International Journal of Scientific Engineering and Technology ISSN : 2277-1581
Volume No. 13, Special Issue No. 1 1 July 2024

IOT Based Weather Monitoring System

Shreya Chourasia[1], Nidhi Prakash[2,] Jayant Singh Bais[3], Shilpi Rajan[4]

LNCT College, Bhopal

[1]Shreyacgourasia042@gmail.com , [2]Nidhiprakash2018@gmail.com, [3]Jayantbais2@gmai.com, [4]shilpijaiswaal7@gmail.com

***Abstract*-This paper presents the design and implementation of an IoT-based weather monitoring system using the LM35 temperature sensor and the ESP8266 Wi-Fi module.The system's objective is to continually track the temperature of the surrounding area and send the information to a distant server for instantaneous processing and display. The environmental temperature is measured by the well-known and accurate LM35 sensor, and data transmission via WIFI via the Thing Speak is IoT platform is enabled by the ESP8266 module. After processing, the data is shown on an interactive screen so that users may track temperature patterns and make defensible judgements. Numerous uses for this technology exist, such as studies on the environment, automation of homes, and agriculture surveillance. The suggested system for global monitoring the weather is dependable, affordable, and expandable.**

Keywords: IOT, Temperature Monitoring, LM35, ESP8266, WIFI Router, Thing Speak etc.

I. Introduction

The creation of automated systems that can gather, process, and share data via the web has been made possible by the Internet of Things (IoT), which has completely changed how humans communicate with our surroundings in recent decades. One such use for IoT is weather tracking, where actual time data gathering and analysis is essential for many industries, such as environmental research, home automation infrastructure, and farming.This paper describes the creation of an Internet of Things (IoT)-based temperature monitoring system that makes use of the Wi-Fi module for the ESP8266 and the LM35 temperature sensor. The LM35 sensor is a great option for monitoring the environment because of its reputation for accurate temperature measurement with a linear output. The ESP8266 module is an affordable and fully connected Wi-Fi solution that offers smooth internet access and actual time sensor data transfer to distant servers.The main goal of this technology is to provide a scalable, dependable, and effective means of continual monitoring the temperature. Users may gain useful insights into fluctuations in temperature and trends by storing, processing, and visualizing the information collected in real-time using the Thing Speak IoT platform. In addition to improving distant weather monitoring, it also creates opportunities for future improvements and interfaces with additional natural monitors and smart gadgets.This article describes the structure, main parts, and advantages of the Internet of Things-based weather monitoring system while going into depth about its design, creation, and implementation.

2. Applications for IoT-based Temperature Monitoring Systems.

Implementing Internet of Things (IoT) technology for establishing a system for monitoring temperatures gives increased possibilities for automation, analysis of data, and continuous monitoring. The several industries in which such an approach is used are listed below:

- **Healthcare and Pharmaceuticals**
- Hospital and medical Centre: Constant observation of operation rooms, patient spaces, and vaccination and medication storage facilities. When temperature depart from predetermined ranges, alerts are sent out.
- Drugstores: Keep track of and report medicine temperature to guarantee adherence to storage rules.
- Labs: Keep an eye on temperatures controlled to preserve the integrity of delicate specimens and equipment.
- Food and Beverage Industry
- Restaurant & Foods Preservation: To save food from spoiling, sensors monitor fridges and give out notifications if temperature climb over acceptable limits.
- Supply Chain: Monitor temperatures in real time while perishable products are being transported to make sure they stay inside safe bounds.
- Markets: To guarantee the freshness and safety of their products, keep a close eye on the freezer and refrigeration departments.
- **Industrial and Manufacturing**
- Data centers: Use real-time monitoring of temperatures to avoid computers and other vital IT hardware from overheating.
- Production Facilities: To prevent breakdowns in equipment, make sure all machinery and process steps are running within acceptable temperature ranges.
- Storage: Keep an eye on dependent on temperature items to ensure that optimal circumstances are maintained and damages are avoided.
- **Agriculture**
- In greenhouses optimize plant growth circumstances by automating climate control mechanisms using actual time temperature information.
- Animal husbandry: To ensure the wellness and efficiency of cattle, maintain optimal environmental circumstances.
- Storage Services: To avoid deterioration and deteriorating, make sure the crops that were grown are kept at the right temperature.
- **Home and Residential**
- Smart Homes: Combine HVAC management with automated home technologies to increase comfort and energy efficiency.
- Remote Tracking: This feature makes it possible for residents to remotely check and control the environmental conditions of their houses, which is great for second homes or holiday homes.
- **Environmental Monitoring**

- Research Stations: Gather temperature measurements in isolated or harsh settings to provide important information for research.

