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VERTICAL FARMING USING INTERNET OF THINGS

Ankit Sonawane, Vaishnavi Ghatage, Milind P Gajare

Student, Student, Assistant Professor
Electronics and Telecommunication,
All India Shri Shivaji Memorial Society, Institute Of Technology, Pune, India

Abstract: Agriculture plays a pivotal role in India's economy, facing challenges such as increased food demand, escalating labor costs, unfavorable environmental conditions, and diminishing agricultural land. To address these issues, the concept of indoor farming, particularly hydroponic farming, has gained prominence. Hydroponics involves using a water solvent to dissolve mineral nutrient solutions, enabling plants to absorb nutrients more efficiently than traditional soil-based methods. In this context, our proposed solution leverages Internet of Things (IoT) techniques to enhance the efficiency of indoor farming through a closed-loop system. The system aims to precisely regulate nutrient levels and pH for optimal plant growth. Key components include a pH sensor, a Total Dissolved Solids (TDS) sensor, and sensors for monitoring temperature and humidity. The analog pH sensor, analog TDS sensor, and DHT11 sensor collect real-time data on pH levels, nutrient concentration, temperature, and humidity, respectively. The collected data is transmitted to a microcontroller, which employs smart decision-making algorithms based on IoT principles. The microcontroller assesses the received data and dynamically determines whether adjustments are needed. For instance, it decides whether to release specific nutrients or pH buffer solutions. The release mechanism is facilitated through a peristaltic pump controlled by a relay. By integrating IoT techniques into vertical farming, our system offers a sophisticated and automated approach to optimize crop cultivation. This not only addresses the challenges posed by traditional farming methods but also ensures resource-efficient and sustainable agricultural practices in the face of a growing population and changing environmental conditions.

I. INTRODUCTION

India is an agricultural country that also happens to be the world's largest economy. It is also the main occupation of people in the country. But some factors such as rising labour costs, unfavourable environmental conditions, and reduced agricultural land have hindered the crop yield using traditional methods. There are various types of agriculture, one of which is hydroponics. Hydroponics is a technique for producing plants or vegetables without requiring soil and instead relying on mineral nutrients, mixtures of solutions and water. As this solution will be utilised as a source of nourishment for plants or vegetables, it must be safe, so it is necessary to control or manage many factors in this liquid. In today's environment, where practically all technologies are becoming smarter, there is a strong desire for automation. This can be accomplished with the help of a closed loop system. In our proposed system we are implementing the system on Lettuce crops, which will be grown in the hydroponic setup and will be monitored throughout the cultivation period. Some variables that we have to control are the nutrient solution's pH value or concentration. There will be many devices involved to monitor humidity, nutrient solution, temperature, and pH value. It will be used to manage and analyse data from many interconnected devices and sensors. There are three aspects to the hydroponic farming ecosystem. The first section deals with detection of Temperature, humidity and pH sensors used. The second section focuses on the system's control system, which may be adjusted to govern it by monitoring the values from the sensors. The last part will look at dynamically adjusting the temperature, humidity, and nutrient concentration so that they are balanced within a given range or threshold. Hydroponic growth located in urban environments can help with maximisation of crops per acre. The purpose of this project is to design, install and maintain hydroponics containing different varieties of crops.

II. LITERATURE REVIEW

Smart hydroponic farming with IoT-based climate and nutrient manipulation system, Rangga Perwiratama, Yosef Kely Setiadi & Suyoto developed a system using IoT based on controlling different parameters. Hydroponic systems provide increased crop productivity and efficiency, high yield per plant per square metre and fresh produce, regardless of the season or the soil temperature. Methods used for Developing Smart Hydroponics System were using different parameters and manipulating climate and nutrients by automatic computer control.

Applied Internet of Thing for Smart Hydroponic Farming Ecosystem (HFE), Somchoke Ruengittinun, Sitthidech Phongsamsuan & Phasawut Sureeratanakorn Developed Hydroponic Farming Ecosystem (HFE) that uses IoT devices to monitor humidity, nutrient solution temperature, air temperature, pH and electrical Conductivity (EC). They found the challenges while testing the accuracy of the sensors. The application was tested to see if it registers the correct values from the sensors. The values sent to the application included the water flow rate, the water levels and the temperature, in which all were sent with a high accuracy.

IOT Hydroponics Management System,this method used for integrating systems based on Internet of Things (IoT) for monitoring and management of a hydroponics garden is proposed. With the rising trend of IoT and through automation, the problems of managing these resources will be solved. Chris Jordan G. Aliac',Elmer Maravillas tested sensor Data Acquisition Time Results. Effect of the Fan and the Sprinkler to Relative Humidity & Air Temperature. Using Hydroponics System, Firebase and Web Application Connectivity.

