International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 12 | Dec 2022 www.irjet.net p-ISSN: 2395-0072

Internet of Things (IoT) Based Plant Monitoring System in an Aeroponics Vertical Farming Technique

Prathamesh Pawar[1], Bharat Kulkarni[2]

[1] Student , [2] Professor
Department of Electronics & Telecommunication Engineering
Dr. V.P.S.S.Ms Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Sangli, Maharashtra 416304 India.

Abstract - *Vertical framing is becoming very much popular practice Now a days. It is a new generation method of farming. Vertical framing helps to maintain the food production chain without disturbing the agricultural misbalance. Among main three types; 1. Aeroponics technique, 2. Hydroponics technique, 3. Aquaponics technique; here we are going to focus on AEROPONICS TECHNIQUE. In this technique we are monitoring few major environmental parameters which are basic need of the crops to grow healthy. Thus, to monitoring such parameters, we take the help of IOT.*

Key Words*: *Aeroponics, ESP32, Artificial Environment, IOT, Vertical farming, indoor.

1. INTRODUCTION

India is 2nd largest country in agricultural production. India is an agriculture dominated country in which 65% to 70% population depends on agriculture. According to Indian GDP, currently agriculture contributes near about 16% -17% of Indian GDP. In India most of the farmers use conventional method for agricultural farming. Conventional agricultural farming means the soil based agricultural farming. Conventional agricultural farming mainly requires 80% of soil and 65 to 70% of global fresh water. The main drawbacks of Conventional agricultural farming are: i) extreme dependency weather and ii) wastage of 45 to 67% global fresh water due to leakage and evaporation. India's dependency on weather and environment leads some time conventional agricultural farming to unsustainable usage of resources. [3]

Now days a nutrition load values of food are very much important factor in day-to-day life of human. Due to huge increase of population, there is a vast demand in agricultural production so full fill this demand most of the farmers are using chemical fertilizers for getting more and more production in less duration of time and thus farmers are compromising nutrition load values of products or crops.

To overcome all these issues Vertical Farming incorporates all planning and design of agricultural farms together in a high-rise building. In Vertical Farming different types of crops, fungi and plants are grown in vertical stacks. Recently, Vertical Farming is being implemented successfully in many countries. This agricultural farming technology helps to produce a lot of crops inside the city. [2] The technique which is focused / used in our project is an Aeroponics technique.

Richard J. Stoner II was first developed use of Aeroponics for growing Edible Plants in 1983. In this type of farming, the water which is to be provided is mixed with some compounds which are not hazardous for human anatomy as well as plant anatomy. Such water is circulated via pipes. Due to creation of artificial environment and indoor implementation of agricultural farming project, there is very-very less chances of insects and pests so there is no need of insecticides as well as pesticides. Thus, we can avoid use of insecticides as well as pesticides.

But if we look into 1990s, NASA had brought attention to aeroponics. It began investigating soilless ways of raising food that could be used in the low-gravity conditions that are present in space travel. NASA had carried out research / investigation on aeroponics on board of the international space research station 'MIR'. Since then, a number of commercial aeroponics systems have been developed for research, industrial and home use.

2. METHODOLOGY

We have tried to build a prototype / structural model of vertical farming and in that tried to maintain the necessary environmental conditions required to cultivate crops / vegetables. In this project, tried to maintain those few basic parameters which are minimal requirements for the crops to grow healthy and those are Temperature, Humidity, Light and pH of nutritious Water.

In that model / structure, we did provide water pipe lines for supplying water which is to be pumped from water tank. This supply water tank is filled with solution of mixture of fertilizer and water in appropriate proportion. The pH value of this tank solution is maintained as per our crops / vegetables. By using the above developed environment, we cultivated mint plants.

For maintaining temperature, moisture, light intensity and Nutritious Water supply etc. we required

microcontroller / node MCU. To achieve our this goal, we have used node mcu / ESP32 Development Kit Board in connection with DHT11 as Temperature / Humidity Sensor, LDR as Light Sensor and pH Sensor to measure nutritious water. For software programming for ESP32 Development Kit Board, we used Arduino IDE platform. For working of ESP32, it required 5V supply.

There are three techniques of vertical farming:

1. Aeroponics technique

2. Hydroponics technique

3. Aquaponics technique

Here we are going to use aeroponics technique. In this technique there is a tank which contains water and nutrients. In the tank there is one submersible pump which is used to pump the water from that tank to spray that water on the roots of the plants. Sprinklers nozzles are used to spray water on the roots of plant.

