labour costs. In hydroponics plants are cultivated in water instead of soil, hence this farming is possible in any location like in home and space. NASA is also using a hydroponic system for growing food for their space scientist in space. Farmers can benefit from a hydroponics plant monitoring system that uses IoT. The IoT platform is utilized to monitor water parameters in these systems, which are used to cultivate plants. Water parameters include Total Dissolved Solid (TDS), temperature, pH, and water level. All of these factors are determined by attaching various sensors. After carrying data by sensors this data is fed to cloud or IoT-based applications for further processing on this data. With the help of Data Analytics and Machine Learning can generate useful predictions for further systems. Controlling water parameters is possible with the help of different actuators. Hydroponic systems connected with IoT are perfect so controlling and monitoring these parameters from a distance is possible for farmers.

II. LITERATURE REVIEW

Paper [1] has described what is the utility of systems used where soil degradation is high, and hydroponic can be framed indoors. It is used in terrace gardening. The author designed a system to produce plants/crops efficiently by reducing the usage of water, nutrients, and area required for farming.

Paper [2] has given information about NFT (Nutrition film Technique), this technique is a popular one that is practiced widely in hydroponic farming. Also, these papers explain what you need to build a NFT system. While controlling different parameters of water with a Nutrition solution we must change the TDS for different plants and vegetables. The temperature range of water is between 18-26°C and the pH range is between 6.0-7.0. These readings vary with different plants. For the different climate changes, change in water temperature is important. Also, hydroponic can be possible indoors so the cost of transportation is not required.

[3] The paper focused on the explanation of hydroponics farming and its IoT-based design and development means after acquiring data from different sensors, data is forwarded to the IoT platform. These papers describe the three layers of IoT, including a perception layer, a transportation layer, and an application layer. The author explains the plot regarding air

temperature and air humidity, sunlight illumination, TDS, and pH of Nutrient solution. These data were taken from the last 20 days. The author performed a correlation study between the temperature of the hydroponic solution and the air using a database that was gathered during system operation. As opposed to the air temperature, it is evident that the water temperature increased later. This enables us to create a plan to use air temperature to forecast variations in water temperature, therefore stabilizing the temperature of the nutrient solution.

In [4], the author discussed intelligent hydroponic monitoring systems. Describe about different sensors that are used for building systems like TDS, pH, etc., and describe the voltage and current rating of all sensors and devices they use. Here Author used the ThingSpeak IoT platform for monitoring and controlling purposes.

III. SYSTEM PROPOSED

When we think about plants, and how they are growing so many people think that it's required soil. But when we think scientifically soil is just a medium for providing nutrition. Plants grow with the help of nutrition and the process of photosynthesis. In photosynthesis, plants use sunlight and chlorophyll to convert carbon dioxide and water into glucose and oxygen. For growing plants sunlight, carbon dioxide (CO_2), and water are necessary factors. By considering all these things, we give our solution to make these hydroponics very effective. In Hydroponic plant monitoring system using IoT design to automate our hydroponic farming.

There are different types of hydroponic systems but NFT (Nutrition Film Techniques) is the most popular system. As many reasons behind the popularity of NFT but some are key and considerable like.

- A reservoir to contain the nutrient solution
- Nutrient pump
- Tubes to distribute water from the nutrient pump to the NFT growing tubes.
- Channel for the plants to grow in
- Net pots to contain plants and growing media to start seedling in
- Return the system (tubing, channel) to guide the used nutrient solution back to the reservoir.
- Papers [2] and [4] give more ideas about NFT techniques.

➢ *Generally, Farmers will Grow two Types of Vegetables*

- *Leafy Vegetables*

Romaine lettuce, green leaf lettuce, red leaf lettuce, butter lettuce, baby leaf lettuce, escarole, endive, spring mix, spinach, cabbage, kale, arugula, and chard are examples of leafy vegetables.

- *Fruity Vegetables*

Cucumbers, eggplant, okra, sweet corn, squash, peppers, and tomatoes are examples of fruity vegetables. We must take certain procedures when cultivating these plants.

- ✓ Step 1: Sow the seeds in the soil and water only until they germinate.
- ✓ Step 2: After germination, develop our veggie into an NFT setup when two leaves are visible.
- ✓ Step 3: Maintain the water parameter in which you will offer nutrients to veggies.
- ✓ Step 4: While giving the nutrition adjust the TDS of water as per the following tables.

