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IOT BASED HYDROPONIC CULTIVATION SYSTEM

Prof. S. M. Jagtap[1], Pratik Badhe[2], Gautami Patil[3], Nikita Navale[4]

[1]Professor, Department of Electronics and Telecommunication, Maratha Vidya Prasarak Samaj's Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik, India

[2,3,4]BE Student, Department of Electronics and Telecommunication, Maratha Vidya Prasarak Samaj's Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik, India

ABSTRACT

The paper "IoT Based Hydroponic Cultivation System" describes the development of an automated hydroponic cultivation system that uses Internet of Things (IoT) technologies to monitor and control various parameters such as temperature, humidity, pH levels, and nutrient concentration. The proposed system consists of a microcontroller unit, sensors, actuators, and a web-based interface. The microcontroller unit collects data from the sensors and sends it to the cloud server, which can be accessed through the web interface. The system also uses machine learning algorithms to predict the yield of the crops and optimize the nutrient supply. The results of the experiments conducted on the system show that it is capable of providing better crop yield and quality as compared to traditional hydroponic systems. The proposed system can be used in indoor farming, urban agriculture, and commercial cultivation to increase the efficiency of crop production and minimize the use of resources.

Keywords: Microcontroller, algorithm, interface, cultivation, agriculture.

1. INTRODUCTION

Hydroponics is a soilless method of cultivating plants that has gained popularity due to its high efficiency and low resource utilization. In recent years, with the advancements in Internet of Things (IoT) technologies, hydroponic cultivation systems can be made even more efficient and automated. IoT-based hydroponic systems can help in optimizing various parameters such as temperature, humidity, pH levels, and nutrient concentration to achieve better yield and quality of crops. The real-time monitoring and control of these parameters using IoT technologies can also reduce the manual labor required for cultivation, making it easier for farmers to manage their crops.

This paper describes the development of an IoT-based hydroponic cultivation system that uses machine learning algorithms to optimize nutrient supply and predict crop yield. The system consists of a microcontroller unit, sensors, actuators, and a web-based interface. The microcontroller unit collects data from the sensors and sends it to the cloud server, which can be accessed through the web interface. The system uses machine learning algorithms to predict the yield of the crops and optimize the nutrient supply.

The proposed system has several advantages over traditional hydroponic systems. It provides real-time monitoring and control of the cultivation parameters, which helps in preventing any potential damage to the crops due to variations in the environment. Additionally, it can help in reducing water and nutrient consumption, which is crucial for sustainable agriculture. The system can be used in indoor farming, urban agriculture, and commercial cultivation to increase the efficiency of crop production and minimize the use of resources. Overall, this paper presents a novel approach to hydroponic cultivation that has the potential to revolutionize modern agriculture.

2. METHODOLOGY

- **Design the hydroponic system:** The first step is to design the hydroponic system, including the layout, materials, and equipment. The design should consider the types of crops being grown, the available space, and the desired yield.
- **Select IoT sensors:** Next, select IoT sensors to collect data on environmental conditions, such as temperature, humidity, light intensity, and water level. The sensors should be compatible with the hydroponic system and able to transmit data to a central hub.
- **Install IoT sensors:** Install the IoT sensors in the hydroponic system, ensuring they are properly calibrated and positioned to provide accurate data.
- **Develop algorithms:** Develop algorithms to analyze the data collected by the IoT sensors and determine if any adjustments are needed to maintain optimal growth.
- **Connect to the IoT network:** Connect the IoT sensors to the network, allowing them to transmit data to a central hub for analysis.
- **Implement control systems:** Implement control systems to adjust the nutrient solution, water level, and lighting based on the data analysis. The control systems should be able to respond quickly to changes in environmental conditions to maintain optimal growth.

- **Monitor plant growth:** Use the IoT sensors to monitor plant growth, including height, leaf size, and stem diameter. This data can be used to track the progress of the crops and identify any issues that need to be addressed.
- **Implement alert system:** Implement an alert system to notify the user if any parameter falls outside the optimal range. This allows for quick corrective action to be taken to prevent damage to the crops.
- **Harvest crops:** Use the IoT sensors to monitor the growth of the crops and determine when it is time to harvest.
- **Analyze data**: Collect and analyze data on plant growth, nutrient levels, and other environmental factors to optimize the hydroponic system's performance. Use this data to make improvements and adjustments to the system.

By following this methodology, an IoT-based hydroponic cultivation system can be designed, implemented, and continuously improved to optimize crop yield and efficiency.

3. WORKING

The working principle of the hydroponics system consists of three major parts Input data, Cloud server (Monitoring and controlling) and Output data.

In this system we are monitoring and controlling the environment around the plants. All the sensors are interfaced to the NODE MCU. Water is used in response to the humidity. UV lights are used to produce lights it helps to grow plants as fast as possible compared with soil plants. The all-output data is interfaced with ESP8266 Wi-Fi module so that all the data is continuously monitored and also data stored on cloud.