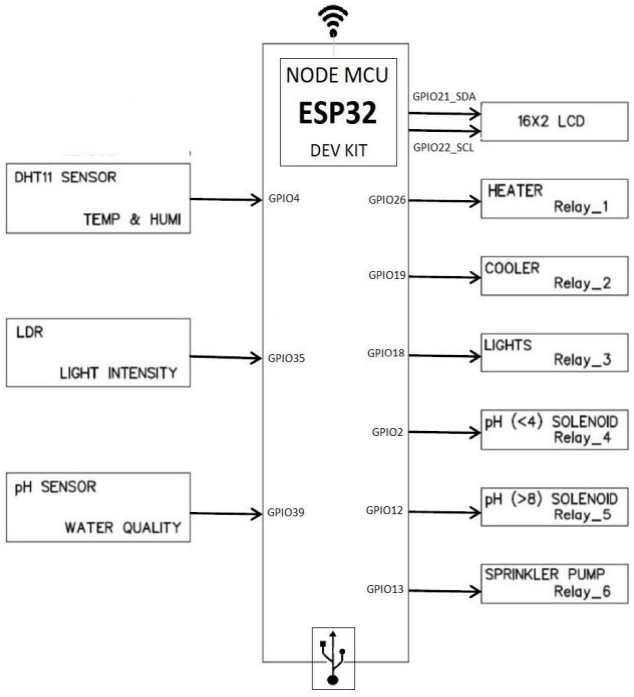

Fig -1 : Block Diagram

In the indoor place to create an artificial environmental, we need to monitor four basic parameters:

i) Temperature

ii) Humidity,

iii) Light,

iv) pH value of water.

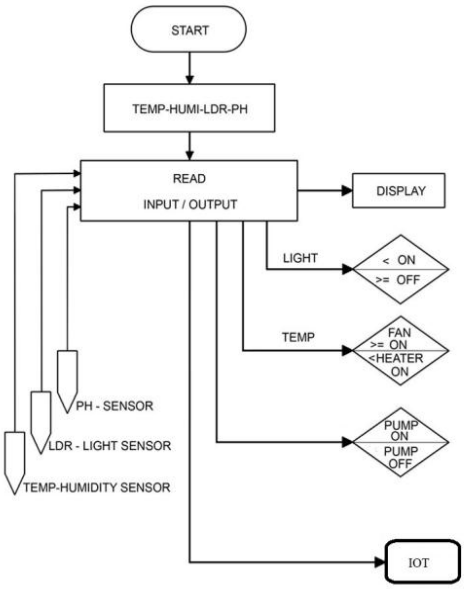

Fig -2 : Flow chart

Components used in our project :

1) ESP32 : ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

It contains digital as well as analog pins which are helps us to reduce the complexity of our project. It is used to sense the various inputs from variety of sensors and acts as main controlling element.

2) pH Sensor : pH probes contain two electrodes (a sensor electrode and a reference electrode) that measure the hydrogen-ion activity in a solution. The exchange of ions generates a voltage that is measured by the pH meter converting the voltage into a readable pH value. pH(the potential of Hydrogen) measures the interaction between hydrogen and hydroxide ions within a water-based solution. A solution with a high amount of hydrogen-ion activity is an acid. In contrast, a solution with a high amount of hydroxide ion activity is a base.

It is uses to find the concentration of hydrogen ions using electric current in water based solution. We used pH sensor to check the acidic/alkaline values of water for exchanging that water from the tank.

3) LDR: A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases.

LDRs or photoresistors are often used in circuits where it is necessary to detect the presence or the level of light. They can be described by a variety of names from light dependent resistor, LDR, photoresistor, or even photo cell, photocell or photoconductor.

4) DHT 11: DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers. The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.

5) LED grow Light: LED grow lights are composed of multiple individual light-emitting diodes, usually in a casing with a heat sink and built-in fans. LED grow lights do not usually require a separate ballast and can be plugged directly into a standard electrical socket.

Individual LEDs usually provide only a single narrow range of colours, and so different colour LEDs are mixed in grow lights in proportions depending on the intended use. It is known from the study of photomorphogenesis that green, red, far-red and blue light spectra have an effect on root formation, plant growth, and flowering, but there are not enough scientific studies or field-tested trials using LED grow lights to recommended specific colour ratios for optimal plant growth under LED grow lights.

6) 16X2 LCD Display : It will be used to visualize the data locally it will help to operate the device standalone.

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of application.

A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.

7) Submersible Pump : A submersible pump is a device which has a motor close joined to the pump body. The whole structure is submerged in the fluid to be pumped. We used pump for circulating the water to sprinklers throughout the structure.

8) Fan : Fan is used for cooling purpose of the system. If the temperature of the system increases the fan will turn on to cool down work.

