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A Novel Approach for Smart Hydroponic Farming Using IoT

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Abstract: **- The effects of the global warming make more difficult for planting in uncontrolled environment. In traditional farming method, farmers require fine quality of soil with natural mineral strengths. It also requires working cost for ploughing and removal of weeds and also needs large amount of space and water. In case of seasonal plants, the yield does not satisfy the customer needs and the expectation of farmers in productivity. For these reasons, a farming method which needs lesser requirements in cost factor and also it easy to maintain and control the important factors such as light, water level temperature, and humidity throughout the year is needed. This proposed work presents a Hydroponic style of farming which is the method of growing plants without soil & sunlight. In this method the plants are grown with only their roots exposed to the mixture of ash fertilizer with water instead of underground soil. This method is a type of indoor agriculture style which is independent of weather, and it also avoids the cost of ploughing and labour works. Watering and controlling of humidity is done with the help of a microcontroller Kit connected to Wireless sensor network with internet which senses the humidity, temperature and water level. With the help of this IoT technology, the real time status of plant's growth could be monitored by the authorized person from remote location. This technology helps efficiently for the agricultural development with minimum resource utilization.**

Key words: - Internet of Things, Smart Hydroponic Style, Wireless sensor Network.

I. INTRODUCTION

Hydroponics is an agricultural method of producing plants in an artificial environment without using soil – nutrients which are provided through water – and by optimizing the growing conditions to improve the production. Hydroponically cultivated plants have a growth rate that is much faster and highly yielding than that of plants grown in soil. Because they are cultivated in containers, pest and disease control is at an optimum. In natural conditions, soil itself acts as a mineral nutrient reservoir but it is not essential for plant growth. The roots can easily absorb the mineral nutrients in the soil if it is dissolved in water. If the minerals are present in the supply of plant's water artificially, then the plant no longer requires soil to thrive. We can grow any terrestrial plant by this method. The method for growing plants by using mineral nutrient solutions, in water, without planting in soil is known as hydroponics. For simplifying and automating many complex real-world tasks the information and communication technology methods are used. The internet plays a major role in implementing information and communication technology sectors. Communications in the internet mainly involve client-server connections. The information and communication technology moves to the next stage on creating and sharing information where the humans rely on machines such as weather monitoring system, etc. At this time the machine-to-machine (M2M) communication is also in a peak where one machine receives the information of other machines. In future, everything around us could be connected and they are able to sense and cooperatively communicate over the Internet, thereby giving birth to the Internet of Things (IoT). The basic idea behind IoT is the pervasive and ubiquitous presence of the things or objects around us like mobiles, sensors, radiofrequency identification (RFID) tags, etc. This leads to the Generation of huge amount of data that need to be stored, processed, and presented in an energy efficient manner.

II. LITERATURE SURVEY

Dr. D.K. Sreekantha et.al[1] analysed that the Internet of things (IOT) is remodelling the agriculture enabling the farmers with the wide range of techniques such as precision and sustainable agriculture to face challenges in the field. IOT technique helps in collecting information about conditions like weather, moisture, temperature and fertility of soil, Crop online monitoring. It enables the detection of weeds, level of water, pest detection, and