➢ **Transportation**

- Cold Chain Logistics: To guarantee the quality of food that is perishable, continuously check the temperatures of refrigerated vehicles and containers.
- Public transport systems: Make sure that buses, trains and aero planes are kept at a suitable level to ensure passenger comfort.

➢ **Energy Management**

- HVAC Systems: By using actual time temperature data, optimize your air conditioning, heating, and ventilation equipment to achieve greater energy conservation.
- Renewable Energy: To maximize efficiency and identify any problems, keep an eye on the weather within wind turbines and rooftop solar arrays.

➢ **Retail and Commercial Buildings**

- Smart Buildings: Monitor and regulate temperatures in conjunction with building control systems to guarantee optimum conditions and energy economy.
- Customer Comfort: Keep the retail area pleasant by continuously monitoring and modifying temperatures.

Temperature Monitoring Application of temperature forecast are given in Figure 1.

Figure.1Application For Temperature Monitoring System

3. Review Of Work

There has been a lot of research carried out in the past for crop production and yield improvement. This section reviews some of the most relevant and recent works.Ferdin Joe John Joseph et al [1] In recent decades, the Internet of Things, or IoT for short, has added value to various goods and businesses. The resilience, connection, and electrical usage of IoT devices have all significantly decreased as a result of their network connections. IoT is an exciting technology that is pushing the boundaries of many sectors and has the potential to advance the analysis of big data. The problem of climate monitoring devices as modules has received a lot of attention from the IoT study community. A new temperature tracking device is created with the Raspberry Pi and a number of detectors.

BulipeSrinivasRao et al [2] The method described in this article provides a sophisticated way to keep track of the local temperature while making the data accessible from any location across the globe. This is made possible by the internet of Things, or IoT, it is a sophisticated and effective way to link objects to the web and to link everything in the world together in an interconnected manner. Things like electronic components, detectors, and vehicle electronics might be found here. Using sensors that are the device monitors and controls environmental parameters including the temperature, humidity, light quality, and CO levels. It then transmits this information to an internet site, where data from the sensors is shown as graphic data. Anybody in the globe may obtain latest information from the established system over the internet.

ung-Chung Tsao et al [3] The creation of a temperature tracking system is the main goal of this study. The primary objective of the study is to build an interconnected data system with ease by utilizing message lining up telemetry transportation (MQTT) technological advances as the interface layer's duties rather than direct-connecting databases. This approach may reduce the difficulty of system movement from different relational database management platforms (RDBMS). Lastly, the benefits are shown through the connected to the internet of weather surveillance method's installation.

Girija C et al [4] The approach described in this article provides a sophisticated way to keep track of local weather conditions while simultaneously making the data accessible from any location across the globe. This is made possible by Internet of Things, or IoT, technology, which is a sophisticated and effective way to link objects to the net and to link everything in the entire globe together in a network. Devices like electronic devices, sensors, and vehicle electronics could possibly be found here. The apparatus uses devices to monitor and control variables related to the environment including relative humidity, temperature, and CO level.

Prof. S.B. Kamble et al [5] The method outlined in this paper provides a sophisticated way to keep track of the local weather and make the data accessible from any location across the globe. This is made possible by Web of Things, or IoT, that is a sophisticated and effective way to link objects to the online as well as link everything in the entire globe together in a network of connections. Things including electronic devices, sensors that are and vehicle electronics might be found here. The temperature, humidity, direction of wind and speed, the amount of rain, and other variables are monitored and tracked by the overall system. The results of this analysis are shown on a display by the computer system in the moment.

