REMOTE MONITORING HYDROPONICS SYSTEM

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Abstract-

The increased population, rapid urbanization of forests, and industrialization, due to which the cultivable land is decrementing enormously and change in climate causes uncertain weather, as a result of this, the temperature is increasing which in turn, affects the quality and quantity of crops and our yearly agricultural pattern. Every individual must encourage farming globally, consecutively to conflict with the situation discussed above. Hence, the technique of vertical farming is incorporated to provide controlled-environment agriculture. Vertical farming mainly aims to optimize plant growth and soil-less farming. Hydroponics comes under the practice of vertical farming. Hydroponics is a process of growing plants in nutrient solutions where, the roots are anchored to an inert growing medium so that it will be easier to supply water and nutrients for the plant. Hydroponics plant cultivation requires high-level monitoring. To monitor the plant's environment continuously, even in the absence of farmers, we have proposed a system that can be remotely monitored from any place. This hydroponics system has certain sensing parameters like pH, light radiation, water level, and humidity. The data of the sensing parameters are collected using the ESP8266 microcontroller. The data are stored in the cloud using a gateway and these data are used for controlling and updating the system.

Keywords: *Arduino- UNO, ESP8266, Vertical Farming, Gateway router, Sensors.*

I. INTRODUCTION

Our current system of agriculture is on the verge of facing a big problem. By 2060, food production should be increased by about 80% to meet the needs of the overall populace. Traditional agriculture is astronomical because of the number of resources used. The production of crops has so far been done both naturally
and artificially. Additionally, the expansion of land has also been the only viable option to increase food production. 70% of water consumption focuses on the cultivation of crops, globally. Uncontrolled practices of irrigation are the reason for this. Currently, 36% of the earth's unfrozen land is being used for the cultivation of food. This percentage will further increase by 2060, 580 million hectares of land should be converted into farmland to meet the needs of mankind. So, we need to find a replacement for our current system of agriculture to face the rising food demand. Hydroponic farming offers a solution to our world's current agricultural problems. Hydroponics is a method in which crops are grown without soil. Here the plants are grown in a nutrient solution. The supplements mixed in water shall be manganese, oxygen, hydrogen, and a lot more depending on the plants. The hydroponically grown plant's roots are in direct contact with the nutrient-rich solution. So, spreading out of roots is not needed for searching for minerals and water. Hence, the root system of plants occupies a small area, so that more plants can be grown in a confined space. Hydroponically grown plants are more beneficial than soil plants because they need not battle any diseases. The growing process is broken down by hydroponic farming which then further eliminates all useless constituents of traditional agriculture. This is a more recent innovation of hydroponic farming. Hydroponic farming is very simple, as it does not rely on the soil. This is highly beneficial as it produces higher yields. The main objective of the hydroponic system is to solve the challenges of modern-day farming.

II. LITERATURE SURVEY

Vertical Cultivating has extended into urban communities. Unused green procedures are used in vertical development for creating vegetables vertically. In the interior urban areas, farming is done all together in a lifted structure. In vertical
cultivating, this development has been emerging within the rustical structure, along with the advancement of auxiliary. Subjective strategy is being reviewed and spoken widel [1]. To start with, we have to recognize the living and upcoming amplification of VF in Africa, South America, and Australia from the year 2008 to 2015. For utilization of VF, development, and methodology is considered at a particular instance for composing totally[2]. The advertising of headways shall be directly advancing for utilizing, creative foreseeing, and the development of wanders for vertical cultivation in suburban ranges. To be honest, it is the cause for the evaluation of cultivation prospectively[3].Food creation is blended into the non-rural districts which are seen as an association with the town and its people. As a result, poverty is reduced, sanitization is included, logical feasibility is increased and the prosperity of humans is. The resources for examination were created from 64 peculiar resources from the year 2007 to 2016 [4].A vertical Hydroponic apex has been made and built by Hardeep Singh. An apex plant is also known as a window farm. An A-Frame system for hydroponic has been consolidated, as a divider for hydroponic and spills for containers which are because of vertical gardening. It