animal intrusion in to the field, crop growth, and agriculture. IOT leverages farmers can get connected to his farm from anywhere and anytime. Wireless sensor networks are used to monitor the farming conditions and micro controllers are used to control and automate the farming processes. To view the conditions remotely in the form of image and video, wireless cameras have been used. A smart phone empowers the farmer to keep updated with ongoing conditions of his agricultural land using internet at any time and any anywhere. IOT technology can reduce the cost and enhance the productivity of traditional farming. In this paper they proposed an application prototype for precision farming using a wireless sensor network with an IOT cloud. Foughali Karim et.al[2] reviews that, as water supplies become scarce because of climatically change, there is an urgent need to irrigate more efficiently in order to optimize water use. In this context, farmers' use of a decision-support system is unavoidable. Indeed, the real-time supervision of microclimatic conditions is the only way to know the water needs of a culture. Wireless sensor networks are play an important role with the advent of the IoT and the generalization of the use of web in the community of the farmers. It will be judicious to make supervision possible via web services. The IoT cloud represents platforms that allow to create web services suitable for the hardware integrated on the Internet. In this paper they proposed an application prototype for precision farming using a wireless sensor network with an IoT cloud. Jumras Pitakphongmetha et.al[3] analysed that, the effects of the global warming, and the plants are affected with UV rays. For this reason more difficult to planting in uncontrolled environment. On the other hand, the yield does not match customers' needs. For these reasons, planting in a greenhouse is easy to maintain and to control important factors such as light, temperature, and humidity. Using of sensors in a greenhouse as Wireless Sensor Networks System are the efficiency of technology used in agricultural development by sending data to the cloud and controlling values such as temperature, light, etc. The results of his study will be useful for the farmer and related organizations applying in the farm. Srisruthi.S et.al[4], analysed that Agriculture requires the dedication of many natural resources, including land, water, and energy. So, they adopted sustainable agriculture which supports careful management and cultivation of crops involving less use of fertilizer, pesticides, calculated use of precious natural resources like energy, water through controlled irrigation and fertigation practices with the help of green sensor technology and electronic control systems. In this paper, they proposed an efficient automated farm monitoring and irrigation techniques which incorporate wide range of sensors to remotely sense and monitor various parameters of the soil like temperature, moisture, fertility and regulate the supply of water and fertilizer to the land based on the requirement. An algorithm formulated with the threshold values of sensor outputs is used to code the microcontroller which performs the required actions by employing relays until the strayed-out parameter has been brought back to its optimum level. The cloud based user friendly interface facilitates real-time data logging of the environmental parameters while also supporting analysis of past statistics for future growth by means of a web-based customizable application. Furthermore, the project aims to optimize the use of land and labour, conserve water, increase crop yield, avoid wastage of energy and provide maximum automation and benefit the society by adopting smart environment friendly technology to implement newer and sustainable ways of agriculture.

Tsung-Han Wu [5], developed an Intelligent Plant Care Hydroponic Box, From the experimental measurement results of IPCH-Box, the developed environment driven control methods include light, water sprinkler and water pump which can effectively lower the CO2 concentration, the temperature and increase water level, respectively. Specifically, the time of CO2 concentration reduction in IPCH-Box is 38.53% faster than the plant system without our mechanism. Sensor technology has been intensively applied to plant care system. There exist two kinds of plant care systems. A large-scale plant care system can be a plant factory or a green houses. On the other hand, a small-scale plant care system with the size of several square feet is typically installed in a green laboratory. Generally, a small-scale plant care system can be transformed from a large-scale system. Chanya Peuchpanngarm et.al[6], developed a DIY sensor-based automatic mobile application for hydroponics. The application enables automatic environmental control for hydroponics via different types of sensors including water, temperature sensor, temperature and humidity sensor, and light intensity sensor. It also consists of the functions for planning, monitoring, as well as harvest data recording, of hydroponic gardening to fulfil the planting demands. The harvest data will be used for hydroponics planning in the next grow. In addition, users can monitor the plant growing progress remotely.

III. SYSTEM DESIGN AND REALIZATION

Data collection, monitoring and evaluation of the system is used to determin which approach is effective. These adaptations are most needed. Therefore, IoT engaged interventions in agricultural sector are more productive.

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Blynk App is used to control and monitor the smart farm. We can control the humidity and temperature using Internet of Things from any place at any time 24/7.

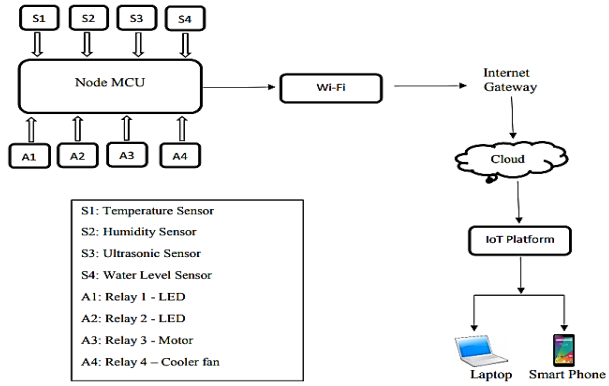

Fig.1 : Proposed Architecture

TABLE 1.

