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IoT Based Greenhouse Monitoring System Using Raspberry Pi

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ABSTRACT

Whilst computerized greenhouse systems are common in commercial crop production, there are few equivalent, but less expensive, systems available for home greenhouses. As a result, the scope of this study is to build and make a smart greenhouse system that monitors and regulate domestic greenhouses both locally and remotely. This thesis concentrated on the design and implementation of a smart greenhouse system's user interface and networking paradigm. This concept presents a conceptual framework for transforming a traditional greenhouse into a smart greenhouse. The goal is for customers to be able to control and manage critical crop aspects depending on their own needs. A user-friendly Thingspeak service where real data is synced from the greenhouse to the cloud and a responsive greenhouse system are the end results.
Keywords :- IoT, Greenhouse monitoring, Raspberry pi.

I. INTRODUCTION

Agriculture is amongst the most significant sectors of the economy, with several nations' economies relying on it. Agriculture makes use of a variety of technologies. These installations are in place for a variety of reasons, the most essential of which is to protect the crops from potentially harmful climatic conditions. Agricultural guarded homes, which come in a variety of styles, are by far the most essential of these structures. They are distinguished by their various forms, materials, and coverings. This home is usually fitted with air conditioning or heating. The price of building these facilities is determined by their efficiency. That their costs are increasing in quality, whereas the cultivated plants in such protected buildings are of great quality, which is why there is such a large market for these.

Temperature, smoke, humidity, and soil moisture are detected in the greenhouse using an IoT and Raspberry Pi-based greenhouse monitoring system of three sensors. The greenhouse effect is a natural occurrence that benefits humans. Many farmers fail to make a profit from greenhouse crops because they are unable to control two critical parameters that govern plant growth and output. High humidity can cause crop transpiration, condensation of water vapour on various greenhouse surfaces, and moisture loss from damp soil if the greenhouse temperatures drop under a particular level.

To overcome such challenges, this greenhouse monitoring system involves the rescue. This project demonstrates the design and implementation of various sensors for the greenhouse environment monitoring and controlling. This greenhouse control system is powered by Raspberry pi it consists of temperature sensor, light sensor, soil moisture sensor, LDR sensor, LCD display module, 12V DC fan, Bulb, and pump. The temperature sensor senses the level of temperature. If it goes high DC fans get on and when the temperature goes low the fan gets off. Soil moisture sensor senses the water level as the level decreases the pumps get on. In the absence of light, the LDR sensor senses and the bulb starts glowing. Also, cloud based ThingSpeak module is used to send the status of the sensor every 30 secs. In this way, it will become easy to monitor and control the system. Also data is synced with Thingspeak server so that monitoring of the greenhouse system becomes easy.

II. LITERATURE SURVEY

Nikesh Gondchawar et. al. (2016) In his paper focussed on, in India, farming employs over 70% of the population and accounts for one-third of the country's GDP. Agriculture has always been a stumbling block to the country's progress. Smart agriculture, which involves upgrading present agricultural processes, is the only answer to this challenge. As a result, the project's goal is to use automation and IoT technology to make agriculture smarter.

Joneus Filip et. al. (2020) according to the author of this research solutions for computerized greenhouses that monitor and act on factors such as humidity, temperature, and crop nutrients are extensively developed for large-scale horticulture companies. Such systems, on the other hand, are based on modern PLC industrial components and, for example, SCADA-systems. As a result, such systems may not be appropriate for amateur gardeners. As a result, a tiny Raspberry Pi-based system was developed.

Carlos González-Amarillo. et. al. (2017) The author of this study discusses how to regulate the environment surrounding the greenhouse. The model allows changes to luminosity, moisture, temperature, and water usage to be made. With the watering system or temperature control, the system provides for automated regulation of the greenhouse's inside environment. The model allows for the calculation of water consumption, plant development patterns, and product harvest timelines. The system outlines the fundamental method for agricultural product internal traceability, from seed to finished product. Through an IoT platform, this greenhouse design enables for the analysis of species behaviour in local agriculture in a Colombian location.

Neel P. Shah et. al. (2017) The authors of this research went into great detail regarding how climate change and its consequences for the ecosystem have prompted farmers to build greenhouses on their farms. However, maintaining a greenhouse and its plantation is a time-consuming task, and the majority of them do so instinctively. A scarcity of excellent quality data is also a problem for agricultural researchers, which is critical for crop improvement. As a result, they have created a cost-effective system based on Internet of Things (IoT) technology that is focused on tackling these specific difficulties. Our system automates greenhouse maintenance activities and closely monitors the growing conditions within the greenhouse.

