Hydroponic Farming-The Modern Day Agriculture

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Abstract- *The goal of this Project is to design and construct a Hydroponic system which is automated using Internet of Things (IoT) that can be integrated into the agricultural curriculum while introducing business skills.*

Keywords- Hydroponics, IoT, Automation, MQTT broker, Database

I. INTRODUCTION

Current status of agriculture in India today is fair. Today people are taking interest in the farming. Youngsters these days are setting examples by using technology to make the Hydroponic field more prestigious.

The mega agri-summit held in Rajasthan on November 2016, shows how the government, as well as people are interested in farming. Good farmers are awarded to expose & promote the Agriculture sector. Several schemes are introduced to help the farmers make a future in agriculture, like Krishonnati Yojna, Rashtriya Pashudhan Vikas Yojna etc. Recently, a 24 hour television channel named DD Kisan also has been launched, which focuses on the Indian farmers. This channel helps the farmers in sorting out any kind of agricultural disputes of the farmers.

Contribution of Agriculture in economic development is huge. The Agriculture sector plays a vital role in the Indian Economy. Agriculture contributes about 16% of total Gross Domestic Product (GDP). India exports a huge amount of agricultural materials like fruits, vegetables, pulses, tea, spices etc., with which the Government is acquiring good revenue from it.

There are ample products being exported as a result of which India is leading the world in exporting products like tea, coffee etc., this in turn is making India proud in the agricultural sector. Most part of the money circulates for purchasing food items, which is beneficial for the financial growth and balance.Wherever robotization had been actualized and human creatures had been supplanted via programmed apparatus, the yield had been enhanced and utilized less manual work to accomplish the task. There is a need to actualize and utilize present day innovation in the agribusiness to increase the yield of the harvest. This paper highlights majorly on the utilization of remote sensors which gathers and organizes the information from various sensors, following which, the information is sent to a principle server utilizing remote convention. To deal with all the issues, it is important to create a coordinated framework which will deal with all components that are influencing the efficiency at each stage.

Fig. 1. Benefits of Hydroponics

In this paper, we can note the Automation of water supply, maintenance of the farm's temperature at required level, maintenance of nutrient's pH level and EC (Electrical conductivity) at appropriate levels, automation required in maintaining intensity of sunlight for the farms and also setting up alarms and indicators for unusual conditions at the farms if any. Also, all the related information is to be displayed on display panel and related information will be sent to the owner of that particular farm.

II. HYDROPONICS

What is Hydroponics?

Hydroponics or soil-less culture is an innovation for developing plants in supplement arrangements that supply every supplement required for ideal plant growth with or without the utilization of a latent medium, for example, rock, vermiculite, shake fleece, peat greenery, coconut fiber, etc,. to give mechanical support.

Why Hydroponics?

Soil is generally the most accessible developing medium and plants ordinarily develop in it. It gives dock, supplements, air, water, and so forth for fruitful plant development. Further, ceaseless development of harvests has brought about poor soil fruitfulness, which thus has diminished the open doors for normal soil ripeness developed by organisms. This circumstance has prompted poor yield and quality. Also, traditional yield developing in soil (Open Field Agriculture) is troublesome as it includes expansive space, parcel of work and extensive volume of water. Furthermore, in a few spots like metropolitan regions, soil is most certainly not accessible for yield developing. Another significant issue experienced. [1]

II] a. Basic requirements of Hydroponics:

- Devices to check the corrosiveness or pH and EC (Electrical conductivity) of the solution.
- Water.
- The supplement arrangement must contain all small scale and large scale components that are necessary for the plant.
- The temperature and air circulation of the supplement arrangement is appropriate for plant root framework.

b. Ideal conditions to be maintained:

pH requirement	5.8-6.5
Temperature requirement	20-30 degree Celsius
Light requirements	14-16 hours per day
EC requirement	1.5-2.5 dS/m

c. Software Requirements:

- 1.6.8, an Arduino programming environment is used for writing code in the Arduino programming language to instruct the Arduino, writes embedded c code, compile and execute them.
- Proteus 8.1 used here for circuit simulation and results verification.
- Eagle 5.7 used here for PCB layout preparation.

