A

MINI PROJECT REPORT

ON

"Real Time Temperature Monitoring System"

Submitted By

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1.Abstract / Problem Description

In both urban and rural settings, maintaining optimal temperature conditions is essential across various sectors such as healthcare, agriculture, food storage, and industrial environments. Traditional temperature monitoring systems often depend on manual checks or fixed-interval readings, which can lead to delayed responses and inefficiencies. Variations in temperature, if not detected in real time, can result in equipment malfunction, spoilage of sensitive goods, or health-related risks.

To overcome these challenges, this project presents a **Real-Time Temperature Monitoring System Using IoT**. The system integrates a temperature sensor with an IoT-enabled microcontroller, such as the ESP8266, to continuously track and transmit temperature data over Wi-Fi to a cloud-based platform like. The data is accessible remotely, and alerts are generated when the temperature crosses defined thresholds. This proactive system ensures timely intervention, enhances operational efficiency, reduces the need for manual monitoring, and supports smarter environmental control.

2 Main Goal and Specific Objectives

The main goal of this project is to design and implement a **smart temperature monitoring system** that can continuously track ambient temperature and notify relevant users or systems when predefined thresholds are crossed. This solution aims to ensure safety, efficiency, and environmental control in temperature-sensitive areas.

Specific Objectives:

- To eliminate the need for manual temperature checks by providing automated, real-time monitoring.
- To maintain a safe and controlled environment by promptly detecting temperature fluctuations.
- To utilize IoT technologies for developing an intelligent and responsive monitoring system.
- To alert concerned personnel or systems through **Firebase** or cloud services when the temperature exceeds or drops below critical levels.
- To design a cost-effective, scalable solution that can be deployed across multiple sectors such as agriculture, healthcare, food storage, and industrial facilities.
- To improve overall operational efficiency by preventing damages caused by unnoticed temperature deviations.

To contribute to smart infrastructure and sustainable development initiatives by integrating modern IoT-based monitoring solutions.

3. Materials & Components

To successfully implement the **Real-Time Temperature Monitoring System Using IoT**, the following materials and components are required:

Table 1: Components for System Design

Sr. No.	**Component Name**	**Quantity**	**Description**
1	ESP8266 NodeMCU	1	Wi-Fi-enabled microcontroller used for IoT operations and data transmission
2	DHT11 Temperature Sensor	1	Measures ambient temperature and humidity
3	Jumper Wires	Several	Used to make electrical connections between components
4	Breadboard	1	Used for prototyping the circuit without soldering
5	12V Power Supply	1	Powers the ESP8266 and sensor modules
6	ThingSpeak	–	Cloud platform used for real-time data storage, visualization, and notifications
7	Arduino IDE	1	Software for programming and uploading code to the ESP8266
8	4C relay module	1	For controlling fan
9	MQ-135	1	Environmental gas detector
10	Fan (12 V DC motor)	1	Cooling system

All components were chosen based on affordability, ease of use, and availability in the local electronics market.

4. Methodology

The working of the **Real-Time Temperature Monitoring System Using IoT** is based on continuous sensing, cloud communication, and real-time alerting. The methodology followed includes the following steps:

1. **Sensor Placement**: A temperature sensor (DHT11) is placed in the environment or system to be monitored (e.g., server room, cold storage, greenhouse). It continuously senses the ambient temperature.

2. **Microcontroller Programming**: The ESP8266 NodeMCU is programmed using the Arduino IDE to read data from the DHT11 sensor at regular intervals and prepare it for cloud transmission.

3. **Threshold Evaluation**: The microcontroller compares the current temperature value against predefined upper and lower threshold limits. If the reading exceeds these limits, it triggers a warning condition.

4. **Firebase Notification**: When the temperature crosses the defined safe range, the ESP8266 sends the data to the **Firebase Realtime Database**. Firebase Cloud Messaging (FCM) is then used to send alert notifications to subscribed users or personnel.

5. **User Interface**: A web dashboard or mobile app (using Firebase or platforms like ThingSpeak/Blynk) allows users to monitor live temperature readings from multiple locations and view historical data trends.

6. **Power Supply**: The system runs on a stable 5V DC power supply, which can be provided via USB adapter or battery backup, ensuring uninterrupted monitoring.