Anita M. Bhagat et al [6] The Wetter Surveillance and information Network undertaking, which is IOT-based, provides real-time weather information. It will track the amount of rainfall, transpiration, water, and warmth. Let's say that researchers and wildlife analysts wish to track alterations in a certain ecosystem, such as a tropical forest or a caldera. Furthermore, these individuals come from various parts of the globe. The SMS-based climate tracking system has multiple disadvantages in this scenario. since it just SMS's a select few people.

Puja Sharma et al [7] You shall track the Varanasi Region's real-time climate factor in our suggested project. The proposed framework will use Internet of Things to operate on a client-server, which architectural approach. The framework of the framework has two tiers. Numerous sensors in the system we suggest will track the local conditions, the amount of precipitation, and pressure within the system. Data was collected by the instrument and sent via the cluster MCU microcontroller. The detected data is uploaded using the

Arduino IDE. The tracking device and the cloud system have been connected via serial monitors. The detector pushes data into a serial monitor. An Internet Protocol (IP) number is monitored by the modem. The webserver's data is viewed using the protocols known as HTTP. This work uses a natural parameter or monitor for tracking weather information over an extended time and presents the data via a web server.

Mr. Mohit Tiwari et al [8] We present a stored in the cloud, Internet of Things-based weather observation system in this research. The purpose of a system for weather observation is to measure, log, and present different meteorological characteristics, such as temperature and moisture. This device uses instruments to identify and track meteorological factors. The knowledge gathered is then transmitted to a storage that can be retrieved over an internet connection. It is possible to anticipate and watch what information that is shown as a result. An Arduino UNO board, cameras, and a module for WIFI are all used by the entire system to transmit info to the cloud-based companies.

BalakrishnanSivakumar et al [9] The system that was suggested is a cutting-edge approach to climate forecasting that leverages IoT to provide easy utilization of accurate information across a vast area. The apparatus uses a number of devices for tracking many aspects of the weather and environment, including humidity, wind velocity, temperature, wetness, light intensity, ultraviolet (UV) light, and even airborne carbon dioxide levels. The online page receives data from these devices, which are then shown as graphical statistics. It is simple to access the data that has been posted to the website from any location in the globe. Subsequent citations may be made using the information acquired on these websites. Especially a smartphone app which delivers warns acts as an efficient alarm system for the endeavor, alerting users to abrupt and severe climate fluctuations. We employ an API than evaluates the information gathered by sensors and forecasts a precise outcome in order to anticipate more sophisticated climate predictions that cannot be accomplished by sensors only. Without the help of this API, information may be archived for later use be accessed with some ease from any location at any time. The structure needs fewer upkeep tasks because to its small footprint and reduced number of operating components.AtulKulkarni et al [10] among the more consistently difficult problems in climatology worldwide is forecasting the weather, which plays a crucial role in the field. This plan covers the design and building of a meteorological screen system employing inexpensive components, making it accessible to all hobbyists in circuitry. Instead of employing instruments to get information on the weather, the idea uses a worldwide weather data supplier to obtain data collected by atmospheric observatories located all over the globe. Extreme weather occurrences presented difficulties to the partly explanation-based challenging forecasting of weather technique. There are simply excessive requirements for climatic occurrences to be detailed and calculated. As communication methods advance, climate prediction professionals can collaborate and exchange resources, leading to the emergence of integrated systems. However, even with such developments on When it comes to precipitation forecasting, such systems of experts are primarily unreliable when it comes to predicting the climate.

AndriyHolovatyy et al [11] The Internet of Things ("IoT") weather surveillance system's software and hardware parts were created & are presented in this article. The micro control device, created on the basis of the Arduino Megabyte2560 board, the computerized temperatures, pressures, and moistness sensor that is being tested BME280, the wireless networking module ESP-01 constructed using the ESP8266 chip, as well as the 16x2 numerical LCD that uses the Hitachi Heavy Industries HD44780 device comprise the circuitry of the Internet of Things weather observation system. Proteus VSM has been used to develop the electronic design and model for the microcontroller that controls the weather tracking gadget. The Internet of Things weather surveillance method's operating mechanism has been created. The Internet of Things gadget keeps an eye on meteorological variables including temperature, rainfall, humidity, and pressure of air.

