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Monitoring of Hydroponics System using IoT Technology

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ABSTRACT: *Agriculture around the world plays important role in the development of agricultural nations. In India almost 68% of people depend upon farming and 1/3 of the national capital comes from agricultural. Problems related agriculture have been always preventing the progress of the nation. The solution to this problem can be solved by smart agriculture and modernizing the present traditional methods of farming. Hence the aim of the project is to implement hydroponic system using IoT technologies using Node MCU. The major features of this project include water driven agriculture system that will eliminate need for soil. With this hydroponic automated system, the crops are supplied with water and nutrients depending on the sensors feedback like temperature and humidity (DHT 11), pH sensor and electric conductivity circuits*.

Key Words: Hydroponics, IoT, Node MCU, DHT11

1. INTRODUCTION

During traditional farming many problems are faced such as manual ploughing, weeding, pest, climate etc. Soil based agriculture introduces some soil-based crop diseases. It also requires large use of land. All these problems are resolved in hydroponics-based farming. Hydroponics framing grows crops speedily, healthier, with less water, in a space saving capacity with no diseases, pests or weeds. It is similar to traditional agriculture system therefore background needed to implement this system would remain same for most of the aspects i.e. to maintain proper nutrient level, using proper irrigation techniques, taking care of the plant etc. Other knowledge which are essential will be regarding for creating a proper as well as reliable network with fail-safe mechanism.

As the population of India is growing rapidly which is affecting food requirement and use of land. Traditional agriculture system requires field and proper care of the plant. This forces farmers to invest their time and resources in order to manage their farms. Farmers spend approximately 1/4th time of a day in water supply and in addition to this there are other tasks that also need attention may that be ploughing, removing weeds, checking for deceases and many more which requires physical efforts by the farmers. Technology such as IoT can help and reduces requirement for land as well as it can also reduce human efforts.

2. OBJECTIVE OF THE STUDY

1. To study the hydroponics farming and related aspects.
2. To design and implement hydroponics system using IoT for monitoring various parameters such as pH level of water, nutrients contain in water, temperature and humidity.
3. To provide real time access of the hydroponics system on mobile app to monitor and improve crop yield.

In this research work aim is to design and implement hydroponics system by using IoT for monitoring various parameters of crop

3. LITERATURE SURVEY

In paper [1] has discussed about different hydroponic systems such an Ebb and flow system, Water culture, aeroponics, wick system and Nutrient film technique. In this project Nutrient film technique is been implemented. Parameters such as temperature and humidity are controlled by Arduino Mega2560.

System with IoT devices [2] have hardware characteristics identical with less power, less processing power, less memory, even the communication resources are called as resources constrained devices. It is one of the advantages as well as disadvantage in development IoT technology system. This study is to implement IoT communication, by using Cloud based subscribe and publish method. The need of combining the Cloud computing with IoT system is to combine things, this will help to manage the messages of every device; to gather and organize data or information through the middleware layer; and through application layer, end user can monitor and control or set the

parameters of the IoT in the Cloud based approach, Cloud computing acts as a control center

In the paper [3] three nodes of system are explained about Computers or mobile applications to control the system. In their system, every node is integrated with various devices, sensors and they are interconnected to one central server via wireless communication modules. Server role is to transmit and receives information from user end using internet connectivity. In system there are 2 modes of operation; manual mode and auto mode. In auto mode system takes decisions automatic and controls the devices installed whereas in manual mode user has freedom to control the operations of system using PC commands or android app.
In paper [4] it analyzes the problems of new IoT methods and usage in general in the area of agriculture/ or farming. Our key goal is to analyze current state of IoT and its areas of potential in rural development and agriculture. It targets to compile systematic approaches, where the most critical ones in terms of project solution are:

- By evaluating & defining selected platforms appropriate use in IoT
- Analyzing protocols and standards useful in IoT
- Mentioning the trends and chances for development for IoT in farming rural and sector development
- Analyzing the knowledge obtained and proposing right steps of confirmation by establishing correct prototypes of model solution for hardware parts and software of IoT.

Paper [5] describes hydroponics in a very brief manner. Paper talks about advantages and disadvantages of hydroponic system. The paper also includes tables that consist information regarding plants and basic comparison between soil and soil-less system. The paper describes different problems that might occur if implementation of hydroponic system is not done properly.

