IoT based Automated Greenhouse

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Abstract **–** The advent of the greenhouse as a sustainable form of smart agricultural farming present a best solution to address the challenges like food scarcity resulting from population growth, climate change and environment change. This method help in off-season crop cultivation even in severe climatic conditions within enclosed spaces. However, effective control and management of crop parameters within the greenhouse are essential. Leveraging advancements in the Internet of Things (IoT) introduces smart solutions for automating greenhouse farming parameters including plant monitoring, atmosphere control, and irrigation. The greenhouse is one of the growing technologies used for cultivation. This work proposes study of technologies used in the greenhouse for monitoring and control. This work analyses the different communication techniques used for monitoring the parameter of greenhouse using relays, sensors. With the help of Wi-Fi connectivity helps to analyse the real data over the cloud, real time working of the equipment. The advantage over the simple greenhouse so that the farmer can easily understand which technology suit the best. This also help farmer to adopt the best suited technique in greenhouse that are cost-friendly, easy to use, and have longer life.

Keywords **–** IoT, Greenhouse, NodeMCU, Firebase.

1. INTRODUCTION – The continuous growth of world population, environmental change, industrialization, the arable land over the globe is decreasing every year [1]. Therefore, the demand and requirement for hygienic food and crop yield have been growing continuously. A survey conducted by the United Nations of Food and Agriculture Organization (FAO) estimated that the population of the world is expected to reach 9.73 billion in 2050 [2]. It is expected that more cropland and water will need to meet the future food demands globally. Furthermore, other challenges such as abrupt changes in climate, lack of labor, and water scarcity spiral the pressure on agriculturists and farmers [3]. Greenhouse plays very vital role in any agriculture industry of the world. From the last few years, pollution has affected the growth of plants. As we see the population of the world is increasing and area for the cultivation is decreasing day by day. Tt is a very basic need of humanity to increase the production rate of crops so that the human needs are fulfilled and to make the country's economic growth more stable. To grow off-season crops, greenhouses are very effective and thus we can grow any off-season crops without fear of the environmental changes. The environment is controlled and regulated, so the production rate can also be increased, Crops having higher importance can be grown with good quality and taste using the greenhouse system. We can also minimize water and fertilizer consumption and can achieve controlled and suitable conditions [4].

The greenhouse is made in closed structure like a house which is covered by either plastic material or glass to cultivate crop in any season. Our prototype had water pipes to provide water from a tank that was controlled by DC motors, temperature and humidity sensors, a NodeMCU, and moisture sensors. In order to monitor temperature and humidity, moisture sensors (YL 69) are placed close to the roots, while temperature and humidity sensors (DHT11) are placed farther away. The NodeMCU receives the data from these sensors and analyzes it.The objective of this work is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield. This makes the proposed system to be an economical, portable and a low maintenance solution for greenhouse applications, especially in rural areas and for small scale agriculturists. One of the prominent factor that affect the crop production is water, Greenhouse production systems are one agricultural practice that decreases crop water requirements by as much as 20% to 40% compared to open-field cultivation (Fernandes et al., 2003). Because water is very important for cultivation due to lack of water crop get burn it cause a huge loss to farmer and in another way excess of water also cause a huge loss to farmer crop get negative impact reduce oxygen level in soil.

2. LITERATURE REVIEW-

IoT technology is extensively employed in many different industries, like smart parking systems, smart healthcare, and so forth, but it is still not used in many countries, especially developing ones, to large-scale agricultural. A Lora-based small-scale smart greenhouse was created; it was capable of monitoring temperature, light intensity, and soil moisture. Data was sent to the Tata server, where it was then retrieved from Microsoft Azure Cloud and shown on the webpage that was created over the network [5]. Using image processing technology, a camera was installed to check whether diseases the crops had in addition to monitoring plant growth conditions in order to improve agricultural efficiency [6].

A wireless network was used to transfer the data to a customized webpage in a Esp8266-based smart and automated controlling agriculture system. Four parameters were monitored in real-time: temperature, humidity, light, and soil moisture. The system was also designed to automatically adjust the environment conditions if any of the predefined thresholds were exceeded, maintaining the ideal conditions for crops to grow quickly [7]. A docker-based data analysis platform was created and put into use; it could be installed easily, independent of the operating system underneath [8].

