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Hydroponics Plant monitoring system using IoT.

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Abstract: Hydroponics, a soil-less method of cultivating plants, offers a sustainable and efficient solution for modern agriculture. This review paper delves into the integration of Internet of Things (IoT) technology with hydroponic systems, emphasizing the advancements and benefits of automated plant monitoring. IoT-enabled hydroponic systems leverage sensors, actuators, and data analytics to optimize plant growth by precisely controlling environmental factors such as nutrient levels, pH, temperature, and humidity. This automation not only enhances crop yield and quality but also reduces resource consumption and labor costs. The paper explores various IoT architectures, sensor networks, and control mechanisms implemented in hydroponics, providing a comprehensive analysis of current trends, challenges, and future prospects. Through this review, we aim to highlight the transformative impact of IoT on hydroponics, paving the way for more intelligent and sustainable agricultural practices.

Index Terms - Hydroponics IoT, NFT, TDS, ThingSpeak, etc.

I INTRODUCTION

In many region of India, many people are depend on the farming occupation. The farming is important sector because human being required food for their live hood. Without food no human are survived, hence farming is the most important part of India. While thinking farming the land farming having many challenges. When we think about traditional farming it's having many challenges now day.

To solve the problem and challenges we have hydroponic farming. The hydroponics farming is one type of organic farming in which the water is considered as important factor here, no involvement of soil is there. No soil means for support to plant we required some medium that medium also described in [1]. The hydroponic mean all nutrition required for plant are provided through NFT solution by mixing into water. In land-based farming nutrition require for plant growth are absorb from soil. The details of nutrition required for plant growth is [2] in this reference. The effect of light and CO2 are also important for photosynthesis. The effect of light on plants is also considerable thing in hydroponics.

Hydroponics Plant Monitoring System Using IoT can easily monitored all parameter of water like ph, TDS, Conductivity (EC) all these parameters are controlled through IoT based platform. Monitoring all these parameters and maintain certain values of these parameter to certain level for proper growth of plant is aim of our system.

The hydroponic farming us very different type of farming than traditional farming it required scientific approach. After understanding and studying hydroponics is implemented. It's observed that some are challenges in traditional farming are solve with the help of hydroponic farming.

- What are challenges in traditional farming? Why we move toward hydroponic farming?

In traditional farming there are many problems to encounter this problem we implements hydroponic system. The problem in traditional farming is as follow

1. Climate
   Climate plays crucial role in agriculture. In which weather which plant grown is already decided. The hydroponic farming is indoor farming so no climate is effect on this. If the large hydroponic farms then green houses are option for these. Changes in climate will not be effect on hydroponic.
2. Labour
   Inside the traditional farming many labour are requires to processing on land like land levelling and many activities so labour cost is also increased. Inside the hydroponic system not more than one labour is required so here labour cost is

also low, and in our project we automate our hydroponic system so no labour are requires only one person can take care of all system.

3. Land
   As population increases requirement of land is also increase for purpose of homes and construction. So day by day is major issue of land. Inside hydroponic farming no land is required anywhere this hydroponic farming is possible. Inside vertical hydroponic farming we can take more production. It is also known as metrics farming.
4. Consistency
   All things of productions are consistency. All here the production consistency done by these hydroponic farming. These is not possible inside traditional farming. For EX- provide vegetables to hotel using hydroponic we can provide all years no climate effect is occurred.
5. Fertilizers
   In traditional farming more fertilizers are required. But inside the hydroponic farming no more fertilizers are required because all fertilizes are directly in contact with root of plant. So cost of fertilizers is also decreases.
6. Water
   Water required for traditional is more as compare to hydroponic framing. Because inside hydroponic no waste of water is there.

Or more understanding advantages of hydroponic farming, let us consider one case study done by Kryzen Hydroponic lab. In these case study is the basic comparison is about traditional farming and hydroponic farming. This comparison is done for basil plant for 50kg production every. And after the comparison is concluded area required for hydroponics is less, worker required are less, water required is less, production is more, at any location these farming is possible, and automation is also possible all these thing are possible in hydroponic farming [3]

II LITERATURE REVIEW

Paper [4] 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 [5] 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.

[6]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. Based on a database obtained during the operation of the system, the author conducted a correlation analysis between the air temperature and the hydroponic solution temperature. It can be seen that the water temperature was delayed as compared to the air temperature. This allows us to develop a strategy to stabilize the temperature of the nutrient solution by using the air temperature to predict changes in water temperature.