4. BLOCK DIAGRAM OF SYSTEM

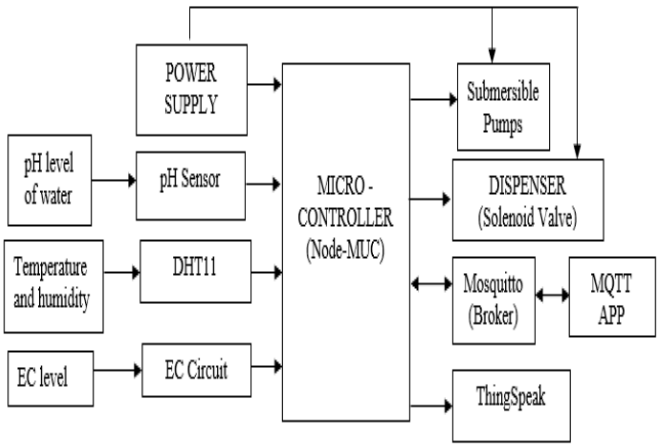

Fig -1: Block Diagram of Hydroponics system

In the above block diagram (fig 1), we can see that three sensors are used namely pH sensor for pH level of water, DHT11 for temperature(*c) and humidity(gm/m3) & Circuit to measure the conductivity of the water level. For communication Single bus data format is used and synchronization between DHT11 and MCU sensor. One communication process is takes about 4ms. Data consists of integral and decimal parts. A complete data transmission is of 40bit , and the sensor sends higher data bit first.

Data format**:** 8bit integral humidity data + 8bit decimal humidity data + 8bit integral temperature data + 8bit decimal temperature data + 8bit check sum (Error bits). If the data transmission is right, the check-sum should be the last 8bit of "8bit integral humidity data + 8bit decimal humidity data + 8bit integral temperature data + 8-bit decimal temperature data".

All these sensors are interfaced to an open source Node-MCU (ESP12) which will act as a microcontroller. This microcontroller is also interfaced with 3.3V power supply. Valves, Pumps, & Dispenser are being controlled by the Node-MCU for efficient working of system. All this information is being send to a mobile app (MQTT).

The controlling of whole system is automated using Node-MCU (Controller) and IoT. However, there is manual controlling provision through Mobile App with the help of LAN connection in case of absence of internet connection. The dispenser is used to mix the nutrients with the water. The water containing nutrients is passed to the pipes with help of submersible pumps.

The water which is not absorbed by the crops is reused by adding nutrients according to the reading from sensor and again passed to the pipes.

4.1 Mechanical System: -

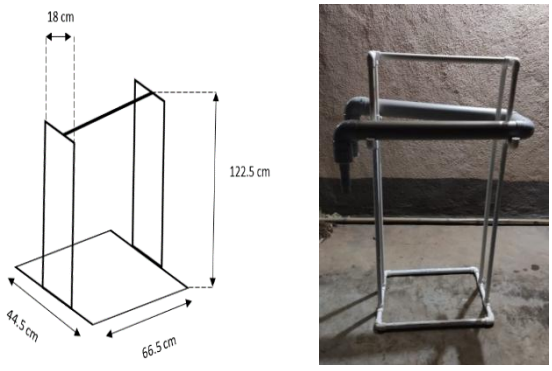

Fig -2: Hydroponics Stand (Front View)

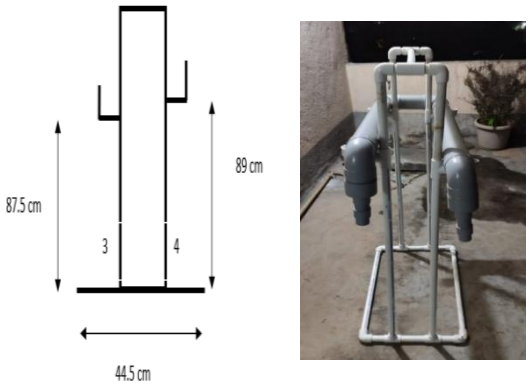

Fig -3: Hydroponics Stand (Side View)

Fig -4: Actual System

5. OBSERVATION AND MEASUREMENTS

Humidity -

For humidity the reading was recorded for every 5 minutes, graph is depicted in fig 5.

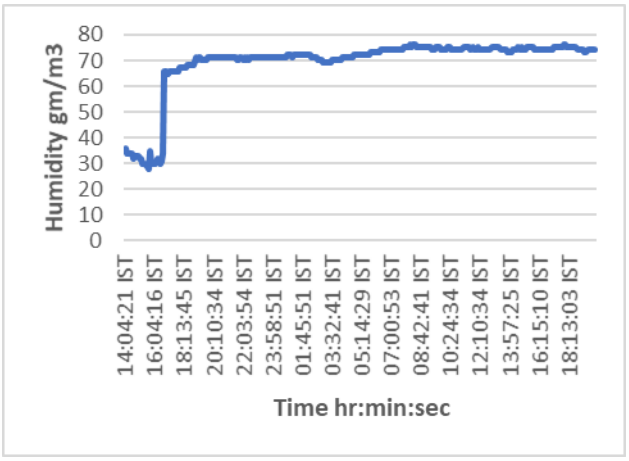

Chart -1: Humidity Vs Time

pH Value: -

For pH values the reading was recorded for every 5 minutes and the reading are plotted in Fig 6