The main meteorological factors that affect outdoor agricultural production are storms and rain. Variations in humidity and temperature can cause various illnesses in crops. In this study, an additional rain sensor was used to detect the weather and trigger the top of the greenhouse to open or close automatically to irrigate the crops. This was done in comparison to traditional monitored parameters: temperature, soil moisture, and light intensity. An Arduino Nano-based smart agriculture system was developed to realize monitoring and controlling of the greenhouse in real time. In addition to seeing the monitoring environment values on a 16x2 LCD display, users may remotely access the data via a specially created phone application [9]. Since

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soil provides the foundation for plant growth, an intelligent soil management system has been created to make it easier for farmers to control and preserve their greenhouse crops [10].

It protects crops from pests, illnesses, and harsh environmental conditions. It functions as a shield between nature and what you are developing, which permits the growth season to be elongated and perhaps improved. Some benefits of the greenhouse are; the production of fresh greens, vegetables and fruits, and the effective use of water and nutrients as opposed to open-field agriculture, thus the return on investment in the greenhouse is often higher than in open field farming. With the support of the regulated climate within the greenhouse, the greenhouse is an ideal alternative for effective harvest generation, seed generation, and transplantation [11]. This study examines how agriculture is practiced with embedded technology and the Internet of Things.The goal of this effort is to design and build a green house system that can both monitor and manage the environmental and plant conditions inside the building to create a setting that is conducive to plant growth. to prosper. It is intended to reduce the amount of time spent manually checking the health of the plants, improve Nigeria's economy, and ensure that food is always available because to the year-round availability of crops. The information obtained from this system is utilized in the agricultural research process to enhance the field. The accomplishments of this study include the building of a model green house structure with wood serving as the framework and plastic film serving as the top and side covering sheets. It also involves environmental condition monitoring and management.This project creates a circuit to connect sensors to the ESP32 microcontroller, providing a monitoring system. The data from this effort can be used to improve agricultural research procedures. The building of a smart greenhouse with the capacity to self-regulate the internal environment would facilitate the availability of certain crops both in and out of season as well as real-time plant monitoring from anywhere in the world, which would boost both the Nigerian economy and the country's ability to provide food on demand[12].

3.PROPOSED SYSTEM-

A. System Architecture –

In this project ,the greenhouse environment monitor the real time and adjust the environment conditions : Temperature and humidity at suitable label continuously .if temperature lower than the threshold then heater would turn ON, and if temperature is higher than threshold and humidity are below the threshold, the fan will activate; otherwise, the heater and fan will be switched off.The construction of the smart greenhouse system in Fig 1.

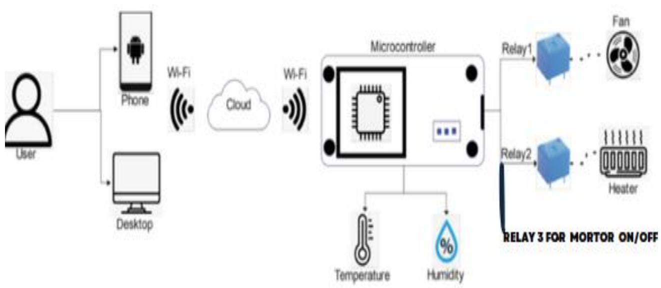

Fig 1. System Architecture [13]

3.1 MODULES DESCRIPTION –

A). NodeMCU – It is a microcontroller which operated on 3.3 V .It has 11 digital I/O pin and 1 Analog In pin, It is open source software and hardware development environment built around inexpensive system-on-chip (SoC) called the ESP8266,contains the element of computer CPU, RAM, WIFI which help to send data over cloud.