Mr. Dattatraya Shinde et. al. (2018) provided some light on how Previously, a farmer's attention was required to preserve his field from many calamities caused by humans or nature. Human efforts are insufficient, and farmers must pay for personnel. Temperature sensor, Humidity sensor, Soil Moisture sensor to check if the field is dry or wet, and an LDR to verify the illumination at that location are some of the sensors they are utilising to monitor the field.

This mechanism ensures that the soil quality is maintained, which is necessary for the optimal growth of the crop.

Naseem Siddiqui et. al. (2018) According to the author The farmer can use this project to predict and analyse greenhouse parameters. Tomatoes and brinjals are the two crops chosen for prediction and analysis. Two samples of crops were obtained, and the system was tested in a greenhouse setting for these crops. Finally, overall annual power consumption and expenses for controlling devices are estimated. Farmers will be able to forecast the overall amount for crop control activity for the next year as a result of this. Using this approach, it has been discovered that regulating action improves product quality and quantity more than crops grown without control action.

Sandip Khot et. al. (2016) The author of this paper discusses how light intensity can be regulated in most gadgets. Most of the time, measuring light from the sun is required to distinguish between day and night. When it comes to assuring efficiency and safety, light measurement and analysis are critical. In farming, plant development is solely reliant on the amount of light falling on the canopy's top. This study describes a Raspberry Pi-based real-time remote light intensity monitoring system that allows users to remotely monitor the lighting system in a green house to improve plant development. This system's key feature is real-time light intensity monitoring and data storing in a cloud database for future use on any internet-connected device. This allows professionals to make the best judgments at the correct moment to achieve the best outcomes in plant growth.

Rana H. Hussain et. al. (2013) The researchers in this study highlight how its application assists farmers in increasing agricultural yield. The standalone XBee module, which is devoid of a microprocessor, is equipped with a variety of tiny sensors. All monitored parameters are sent to a computer through a wireless link to be evaluated, and then appropriate orders are sent to particular equipment to overcome drifts in environmental parameters inside the greenhouse.

Yi-Jui Chen et. al. (2017) Her study demonstrated how, with the development of cloud computing and low-cost Internet-of-Things (IoT) devices, we can use these low-cost and effective technologies to monitor environmental conditions, plant development, and facility control. A real-time platform for dynamically evaluating the acquired data may considerably increase greenhouse cultivation efficiency, maintenance costs, and decision making, in addition to making it easier to monitor/control greenhouse facilities. In this work, a low-cost greenhouse monitoring system with real-time data processing is designed for small and medium-sized greenhouse installations. We create an efficient and effective greenhouse system using RethinkDB, Raspberry Pi, Tornado, and Splunk to meet the following aims. This system architecture serves as a possible solution/bridge to precise agriculture in the end.

III. Block diagram of the system

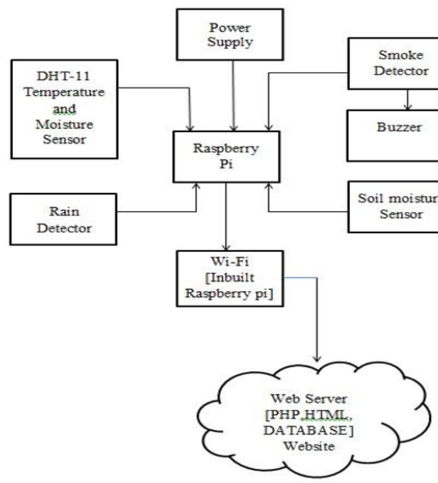

Fig. 1. Block diagram of Greenhouse monitoring system

Working of the system

This green house monitoring system is based on Raspberry Pi. Raspberry pi being a low priced computer it is more than enough for a household greenhouse management system. The system also includes various sensors and modules, such as, DHT11 sensor, rain detector, smoke detector etc. The sensors detect the soil moisture if the moisture is adequate it monitors the data and sends it to lcd screen and to the thingspeak server. If the moisture drops, water is being released in to soil. Next is the temperature sensor, it detects any change in the temperature accurately and turns On and Off the fan as required by the system. Also the data is fed to the Thingspeak server.