R Suresh Babu et al [12] The technique described in this piece provides a sophisticated way to keep track of the local temperature while simultaneously making the data accessible from anywhere in the globe. This is made possible by Web of Things, or IoT, which is a sophisticated and effective way to link objects to the online and to link everything in the universe together in an interconnected way. Everyone in the world may obtain latest information from the established framework over the World Wide Web.

Mr.PravinPawar et al [13] The objective of the undertaking is to construct a system for weather tracking based on the idea of employing the Raspberry Pi computer as both an interface device and a server for the website. The Web of Things is developing at an accelerating rate. Weather has an impact on a variety of industries, including farming and manufacturing, so it's necessary to have an observing location that can determine precipitation, temperature, light-dependent resistor that humidity, and barometric pressure. These measurements can then be saved on a computer so that the data can be used via the Internet to any location. Every house, college, or site of business has a unique a microclimate therefore this method is helpful in measuring it, generating regional information, storing it in a database, and comparing it to earlier data.

Jamal Mabrouki et al [14] Systems for tracking have become increasingly important in our daily lives in the last few decades. We therefore provide an automated weather observation device for this study that enables changing and immediate time temperature information of a specified area. The web of things and embedded technology provide the foundation of the proposed framework. Communication technologies, sensors that are and electrical gadgets are also a part of the framework. This system's primary goal is to use detectors to sense several climatic characteristics, including the level of humidity, temperature, and the existence of certain substances.A.Subhadra et al [15] In this instance, we offer a clever paradigm for online environment disclosure. We present an arrangement that takes web-based climatic factor details into account. Without the aid of an atmospheric calculating organization, it enables people to easily verify the climatic facts online. The device uses a rain detector, temperatures, and stickiness detector to display the weather and announce the information in real time.

Table.1 Summary of Literature Review

Authors	Methodology	Parameters
Ferdin Joe John Joseph et al [1]	This methodology uses PM 2.5 sensor and monitor it periodically and stores in a cloud server.	This gets basic parameters like temperature, humidity and few other parameters.
Bulipe Srinivas Rao et al.[2]	methods to calculate the pollution parameters, like noise levels and CO levels in the surrounding environment.	parameters (e.g., noise, CO and radiation levels
ung-Chung Tsao et. al [3]	propose a robust system architecture, good deploy methodology, and efficient algorithms to visualize and retrieve data	the research is to use the technology of message queuing telemetry transport (MQTT)
Girija C et al [4]	MQTT technology used for communication layer Implementation of IoT-based weather monitoring system	parameters (e.g., Temperature, Humidity and CO etc.)
Prof. S.B. Kamble et al [5]	The paper uses Arduino and Raspberry Pi to connect and collect data from various sensors. The data is stored in a local database and visualized on a web application dashboard.	Monitored parameters: temperature, humidity, barometric pressure, light intensity, air quality, rainfall. IoT system measures and monitors various environmental conditions accurately.

4. Sensor Specification & Testing.

In addition to its accuracy and simplicity of integrating, the temperature sensor known as LM35 is commonly used in a variety of industries. It may be connected to an ESP8266 microprocessor to allow temperature information to be remotely monitored using Internet of Things systems such as Thing Speak. This paper offers a thorough theoretical explanation concerning the LM35 sensors, including its features and testing as well as information processing procedures with an ESP8266 microprocessor.

LM35 Sensor Overview

Because of its accuracy, straightforwardness, and simplicity to incorporate into a variety of electrical applications, an LM35 is a widely used temperature gauge. It does not need any additional calibration or editing in order to deliver correct readings; instead, it produces an analogue voltage for output proportionate to the temperature measured in Celsius. An extensive description regarding the LM35 sensors is given in this document, together with information on its benefits, pin layout, operating principle, and uses. The voltage that is generated of the LM35 accuracy integrated-circuit temperature measurement device is inversely related to the current temperature in Degrees. It is very user-friendly and accurate.