Fig. 2. Hydroponics Set-up

III. LITERATURE SURVEY

IoT based Smart Agriculture identified with remote sensor organize, scientists measured soil related parameters, for example, temperature and stickiness. Sensors were set underneath the dirt which speaks with hand-off hubs by the utilization of compelling correspondence convention giving low obligation cycle and henceforth expanding the life time of soil observing framework. The framework was created utilizing microcontroller, widespread no concurrent beneficiary transmitter (UART) interface and sensors while the transmission was finished by hourly testing also, buffering the information, transmit it and after that checking the status messages. The downsides of the framework were its cost and organization of sensor under the dirt which causes weakening of radio recurrence (RF) signals. [2]

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Field Monitoring and Automation utilizing IOT in Agriculture Area proposes the upsides of having Information and Correspondence Technology (ICT) in Indian agrarian area, which demonstrates the way for provincial ranchers to supplant a portion of the ordinary systems. Observing modules are exhibited utilizing different sensors for which the data sources are nourished from Knowledge base. A model of the system is done utilizing TI CC3200 Launchpad interconnected sensors modules with other vital electronic devices. [4]

To develop our application, we studied two groups of mobile applications for gardening. First one is the group of garden planning applications that do not support automatic

control functions. The second one is those that do support automatic control functions by using sensor technology that is similar to what we planned to implement.

For the first group of applications, we reviewed their functions in order to understand the requirements of the features to be developed. For example, Garden Plan Pro [5] is a garden planning application that allows users to plan the growing area and define area requirements. This application supports users to create a year plan for their gardening. More importantly, it uses location data to suggest users what to plant and when to harvest.

For the second group, we reviewed three applications that are integrated with sensor technology. The first one is Koubachi Wi-Fi Plant Sensor [6] for indoor planting. It helps in maintaining a suitable environment for plants and also enables the users to view planting environment remotely at any time. A notification is sent to the users about the bad weather conditions.

IV. SYSTEM ARCHITECTURE AND FUNCTIONS

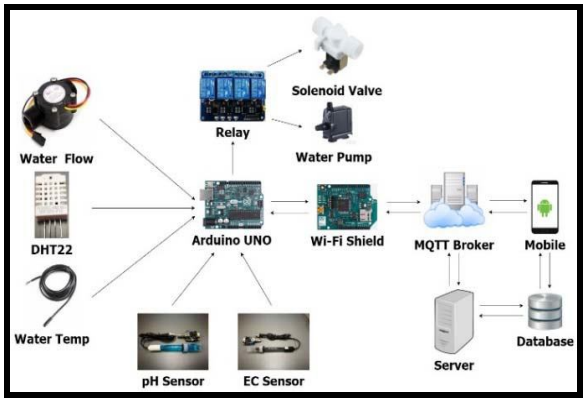

Fig. 3. System Architecture

The architecture above consists of multiple sensors.

- An Arduino UNO board,
- A Wi-Fi Shield,
- A Relay,
- An MQTT Broker,
- A Server,
- A Database and
- A Mobile user.

The Arduino UNO is the fundamental microcontroller of the system which receives data from sensors and passes the data to other parts. The Data from sensors will be combined to one string and further will be converted to JSON.

After which, the microcontroller will send that string to the server through the MQTT Broker [7] (A connectivity protocol for the IoT).

The MQTT Broker is a mediator that sends and receives data. It has 3 functions:

- First, data is directly sent by the MQTT broker to the mobile application.
- Second, information is sent by the MQTT broker to the server.
- Third, commands are received from the server and are then sent back to the sensors. The server processes and saves all the values in the database.