In [7], 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.

System [8] is review worked in hydroponics agriculture for IoT based plant monitoring system. The author gives clear idea about chemical fertilizers are hazardous for mankind are prosily utilize in the present-day farming. Here hydroponic is organic farming provide by authored. It is also explained how hydroponic farming is plays an important role in space. Because in space no soil is there so in space for growing food hydroponics is good solution this system is well suitable for space.

Prescribe work [9] described about hydroponic is less water system as compared to traditional farming. Growth rate plants in hydroponic farming is 50% faster than land farming, because it does not need to expand their roots for nutrition search. The height is also large in hydroponic all the analyses are done here and after some month's experiment it's concluded that by controlling the environment and parameter in hydroponics we can take more production.

III SYSTEM PROPOSED

. Hydroponic plant monitoring system using IoT is closed loop control system. Where all the environment are controlled and monitored through different sensors. Here in hydroponics system different parameter is used to control. The hydroponic system may be implemented using different technique. NFT is more popular because NFT have their own advantages. IN NFT technique the nutrition are continually supplied to plants with the help of flowing water. Our system is NFT type of system, our system is sufficient for 3 plants.

We decide to cultivate the spinach plant. First, we blow the seed in cockpit give water up to 7 days when two leaf are grown then we placed to these into NFT system. In NFT continues flow of water is there. And then with the help of sensor the pH, TDS, EC all these parameters are calculated. For proper growth of plants, the values of these parameter are fixed, as plant is changed the values of these parameter is changed. The values for different plant is mention in [] reference.

The values of pH, TDS are measured by sensor, but for calculation of EC some manual calculations are added into system programming

To calculated EC from TDS sensor reading
To get EC, multiply by PPM reading by 2 and divide by 1000

$$\mathrm{EC} = \frac{PPM*2}{1000}$$

After Studying many references the values of parameter for spinach are given below

Table III.1 Reading for spinach plants

Sr. No	Parameter	Values
1	TDS	1200-1540
2	PH	6.0-7.0
3	EC	2.5-3.2

To proper growth of plant maintain these values of water contain NFT solution and for more about how these parameter are mention in review work [10]

After taking all these values from these sensor and calculating different values these data is fed to Iot platform using WIFI module then further processing is possible on these data. How these processing is done all these IoT layered and all these things are mentioned the paper [10].

III.I Block Diagram of System

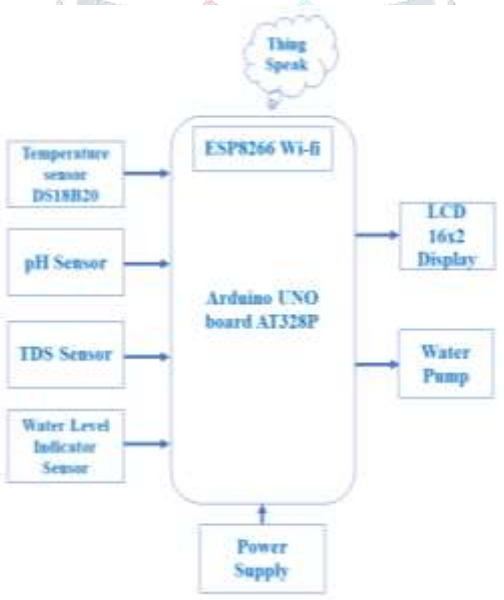

Figure III.1 Block Diagram of System

The Figure III.1 Block Diagram of System shows the block diagram of a Hydroponic system using IoT. This system works on the esp8266 module which is a Wi-fi based module. Arduino 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