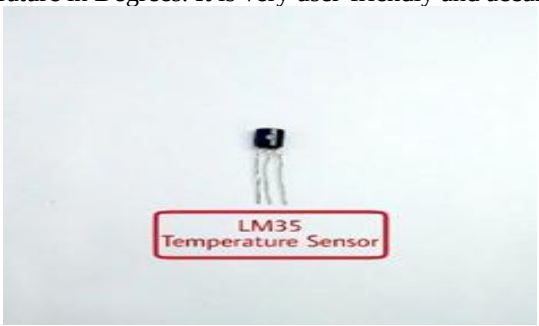

Figure.2 LM35 Temperature Sensor

Pin Configuration:

Attached to any positive power source (4V to 30V) is Pin 1 (Vcc).

An analogue output voltage related to temperatures is provided by pin 2 (Vout).

Pin 3 (GND): Attaches to the power provides earth.

Key Specifications:

Voltage Output: 10 mV/°C.

The accuracy at 25°C is ±0.5°C.

The range of temperatures for operation: -55°C to +150°C.

4V to 30V is the supply voltage.

60 µA is the current usage.

Reaction time at a 1°C change is 1 ms.

The electrical voltage differential across the diode changes with temperatures, which is the basis for the operation of the LM35 sensor. The analogue voltage it produces is proportional to the Centigrade temperatures. For instance, the end result value is 250 mV at 25°C.

Testing and Processing with ESP8266

Hardware Connections are illustrated in Figure 3.

- Components Required:
- LM35 Temperature Sensor.
- ESP8266 (NodeMCU) Module.
- Breadboard and Jumper Wires.
- USB Cable for Powering and Programming ESP8266.

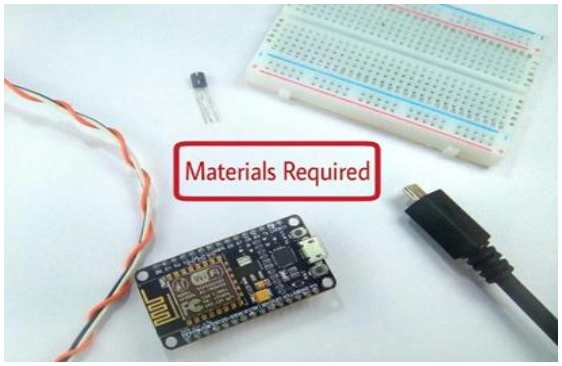

Figure.3 Component and Circuit layout

LM35 Connections:

- Vcc (Pin 1): Connect to the 3.3V pin on the ESP8266.
- GND (Pin 3): Connect to the GND pin on the ESP8266.
- Vout (Pin 2): Connect to the A0 pin (analog input) on the ESP8266.

ESP8266 Connections:

- 3.3V: Provides power to the LM35 sensas shown in Figure 2 or.
- GND: Ground connection for the circuit.
- A0: Reads the analog signal from the LM35 sensor.

Configuring Thing Speak

An open-source Internet of Things platform called Thing Speak lets users gather, store, process, examine, display, and act upon information collected by senses or devices. Projects including intelligent farming, automated homes, monitoring the environment, and other related areas benefit greatly from its implementation. The philosophical foundations and practical procedures for configuring Thing Speak for gathering data and visualization are explained in this tutorial.

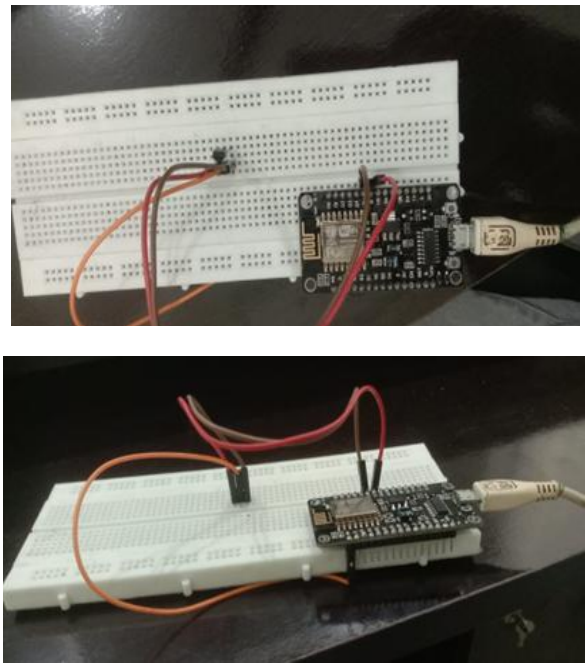

Figure.4 Circuit diagram ande Connections

The circuit diagram and the connections are given in Figure 4.