Deployment Parameters

Parameters	Value	Working Voltage
Temperature and Humidity	DHT – 11	5V DC
Ultrasonic Sensor	HC-SR04	5V DC
Relay Module	4 channel	5V DC
Water Level	K-0135	5V DC
Green House	-	-

A. Monitor Interface

Hardware Requirements

NodeMCU is used for implementing the greenhouse monitoring. The following sensors and other peripherals are used to collect real time data from the smart hydroponic farm:

• DHT11 is a digital composite sensor contains digital signal output for measuring temperature and humidity.

• Ultrasonic Sensor Module (HC-SR04) includes an ultrasonic transmitter, a receiver and a circuit. There are 4 pins, 2 for power supply and 2 for sending specific frequency of sound waves and listening the sound waves bounce back.

• A Four Channel Relay Module (5V) for switching AC/DC is used to trigger a DC motor (12V) and LED light (12V) to operate the valves.

• Water Level Sensor (K-0135) – It checks the basement in vertical and gives the analog value of output based on water level.

B. Experimental Setup

Area: The greenhouse is built on a plastic container with the size of 45.72 * 30.48 * 15.24 (length * width * height: cm) filled with water nutrients.

Plants: The plants used in this research are mint with stems, petioles 25-40 cm wide, 5-10 cm long, plant is growing very fast. Just harvested within 35-45 days.

Setup: the experimental setup I have made, a beautiful container in which one can find water which a floatable bed touches the container who has 8 net pots in which the plants are kept.

C. Algorithm for Proposed System

Input:

W(necessary water level), H (necessary Humidity), L (necessary Light Density), T (necessary temperature)

Output:

Controlling room temperature, Light and water level

Process:

Wi - Water level obtained from sensor
Hi - Humidity obtained from sensor
Li - Light obtained from sensor
Ti - Temperature obtained from sensor
AU – Authenticated User
Step 1: Read the sensor values (Wi,Hi,Li,Ti).
Step 2: If the sensor values greater than the threshold values (W,H,L,T).

2.1: Trigger the Email to AU.

2.2: The AU make the decision to control the actuators based on the values of (W,H,L,T).
Step 3: If the sensor values less than the threshold values (W,H,L,T) Repeat step 2.1 & 2.2.

IV. RESULTS AND DISCUSSION

A. Plant growth

The below chart describes the performance of the smart hydroponic farming method in comparison with the existing and traditional farming method. Traditional farming method a conventional way of growing plants using soil. The graph gives a clear visual of our proposed method which has more advantages and it provides quicker yields. This method does not requires soil and it yields the growth of plants by using the organic nutrients added in the water.

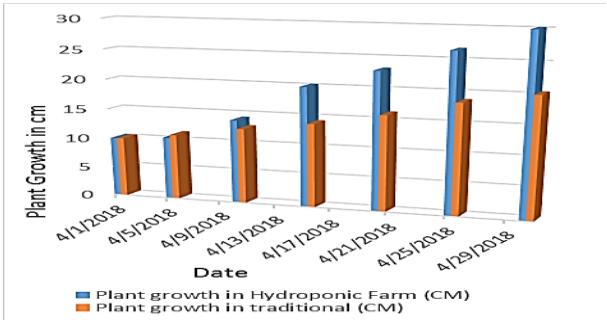

Fig 2. Plant Growth

B. Farming Method

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The method consists of a container filled with water with net pot's to grow the plants. For holding the plants within the pot leca clay is used.

Fig 3. Hydroponic Farm Architecture

The clay is very light weight and it is a majorly used growing medium in hydroponic farming methods. It retains water during periods of drought and insulates the root with increased oxygen level and promotes the growth. The setup also contains the LED light, cooler fan, temperature and ultrasonic sensors for monitoring and controlling the plant growth. It also has a water level sensor immersed inside the water to monitor the water level in the container.