IoT based hydroponics system using Deep Neural Networks, Development of IoT based Hydroponics Control System prototype for tomato plant with sensors interfaced to Arduino and Raspberry Pi3 acting as Edge. Development of Intelligence at the edge by deploying Deep Neural Network model towards providing appropriate control action to hydroponics systems in real time with higher accuracy. Implementation of Deep Neural Network at the cloud towards the classification of control action based on parameters collected from hydroponics systems. Manav Mehra, Sameer Saxena, Suresh

Sankaranarayanan, Rijo Jackson Tom found the challenges where 5 parameters were taken as input for controlling the hydroponic environment which is pH, temperature, humidity, level, lighting. These parameters are trained using Deep Neural network towards providing the appropriate control action which is labelled. The predicted control action for the real-time data is stored in the cloud.

IoT based Automated Hydroponics System, Shreya Tembe, Sahar Khan, Rujuta Acharekar Developed an Arduino based project the plant will be planted indoors and parameters such as pH level, temperature, and humidity electrical conductivity will be monitored. Based on the monitored data, the automated part includes sprinklers for pest, humidity adjustment unit and pH up/down pump accordingly. This again is interfaced with a Wi-Fi module making data easy to monitor. The system automatically supplies nutrients and nutrients can be monitored. Implementation of pest detection and connecting to Wi-Fi modules (IoT based) to make the automated model more flexible. This system saves water and fertilisers, gives better yields as compared to the soil system.

III. IMPLEMENTATION

- The pH sensor and TDS sensor is interfaced with Arduino UNO to collect the instantaneous data of the nutrient solution.
- Water has ph 7, but ideal ph of lettuce is between 5.5 - 6.5, so whenever the ph is above 6 the ph down pump will switch on to maintain the ph.
- The ideal TDS for lettuce is 560 - 840, so when it goes below 800, the nutrient pumps will switch on and release the nutrients.
- The temperature and humidity sensor will also send the data. This data will be sent to the Arduino.
- The Peristaltic pumps are interfaced with Arduino through relay.
- The Arduino will smartly decide which pump to start according to the data received.

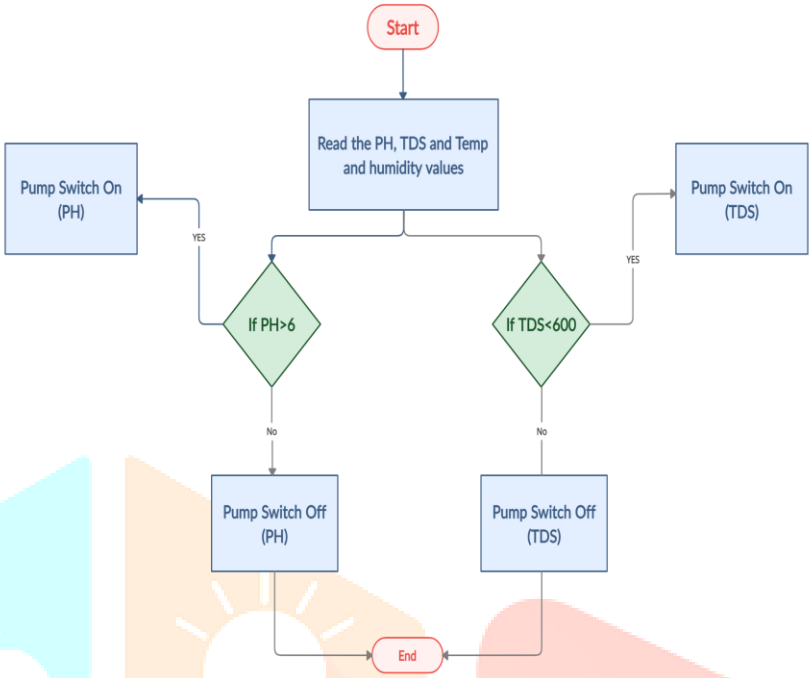
- The peristaltic pump will accordingly release the nutrient or pH up/down.
- The LCD will display the parameters or output which is given by the Arduino.