Proposed system

The Smart greenhouse monitoring system is designed specially for domestic and household greenhouses, and it includes some requirements as stated below.

a) **Hardware Requirement**
b) **Software Requirement**
c) **Hardware requirement**
d) **Raspberry Pi.**

Raspberry pi is the main computer framework on which the system is based. It is because of it s GPIOs which helps communicating with the sensors efficiently. Also the power requirement is also far less and it could work with a battery. It also includes a wifi module which helps our system to communicate with the thingspeak server.

i. DHT11 Sensor

DHT 11 is a commonly used Temperature and moisture sensor. It is used for constant monitoring of temperature of the system. As, greenhouse needs to be in adequate temperature zones so as to work efficiently, this system utilizes it.

ii. LCD

LCD is also an important part of this system as it displays all the sensor values. The LCD is interfaced with the Raspberry Pi.

a. Software requirement

i. Thonny IDE

As our system is developed using Python language, Thonny IDE is used to write and develop its program. Thonny is inbuilt IDE in the Raspberry Pi OS.

ii. Thingspeak server

Thingspeak server is an important part of this system. All the data collected by sensors is stored and shared with Raspberry pi. Raspberry pi displays that data on LCD screen and as well as synchronizes the data with the Thingspeak server. ThingSpeak is an open-source Internet of Things (IoT) application and API for storing and retrieving data from things over the Internet or over a Local Area Network utilising the HTTP and MQTT protocols.

Algorithm and Flowchart of the System

Algorithm

1. Start
2. Initialize the system.
3. Capture Soil moisture, humidity, temperature,smoke in the Greenhouse.
4. Send captured data to ThingSpeak server.
5. Compare the captured data with the set point of the sensors.
6. If temperature data exceeds turn on the buzzer and turn on the fan.
7. If temperature data does not exceed go back to step 3.
8. If humidity data exceeds turn on the buzzer and turn on the fan.
9. If humidity data does not exceed go back to step 3.
10. If soil moisture data exceeds turn off the water motor.
11. If soil moisture data does not exceeds turn on the water motor.
12. If smoke is detected turn on sprinkler and buzzer.
13. Go back to step 3