Create a Thing Speak Account:

- Go to Thing Speak and create an account.
- Create a new channel and add a field (e.g., Field 1) for temperature data.

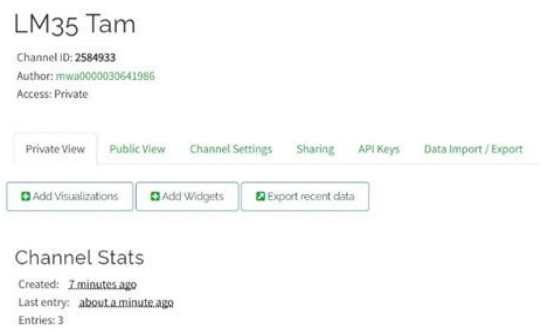

Figure.5 New Channel

Snapshot of IOT channel is shown in Figure 5.

Obtain the API Write Key:

Select the Write API Key by going to the API Keys tab on your Thing Speak channels.

Using Your Code's API Key:

Enter your real Thing Speak Write API Key in lieu of the "your_ thing speak_ write_ Api _" key in the source code.

Update your WiFi login information with your SSID and passwords as well.

Uploading the Code

Connection the ESP8266 to A Computer: For connecting the ESP8266 to a computer, use the USB cord.

In the Arduino IDE, choose the proper COM port.

Put the Code Online:

Within the Arduino IDE, click the upload button.

To verify if the embedded system ESP8266 is connected to the WIFI and delivering information to Thing Speak access the Serial Monitor.

5. Purpose methodology

- Purpose:

Monitor & collecting information: It appears that the LM35 sensor is being used by the system primarily for tracking temperatures.

Data Transfer: Sending this information to a centralized computer (Thing Speak) so that it may be analyzed and stored.

Continuous surveillance involves visualizing and analyzing data in immediate time using a tracking unit.

Integration of the Internet of Things is the process of connecting and communicating among gadgets and servers by means of an IoT router.

- Methodology:

Sensor Connectivity (LM35): To determine the thermal precisely, attach the temperature sensor made by LM35 to the microcontroller, which is probably the ESP8266.

Data purchase: Regularly receive temperature information from the sensor using the microcontroller.

Data Delivery: To securely communicate this information to the Thing Speak server, build a protocol (such as HTTP or MQTT).

Computation on the computer's side: Set up Thing Speak to accept, store, and perhaps examine incoming temperature readings.

Real-time Monitoring: To view information from Thing Speak in instantaneously, set up an oversight unit (maybe an online interface or display).

IoT Router Configuration: Make sure the router is set up correctly to manage data transfer between the Thing Speak website and the microprocessor safely and effectively.

- Implementation Steps:

Physical Setup: Make sure the cabling and electrical connections are proper when connecting the LM35 sensors to the ESP8266 device.

Code Creation: Create software for the ESP8266 that uses the right modules and interfaces to receive sensors data and send it to Thing Speak.

Configuring Thing Speak: Make a profile, create pathways, and get the required API keys to send data.

Monitoring Interfaces: Create or set up an online dashboard or application as part of a system for tracking to display temperatures obtained by Thing Speak.

Testing and an iteration: Check the system's overall performance, data quality, and ability for monitoring in immediate terms. Adjust the design as needed in light of the testing's findings.

These instructions will help you design a block diagram in an efficient manner so that you may use the ESP8266 module coupled with Thing Speak and the LM35 thermometer to transmit information and monitoring temperatures.