Table 1 ph Values for Leafy Vegetables

Weeks \Seasons	TDS in ppm	
	Summer	Winter
1st week	150	200
2nd week	200	250
3rd week	280-300	300-330
4th week	350-400	400-450

(These Just Reference Values)

- Maintain pH up to 5.5 to 6.5 For plants to grow best, they need to be exposed to full sunlight for at least eight hours each day. Placing plants by a window, even if it is well-lit, is not enough for optimal growth. The use of lights to extend the exposure time is not a sufficient substitute for natural sunlight. Inadequate exposure to sunlight can lead to slow growth and development, which is usually seen as spindly-looking plants. If you want to avoid nutrient-element deficiency symptoms, it is essential to ensure that your plants are exposed to full sunlight.
- Maintain tempature upto 24°C and 30°C (Here these parameter is shown only for leafy vegetables. It changes concerning the type of vegetables.)

➢ *Block Diagram of System*

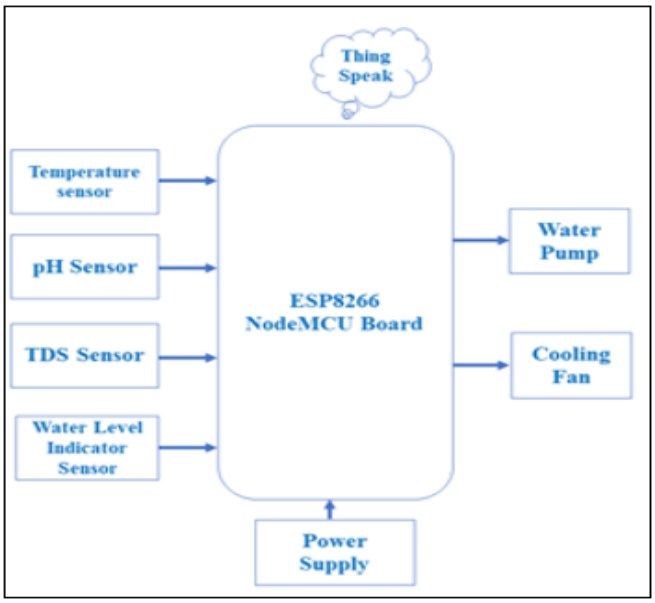

Fig 1 General Block Diagram

The figure shows the block diagram of a Hydroponic system using IoT. This system works on the NodeMCU board which is a Wi-fi based module. This module takes the inputs from the sensor processes the input data and generates the output. There are various sensors are used to capture the data

from the physical environment. We used the temperature sensor DS18B20 to measure the temperature of the water, it is a waterproof temperature sensor. The pH sensor module kit is used to measure the pH of water continuously. Another one is a TDS sensor module, which is used to measure the electrical conductance (EC) of water. Water level indicator sensor for alerting water level of tank. To maintain the surrounding environment of the plant and the water level in the tank, use a water pump and cooling fan. For real-time monitoring of the parameters and future use of data, ThingSpeak is an open-source cloud platform.

➢ *Some Advantages of our System are as follows*

- This type of farming reduced labour costs.
- Soil-based farming has some soil-based crop diseases, here no soil no soil-based diseases are there.
- It required small land.
- Soilless farming.
- Plants can grow anywhere indoors and outdoors.
- Reduced water usage.
- With the help of IoT monitoring and controlling is possible from anywhere.

IV. CONCLUSION

Hydroponic farming is a type of organic farming that involves growing plants using water. Many farmers are turning to hydroponic farming due to its numerous advantages. Hydroponic farming is mainly based on water, so maintaining the proper water and required solution to this system is important doing such activity manually is hard and time-consuming so IoT-based hydroponic plant monitoring system is used. This system monitors those important parameters and maintains them according to our needs.

In today's world, land is becoming scarce and its prices are increasing day by day. To tackle this issue, hydroponic systems are proving to be very useful as they enable plants to grow on less land and with less water. These systems are cost-effective and require regular maintenance, along with a continuous supply of water and electricity. In the future, to reduce the need for continuous electricity, we can utilize solar plates to save electricity.

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