can be used for harvesting plants like radishes, cucumbers, beans, and chives. It can moreover be used for the formation of the interior of plants such that the apex is given light, with small space for development. The structure of the nursery of the apex that has been depicted below can have up to 28 crops for every apex. The modification of arrangement can be shown instantly. Dangling of towers from the top shall be depleted to a desolate container for gathering arrangements for certain occasions. Recorded things beneath can be purchased at a shop, with the net pots as an exception that shall be obtained from sellers of hydroponic or online. Tower material is modified on the off chance that, utilizes the sustenance grade material [5].The loads that are declining for the arrival of each individual include designs for relentless people who are growing, urban sprawl, diminished supply of water, and continuity of altering naturally. Cultivation decay for arrival resources, makers of procedure are looked upon with likelihood. The upcoming era for food which is developing integrates a package with lots of undeniable usages and streamlines land usage. The vertical framework's property expects to offer aid basically and the impression of interior biologically reduces non-rural structures, indoors, structures which are tall and controlling climate. Ensuring that the workplaces are offering intriguing focuses. The issues included here, are estimated based on the focus on potential integrity and the hurdles. Outcomes of Potential is identified by the makers of approach for thought, and for energizing and assisting examination commercially [6]. Frameworks of hydroponics and adjusting species that are fancy are explained here. Another approach for taking care of nurseries is vertical nurseries and engrafting them inside of the community. The crops are created with or without a medium for the development of roots, which means the system of hydroponics is formed without soil. Rustic yields in these systems include several varieties with different essentials and for the obligation of complicated conditions of the environment. Additionally, gestures of warmth and lightness are observed. The arrangement of the system of hydroponics came to closure that there is various advancement due to balancing. Some systems for reutilizing hydroponics are suggested for using them in developing vertically [7].

III. PROPOSED WORK

All the environmental parameters are integrated into a single system for the growth of crops which is dealt with in the hydroponics system which is implemented. The required amount of water-soluble nutrient solution is supplied to the crops with the appropriate quantity of water. Many controlling parameters such as pH level, humidity, light intensity, and water level are analyzed for monitoring. The controller regulates the controlling action in the correct proportion which is enabled by the obtained input from the sensors**.** The block diagram of our proposed system is illustrated below.