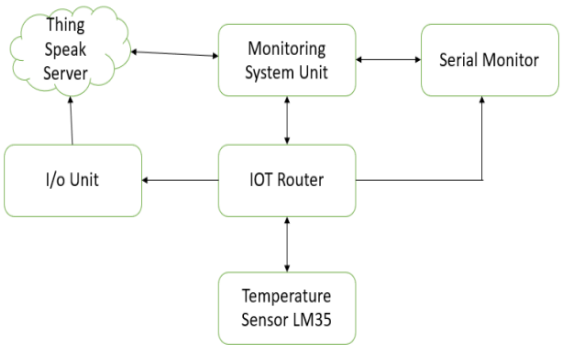

Figure.6 Purpose Methodology

6. EXPERIMENTAL OUTCOMES

In this paper, the results of the proposed IOT Based Weather Monitoring System are presented. The results are presented in two phases. The first phase presents the IoT-based Internal Weather Monitoring System.In the second phase, the External Weather Monitoring System results are presented.

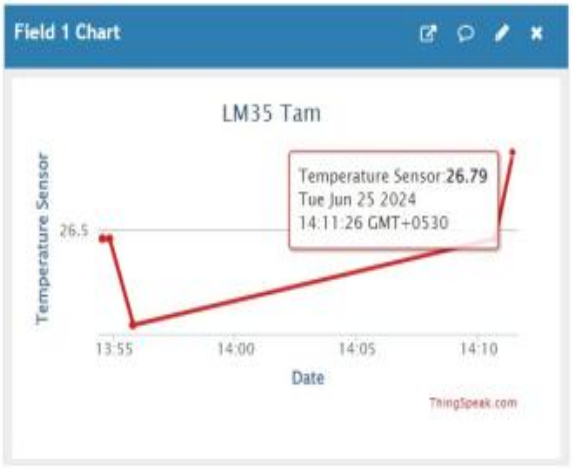

Figure.7 External Weather Monitoring System

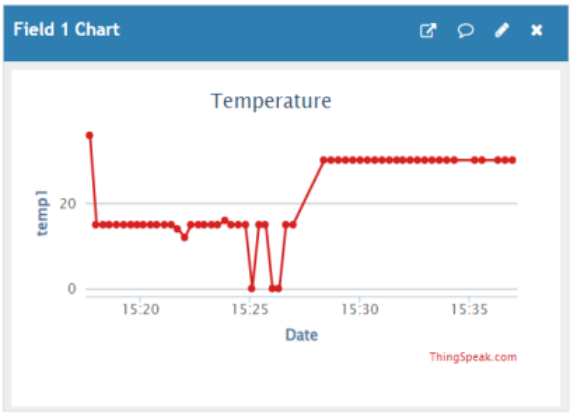

Figure.8 Internal Weather Monitoring System

The results of the data extraction and monitoring for weather temperature for outdoor and indoor environment are shown in the Figure 6 and Figure 7 respectively.

7. CONCLUSION

The goal of this study was to provide a suggestion for the development of a IOT Based Weather Monitoring System Using LM35 connecting a ESP8266 this server data explain the Thing Speak Cloud Server The term "real- tracking of temperatures is made dependable and effective with the help of the WIFI module ESP8266 and LM35 temperature sensor integrated into an IoT-based weather tracking system. Accurate readings of temperatures are guaranteed by the LM35 sensor, which is renowned for its linear output and excellent precision, and the ESP8266 component, which enables smooth data transfer to cloud servers like Thing Speak. This configuration makes it possible to monitor and analyses data continuously, as well as to get actual time temperature information remotely. This makes it ideal for a wide range of uses, from agricultural management to ecological tracking.

Accurate Temperatures Measurements: The LM35 sensors ensures accurate readings by providing high precision with less its own heating.

Real-Time Information Delivery: Real-time tracking and evaluation are made possible by the ESP8266 module ability to send data continuously to cloud systems.

Scalable and Adaptability: Adding additional detectors to the system for more thorough weather tracking is a simple and straightforward process.

Efficiency: The architecture is usable for a range of use cases since it makes use of reasonably priced elements.

