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Design an Implementation of Hydroponics Green House Farming using IoT

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ABSTRACT
How to meet our civilization's food needs is one of the primary problems. The Food and Agriculture Organization (FAO) of the United Nations predicts that 9.1 billion people will live on the world by the year 2050.This means that the expanding global population makes addressing the issue of food availability very vital. How to boost agricultural productivity is the issue at hand. Aside from that, how to use fewer pesticides so they don't hurt people. Making a smart greenhouse system is one way to solve this issue. Pesticides are not used in farming in this sophisticated greenhouse system.
With the help of this research, smart greenhouses for hydroponic farming will be created (IoT). Hydroponics is the method of growing plants in fresh or salt water without using soil (land). The roots get nutrients for the plants in the form of a solution, which may be either static or fluid. Both glass and green houses can be used to grow hydroponically. The restriction in a greenhouse environment is to maintain a specific amount of temperature, pressure, and humidity. We also looked at the chlorophyll content of leaves grown hydroponically in a greenhouse arrangement to determine the mustard plant's nitrogen status. The system's controller is the Arduino Mega2560.
The temperature, humidity, TDS, PH, light, and actuator conditions for pumps, lights, fans, sprayers, and valves are all recorded in the real-time database firebase. The ESP-01 module establishes a link to the internet to enable internet-based data transfer between the Firebase platform and the Arduino Mega2560. The outcomes demonstrated that all elements, including sensors and actuators, were operating correctly. An application on a smartphone can be used to operate all actuators as well as monitor the greenhouse's environmental conditions.
Keywords–*Hydroponic, Automation, IoT, Blynk Application*

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I. INTRODUCTION

The need for a solution to the food supply problem has grown along with the increase in global population. The decrease in agricultural land is due to the fact that many of the lands utilised for agriculture are now being used to construct homes, offices, retail malls, etc., which reduces agricultural production. How to boost agricultural output while having less land is the issue at hand.

Another issue is how to employ less dangerous chemicals, such pesticides, in agriculture so that they don't affect people who consume agricultural goods.By using information and sensor technologies to build a smart greenhouse system, this issue can be solved, increasing agricultural yield even on small plots of land.

Hydroponics is the practise of growing plants in water without the use of soil. The fundamental requirements for hydroponics include plant media, mineral nutrients, nutrient solutions, temperature, water, light, and air.Plant roots absorb nutrients from a fluid, which may be moving or still. In a greenhouse setting, hydroponic growing is feasible. In a greenhouse setting, hydroponic growing is feasible. A constraint is keeping the greenhouse's temperature, humidity, PH, TDS, and light levels at particular levels.

A greenhouse is a crop production method that includes space for controlled agriculture and is protected from the elements by a transparent roof. Longer growing seasons, the opportunity to collect high-quality agricultural goods, and protection from pests, diseases, and the consequences of climate change are just a few benefits of using greenhouses. Additionally, pesticides are not used when farming in a greenhouse. Through the use of smartphones and Internet of Things (IoT) technologies, we can regulate and keep an eye on greenhouse environmental conditions.

It will make greenhouses "smart," specifically smart greenhouses, by combining IoT technologies with them. In the past, methods for hydroponic cultivation in IoT-based greenhouses have been researched. According to Saraswathi et al., the maintenance of electrical conductivity, PH levels, and greenhouse environmental monitoring have all been automated. Prior research did not go into great detail on assessing the effectiveness of the greenhouse system or the nitrogen status of the plants within the greenhouse system; instead, it simply concentrated on the fundamentals of managing and analysing climatic conditions.

Designing and testing intelligent greenhouses for hydroponic farming is the aim of this project. We created an intelligent greenhouse system that is anticipated to provide an alternative method for boosting agricultural output and raising healthy, pesticide-free plants.

ThefollowingTechnologieswillbeusedinthisproject:

- **Arduino Uno:** The Arduino Uno is an open-source microcontroller board that was created by Arduino.cc and was made available in 2010. The ATmega328P microprocessor from Microchip serves as its central component. A variety of expansion boards and other devices can be connected to the board's sets of digital and analogue input/output pins. It contains a reset button, 14 digital input/output pins, six of which can be used as PWM outputs, a USB connector, a power jack, an ICSP header, six analogue inputs, a ceramic resonator working at 16 MHz, and a ceramic resonator.