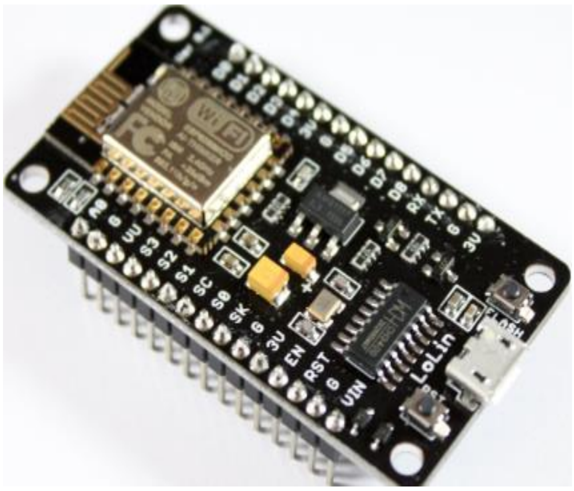

Fig 1.1 ESP8266

B). Moisture sensor (YL69) –

The YL69 is an inexpensive soil moisture sensor used to detect the amount of moisture content present in the soil. The operating voltage is 3.3v to 5v and current is 35mA.This sensor consists of two electrodes which when comes in contact with the soil the voltage fluctuates i.e. the output voltage decreases when the moisture is present and the output voltage increases when the soil is dry.

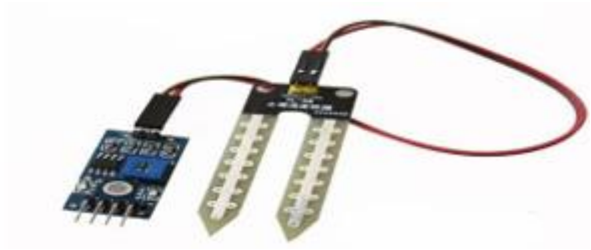

Fig 1.2 Moisture sensor (YL69)

C). DHT 11 Temperature and humidity sensor -

DHT11 is one of the basic affordable digital sensors which can measure temperature and humidity. It has an operating voltage of 3 to 5 volts & max-current of 2.5mA.The temperature range lies between 0°C to 50°C, while the humidity percentage ranges between 20% to 80%. It consists of a thermistor which employs Negative Temperature Coefficient (NTC) and a humidity sensing component to detect the moisture in the air.

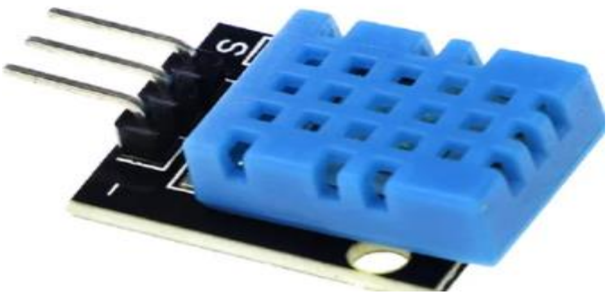

Fig 1.3 DHT 11 Temperature and humidity sensor

D) Relay -

Relays are the simplest type of electromechanical switches. Similar to ordinary switches that we manually close or open, relays are switches that link or disconnect two circuits. A relay, on the other hand, uses an

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electrical signal rather than a human operation to drive an electromagnet, which connects or disconnects a circuit.

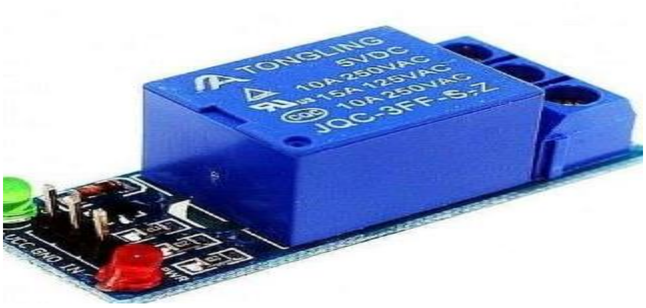


Fig 1.4 Relay

E) Fan-

Fan are installed on the side wall of a greenhouse to maintain the temperature and to regulate the air flow within the green house.

Fig 1.5 Fan

F) Bulb –

Bulb It is a small and simplest light that brightened the dark space.