Flowchart

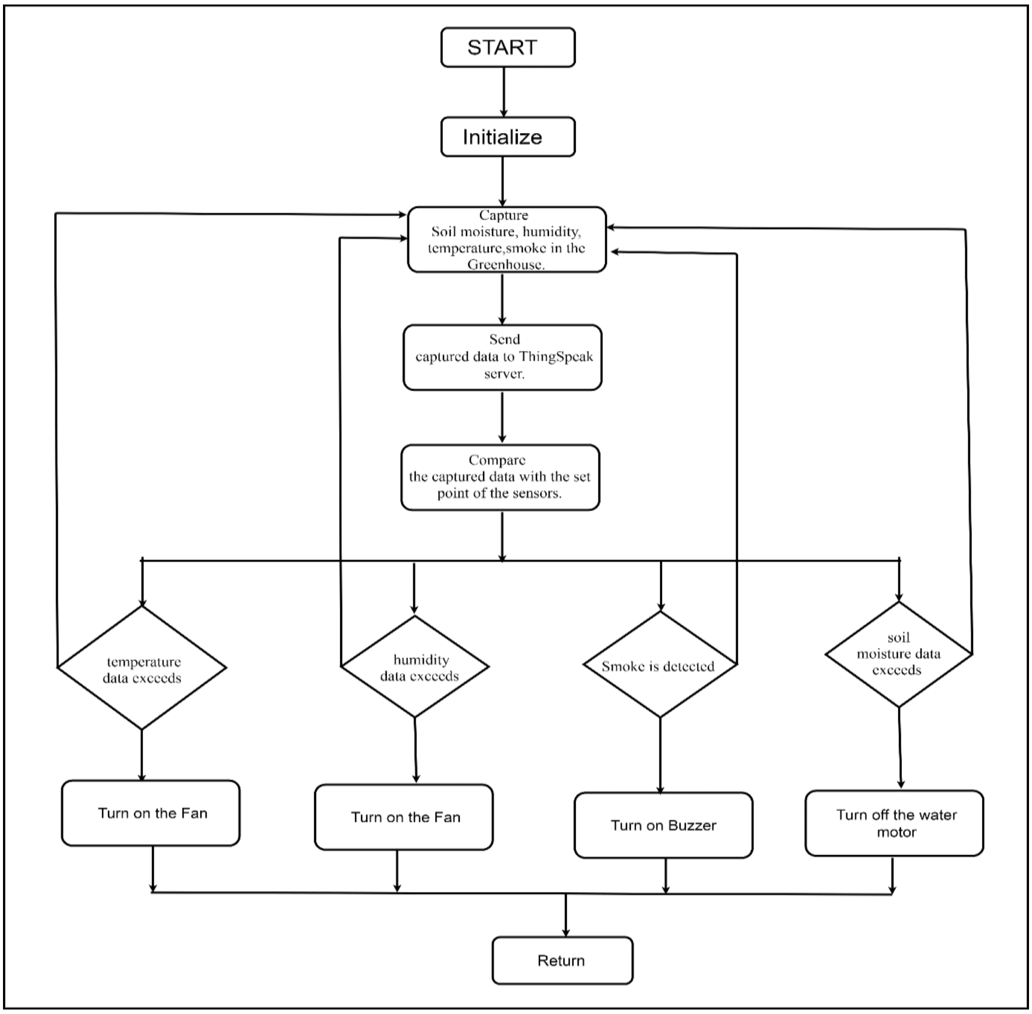

Fig. 2 Flowchart of the system

IV. RESULTS AND DISCUSSION

Humidity	Time
58	5.40
56	5.42
57	5.46

Table 1 Humidity Sensor Value of The Greenhouse Monitoring System

Temperature	Time
29	5.38
30	5.40
30	5.42

Table 2 Temperature Sensor Value of The Greenhouse Monitoring System

Soil Moisture	Time
0	5.44
10	5.46
10	5.48

Table 3 Soil Moisture Sensor Value of The Greenhouse Monitoring System

Rain Sensor Value	Time
0	5.44
10	5.46
10	5.48

Table 4 Rain Detector Sensor Value of The Greenhouse Monitoring System

Smoke Sensor	Time
0	5.44
0	5.46
0	5.48

Table 5 Smoke Sensor Value of The Greenhouse Monitoring System

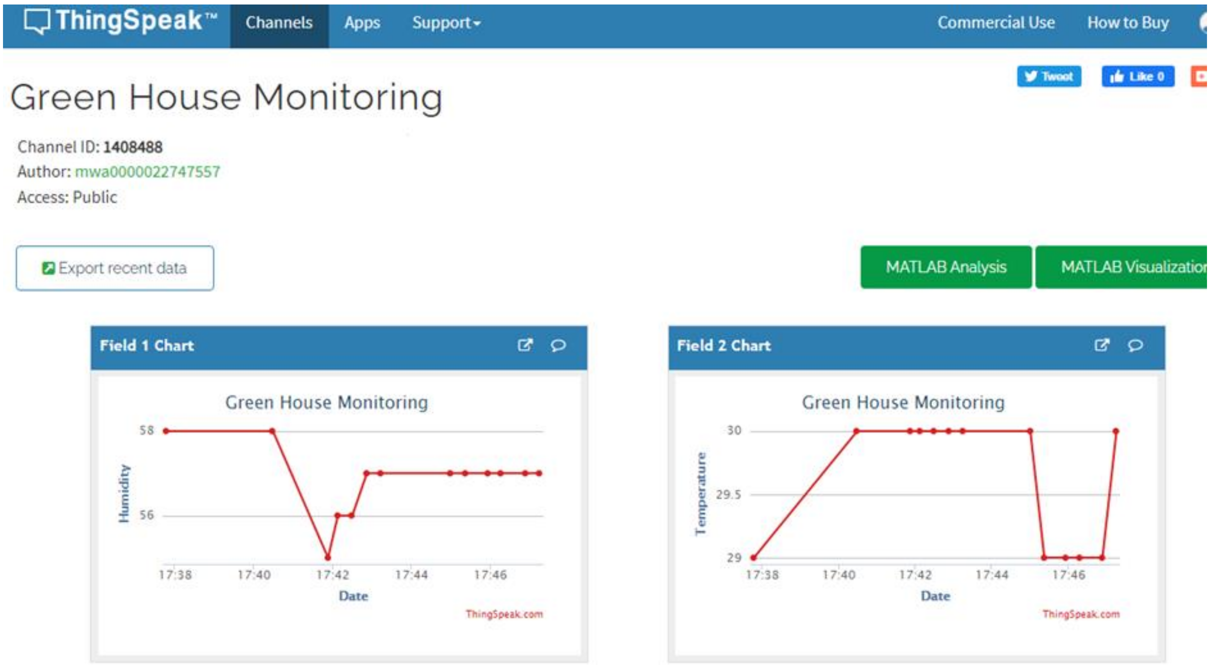

Fig. 3 IoT dashboard on Thingspeak displaying synced values of Humidity and temperature.