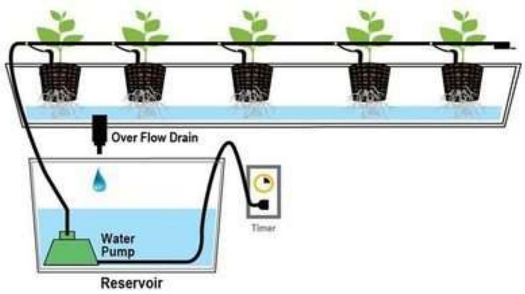

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Figure 01: Working Principle.

4. MODELING AND ANALYSIS

Algorithm:

1. **Collect environmental data**: The IoT sensors will collect environmental data such as temperature, humidity, light intensity, and water level.
2. **Analyze the data:** The collected data will be analyzed using algorithms to determine if any adjustments are needed for optimal growth.
3. **Adjust nutrient solution**: Based on the data analysis, the nutrient solution will be adjusted to maintain the required pH level and nutrient concentration.
4. **Control water level:** The IoT system will control the water level in the hydroponic system to ensure the plants have adequate water for growth.
5. **Control lighting:** The lighting system will be controlled by the IoT system to ensure the plants receive adequate light for growth.
6. **Monitor plant growth**: The IoT sensors will monitor plant growth, including height, leaf size, and stem diameter.
7. **Alert system**: If any parameter falls outside the optimal range, the IoT system will send alerts to the user to take corrective action.
8. **Harvesting:** The IoT system will monitor the plants' growth and alert the user when it's time to harvest.
9. **Data analysis:** The IoT system will collect and analyze data on plant growth, nutrient levels, and other environmental factors to optimize the hydroponic system's performance.
10. **Continuous improvement:** Based on the data analysis, the system will be continuously improved to optimize plant growth and increase yield.

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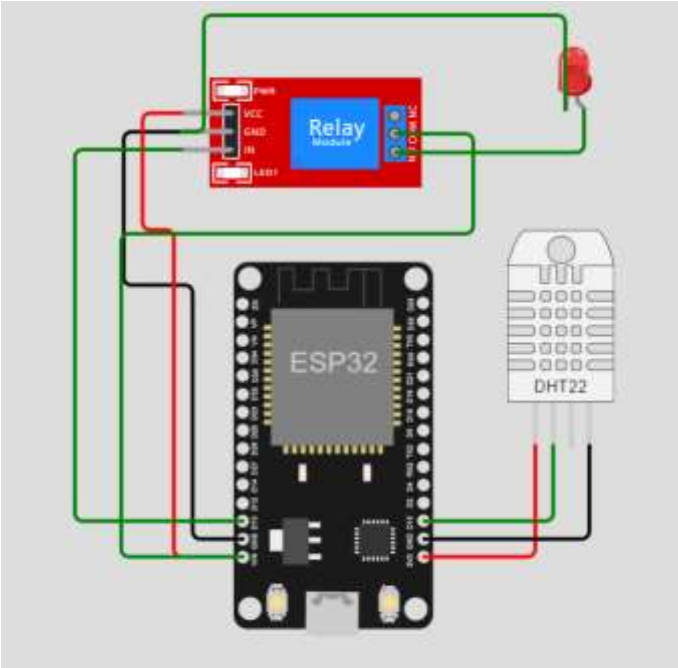

Figure 02: Circuit Diagram.