Fig 1.6 Bulb

H). EXPERIMENTAL SETUP –

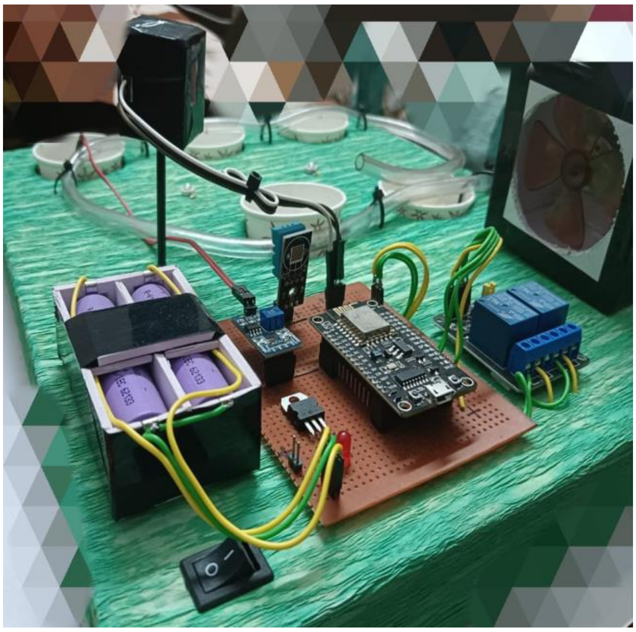
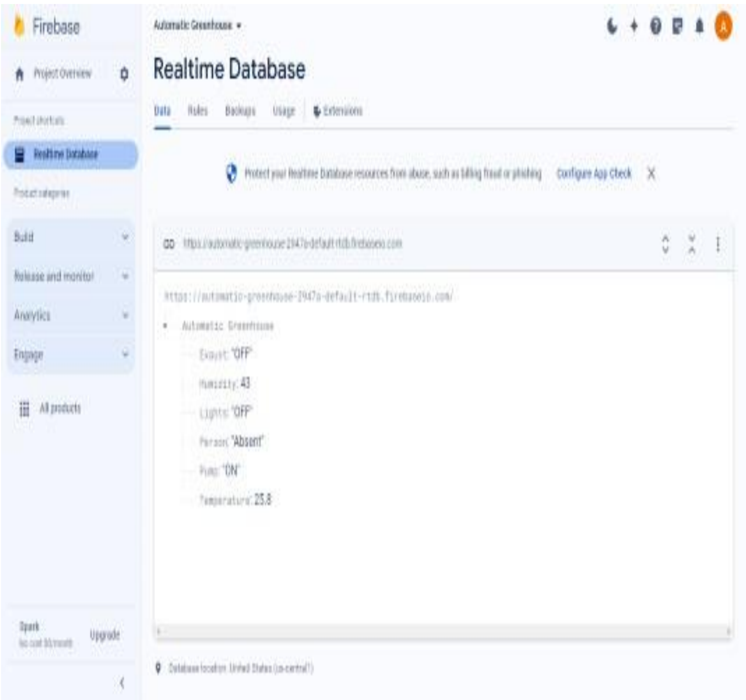


Fig 1.7 Connection of Hardware Modules.

As seen in Fig. 1.7, this project is built around the NodeMCU microcontroller in conjunction with additional electrical devices. Low-cost Internet of Things development platforms make NodeMCU open-source. The temperature and humidity sensing node is the DHT11 sensor, its operating voltage is 3V to 5V and it has pin like GND, VCC, and serial data pin used to collect data to the microcontroller, moisture sensor is used to collect the moisture data and send to microcontrollers. Microcontrollers are deployed on the top of PCB board. 2000 mAh batteries are used to support the power to the system. The relays connect to fan, water pump, heater (bulb).The data gathered by the different sensors collected to microcontroller and it send the real time data to the Firebase cloud by the help of Wi-Fi .



. **Fig 1.8 Firebase results**

4. RESULTS –

The data can be assessed through the application of Firebase remotely. From the Firebase platform the user can monitor the greenhouse environment in real-time as shown in Fig 1.8. It also shows the operation on equipment that is performed in the greenhouse like fan ON/OFF, water pump ON/OFF etc.

5.CONCLUSION–

Based on the Experiment , data analysis we can conclude that it shows all the activity at real-time on the cloud so, that the user can monitor the real-time data remotely. It also shows the equipment activity after crossing the limit of power though we can produce more crop at low cost. In future we can apply the machine learning technology for predict the real time monitoring of individual plant for disease control ,pests control so we can get more production from each plant .It can also reduce the man intervention reduce the labor cost so that each farmer can cultivate through greenhouse for more production and it also decreases the problem of water.

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