IV RESULT

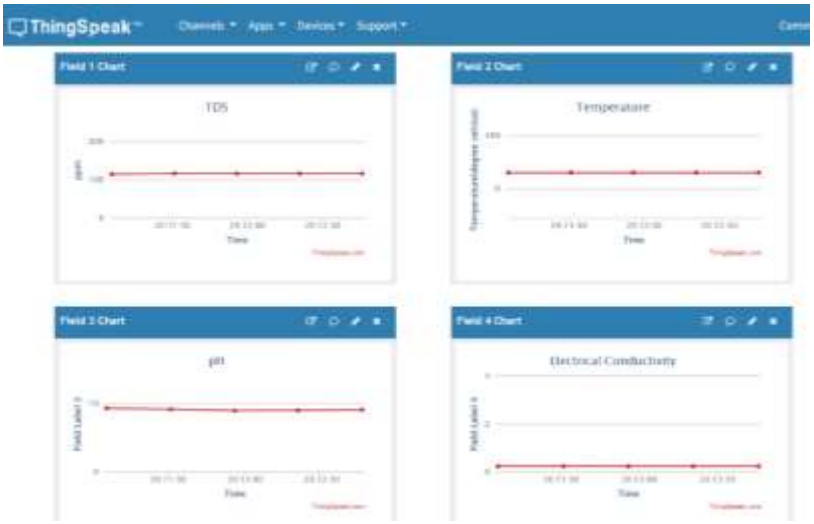

Figure IV.1 Output on Thingspeak

The above Figure IV.1 Output on Thingspeak reading of EC, TDS, pH, Temperature are reading of water with very less NFT solution added into the water because as per reference [10] . At initial stage in first week of plant the TDS is near about 150-170 ppm, And our reading are TDS is 105 ppm, Temperature are near 27℃, pH is near to 9.0 (9.0 because proper calibration is not there of sensor), EC near to 0.4.

Figure IV.2 Project Model

V CONCLUSION

Without soil farming id the main objective of our system, when soil is present then various dieses related with soil is involved. So the cost of insecticides and fungicides is increased in traditional farming. These type of challenges are easily solve with our proposed hydroponic system. With the help of IoT the data monitoring, data exploration and data processing possible easily. The data is further used for growing period analysis of certain plant. Also which nutrition is required for growth of plant is also suggested by these data.

By doing market rate analysis using advance software and machine learning, then we can grow plant into these hydroponic system. These perfect solution with automation. Maintaining the values of parameter is necessary here. The wrong values of pH will effect the photosynthesis and thus effect to the growth of plant. Hence it's necessary to adjust parameter.

VI REFERENCES

[1] B. W. H. W. a. C. G. Morgan Pinkerton, "Common Media Used in Hydroponics," *UF/IFAS Environmental Horticulture Department*, August 2022.

[2] "NSW Deparment of primary Industries," [Online]. Available: https://www.dpi.nsw.gov.au/agriculture/soils/soil-testing-and-analysis/plant-nutrients#:~:text=Soil%20is%20a%20major%20source,are%20calcium%2C%20magnesium%20and%20sulfur..

[3] "Comparisosn of hydrophonic farming and Traditional farming," kryzen, [Online]. Available: https://www.kryzen.com/hydroponics-vs-traditional-farming-2/.

[4] S. P. U. S. Nivesh Patil, "Monitering of Hyderophonics System using IoT Technology," *International Reserch Journal of Engineering and Techonlogy(IRJET)*, vol. 07, no. 06, pp. 1455-1458, June 2020.

[5] A. K. D. N. B. G. S. S. CH. VASANTHA LAKSHMI1, "Hydroponic Farm Monitoring System Using IoT," *ICONIC RESEARCH AND ENGINEERING JOURNALS* , vol. 3, no. 10, pp. 257-261, 2020.

[6] B. T. V. T. Q. H. N. Huu Cuong Nguyen, "Automatic Monitoring System for Hydroponic Farming: IoT-Based Design and Development," *Asian Journal of Agriculture and Rural Development* , vol. 12, no. 3, pp. 210-219, 2022.

[7] S. M. J. W. A. A. J. O. Jalani H. Naphtali1, "An Intelligent Hydroponic Farm Monitoring System using IoT," 2022.

[8] D. S. C. Mitali V. Shewale, "IoT based plant Moniter System for Hydroponics Agriculture: a Review," *International Journal for Reserch in Applied Science and Engineerig Technology*, vol. 6, no. II, pp. 1628-1631, 2018.

[9] D. S. C. Mitali V. Shewale, "Internet of Things Based Plant Monitering System for Hydroponics Agriculture," *Journal of Emerging Technologies and Innovation Research(JETIR)*, vol. 5, no. 8, pp. 242-249, 2018.

[10] S. P. D. S. C. J. Nikhil D. Mahajan, "Hydroponics Plant Monitoring System using IoT: A Review," *International Journal of Innovative Science and Research Technology (IJISRT)*, vol. 8, no. 12, pp. 2424-2426, 2023.

[11] I. M. N. K. P. S. R. G. Gokul S, "Smart Hydroponic System Using IOT".