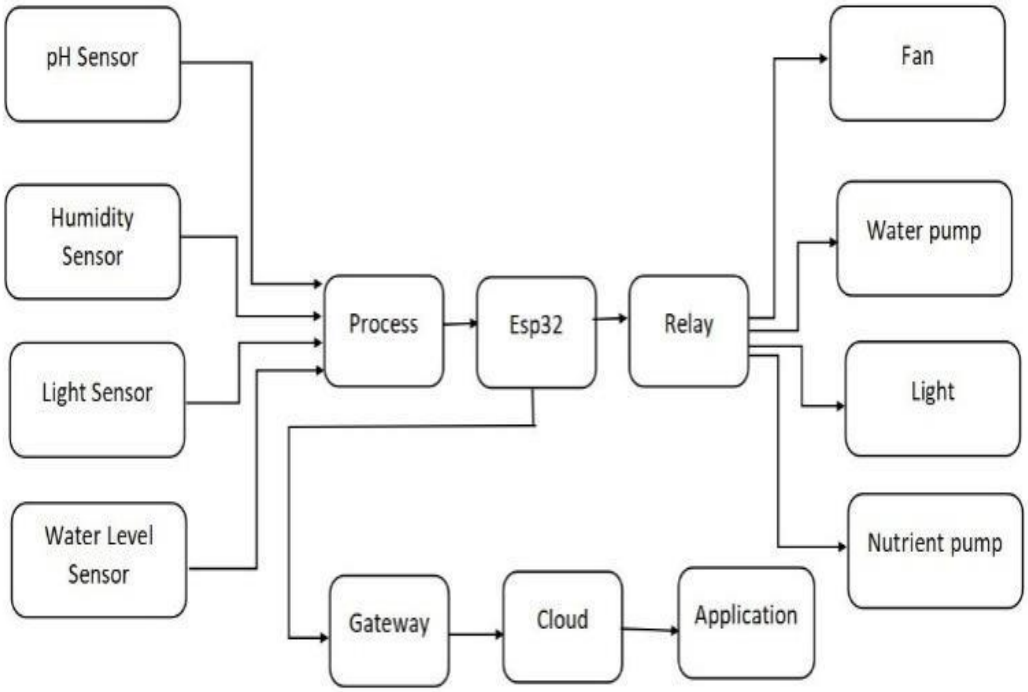

Fig 1a. Block diagram

Initially, a setup is built for a well-organized flow and functioning for formulating the system. The parameter given is important as many aspects govern the rate of growth and plant yield. Not only the nutrients are required for proper growth, but also a controlled environment that is well-constructed is essential for proper growth and plant nourishment. As shown above, in hydroponics agriculture, the microcontroller is the brain of the health monitoring system for the plant, then the overall functioning of various parameters which is responsible for the growth of the plant is enabled. Several environmental conditions such as pH, the conductivity of water, and luminosity are continuously monitored by the microcontroller to achieve optimal plant growth. The preferred pH range for the hydroponic plant lies between 5.8 to 6.8. The tap water does not hold a constant value for pH. There is a need to continuously monitor the value of pH and needs to be controlled on daily basis. The plant's photosynthetic activity is affected by altering the pH and the plant's maximal growth is achieved by increasing its value for pH. In addition, to that, the plants intake various macro and minor nutrient elements which are unbalanced and cause pH to become unstable in the root zone. The best range for managing the nutrient and nutrient solution for the pH of the hydroponics plant is necessary for its maximum growth. The absorption rate of nutrients is affected by the conductivity of water which is monitored constantly. The proper level of conductivity results in maximum growth and plant yield. Another important factor for plants is light. Each plant's requirement for light is different from the others and its genetic structure is varied accordingly. The luminosity meter is used for measuring ambient light, where output is given in lumens. In the

system of hydroponics agriculture, to get maximum yield the plants should be kept under light for 16 hours and in the dark for 8 hours. Through relays, the controller's inbuilt RTC function is used for turning lights ON/OFF every 16 hours, and so on.