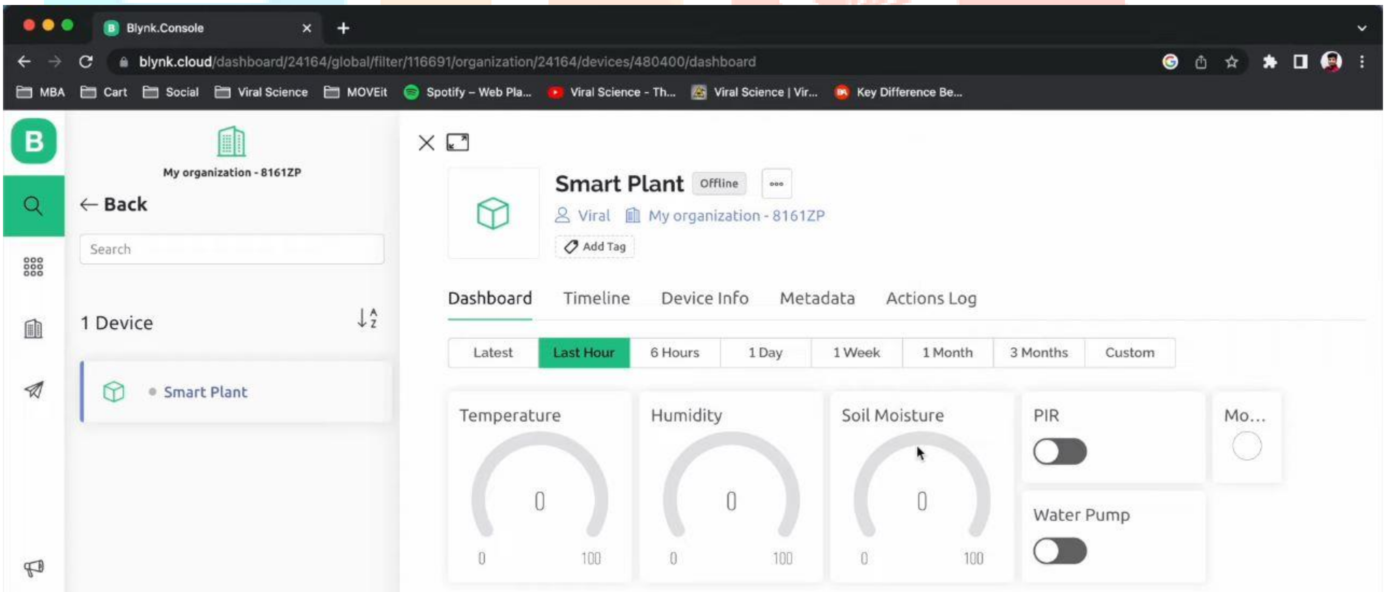
All the sensors are connected with the microcontroller which is an Arduino UNO. Analog TDS sensor or Total Dissolving Solvent Sensor is used to measure the TDS of the nutrients. The Analog pH sensor is interfaced to detect the pH of the solution. DHT 11 sensor is interfaced to detect the temperature of the surrounding area. Four Peristaltic Pumps are interfaced with Arduino through Relay. All the data is collected by the Arduino and displayed on the LCD.

IV. SOFTWARE DESIGN

We have used the Arduino IDE for programming the Arduino UNO board, compiling and uploading it to the board.

Proteus 8.1, for simulation of the project and circuit designing.





V. Hardware Design

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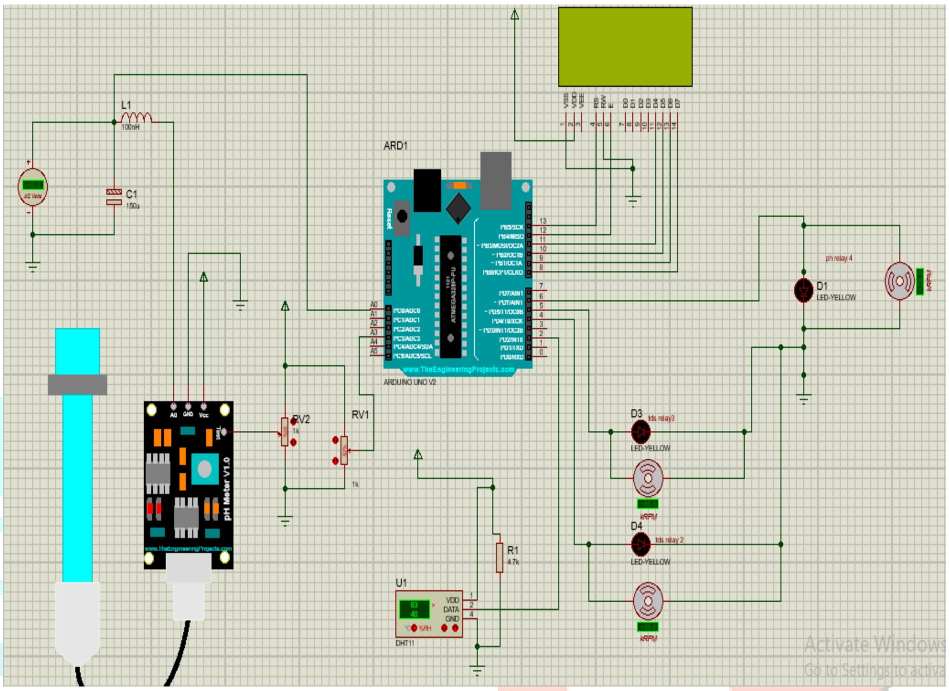