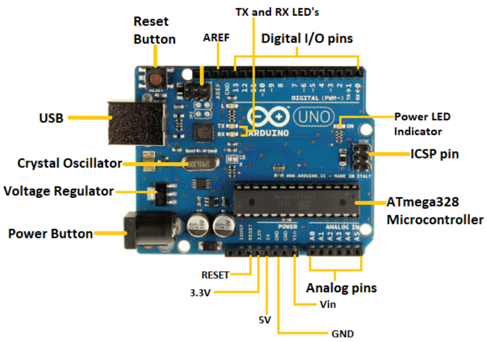


Fig 1.1 : Arduino Uno

- **Blynk Application:**Blynk is an Internet-of-Things platform for iOS or Android smartphones that allows users to remotely control devices like Arduino, Raspberry Pi, and NodeMCU. Using this application, you can compile and provide the right address on the various widgets to construct a graphical interface or human machine interface (HMI).

- **LCD:** A type of display that makes use of liquid crystals is the LCD (Liquid Crystal Display). Here, we'll upload the Arduino sketch via the computer's serial interface. The characters will appear on the LCD.

- **Relay:**Relays are switches that may close and open circuits using both electromechanical and electrical means. It controls the opening and closing of circuit connections in electrical circuits. Relays are frequently used in manufacturing, building automation, and control panels to switch the lower current levels in a control circuit and manage electricity.

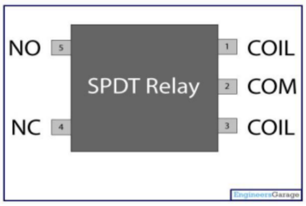


Fig 1.2: Relay

- **Water Pump:**The nutrition solution must be appropriately mixed by being circulated throughout the reservoir by the water pump. The solution is transported from the reservoir to the desired location by the water pump. This is a flood table or grow tray for drip or ebb and flow systems. Hydroponics uses submersible fountain and pond pumps, which are readily available at most home improvement centres.

- **TDS Meter:** Anyone trying to grow hydroponically needs a TDS metre as a necessary tool. Total dissolved solids, or TDS, are quantified in parts per million (PPM) (parts per million). It essentially measures the amount of salt and minerals in a solution.

- **ESP8266:**A comprehensive and self-contained Wi-Fi networking solution is provided by the ESP8266, which can either host the application or offload everything. An additional application processor handles Wi-Fi networking operations. when the ESP8266 serves as the host for the programme and acts as the device's sole application processor.