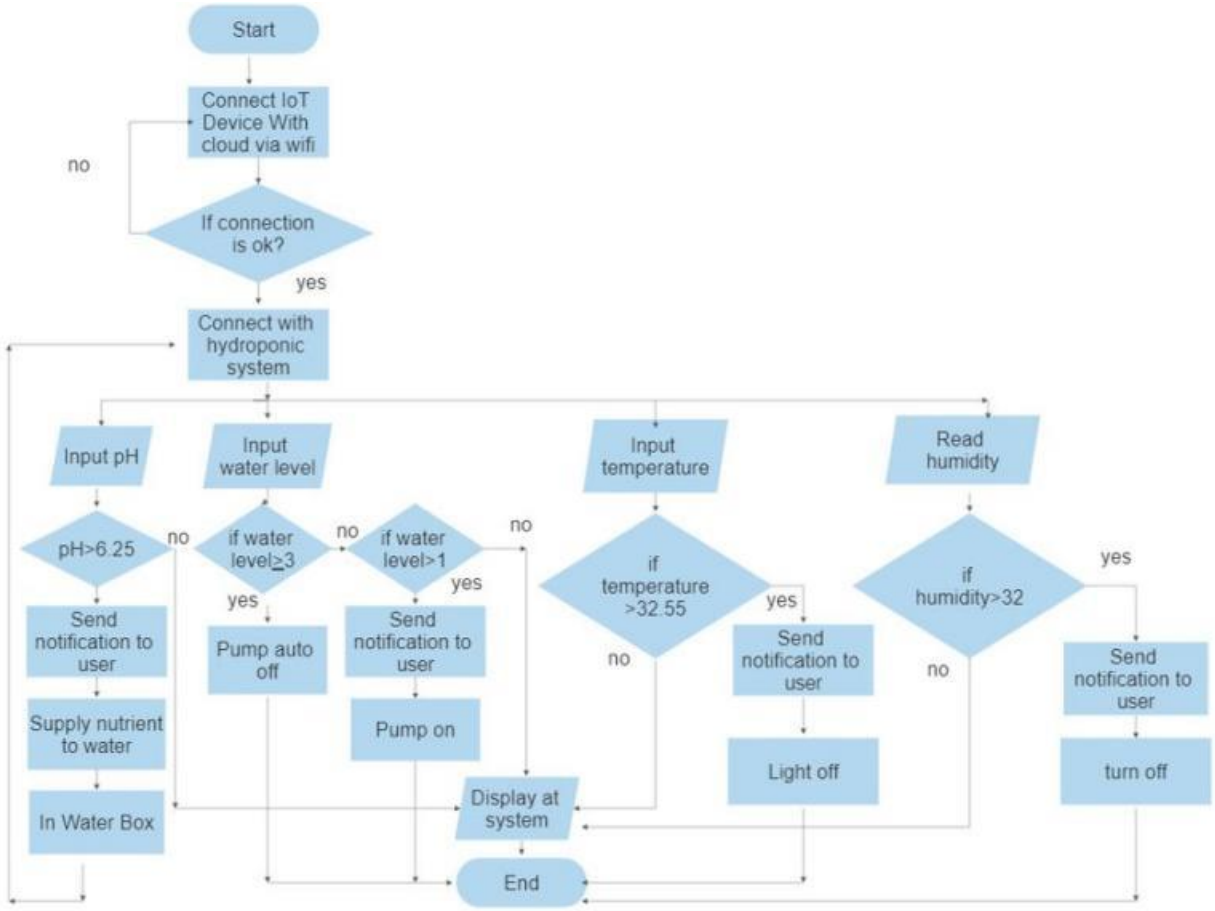

Fig 1.b. Workflow diagram

For monitoring and controlling the growth of hydroponics plants from remote places, an android app was developed for this system with the use of the Internet Of Things. The growth of the plant is graphically represented and is manipulated by drawing it on the graphical user interface and analyzing the growth of the plant and effectively controlling the growth of the plant. The growth of the database can be seen in the output window where the report is generated in an Excel file, the methodology can be compared offline and the data obtained can be used for future references. Various parameters have certain output readings which were taken while the plant is being monitored and controlled and is displayed with the help of a liquid control display. Vertical hydroponics farming comprises three main sections such as sensor interfaces, microcontrollers, and hardware respectively. pH, humidity, light, and water level sensor falls under the section sensor interface. Connection of microcontroller ESP32 with sensors interfacing section via a port. ESP32 microcontroller is also connected to a four-channeled relay. The components for hardware are a fan, water pump, light, and nutrient pump. These components fall under the hardware section. Connection of relay which is four-channeled to the output, that is the hardware components. An ESP32 microcontroller has been connected to a display. Through the gateway router, information will be saved in the cloud storage. Data is displayed on the display using a mobile application and the components of hardware can be controlled by the person using their cell phone. The adaptor is given as voltage, in hydroponic and automatically controlling systems. Connection of the system of hydroponic with an automatic controlling system. Automatically controlling systems input shows

hydroponic systems output. Automatically controlling systems have been connected to the router gateway, for controlling the system of hydroponic also for giving instructions using a mobile phone via the server of the cloud. The listed process occurs while supplying the system with voltage. Supplying tank reservoirs with sufficient liquid and minerals.

The reservoir tank comprises water and nutrient mixed solution and the obtained solution is used for measuring its pH. A certain reference value can be set by the user for pH and the value obtained will be stored in the cloud. The value obtained is in comparison to the reference pH value. In the reservoir tank, if the solution pH is equal to the pH of reference then, the solution goes back to the tank of hydroponic. In the reservoir tank if the pH value of the solution is still acidic even after certain iterations then, then eventually draining out a solution, termination of the process once again beginning of cycle from the first step. Hydroponic tanks solution then goes to the tank reservoirs, if there is a certain delay. The sensors such as temperature and humidity are kept constant throughout the system. With the help of the wifi module, the values that were obtained from the sensors are sent to the app. Present details of the humidity sensor, temperature sensor, and pH sensor are shown by mobile application. The person shall turn off or turn on the corresponding values of the humidity sensor, temperature sensor, and pH sensor. Therefore all the values that were sensed are transmitted to the application again and thereby monitoring the system remotely is enabled.

IV. RESULT

For Hydroponic plants, Temperature and Humidity is the most important parameter, so these plants need a lot of maintenance our system provides the best monitoring for hydroponics plants. Our system measures temperature, humidity, and Air Level around the plant for a week and we have absorbed the readings of the system and those data are saved in the local database. The table given below shows readings of different sensor data.

Table 1. Measurement of real-time sensor data

Types of sensor	**Date: 09/02/2022**	**Date: 17/02/2022**	**Date: 03/03/2022**
Air level sensor	45	51	49
Temperature sensor	27	30	28.5
Humidity sensor	25.5	27	24

The information in the local storage system was then uploaded to a cloud using the graph of a particular sensor we analyzed the data and absorbed the growth of plants. The graph is shown below. The below graph shows the graph of each sensor. Fig 2a shows the hardware connection of our system, Fig 2b shows the Arduino output, and Fig 2c,2d,2e shows the cloud output.