3. RESULT

During this project we select mint as a farming material. For better growth of mint, always kept its temperature in between 15 to 25 degree Celsius also maintain pH factor of water in between 6.0 to 7.5 because mint has wide range for pH which is 6.1 to 7.8. but ideally it should be in between as give above.

During working on this project we observed that mint can sustain in between 21 to 29 degree Celsius, also pH up to 7.5.

Sr. No	Parameter	Observed
01	Temperature	21-29 ∘C
02	Humidity	72%
03	pH	6.1-7.8

4. CONCLUSIONS

In aeroponics technique, we can grow different types of plants throughout the year by maintaining the respective parameters like temperature, humidity, pH, LED light with the help of IOT. Because of IOT we can monitor parameters from anywhere, any time. Due to indoor structure and monitored environment, there is less chances of becoming diseased plants and need very less of pesticides and insecticides. At the end, we can get fresh, clean and healthy food production.

5. REFERENCES

[1] "Automated Aeroponics System for Indoor Farming using Arduino", Ferdousi Rahman, Israt Jahan Ritun, Md.Ryad Ahmed Biplob, Nafisa Farhin, Jia Uddin. Department of Computer Science & Engineering BRAC University Dhaka, Bangladesh, October 2018.

[2] "A survey on Vertical Farming", Saravanan M & Saravana Krishnan M (Student SKCET), Srivaishnavi D (Assistant Professor SKCET). International Journal of Engineering Research & Technology (IJERT), September-2018, Vol.7 Issue 09, September-2018.

[3] "Smart Vertical Farm Using IOT" , Abhishek A M, Chandrakanth R, Mahesh C, Manoj M Marigiri, Ramya B K, B. E. Students, Department of ISE, SJB Institute of Technology, Bengaluru, India. 'International Journal of Innovative Research in Computer and Communication Engineering' (IJIRCCE), April 2018, Vol.6, Issue 4, April 2018.

[4] "An Innovative Approach on Vertical Farming Techniques", M. Jegadeesh, Dr. J.Verapandi, Research scholar, Assistant Professor, Department of Environmental Science Bharathiar University, India. Department of Environmental Science, Bharathiar University (SSRG-IJAES), October 2014, volume 1 Iusse 1 October 2014.

[5] "Aeroponics technology : blessing or curse", (1)Gagandeep Kaur, (2) Dilip Kumar,(1)Academic and Consultancy Services-Division, Centre for Development of Advanced Computing (C-DAC), Mohali, India. (2)Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, India (IJERT), July 2014, Vol.3 Issue 7, July-2014

[6] 'Smart Agriculture System using IoT Technology' Muthunoori Naresh, P Munaswamy International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7 Issue-5, January 2019

[7] 'Exploring Economical & Environmental Benefits Of Vertical Farming Using Multi Story Panels'

1 Archan.B.Bhangaonkar, 2 Munir.P.Joshi, 3 Sahil S.Huseni

1 Student, Department of Civil Engineering, Sardar Vallabhbhai Patel Institute of Technology, India

2 Student, Department of Civil Engineering, Sardar Vallabhbhai Patel Institute of Technology, Vasad, India

3 Assistant Professor, Department of Civil Engineering, Sardar Vallabhbhai Patel Institute of Technology, India

International Journal of Advance Engineering and Research Development (IJAERD) NCAN-2017, February-2017.

[8] 'Vertical Farming: A Concept'

1 Rashmi Maria Royston, 2 Pavithra M.P.

1 (Civil Engineering, REVA Institute of Technology and Management, Bangalore),

2 (Civil Engineering, REVA University, Bangalore)

International Journal of Engineering and Techniques - Volume 4 Issue 3, May 2018

[9] 'A Review of Vertical Farming Technology: A Guide for Implementation of Building Integrated Agriculture in Cities'

Fatemeh Kalantari 1 , Osman Mohd Tahir 2, Ahmad Mahmoudi Lahijani 3 and Shahaboddin Kalantari 4,

1,2 Department of Landscape Architecture, Faculty of Design and Architecture,

University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

3 Department of Mechanical Engineering, Faculty of Engineering, University Putra Malaysia,43400 UPM Serdang, Selangor, Malaysia

4 Department of Civil Engineering, Islamic Azad University of Chalous, Chalous, Iran. Advanced Engineering Forum ISSN: 2234-991X, Vol. 24, pp 76-91 Accepted: 2017-09-05 Online: 2017-10-11

[10] 'Monitoring Parameter Of Plant In Vertical Farming Using Aeroponics Technique'

1 Gaikwad Suvarna 2 Pawar Prathamesh
3 Patil Priyanka
IRJET (International Research Journal of Engineering and Technology) Volume: 07 Issue: 05 | May 2020