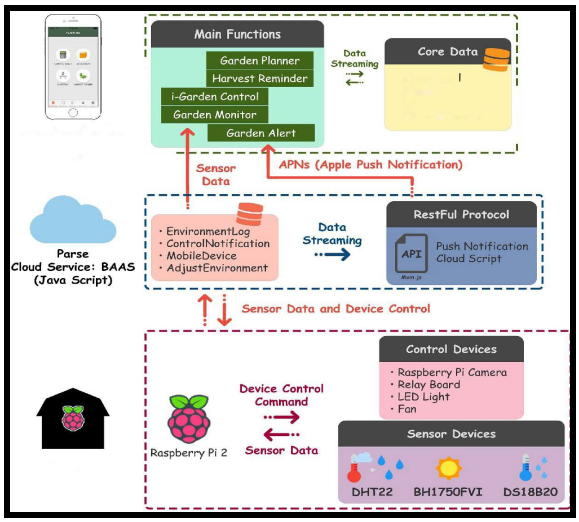

Fig. 4. System Architecture of Smart Suan Pak Nam

- **Smart Suan Pak Nam mobile application:** Composes of functions for outlining and monitoring hydroponics garden. Users will receive a notification when the plants are suitable for harvesting and also about the inappropriate environment of hydroponic system if any. It has a database in mobile called "Core Data" containing the data of plants, house, planting target, and harvest records as an addition. [8]
- **Hydroponics house with sensor technology:** This hydroponics house is installed with sensors for controlling the environment. There are three sensors that are involved –

Temperature and Humidity sensor, Water temperature sensor, and Light intensity sensor.

We use Raspberry pi version2 to interface sensors and cloud service.

- **Cloud Services** keep all the data that is read from the hydroponics house's sensors and performs functions to send notifications automatically to the owners.

V. SYSTEM FLOW DIAGRAM

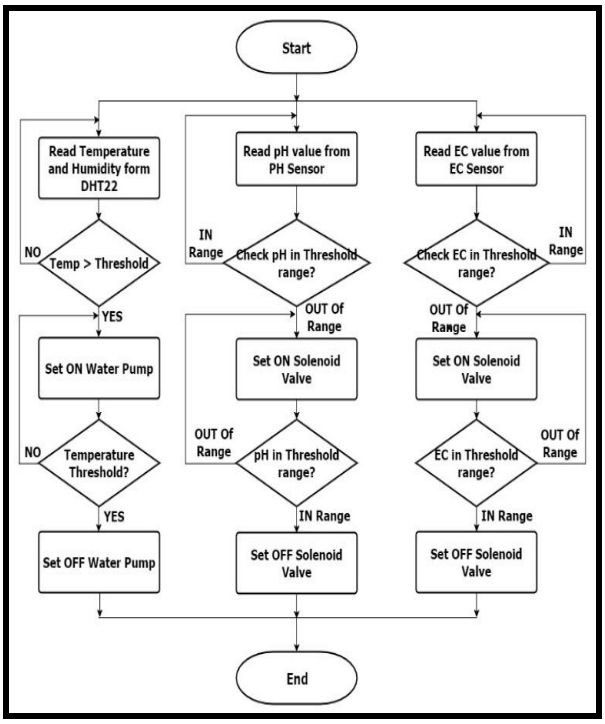

Fig. 5. Flow Chart

VI. RESULTS

Images of fully grown lettuce plant

Fig. 6. Lettuce

Fig. 7 Hydroponic set-up growing Lettuce

VII. ADVANTAGES AND LIMITATIONS

Advantages:

- Limitations of conventional manual method Hydroponics farming are solved using automation of hydroponics farm.
- pH and EC of the nutrients is maintained using this system.
- There is no need to go to the farm to measure pH & EC.

- Measurement of pH and EC will be automatically informed to Farm owner through Global System of Mobile Communication (GSM).
- If pH & EC are not in the appropriate range, it can easily be maintained automatically, by adding fresh water or nutrient solution.
- Energy input problem solve using Solar panel technology.
- Aeration problem solved by using oxygen pump.
- In winter and rainy season, the problem of low light is solved using LED strip.

Limitations:

- Higher initial capital expenditure.

VIII. CONCLUSION

Automation is done in order to achieve many benefits for healthy growth of plants which results in increase of yield with appropriate amount of nutrients, light, water and healthy temperature conditions. This can be done using Arduino/Raspberry pi based automation of water and nutrient solution. Automation makes the system more efficient in the absence of humans. It updates the farm owner of the status of his farm.

In this way, the proposed system has many advantages over conventional method of farming.

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