Plant Monitoring System in An Aeroponics Vertical Farming Technique using IoT : A Review

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Abstract : *The need of diversification from traditional agriculture farming aroused due to some reasons and among them main reason are 1) unpredictable seasonal cycle, especially the monsoon season, 2) in the traditional agricultural practices to increase the crops yield farmers use more and more fertilizers and pesticides, which gradually leads to contaminating not only agricultural soil but also ground water. There are also another factors which affects the environmental conditions, but we are focussing our project of vertical farming*

To overcome the issue aroused due to traditional agricultural farming the new technique of 'Vertical Farming' is emerged and developing rapidly. Under the vertical farming few main concepts are growing and those are 1) hydroponics, 2) aeroponics, 3) aquaponics. An Internet of Things (IoT) Based Plant Monitoring System In An Aeroponics Vertical Farming Technique is one of them.

The main idea behind vertical farming is 1evelopp agriculture without soil. In all three vertical farming systems, there is no need for land because no soil is required to grow the crops. This allows the greatest benefit which is that; such soil-less agriculture farms can be built under one roof, and that too as multistorey buildings in the middle of cities. Another significant advantage of vertical farms is that the horizontal spread of land is reduced, which can be used to provide housing for the growing human population, infrastructure, and fast-growing industrialization.

Keywords **: Aeroponics, Parameter Monitoring, IOT, Vertical farming, Indoor, Outdoor.**

1. Introduction

India is the second-largest agricultural nation in the globe, as we all know. In areas where 60 to 65% of the populace resides, agriculture is significant. One of the leading nations in the agricultural world is India. Agriculture presently contributes between 16 and 17 percent of India's GDP, according to GDP figures. Traditional soil-based agrarian farming makes up the majority of farming in our nation, while vertical farming is a more recent, virtually soilless technique.

Technology plays a big part in the contemporary farming method known as vertical farming. There are two categories of vertical farming: interior vertical farming and outdoor vertical farming. There are three primary methods for vertical farming as well. First, hydroponics Two) Aeroponics Three) Aquaponics In this

endeavour, we're attempting to develop an aeroponic vertical farming model.

We are embracing both food production and the IoT for evaluating the farm activities to fully automate, taking a few ideas of traditional farming guidelines into consideration. In order to track agricultural environmental factors like temperature, humidity, light exposure, and intruder recognition, we are installing a number of hardware devices that are integrated with software conceptualization and other technological services. IoT, cloud computing, and fundamental digital communication are used to implement these integrations, which enable the entire agricultural sector to revolutionise into a more sophisticated approach to food production. In some ways, we are moving away from the conventional agricultural approach, where crops are grown naturally without human intervention and the best use of the environment is the objective. By implementing this technology, we can decrease resource waste and give crops and plants the proper care they need to develop. [3]

IoT is the most promising technology for automation and management currently available on the market. Over the past few years, it has been the subject of extensive study. Traditional irrigation techniques are still being used by farmers, which has led to poor agricultural yields. Consequently, using machinery and contemporary technology can increase crop yield. So, by using the IoT, we can watch rainfall, soil moisture, ambient temperature and humidity, and light intensity conditions; this allows us to take the necessary actions to take care of the crops and give them the nutrients they need at the appropriate times. [3]

1.1 Literature Servery

This paper approaches with an effusively indoor cultivation system based on the modern farming concept called aeroponics, in a controlled environment using Arduino and different parameter measuring sensors. Aeroponics is the modern agricultural conception in which the plants are grown without soil using a nutrient solution sprayed in the roots and is more efficient than traditional farming. The longstanding farming techniques are mostly dependent on the soil conditions and outer atmosphere, but using this technology, the cultivation process is more resourceful with better control system and data monitoring as well as convenient for general urban indoors. The proposed system states easily available and user friendly components, allowing people to reproduce and modify without needing advanced technological skills and tools.[1]

As the world population growing in an uncompromised way, soon in few years 70% of the agricultural lands will be superseded by flats and buildings. In order to maintain the stability of food production, a boon was brought forth in the name of Vertical Farming. This is one of the growing modern farming methodologies. The introduction of Vertical Farming into the cities have helped the development of food industry and it simultaneously reduces poverty, adds food security and enhances human well-being.[2]

Internet of Things (IoT) is network featuring interconnected devices making physical world transparent with less human efforts. Submerging of this technology in the field of agriculture is bringing enormous changes. By the end of 2050, world population reaches 9.7 billion with additional land of 109 million needed if conventional farming practices are continued. This paper mainly focuses on implementation of vertical farming using IoT based monitoring which overcomes existing issues with vertical farming. The

main drawback of the conventional farming is it requires vast amount of water and acquisition of land for production; it is completely dependent on seasonal production and the yield of crops grown under different environment conditions. This leads to degradation of the food production with inefficient consumption of natural resources. With the integration of vertical faming type of agriculture and IoT technology, we are automating the farm activities with less human intervention and eradicating all the issues caused.[3]