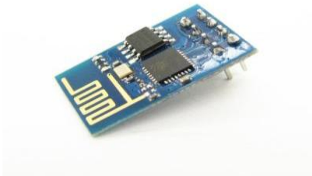


Fig 1.3 ESP8266

II. BLOCKDIAGRAM

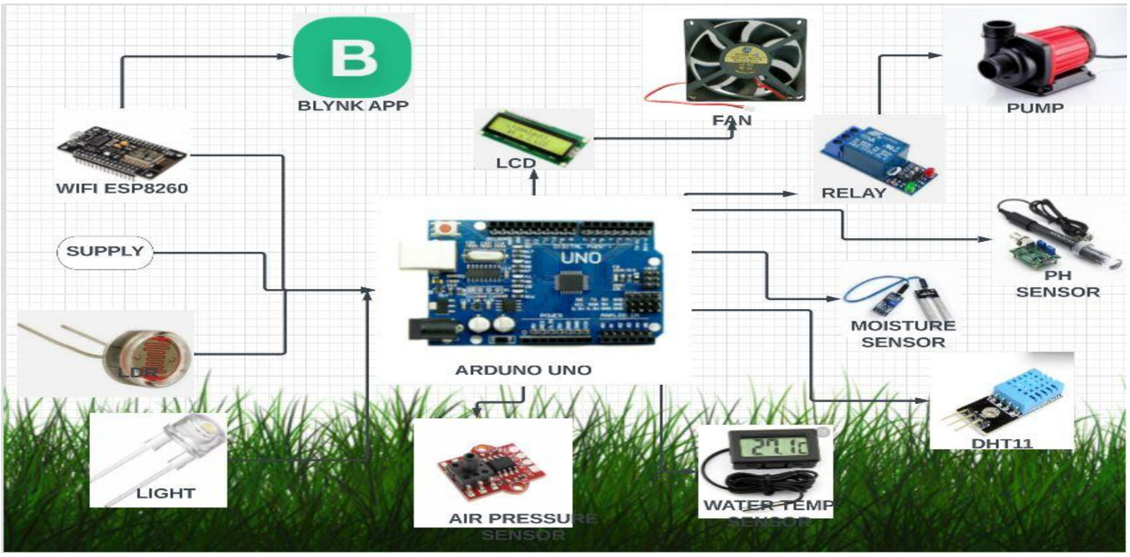


Fig2.1:BlockDiagramRepresentation

Fig2.1explainstheinterconnectionofdifferentsensorswithoneanother.Therearemainlyfoursensors which we are using in this project and theyare:

- **Temperature Sensor:**The electrical output of the LM35 integrated analogue temperature sensor is proportional to the degree Celsius. Everyday domestic appliances including microwaves, refrigerators, and air conditioners as well as all engineering sectors use them.

Fig 2.2: Temperature Sensor

- **PH Sensor:** The glass electrode is the most typical PH sensor. It is employed in a wide range of sectors and numerous industrial applications. The glass electrode method can test the PH of different solutions and has great reproducibility. A potentiometric or electrochemical sensor with a voltage output is called a PH electrode.

Fig 2.3 : pH Sensor

- **Moisture Sensor:** Two probes make up the soil moisture sensor, which measures the volumetric content of water. The two probes enable current to flow through the soil, providing the resistance value needed to calculate the soil's moisture content. A resistive soil moisture sensor measures the soil's moisture levels by utilizing the correlation between electrical resistance and water content. These sensors have two exposed probes that are placed directly into a soil sample, as you can see.

Fig 2.4: Moisture Sensor

- **Pressure Sensor:** A device for measuring the pressure of gases or liquids is called a pressure sensor. The force necessary to prevent a fluid from expanding is expressed as pressure, which is typically expressed in terms of force per unit area. A pressure sensor typically performs the function of a transducer by producing a signal in response to the applied pressure.

Fig 2.5: Pressure Sensor

- **LDR:** A light-dependent resistor, sometimes referred to as an LDR, photo resistor, photoconductor, or photocell, loses value as incident light intensity rises.A semiconductor with a high resistance makes up an LDR. By conducting electricity, the ensuing free electron reduces resistance.

Fig 2.6: LDR

III. Hardware and Design IoT systems

IoT Based Hydroponics Green House Farming using ESP8266 and Arduino.

Farmers need top-notch soil with strong natural mineral contents for the traditional farming approach. It also demands labour costs for weeding and ploughing, as well as a lot of area and water. Since growth will take place in places like dry deserts, hydroponic farming will be helpful in challenging environments. Due to environmental control, indoor plantations and greenhouse farming can facilitate growth in these environments. By 2050, it is predicted that there will be 9.6 billion more people on the planet, which will result in a reduction in the amount of land that can be used to grow food and produce.

Alternative farming methods will need to be developed to feed the growing world population. Since they don't require soil, hydroponic growth techniques are helpful in regions where cities are rapidly growing and the land is being rapidly urbanized.We'll explore how hydroponic farming can be used for both its various applications on Earth and its potential for usage in future space travel.

Because there isn't yet any soil in space that can support life, NASA is investigating and researching hydroponic systems. It would be challenging and unnecessary to transport soil into space. Hydroponics will allow us to grow plants inside spacecraft and on the ground for extended journeys. Additionally, it will supply a sizable amount of food for space flight.