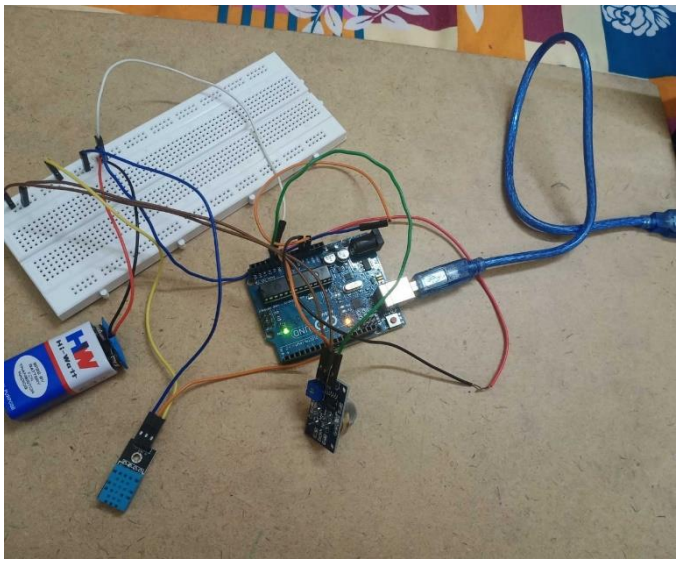

Fig 2a. Hardware Connection

COM3

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----->TEMPERATURE is normal = 32.30C
CO2 Level

108 PPM------->RAWPPM = 959
----->TEMPERATURE is normal = 32.30C
CO2 Level

108 PPM------->RAWPPM = 959
----->TEMPERATURE is normal = 32.30C
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Fig 2b. Arduino Output

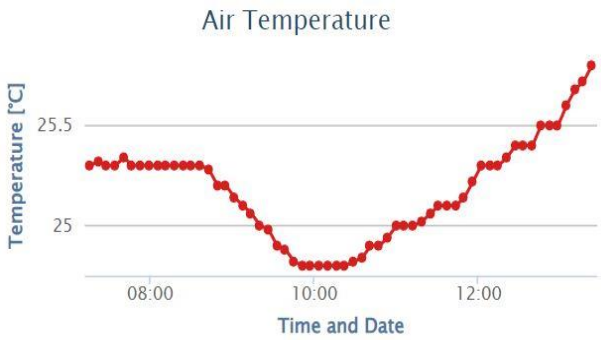

Fig 2c. Cloud Output of Air Temperature

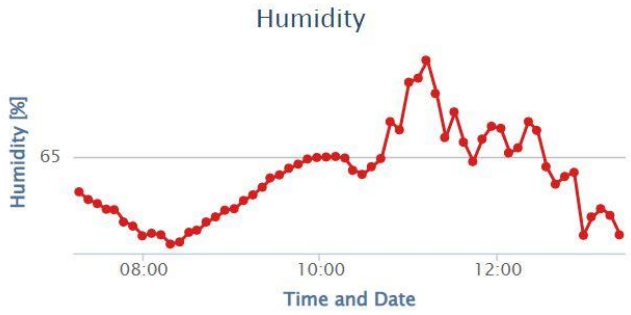

Fig 2d. Cloud Output of Humidity

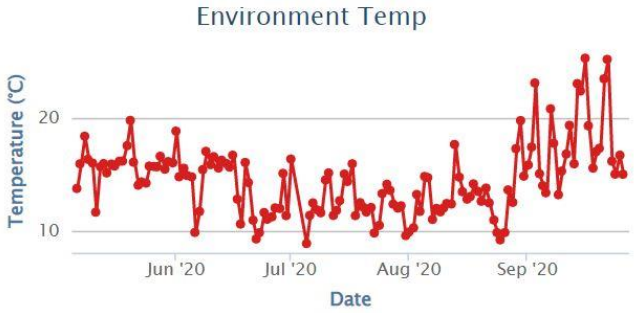

Fig 2e. Cloud Output of Environment Temperature

V. CONCLUSION

People can grow crops anywhere less expensively and efficiently so that it has less effect on the environment using the help of hydroponics. An IoT-based hydroponics system can help farmers for making cultivation more convenient since all the process on the farm becomes automated and is quite precise. The vertical hydroponic system is based on the concept of IoT has been developed. A hydroponic system can be controlled and monitored by an IoT device. The hydroponic system that has been proposed can work smoothly on each factor of the environment and the system performs well for the condition that has been set. Hydroponics plants require less amount of water and supply water in proportions that are fixed, the critical environment can be achieved. This is the greatest advantage over conventional irrigation systems where a large amount of water is not recycled and is wasted. Production cost is lowered for the farmers since the cost of water is also reduced. Only 1 or 2 litters of water is required by hydroponic plants per week on average whereas 10 litters of water is required for the cultivation of soil per week. Fresh vegetables can be grown by people in urban areas in their gardens at home or in their backyards. Hydroponics farming can be done in low-cost empty areas. This technology is far better than traditional farming because it produces a higher yield.

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