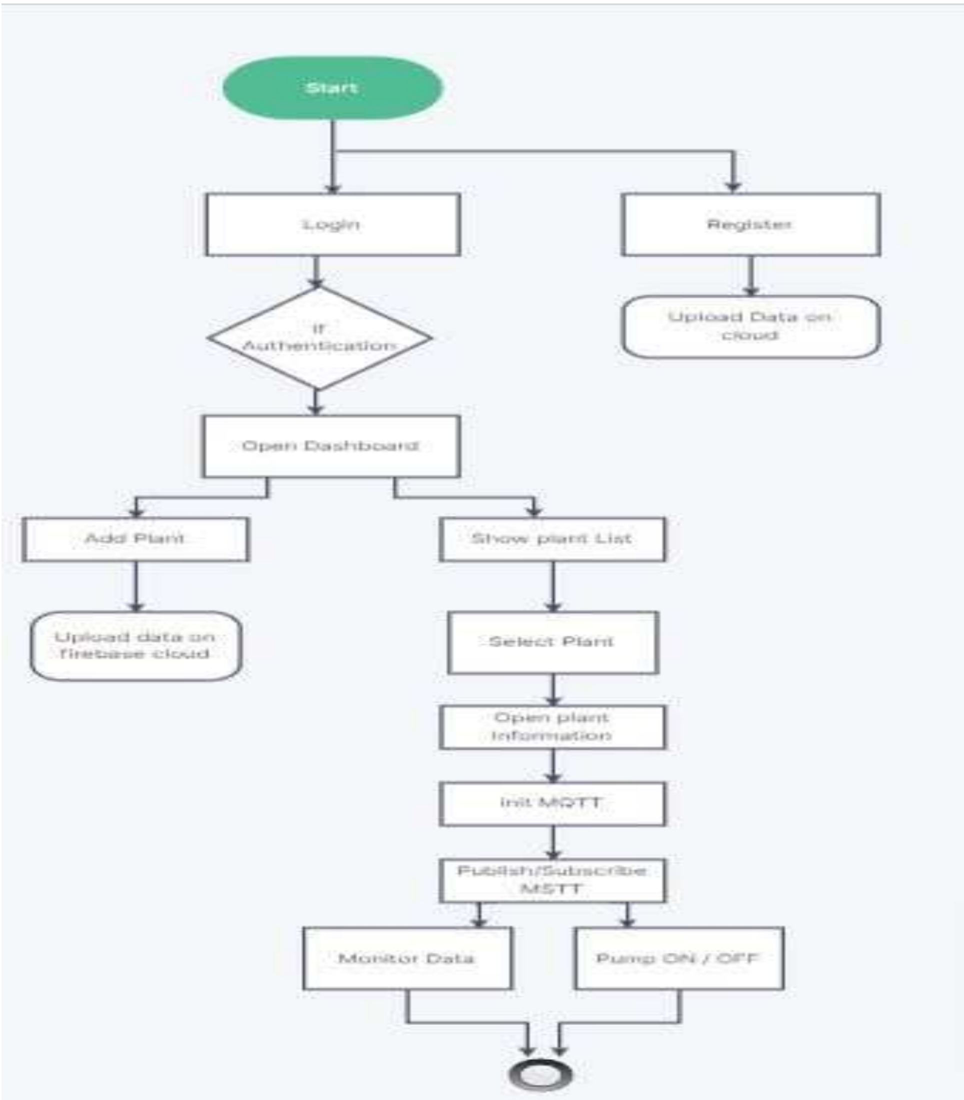

Figure 03: Flowchart of App.

The device flow diagram describes the project's approach, initializes every sensor, including the microcontroller and NodeMCU, and reads the environment's physical data. When the data is read, the microcontroller can provide read sensors. When the smartphone user receives the data from the microcontroller, When the sensor readings pass the actuator's threshold, another actuator will turn on.

5. RESULTS AND DISCUSSION

The results of an IoT-based hydroponic cultivation system can be significant. By using IoT sensors to monitor environmental conditions and make real-time adjustments to the hydroponic system, the system can optimize plant growth and increase yield.

Figure 04: Login Account.

Figure 05: Dashboard.

Figure 06: List of Plants

Figure 07: Pump Stop.

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Figure 08: Pump Start

Figure 09: Connect the task

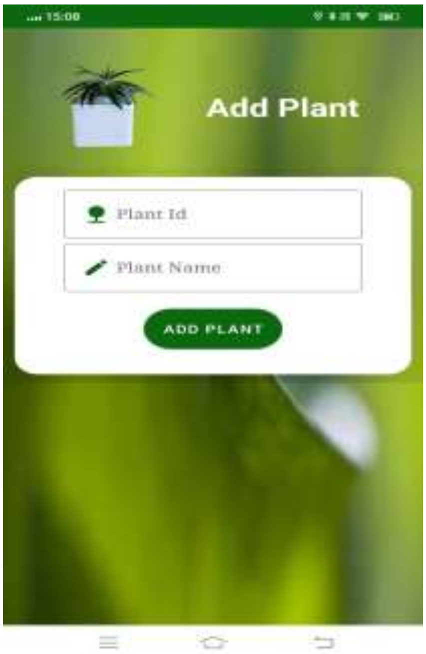

Figure 10: Add Plant

Figure 11: After Starting Pump

This system was designed to track and keep an eye on environmental factors. The end product concentrated on the effective automated regulation of the greenhouse environment. The automated control mechanism runs fully on a coding foundation. Portable gadgets like mobile devices are used to manage the temperature, humidity, soil moisture, and content.

6. CONCLUSION

In conclusion, an IoT-based hydroponic cultivation system can greatly improve the efficiency and yield of hydroponic farming. The system uses sensors to monitor environmental conditions, adjust nutrient solutions, control lighting and water levels, and provide alerts to users when parameters fall outside the optimal range. By collecting and analyzing data on plant growth and environmental factors, the system can be continuously optimized for better performance and increased yield. This technology is particularly useful in areas with limited land or water resources, where hydroponic farming can provide a sustainable and efficient way to grow crops. Overall, an IoT-based hydroponic cultivation system is a promising application of technology to address the challenges of modern agriculture.

By using IOT based Hydroponic system, nutrients are provided to the plants through less water, of monitoring system nourishment. All the sensor parameters are continuously monitored on mobile for better environment control. We can observe that plant grows well by using this system without use of soil. The rate of growing plants in hydroponic system is greater than the soil.

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