REFERENCES

1. Ferdin Joe John Joseph "IoT Based Weather Monitoring System for Effective Analytics" International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-4, April, 2019 https://www.researchgate.net/publication/332799164
2. BulipeSrinivasRao, Prof. Dr. K. Srinivasa Rao, Mr. N. Ome Internet of Things (IOT) Based Weather Monitoring System International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 5, Issue 9, September 2016 https://www.researchgate.net/publication/369384102
3. Śung-Chung Tsao, Yin Te Tsai, Yaw-Wen Kuo, Chaokung Hwang "An Implementation of IoT-Based Weather Monitoring System" at: https://www.researchgate.net/publication/339099436
4. Girija C, Harshalatha H, Andreanna Grace Shires, Pushpalatha H P "Internet of Things (IOT) based Weather Monitoring System" Special Issue – 2018 International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org NCESC - 2018 Conference Proceedings
5. Prof. S.B. Kamble, P.Ramana P. Rao, Anurag S. Pingalkar, Ganesh S. Chayal "IoT Based Weather Monitoring System" Vol-3 Issue-2 2017 IJARIIE-ISSN(O)-2395-4396
6. Anita M. Bhagat, Ashwini G. Thakare, Kajal A. Molke, Neha S. Muneshwar, Prof. V. Choudhary "IOT Based Weather Monitoring and Reporting System Project" International Journal of Trend in Scientific Research and Development (IJTSRD) Volume: 3 | Issue: 3 | Mar-Apr 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470
7. Puja Sharma and Shiva Prakash "Real Time Weather Monitoring System Using Iot" ITM Web of Conferences 40, 01006 (2021) ICACC-2021 https://doi.org/10.1051/itmconf/20214001006
8. Mr. MohitTiwari, Deepak Narang, PriyaGoel, AnupmaGadhwal, Abhinav Gupta and AnkushChawla "WEATHER MONITORING SYSTEM USING IOT AND CLOUD COMPUTING" International Journal of Advanced Science and Technology Vol. 29, No. 12s, (2020), pp. 2473-2479 at: https://www.researchgate.net/publication/342359226
9. BalakrishnanSivakumar, and ChikkamadaiahNanjundaswamy "Weather monitoring and forecasting system using IoT" DOI: https://doi.org/10.30574/gjeta.2021.8.2.0109
10. Atul Kulkarni, Debajyoti Mukhopadhyay "Internet of Things Based Weather Forecast Monitoring System" Indonesian Journal of Electrical Engineering and Computer Science Vol. 9, No. 3, March 2018, pp. 555~557 ISSN: 2502-4752, DOI: 10.11591/ijeecs.v9.i3.pp555-557 at: https://www.researchgate.net/publication/322615926

11. AndriyHolovatyy "Development of IoT Weather Monitoring System Based on Arduino and ESP8266 Wi-Fi Module" IOP Conf. Series: Materials Science and Engineering 1016 (2021) 012014 IOP Publishing doi:10.1088/1757-899X/1016/1/012014
12. R Suresh Babu, T Palaniappan,KAnushya, M Kowsalya , M Krishnadevi "IoT Based Weather Monitoring System" ISSN2394-3777 (Print) ISSN2394-3785 (Online) Available online atwww.ijartet.com International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. 5, Special Issue 13, March2018 https://www.researchgate.net/publication/328782869
13. Mr.PravinPawar, Mr.SudarshanLahade, Mr.SaurabhShinde, Prof.PradeepKhatua "IoT Based Weather Monitoring System" Vol-3 Issue-3 2017 IJARIIE-ISSN(O)-2395-4396
14. Jamal Mabrouki, MouradeAzrour, DrissDhiba, YousefFarhaoui, and Souad El Hajjaji "IoT-Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor Networks with Remote Graphical Application and Alerts" BIG DATA MINING AND ANALYTICS ISSN 2096-0654 04/07 pp25–32 Volume 4, Number 1, March 2021 DOI: 10.26599/BDMA.2020.9020018
15. A.Subhadra,R.Ganesh, K.Maheshbabu, K.SaiSandeep, J.MaheshKumar "IOT BASED REAL TIME WEATHER MONITORING SYSTEM" International Journal of Engineering Applied Sciences and Technology, 2020 Vol. 4, Issue 11, ISSN No. 2455-2143, Pages 384-392 Published Online March 2020 in IJEAST (http://www.ijeast.com)