The Vertical Farming is the advanced level of agriculture technology where this has to be practiced when there is unavailable of land and other requirements for the perfect structure of farming mode, this is the new way or approach in the advanced level and this paper deals the methodology, harvesting technique, water management and crop cultivation & yielding process. And some of natural renewable resources are used such as windmill, solar etc, where these are not similar to the normal agricultural process, some of the other practices have to be for the good yielding process.[4]

Soil is main platform for pests and infections to grow results in infected vegetation growth leading to lower crop production. Aeroponic technology, a soil-less culture has capability to grow plants in a conditioned, pest and disease free environment. Enhanced disease-free yield leads India to be at top growers and exporters in near future. Aeroponic system has the potential to produce enhanced vegetative growth without use of any artificial hormones, pesticides or insecticide. This soil-less culture can overcome all the constraints that are present in soil culture production. Once the system is established, it lowers production cost.[5]

2. The proposed system model and its working in brief

All the connectivity between the electronics boards and sensors is as shown below in the Fig. 1 block diagram.

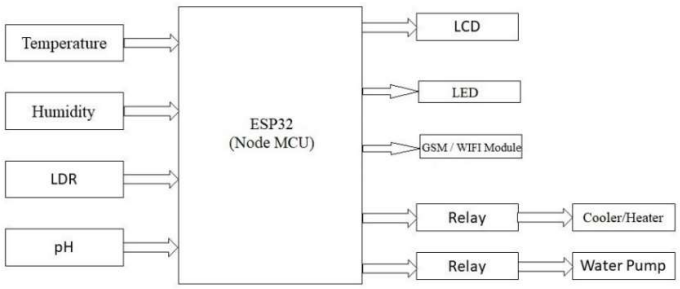

Fig. 1 block diagram.

We have made an effort to construct a single-story prototype for “vertical farming using aeroponics technique.” We made an effort to keep a few fundamental parameters in the same prototype model, including temperature, humidity, light intensity, and the pH level of

irrigation water. Temperature, humidity, light, and pH sensors are used, along with an ESP32 microcontroller device, to maintain these factors within the upper and lower limit values, or to regulate the prototype model's predetermined environmental conditions. All supporting devices like heater, cooler, LED lights, pH-control solenoids, and water spray pumps are controlled and driven by the ESP32 microcontroller. This ESP32 microcontroller device is incorporated with Bluetooth and Wi-Fi capabilities. Through the wi-fi connectivity, the ESP32 microcontroller connects to the BLYNK IoT platform. Using this BLYNK 2.0 platform, we can monitor our "vertical farming project using aeroponics technique" anywhere in the world via the internet. The main advantage of this BLYNK 2.0 IoT platform is that we can control supporting devices and maintain the required environment for our project. The supported devices do their assigned jobs as mentioned below. To maintain temperature and humidity, the heater and cooler are turned on and off. Temperature and humidity are controlled by the DHT11 sensor. LED lights are operated to maintain light intensity. Light intensity is controlled by the LDR sensor. The pH level of irrigation water is controlled by a pH sensor.

The prototype structure of the "vertical farming using aeroponics technique" model is built as described below.

The water storage tank is located in the bottom space. This water tank is filled with water and an appropriate mixture of N-P-K fertilisers and water. The pH value of this tank solution is maintained as per our crops or vegetables. Above this water tank, the mint plantation layer is located. In this layer, mint is grown in netpots. Netpot is filled with "fly ash pebbles" to support the mint plants. Below the netpot, the water spraying nozzles are connected to water pipe lines to spray nutrient rich water on the roots of mint. These water pipe lines are connected to the submersible pumps placed in the bottom water tank. All electronics boards, such as the ESP32 microcontroller board, relay driver board, and power supply unit, are placed on the topmost platform.

An "Arduino IDE platform" is used to develop the software programming to load the ESP32 Development Kit Board. The ESP32 Development Kit Board works on 5 VDC power.

3. Conclusion

Plants are less likely to develop disease due to indoor structure and a monitored environment, which means they require fewer pesticides and insecticides. Also, we can grow different types of plants throughout the year by maintaining the respective parameters like temperature, humidity, pH, and LED light with the help of IoT. Because of the Internet of Things, we can monitor parameters from anywhere at any time. At the end, we can get fresh, clean, and healthy food production.

4. 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] *'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.*