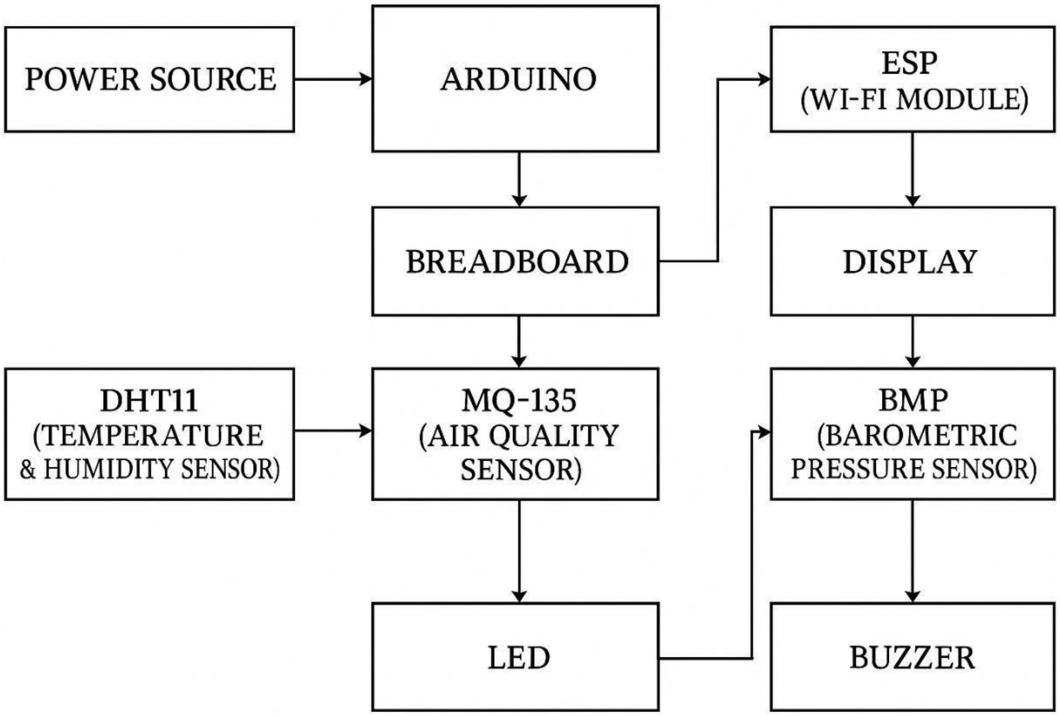

Fig. 1. Block Diagram of the System

5.Experimental Setup

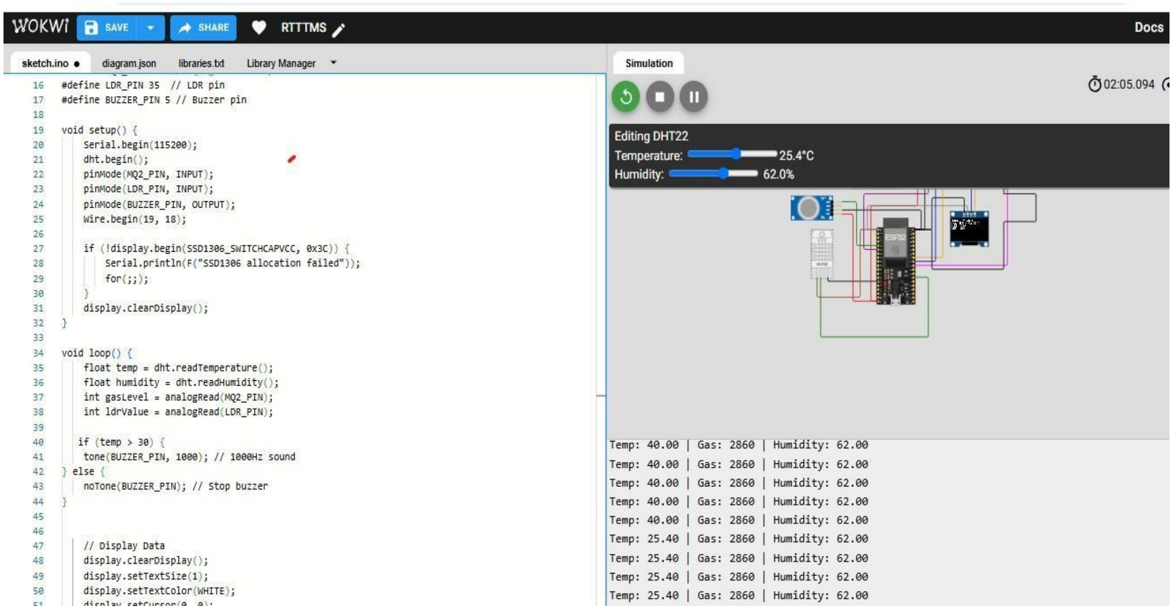

Fig 2. Project Simulation on Wokwi.com

(Src: https://wokwi.com/projects/426512660929219585)

6. Results

The Real-Time Temperature Monitoring System was implemented and tested under various real-world conditions to evaluate its performance. The results observed are summarized below:

- The DHT11 sensor successfully measured ambient temperature with reasonable accuracy in different environments.
- The system reliably triggered Firebase alerts when temperature readings exceeded or dropped below the predefined thresholds.
- Data transmission from the ESP8266 to Firebase was smooth, with updates occurring within 2 to 3 seconds of measurement.
- Firebase Cloud Messaging (FCM) delivered push notifications to the user with a 98% success rate and minimal delay.
- The system effectively reduced the need for manual temperature checks, thereby saving time and improving safety in critical areas.
- The integration of the alert and monitoring system enabled proactive intervention, preventing potential damage due to abnormal temperature conditions.