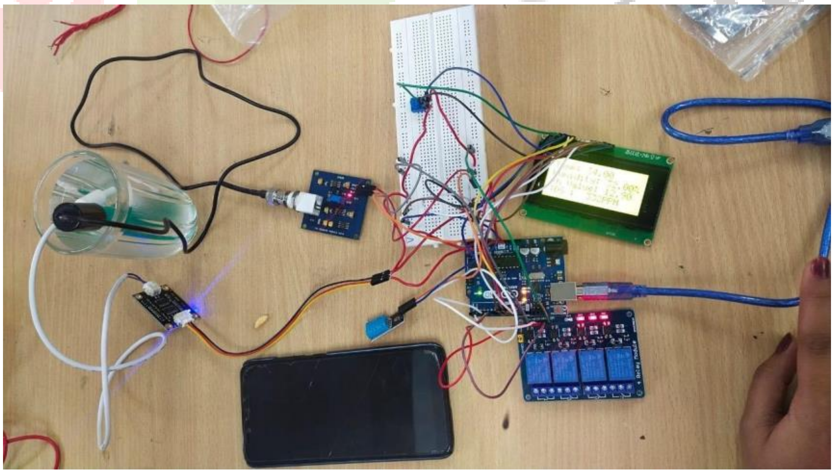

VI. Expected results and test results

The project is divided into two ends i.e. the software end and the hardware end. Hence we have the expected results accordingly.

- Software end : As long as the power is connected to the system the Arduino UNO will receive parameter values from the sensor. The programmed Arduino UNO will process, analyse and decide the further actions according to the program. The algorithm provided is a closed loop system. The Algorithm designed for calibration of the sensors, PH and TDS adjustment are providing the results as expected.
- Hardware end : Hardware is divided into
  - Sensing Unit
  - Control Unit
  - Actuating Unit Sensing Unit -

The sensing unit consists of pH, TDS, Temperature and Humidity sensor which are providing the expected results.

Control Unit -

The Control Unit(Arduino UNO) will provide the necessary outputs by processing the data received from the sensors to achieve real time regulation of the parameters needed for hydroponics.

We tested the pH values for different solutions which is given below:

PH testing of different samples:

Sr. No.	Sample Solution	Expected Result	Actual Result
1.	Drinking Water	6.5 - 8.5	7.19
2.	Lemon Juice	2 - 3	3.2
3.	Baking Soda	8.3	8.04
4.	Milk	6.5 - 6.8	6.54

VII. Conclusions

The hydroponics system is designed in such a way that it will regulate the PH and TDS i.e. the amount of nutrients with the help of sensors which are interfaced with a microcontroller, according to the requirement of the crop selected. The system will work regardless of the place where the crop is grown and without any human intervention.

VIII. References

1.Rangga Perwiratama ,Yosef Kely Setiadi, Suyoto,"Smart hydroponic farming with IoT-based climate and nutrient manipulation system",Universitas Atma Jaya Yogyakarta, Indonesia 55281, 978-1-5386-8448-1/19/$31.00 ©2019 IEEE

2.Somchoke Ruengittinun,Sitthidech Phongsamsuan, Phasawut Suri Ratanakorn, "Applied Internet of Thing for Smart Hydroponic Farming Ecosystem (HFE)", Dept of Computer Science, Kasetsart University, Bangkok, Thailand, 2017 10th International Conference on Ubi-media Computing and Workshops (Ubi-Media), 978-1-5386-2761-7.

3.Chris Jordan G. Aliac', Elmer Maravillas, "IOT Hydroponics Management System", CCS Intelligent Systems Lab, CIT- University, N. Bacalso St. Cebu City, 978-1-5386-7767-4/18/$31.00 ©2018 IEEE.

4.Shreya Tembe, Sahar Khan, Rujuta Acharekar, "IoT based Automated Hydroponics System", International Journal of Scientific & Engineering Research, Volume 9,Issue 2,February 2018,ISSN 2229-5518.

5.Manav Mehra, Sameer Saxena, Suresh Sankaranarayanan, Rijo Jackson Tom, M. Veeramanikandan, "IoT based hydroponics system using Deep Neural Networks", Department of Information Technology, SRM Institute of Science and Technology, Chennai 603203, India