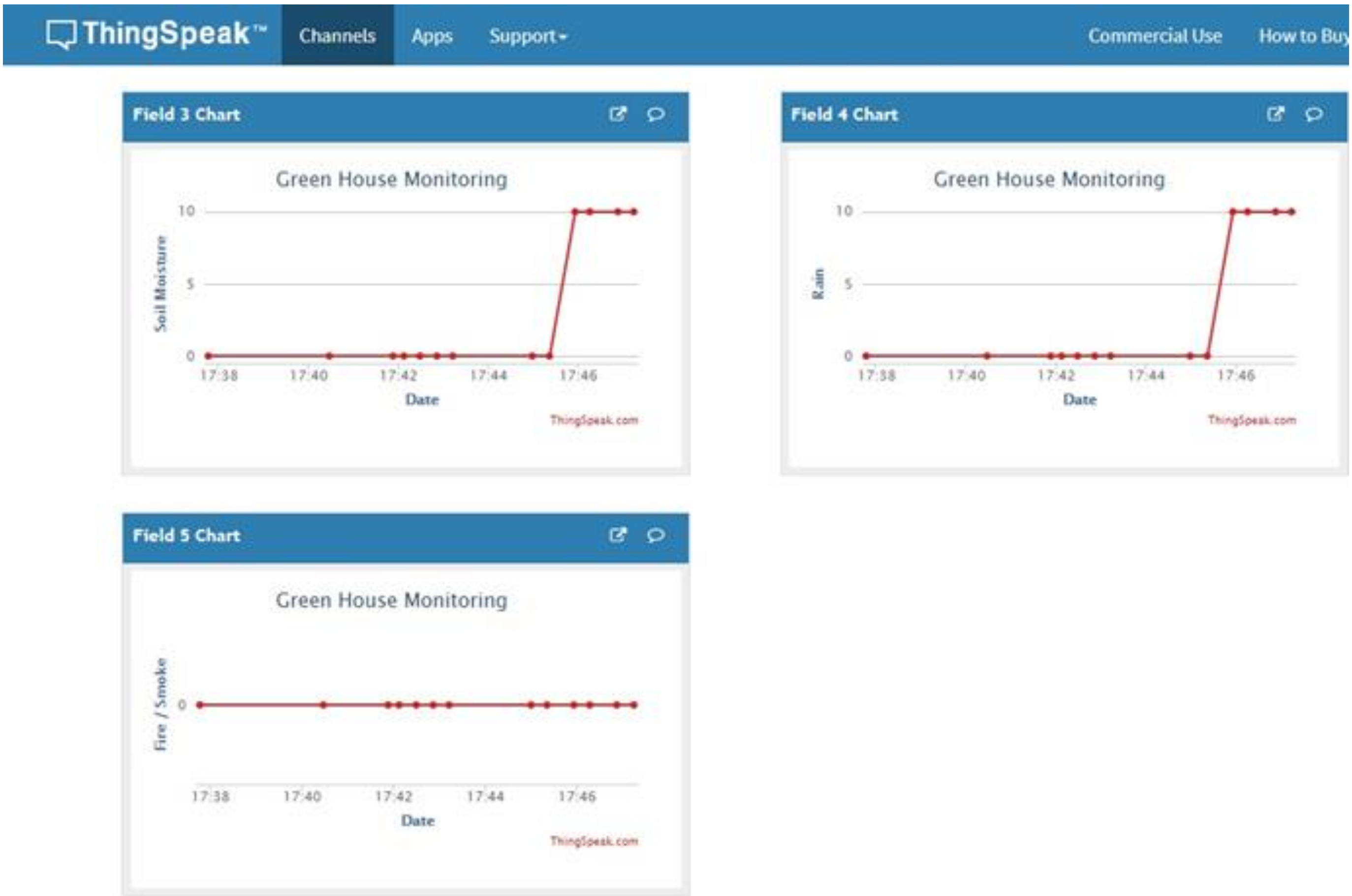

Fig. 4. IoT dashboard on Thingspeak displaying synced values of Soil Moisture, Rain, Fire

V. CONCLUSION

Humans are considered responsible for this polluted and dangerous environment. This is a major concern for the whole world. Thus, a smart way to monitor the various environmental parameters using a RASPBERRY Pi and IoT module has been discussed in this project. It is a low-cost, precise and efficient method of monitoring. The data is collected and monitored by using MQ2 gas sensor, Rain Sensor, DHT 11,Etc. The monitoring of accumulated data in the cloud storage helps to analyze the various patterns in the environmental parameters and accordingly notifies the farmer.

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