We guarantee that the plant receives all of the nutrients from the water solution by using this method.This is made possible by hydroponic systems, which enable crop production in urban settings where conventional farming is not feasible. The parameters of our project are automatically controlled. Additionally, utilising IOT technology, cultivators may monitor plant development conditions and change parameters from a distance. For both plants 1 and 2, we have taken into consideration the Arduino Uno with three different types of sensors, including temperature, PH, and LDR sensors. A wi-fi module called ESP8266 is used to connect to a server via the internet of things as shown in fig below.

Fig 3.1: Arduino Structure

Materials Required.

(i) Arduino Uno and Programming Cable (vii) pH Sensor
(ii) ESP8266 Wi-Fi module (viii) Moisture Sensor
(iii) Humidity Sensor (ix) Water Pump
(iv) Water Temperature Sensor (x) LDR
(v) Moisture Sensor (xi) LCD
(vi) Light Sensor (xii)Relay and TDS Meter

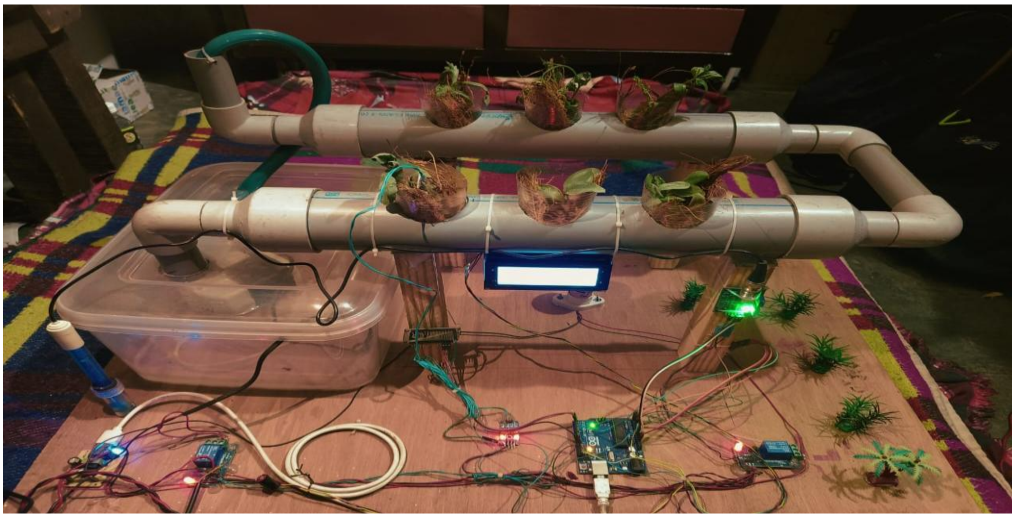
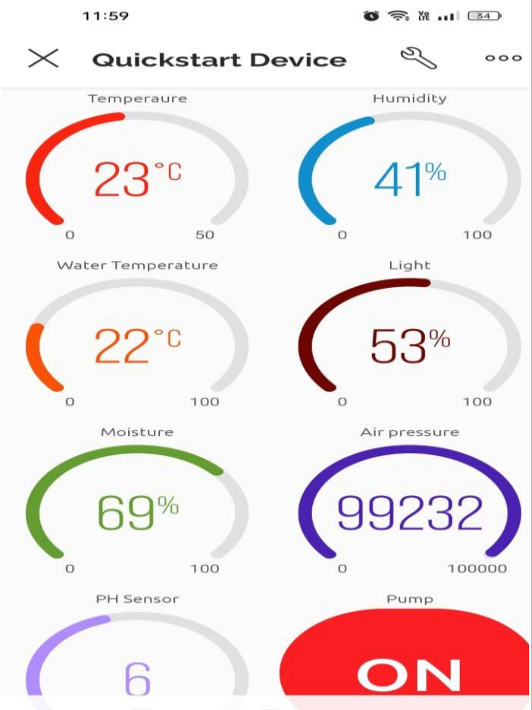


