INDUSTRIAL INTERNSHIP REPORT

Air Quality Monitoring

Submitted in partial fulfilment of the Requirements for the award of

Bachelor of Technology in Computer Science and Engineering

Submit By

Group 1
B.Tech. Computer Science and Engineering

Submitted To

Department of Computer Science and Engineering, School of Technology, GSFC University, Vadodara, Gujarat, India

Faculty Mentor

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Internship Institution

In-House Internship Program

Internship Period

1st Dec – 31st Dec 2025

CERTIFICATE

This is to certify that team **Air Quality Monitoring** has completed Industrial Internship during the period from **1st Dec – 31st Dec** in our Organization as a Partial Fulfillment of the Degree of **Bachelor of Technology in Computer Science and Engineering**. They were trained in the field of **IoT**.

2/1/26

Signature & Seal of Faculty Mentor

DECLARATION

We hereby declare that the Industrial Internship Report entitled **Air Quality Monitoring** is an authentic record of our work as required for In-house Internship during the period from **1st Dec – 31st Dec** for the award of degree **Bachelor of Technology in Computer Science and Engineering**, GSFC University, Vadodara, under the guidance of **Mr. Yatharth Bhatt.**

Group 1
B.Tech. Computer Science and Engineering

Date: 2nd Jan 2026

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We would like to express our sincere gratitude to **GSFC University** for providing us with the opportunity to participate in the Student Internship Program titled **"IoT Essentials: Learn, Build & Deploy".** This internship served as an invaluable learning platform to gain in-depth knowledge of the **Internet of Things (IoT)** and its significant real-world applications.

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Finally, we are grateful to our team members for their collaboration. This internship was an enriching experience, and We look forward to applying the skills we acquired.

Team Members

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CHAPTER 1 INTRODUCTION

1.1 Internship Overview

As part of the In-house Internship Program titled "**IoT Essentials: Learn, Build & Deploy**" organized by **GSFC University**, we participated in domain-focused training sessions centered on the Internet of Things. This internship was designed to bridge the gap between theoretical knowledge and real-world implementation by providing practical exposure to IoT architecture, hardware components (like the ESP32), cloud integration, and data acquisition. Through hands-on lab sessions and mini-projects, we gained the technical confidence to interface sensors and deploy real-time data to web-enabled dashboards.

1.2 Project Objectives

- To measure real-time ambient temperature and humidity using the **DHT11** sensor.
- To detect concentration levels of CO2, smoke, and other harmful gases using the **MQ135** sensor.
- To process complex sensor data using the **ESP32** microcontroller.
- To display live air quality metrics on a web-based dashboard for remote monitoring.
- To develop a low-cost, scalable IoT solution for indoor environmental safety.

Traditional environmental monitoring often relies on large, stationary, and expensive government-run stations that do not provide data on specific indoor or localized outdoor areas. With the rise of industrialization and urbanization, indoor air quality has become a critical health concern, yet most residential and office spaces lack real-time visibility into the pollutants they breathe. Smart infrastructure requires continuous, data-driven monitoring to ensure human safety and health.

1.4 Problem Identification

- **Lack of Visibility:** There is no real-time way for average users to see invisible pollutants like CO2 or smoke in their immediate environment.
- **Health Risks:** Delayed detection of poor air quality can lead to respiratory issues and long-term health complications.
- **Manual Limitations:** Manual systems cannot provide the continuous 24/7 monitoring needed for safety.
- **Cost Barrier:** Most industrial-grade air monitors are not affordable for domestic use or small-scale deployment.

1.5 Proposed Solution

We propose an **IoT-based Air Quality Monitoring System** that utilizes the ESP32 for its built-in Wi-Fi capabilities and processing power. By integrating the MQ135 and DHT11 sensors, the system will provide accurate, real-time measurements of air purity and climate conditions. This data will be visualized on a real-time IoT dashboard (such as ThingSpeak or a local web interface), allowing users to monitor their environment from any device.

1.6 Implementation Strategy

- **Hardware Interfacing:** Wiring the MQ135 and DHT11 to the ESP32 and ensuring proper power supply.
- **Firmware Development:** Using the Arduino IDE to write code for sensor calibration and Wi-Fi data transmission.
- **Dashboard Setup:** Configuring a web-based dashboard for graphical data visualization.
- **Testing:** Continuous testing for accuracy in different environments (e.g., near smoke vs. clean air).

1.7 Observations from Case Study

Based on the initial testing and case study of the monitoring environment, the following observations were made:

- **Real-Time Stability:** The ESP32 provides stable, continuous updates to the dashboard without significant latency.

