SOILLESS CULTIVATION USING IOT

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Abstract - *In recent years, one of the arising problems is a shortage of agricultural land due to various reasons, from agricultural lands being sold to poor soil minerals, if this keeps on going, we won't be having enough food and will go starving. To solve this issue, we can't convert the sold agricultural lands in which buildings are being built. To compensate for our growing population and shortage of land, we could use Soilless Cultivation using IOT which can be also referred to by the term "Hydroponics" along with IoT. Growing crops using only Hydroponics requires maintaining a pH level of 6.5 (Slightly acidic) on average, and a temperature of 27° C which is an ambient condition for the growth of the plant. But monitoring them often is a tedious process that can be eliminated by our solution. We use sensors to get the pH level of the water constantly, on unsuitable pH levels, it makes a restful HTTP request to the given endpoint which in turn triggers the cloud messaging functionality and sends a push notification to the android client, and an immediate response can be done to avoid. The temperature of the water and atmosphere is monitored too, when they are too higher or lower than the prescribed level, it will trigger an endpoint call that sends the cloud message from the cloud server and alerts the in-charge about the change. Ordinary hydroponics which just sends readings to remote servers does not implement displaying their data in the android app.*

Key Words: Soilless cultivation, agriculture

1.INTRODUCTION

As we are moving further every day the rise of the population has resulted in the shortage of cultivation land, thus resulting in less food production, leading to starvation. This can be managed with the help of hydroponics. Hydroponics is the process of cultivating without soil but only with help of direct nutrients induced into the plants growing in an aqueous solvent. This can be done varying from a very small scale to as huge as an industrial structure. Since hydroponics involves many technical aspects such as maintaining the PH levels, Monitoring the nutrient content, managing sunlight, and various other things. These aspects can be handled efficiently with the implementation of IoT.

1.1 OBJECTIVE

PH levels need to be maintained because water with too high or alkaline can affect the intake of nutrients. The induced nutrients should be efficiently used and should not be misspent. The overall expenses should be reduced with the help of implementing IoT. The Comprehensive experience should be user-friendly and easily understandable. The water flow has to be monitored and should be regulated based on the current requirement of the plant

1.2 EXISTING SYTEM

The existing system provides only a prototype where the plants can be grown by implementing hydroponics principles. The actual plant is not grown and the suitable conditions are analyzed only with the data and no plant has been grown to test the desired conditions. The data that has been collected from the sensors are displayed only through a website which many times does not have ease of access and lacking the latest mobile application advantages. They are using the website and storing the tokens in cookies, this opens vulnerability for a data breach.

1.3. CHALLENGES

In the existing system, the management system is developed as a prototype and it has not been provided with actual conditions to grow crops in real-time. They are using a website to display the data which is not more user-friendly all the time. Growing the plants in a conventional way requires a huge area of land. Pesticides needed to sprayed in order to avoid loss of crop. A large number of fertilizers are required to supply a small number of nutrients. Fertilizers and pesticides that get wasted, if discharged into water bodies cause various diseases like blue baby syndrome. Wastage of resources such as water, fertilizer, pesticides.

1.4 BENEFITS

The water flow, pH level, and temperature will be monitored, the collected data will be sent to the firebase or a private server. Once the data has been mutated on the server we are checking to conditions that we have defined for the actions to be performed. The android application provides a user-friendly experience, and with a small area of space we can grow many plants compared to a conventional land

2. LITERATURE SURVEY

[1]Chris Jordan G. Aliac', Elmer Maravillas (2018), "IOT Hydroponics Management System", CCS Intelligent Systems Lab, CIT- University N. Bacalso St. Cebu City

This paper reviews an integrated structure for monitoring of the proposed hydroponics system. The proposed research work aims in providing observations of PH, water level, air temperature, and relative humidity. A simple mechanism is created to control the irrigation of water and nutrient solution intake. The data collected from the sensors are stored in a backend and shared with users via the internet. Management of resources in a hydroponics set-up would become easier and more efficient based on the success and results of this study

[2] Olakunle Elijah, Student Member, IEEE, Tharek Abdul Rahman, Member, IEEE, Igbafe Orikumhi, Member, IEEE, Chee Yen Leow, Member, IEEE, and MHD Nour Hindia, Member, IEEE (2018), " An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges" , IEEE INTERNET OF THINGS JOURNAL, VOL. 5, NO. 5, OCTOBER 2018