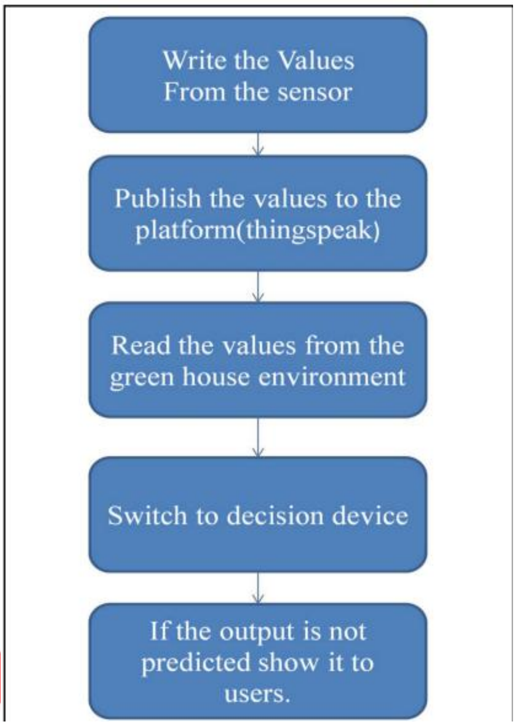
Fig 3.2: Hardware Structure using Arduino Uno

IV. Software Used to simulate the devices:

Configuring Through Blynk app:

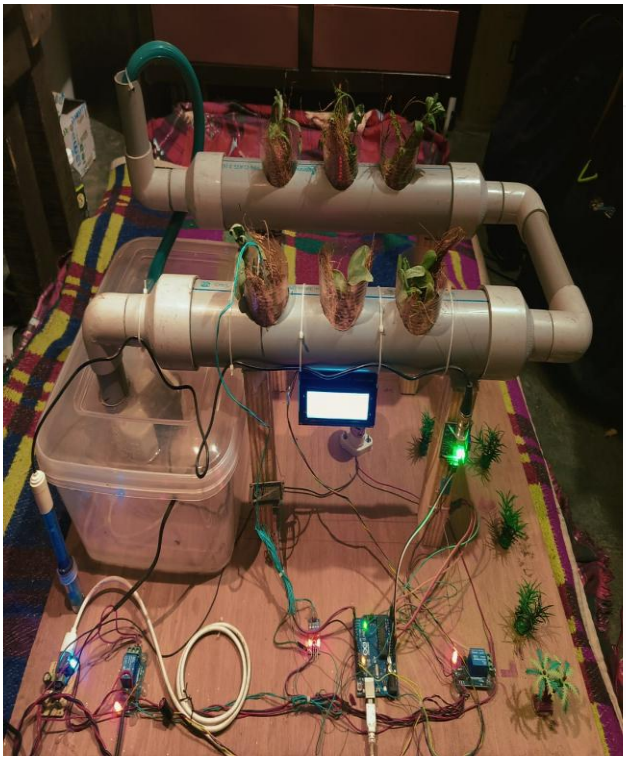
To operate this device, we have used Blynk app. With the use of Bluetooth and wifi in our device and in our project, we integrate it and connect through it. we have write the code to connect it and represent all the sensor device value in our application page which are display in below fig:





V. SIMULATION AND RESULTS:

We have built a successful IoT based smart greenhouse for hydroponics. The results showed the correct operation of the intelligent greenhouse system for hydroponic cultivation, as it can monitor temperature, humidity, TDS, pH and light conditions. You can turn actuators such as fans, pumps, lights, sprinklers and valves on or off with a smartphone app. The correlation coefficient between the TDS sensor and TDS meter value showing a value of 0.9769 indicates a strong correlation between the TDS sensor and the TDS meter value. The measurement results of the PH sensor and PH meter showing a coefficient of determination of 0.9424 indicate a significant correlation between the PH sensor and PH meter data. Two chlorophyll meters can measure the chlorophyll content of hydroponically grown mustard plants in a smart greenhouse system to determine the nitrogen content of the plants. The absence of chlorophyll in the mustard plant indicated that it had no food and needed more nitrogen. In our next development work, we will create a basis for a service accounting system for smart greenhouses with versatile service option help in the segmentation and classification of brain tumors with work and information deficits.