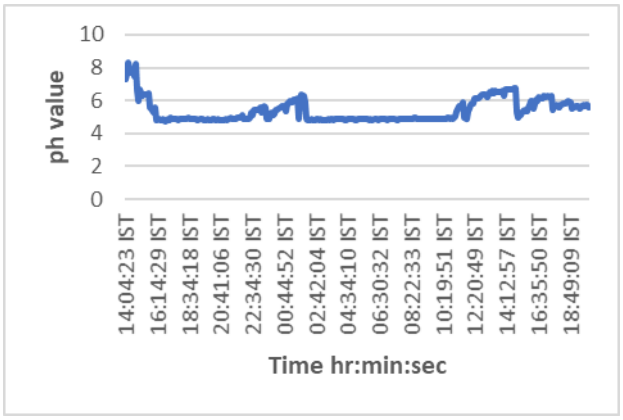

Chart -2: PH Value Vs Time

Temperature Value:

For temperature values the reading was recorded for every 5 minutes and here are the results.

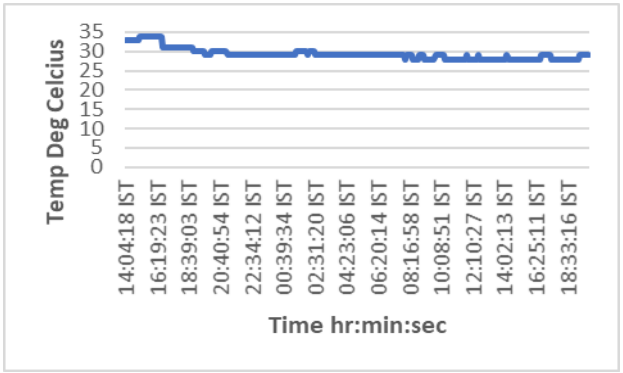

Chart -3: Temperature Vs Time

EC Value:

For temperature values the reading was recorded for every 60 minutes and here are the results.

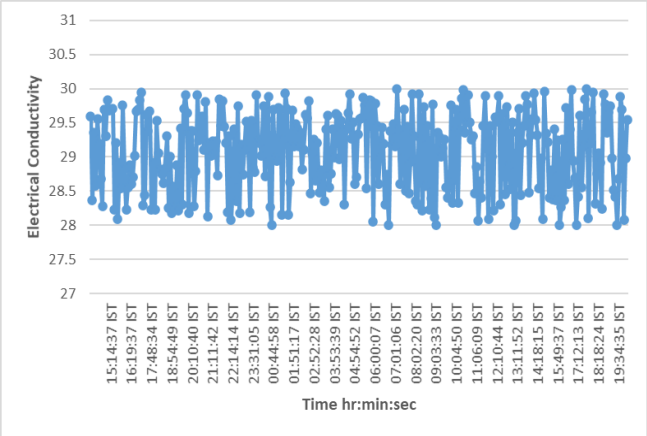

Chart -4: EC vs Time

6. ADVANTAGES & APPLICATION

6.1 Systems advantages are discussed as follows:

- Soil-less agriculture
- Plants can grow all year around – both indoors and outdoors.
- Reduces water usage.
- Crop yield per area increases due to multilevel farming.
- Plants grow quicker and organic in nature
- No need for weeding.
- Soil borne pests are eliminated, which means reduced needs for pesticides.

6.2 Utility of System

- Used where soil degradation is high, hydroponics can be farmed indoor
- Used in terrace gardening.
- Nasa is using hydroponics for farming in space

7. RESULTS AND DISCUSSION

From Chart -1 shows that our system is maintaining humidity around 70 which is most suitable for suitable plant. Chart -2 depicts system tries to maintain pH value when every it varies from set value by adjusting nutrients. This help in maintaining the required ph. From Chart -3 measurement of temp at different timing this also gives idea for us about the variations in temp. Further if temp control is required for particular crop then system needs integrated for the same. Chart -4 describes the electrical conductivity of the water in the storage tank if the value goes below the threshold (28) which indicates low nutrient content in water. The dispenser is turned on to increase the nutrient in water until the EC is around median.

8. CONCLUSIONS

Our designed system achieved to produce plants/crops in an efficient way by reducing the usage of water, nutrients and area required for farming

Our outcome was achieved by collecting all data regarding working system so that it can be monitored and controlled by the IoT. The data of the designed system is collected on ThingSpeak and displayed on "IoT MQTT Panel" mobile application which will help the user to monitor and control plants condition easily.

Further this system can be developed or modified by adding Artificial Intelligence and Image Processing in future.

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