The proposed research work discusses the riveting shift towards smart agriculture practices. Every day we are coupled with diminishing natural resources, limited arable land, and unpredicted weather the food scarcity has become a day-to-day problem. The use of IoT and data analytics are employed to increase the productivity of the agricultural sector. The IoT integrates the existing technologies such as wireless sensor networks, radio frequency identification, cloud computing, and end-user applications. The future trends and opportunities such as technological innovations, applications scenarios, business, and marketability are examined in this work

[3] MUHAMMAD SHOAIB FAROOQ, (Member, IEEE), SHAMYLA RIAZ, ADNAN ABID, (Member, IEEE), KAMRAN ABID2, AND MUHAMMAD AZHAR NAEEM (2019), "A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming"

The purposed research work discusses the implementation of IoT in agriculture. The technologies used in IoT-based smart farming such as cloud computing, big data storage, network architecture, network topologies have been covered in this work. The security issues on implementing IoT technologies are also brought into the picture. smartphone-based and sensor-based application development for IoT is too brought to the discussion

3 PROPOSED WORK

The water level, pH level will be monitored, the collected data will be sent to the firebase server. Once the data has been mutated on the server we are checking two conditions

1.Whether the pH levels are stable
2.Checking the optimum temperature

If the two conditions are not satisfied, then we will send a push notification alerting the user. If the conditions are satisfied the data is written on the server and when the app starts running the data will be displayed in the app The process starts from the hydroponic system where we have integrated it with a temperature sensor, pH sensor, and ultrasonic sensor. once the system is up and running we will be able to collect the data with help of sensors and the collected data will be sent to the cloud service and will be waiting for confirmation for the next decision to be made which is possible by the back end algorithm that has been used to instruct the server what needs to be done. After checking the necessary conditions, the data is moved to the respective next process which is either updating on the server or alerting the user. The processed information is displayed to the user with the help of an android application

3. MODULE DESCRIPTION

IoT MODULE

This is the core of our system where

1.With the help of sensors, we acquire the required data

2.The collected data is synced to the server

Hydroponic plants are placed in Net Pots which prevent the plant from being submerged in water. The pH sensor is placed at the reservoir, where the water is induced with nutrients and then later supplied to the plant. The microcontroller reads the pH readings from the EC-4743 sensor and sends them to the cloud NoSQL database(Mongo DB). We also monitor the temperature levels with the help of the TMP36 sensor and the data is sent to the cloud NoSQL database, where a cloud function watches the values stored in it. The position of the sensors are placed very carefully since we have the presence of water so we should prevent the sensors from getting damaged

SERVER MODULE

We monitor the pH values and log them into our NoSQL database, as these NoSQL databases can scale largely in both horizontal and vertical manner. When abnormal changes occur like temperature is not at the ambient level on an average of 5 readings or more we create a cloud message and send it to our mobile devices where the user is notified of the changes. If our application is set to auto mode, which automatically pumps the water containing the nutrients to the plants. The pH levels and temperature levels are monitored. The data is sent using cloud messaging service

CLIENT MODULE

Client module: The data collected from the IoT implement will be sent to firebase, immediately after the data is mutated on the server the data will be dispatched towards the client. The data received on the client end will be in raw JSON format this can be parsed with the help JSON parser and now the data has been successfully transfigured into required data classes. The achieved data classes are now fed as parameters for the recycler view adapter. The recycler view Adapter now sets the value passed from the data class into appropriate views. The client receives the notifications from the server by listening to them using google play services. The client updates the view with data immediately after receiving it from the server and parsing it to data classes

The modules work in harmony to provide user an efficient and better management of the hydroponics system. All the three modules satisfy different tasks and with the combination of these tasks we are able to get the final product

