M.G.M.'S COLLEGE OF ENGINEERING, NANDED.

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Department of Electronics & Telecommunication Engineering

T.Y Mini Project Abstract

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Mini Project Title:

Intelligent IoT Weather Dashboard using ESP8266 with Google Sheets and ML Forecasting

❖ Objective:

The project aims to design and implement a **low cost IoT based weather station** using the **ESP8266 microcontroller** and **BME280 sensor**. The system will collect real time environmental parameters such as temperature, humidity, and pressure, and log them automatically to **Google Sheets** for data analysis and long term archiving. A **custom self hosted web dashboard** will be developed to visualize both live and historical weather data, providing users with interactive and easily interpretable insights—similar to platforms like **Blynk** or **ThingSpeak**, but with complete control and customization. Additionally, the project will incorporate **basic machine learning models** to analyze the collected data and generate **short term weather trend predictions**, enhancing the station's capability beyond simple monitoring to intelligent forecasting.

❖ Introduction:

Weather conditions significantly influence agriculture, environmental studies, and everyday life. However, conventional weather stations are often expensive and usually provide only generalized, city level data. To address this limitation, this project introduces a **Smart IoT Based Weather Station** that leverages the **ESP8266 microcontroller** and **BME280 sensor** to collect precise, localized environmental parameters such as temperature, humidity, and pressure. The acquired data is automatically transmitted to **Google Sheets** for long term storage, from where it is accessed by a **custom built web dashboard** designed to visualize both real time and historical trends through interactive charts. Unlike platforms such as Blynk or ThingSpeak, this dashboard offers complete flexibility in terms of design and data control. Furthermore, the system employs **machine learning algorithms** on the recorded dataset to forecast short term weather patterns, including temperature fluctuations and humidity variations. In essence, this project seamlessly integrates **IoT, cloud computing, data visualization, and artificial intelligence** into a single, scalable, and intelligent weather monitoring solution.

❖ Block Diagram & Explanation:

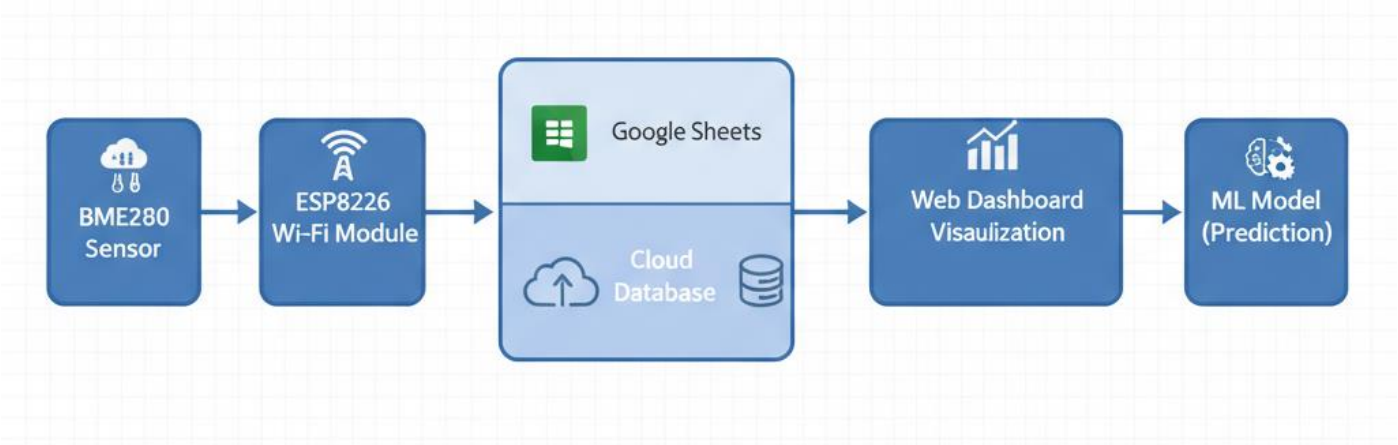

Fig. 1: Block Diagram of the IoT Based Smart Weather Monitoring and Analysis System

- BME280 Sensor – Senses temperature, humidity, and pressure with high accuracy.
- ESP8266 – Reads sensor data and uploads it to Google Sheets via Wi Fi using an HTTP API.
- Google Sheets / Cloud Database – Acts as a lightweight cloud platform for real time data storage and backup.
- Custom Web Dashboard – Fetches data from Google Sheets API (or a lightweight backend) and displays:
    1. Live readings (auto refresh).
    2. Historical trend graphs (line and bar charts).
    3. Average, min, and max values.
    4. Comparison charts (like ThingSpeak/Blynk).
- ML Model – Analyzes historical data to predict short term temperature/humidity trends using regression models, and displays forecast results on the dashboard.

❖ Advantages

- Low Cost & Compact – ESP8266 and BME280 make it budget friendly and easy to build.
- Custom Visualization – No dependency on third party dashboards; full control over design and UI.
- Real Time Monitoring – Data auto refreshes every few seconds via Wi Fi.
- Scalable Architecture – Can add air quality, rainfall, or light sensors easily.
- Predictive Intelligence – ML models forecast short term conditions from logged data.
- Accessible Anywhere – Dashboard can be viewed on mobile, PC, or tablet.

❖ Applications

- Smart Agriculture: Track temperature and humidity for irrigation planning.
- Campus/Community Monitoring: Local weather display in colleges or hostels.
- Smart City Integration: Real time data collection from multiple local nodes.
- Educational Use: Demonstrates IoT + Cloud + ML integration in one project.
- Research Studies: Continuous data collection for trend analysis.

❖ Conclusion

The **IoT Based Smart Weather Station** effectively integrates **sensor technology, cloud based data logging, real time web visualization, and machine learning** into a unified system. Unlike conventional setups that merely record sensor readings, this innovative system features **live interactive dashboards**—similar to platforms like Blynk or ThingSpeak— while also utilizing **AI driven forecasting** to transform raw data into actionable insights. Designed to be **cost effective and scalable**, the project exemplifies a **practical, multidisciplinary application** of IoT, web development, and AI/ML technologies, making it an excellent choice for both **mini and major academic projects**.

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