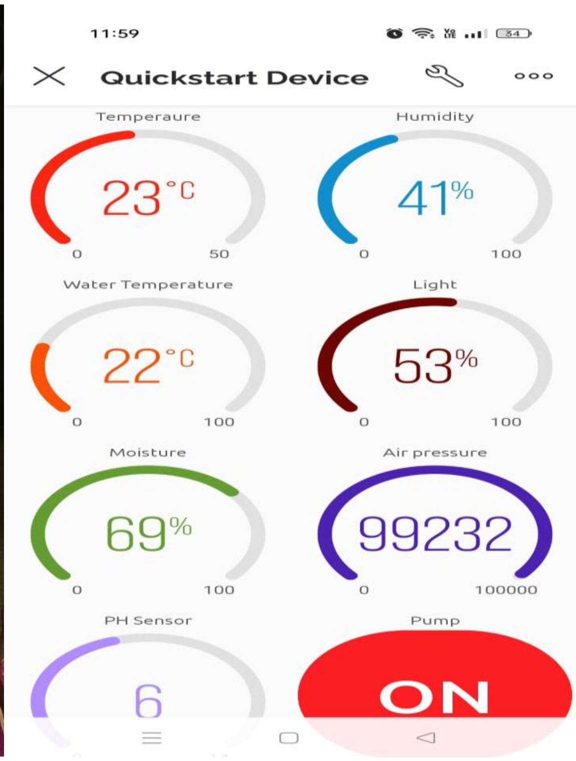


Fig 5.1: Hardware Structure **Fig 5.2: Results on Blynk Application**

The system checks to determine if the plant is growing well utilizing the original plant samples. Multiple plant species that received the same treatment were used in testing. Pokchoy, lettuce, and kale were the plants employed in this test when they were in their teenage years (after nursery). Plant growth is tracked during the testing process for a few days. Photographs of the plant were taken to track its growth as shown in below table:

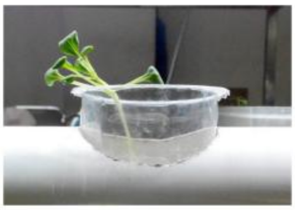
No.	Observation	Information
1		The first observations on pakcoy plants, plant pakcoy seen growth slowly issuing new leaf segments.
2		In the second observation, the plants grow taller pokchoy visible and visible leaf segments increases and slightly enlarged.
3		The first observations on lettuce, lettuce plants grow slowly visible on the leaf segment that looks wide.

Fig 5.3: TESTING RESULT USING PLANTS ON HOMMONS

To check whether the smart greenhouse system is performing as planned, each sensor and actuator is put through a functional test. Comparing the DHT11 sensor's measurement findings with those of the temperature and humidity metre (HTC-2) after 20 measurements is how the DHT11 sensor's performance on the greenhouse controller is tested. The findings of the DHT11 and HTC-2's temperature and humidity measurements are displayed in Figs. 1 and 2. From these findings, it can be observed that there is a big difference in value when the device is first turned on, but after a few seconds, it virtually reaches the same temperature as the other device. Since the device was turned on, the DHT11 sensor has continuously recorded temperature and humidity measurement readings, however the HTC-2 takes longer to attain these conditions.