4.1 ARCHITECTURAL DESIGN

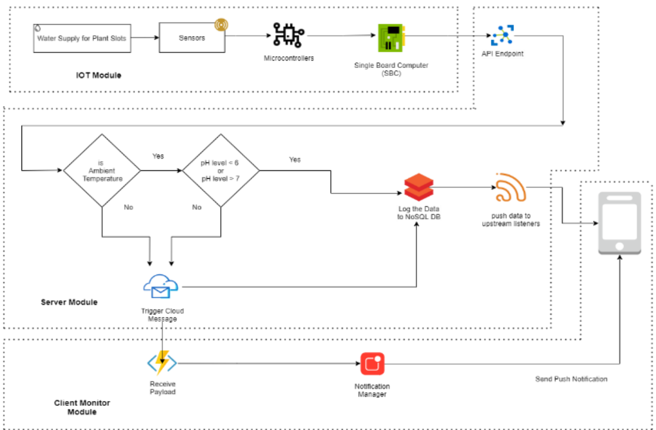

Fig -1

5.IMPLEMENTATION OF THE SYSTEM

The IoT part of the implementation comprises a PVC pipe, porous cups, soil equivalent, pH sensor, Temperature Sensor, Ultrasonic Sensor, and Air pump. The water is supplied into the PVC pipe with the necessary nutrients added and the air pump is activated to provide aeration for the crops. The System is up and running. The data from the sensors are collected and sent to a server. From the server, we are able to decide whether the data is either stored in the server or updated immediately to the end-user by push notification. The end-user is able to view the collected through an android application developed using Kotlin. This application provides versatility, accessibility, and security to the user.

Fig-2

The pH sensor is inserted into the IoT system and made sure sensor is placed effectively for optimum results

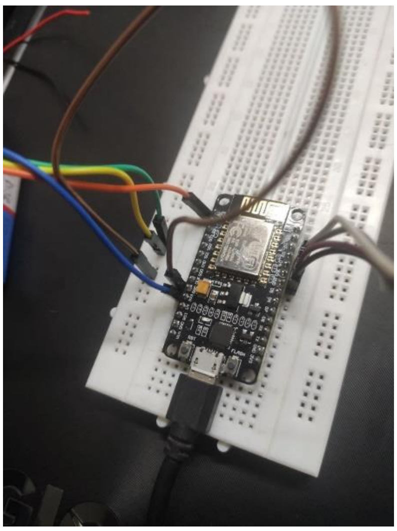

Fig 3

The node mcu is connected with the bread board and the connections from the sensors are made with the respective pins, from this the data is collected and sent to the server from there based on the data that have been collected the notification will either be sent immediately or just mutated on the server

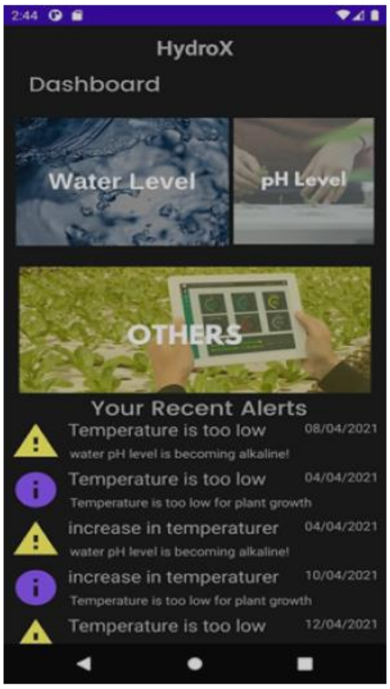

Fig 4

In the above figure we are able to see the dashboard of the application where we are greeted with Water level, ph level, and temperature icons are displayed and the general status of the application is also presented.

Fig 4

The water level on different dates is displayed

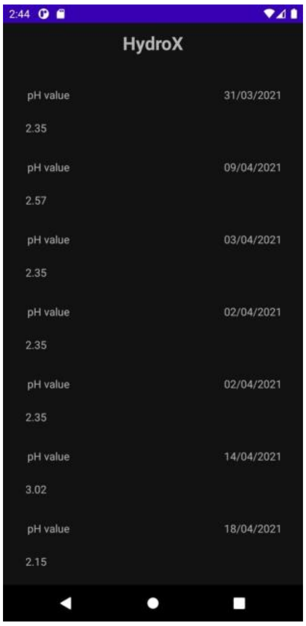

Fig 5

The Ph levels on different dates is displayed

6. CONCLUSION

This paper proposes an integrated system to monitor the water level, pH level, and temperature. the collected data is displayed with the aid of an android application. The data is able to be displayed with the help of the sensors which allow us the collect the information from the hydroponics system and feed the data into the desired server and from the server, we are able to pull the data and display it in the application. The android application provides a user friendly and ease of access of the information

7. FUTURE WORK

This work can be extended by automating the tedious process of managing the nutrient solutions, changing the pH to optimal level when the pH level is not in required level for plant growth, turning on and off the grow light when required for the plant growth with water regulation system to make sure the water is aerated and enriched with required nutrients in a large scale .

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