C. Monitoring & Controlling

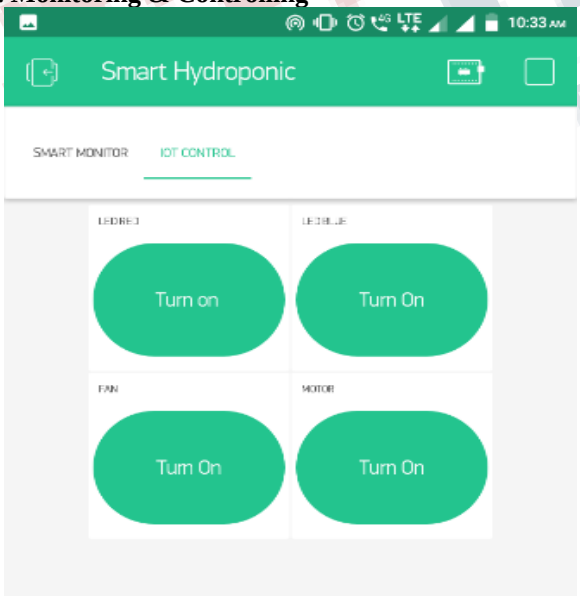

Fig 4.Blynk App for Control

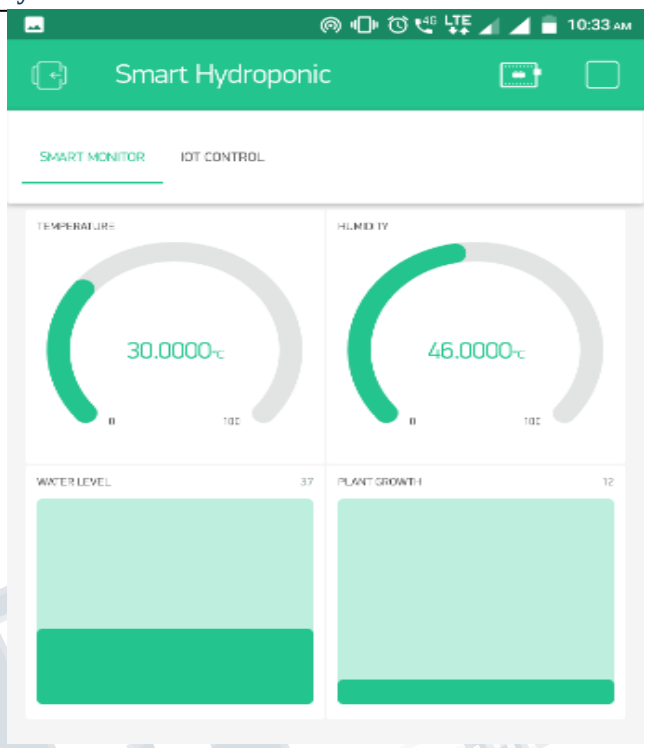

Fig 5.Blynk App for Monitoring

For controlling and monitoring the smart hydroponic farm method, IoT based API's called Blynk and Thing speak is used. Blynk is a platform which supports with android or ios application to control Arduino, Raspberry Pi modules over the internet. The data such as temperature, humidity, water level and plant growth are received from hydroponic farm by NodeMCU module by using various sensors such as ultrasonic, DHT11 and K-0135 sent to the blynk application through ESP8266 Wi-fi module over the internet. Thing speak is also an open source cloud based API for storing and retrieving data from the things using the HTTP protocol over the internet. The method for data received by the Blynk application is same as for receiving in the Thing speak application.

IV. CONCLUSION

The proposed hydroponic system hence implements the integration of different varieties of crops. The short comings of the existing system like growth of a single type of crop in the entire system have been overcome. A methodological approach has been taken forth to regulate the working of the system. The plants grown under this system is analysed with traditionally grown ones and has been found that these plants grow a lot quicker with minimum requirement of nutrients. They are much

cleaner with minimum organic constituents using up only required water, preventing loss of water. Also the cost for cropping is nominal on consideration of its advantages. Hence this model encourages practicing of an alternate approach towards farming that is eco-friendly and efficient on comparison with upcoming techniques.

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