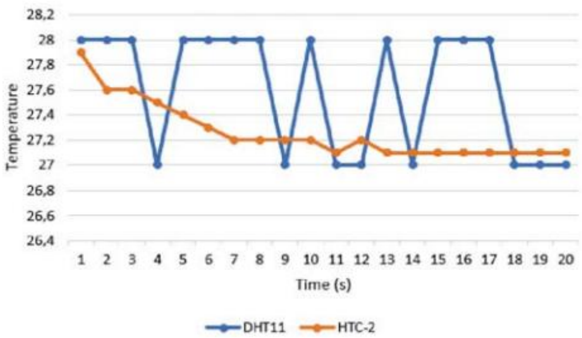


Fig 5.4 : Reading of temperature from the DHT11 HTC-2

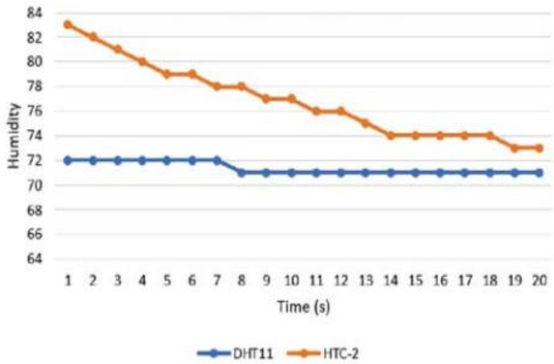


Fig 5.5: Reading of humidity from the DHT11 . and and HTC-2

The coefficient of determination (R2) is utilised in this study to assess how strongly two measurement results from two separate pieces of equipment are related [11]. By comparing the TDS sensor's measurement results with those from the TDS metre, which was used for 20 measurements, the TDS sensor on the greenhouse controller is tested. The link between the TDS sensor value and the TDS metre value is shown in Fig. 3 with a coefficient of determination (R2) value of 0.9769, indicating a significant correlation between the two readings.By contrasting the measurement outcomes with those of the PH metre, which was used to take measurements six times, the PH sensor on the greenhouse controller is put to the test. Fig. 4 depicts the link between the data from the PH sensor and the PH metre; the R2 coefficient of 0.9424 indicates a significant correlation between the two readings.

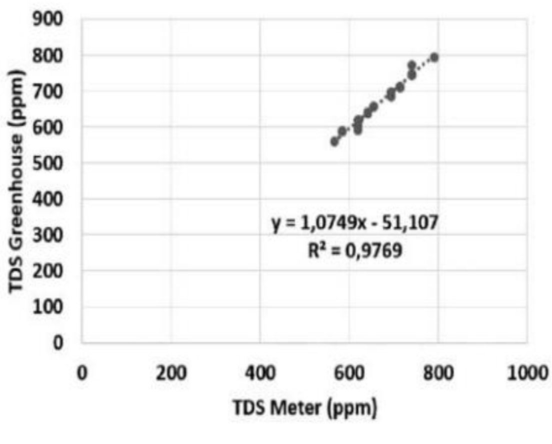


Fig 5.6: Relationship between the reading from TDS sensor and TDS meter

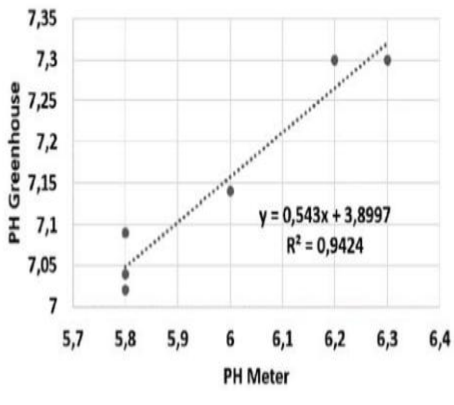


Fig 5.7: Relationship between the reading from PH sensor and PH meter

The light sensor testing procedure includes wearing the lights on or off, observing the lighting circumstances both in person and via a smartphone app for the greenhouse, and documenting the data.The testing of the light sensors in Table I was a total success.

TABLE 5.1: LIGHT SENSOR TESTING

Lamp condition in the greenhouse	A light condition in the greenhouse	A light condition in Smart greenhouse application	
		Dark	Bright
Turn off	Dark	√	x
Turn on	Bright	x	√

VI. CONCLUSION:

The design, development, and application of our initial research into a smart hydroponic system that connects to a cloud server via the Internet of Things are covered in this paper.Open Garden is the data collection module we use. Before being transmitted to a Wi-Fi module and ultimately to a cloud server, the Open Garden data is serialized. An online front-end web application or an Android app can then be used to display the data. The system has passed testing and is now ready for usage. Here, we want to use the information obtained from the system to construct a complex model. By presenting some patterns or broad forecasts based on the data, this model might be used as a choice for regulating the actuator or as knowledge for the user. This investigation's conclusions are substantially clearer and more precise. The precision of the result will vary depending on how each step is marched.

VII. FUTURESCOPE

Future research will involve gathering environmental data from sensors and installing artificial intelligence to enable the Hydroponic Management and Monitoring System to function automatically.

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