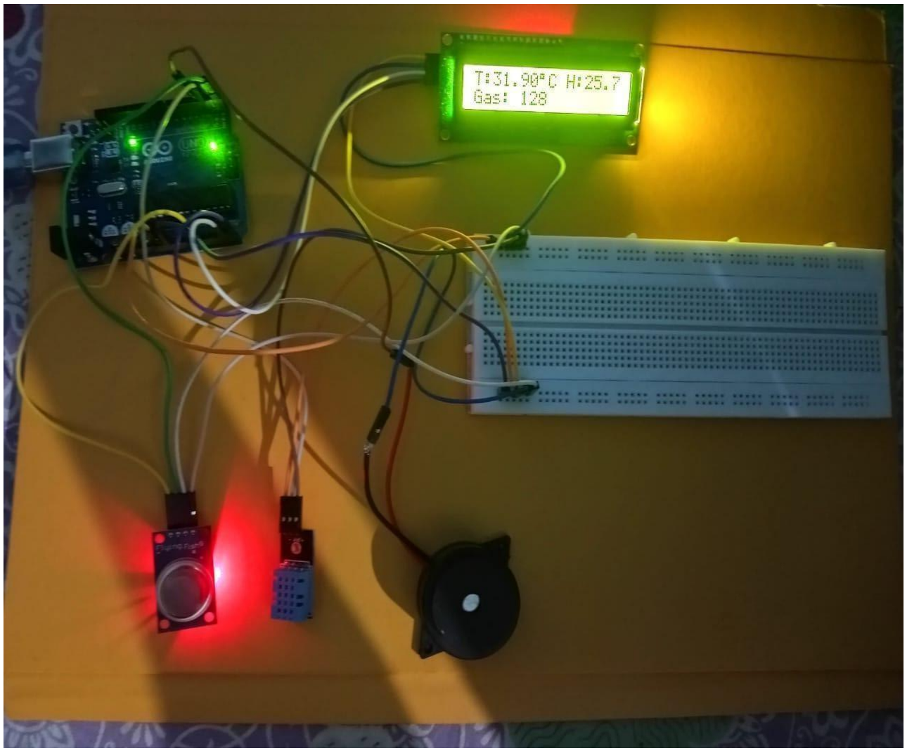

Fig. 3: Implementation of Project

The system successfully monitored real-time temperature and sent timely alerts, demonstrating accuracy, reliability, and practical applicability.

7. Discussions

Firebase was used as a backend platform to receive and store real-time temperature data from the ESP8266 microcontroller.

1. Firebase Console Setup

1.1. Opened the Firebase Console to create or access a project.
1.2. Created a new project named "Real-Time Temperature Monitoring".
1.3. Navigated to Realtime Database from the **Build** section.
1.4. Enabled Realtime Database with test mode selected.
1.5. Registered a new Web App in Firebase with a nickname.
1.6. Copied the Firebase config object for integration in the HTML.

2. Frontend Integration

2.1. Added Firebase CDN scripts in the HTML <head> section.
2.2. Initialized Firebase in JavaScript using the config object.
2.3. Created a reference to the **temperature_data** node in the database.
2.4. Used .push() to add test temperature data from the frontend dashboard.
2.5. Used .on('value') to fetch and display live temperature updates.
2.6. Successfully displayed the temperature readings on the dashboard UI.
2.7. Verified real-time updates and dynamic rendering in the dashboard. **3.**

Before Making Connection with ESP8266

```
javascript CopyEdit

function addTestData()

{

const testData = {

        "temperature_C": (Math.random() * (30 - 15) + 15).toFixed(2), // Random temperature
between 15°C and 30°C

        "humidity_percent": Math.floor(Math.random() * 100), // Random humidity percentage

        "timestamp": new Date().toISOString()

    };

    const newRef = temperatureRef.push();

newRef.set(testData)

        .then(() => console.log("Test data added successfully"))

        .catch(error => console.error("Error adding test data:", error)); }
```

8. Conclusion and Future Work Conclusion:

The **Real-Time Temperature Monitoring System Using IoT** is an efficient solution to the challenges associated with manual temperature monitoring. It automates the process of tracking ambient temperature, sends real-time alerts, and ensures that critical systems or environments stay within safe temperature ranges. The system helps prevent potential equipment failures, product spoilage, and safety risks by providing continuous monitoring and proactive intervention. Overall, the project contributes to smarter, safer, and more efficient environmental control systems, offering a step forward in utilizing IoT technologies for realtime data collection and alerting.

Future Work:

While the current system fulfills its core purpose effectively, there is considerable potential for future improvements and expansions:

- **Sensor Upgrade:** Adding more advanced temperature sensors (e.g., DHT22 or LM35) for higher accuracy and broader measurement ranges.
- **Mobile App Integration:** Developing a mobile application to receive alerts and display live temperature readings for users on the go.
- **Solar Power Supply:** Making the system energy-efficient by integrating solar panels to power the temperature monitoring system, making it suitable for remote locations.
- **Multiple Sensor Integration:** Implementing multiple sensors across different zones to monitor temperature in diverse environments simultaneously.
- **AI Integration:** Using machine learning algorithms to predict temperature trends and optimize cooling/heating control systems, reducing energy consumption.

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