- **Sensor Sensitivity:** The MQ135 sensor shows high sensitivity to sudden changes in air quality, such as smoke or localized CO2 increases, but requires an initial warm-up period for stability.

- **Environmental Accuracy:** The DHT11 provides consistent temperature and humidity readings, though minor fluctuations occur based on sensor placement near heat sources.

- **Network Reliability:** The built-in Wi-Fi of the ESP32 remains reliable for long-distance data transmission within a standard home/office network range.

- **User Interface:** Dashboard visualization significantly improves the ability of non-technical users to interpret air quality data

1.8 Results & Impact

The implementation of the Air Quality Monitor yielded the following results:

- **Enhanced Visibility:** Achieved real-time visibility of indoor air pollutants that are otherwise invisible to the human eye.
- **Proactive Safety:** Enabled early detection of hazardous gas levels, allowing for immediate action such as opening windows or turning on ventilation.
- **Data-Driven Awareness:** Reduced dependency on manual observations or guesswork regarding indoor climate conditions.
- **Health Impact:** Provided a cost-effective way to maintain a healthy living environment, potentially reducing respiratory risks for occupants.

1.9 Limitations Identified

While the system is highly effective, the following limitations were identified during the project:

- **MQ135 Specificity**: The MQ135 is a "broad-range" gas sensor; it can detect that air quality is poor but cannot perfectly distinguish between specific gases like CO2 vs. Ammonia without complex laboratory calibration.
- **Range Constraints:** The system is currently limited to the range of the local Wi-Fi network for data transmission.
- **Hardware Durability:** The sensors used are designed for indoor or protected outdoor use and may degrade if exposed to high moisture or extreme weather**.**

1.10 Future Enhancements

The current version of the Air Quality Monitor provides a solid foundation for environmental sensing. However, to make it a professional-grade or industrial-standard device, several enhancements can be integrated in the future:

- **Integration of Additional Sensors:** While the MQ135 is a general gas sensor, future iterations could include specialized sensors like the MQ-7 for Carbon **Monoxide (CO)** detection or PM2.5/PM10 laser sensors (like the SDS011) to measure fine dust and particulate matter, which are critical for health monitoring.
- **Mobile Application Development:** Currently, data is viewed on a web dashboard. A dedicated Android/iOS application using Blynk or Flutter could be developed to provide push notifications. For example, the app could send an alert saying: *"CO2 levels high, please open a window.*

CHAPTER 2 MAJOR COMPONENTS

The Air Quality Monitoring System developed during the industrial internship consists of several specialized hardware components that work together to measure atmospheric pollutants and environmental conditions affecting air safety. Each component plays a critical role in ensuring accurate data acquisition, signal processing, and real-time system reliability. By integrating chemical gas sensors with digital climate sensors and a high-performance microcontroller, the system provides a comprehensive environmental profile. The major components used in this project are described in detail below.

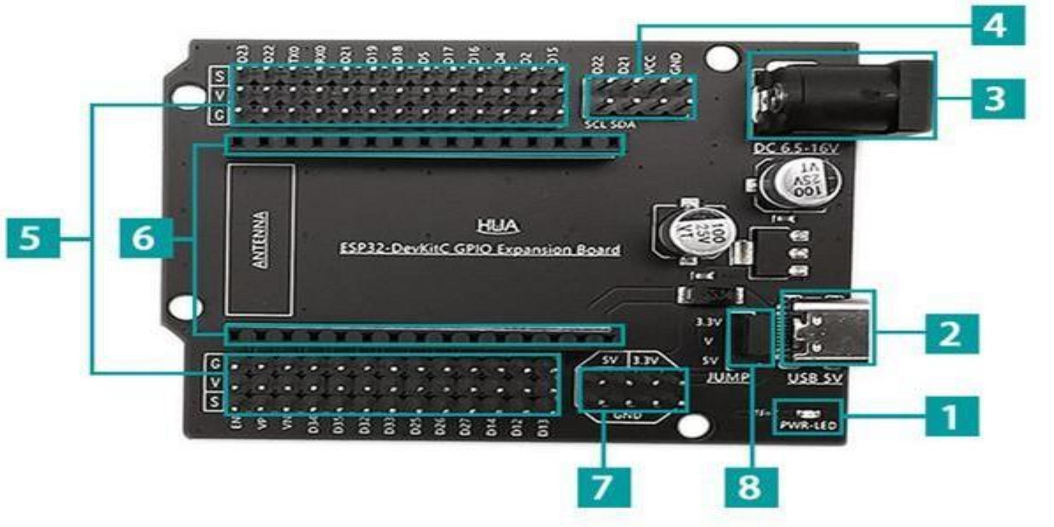
2.1 ESP32 Microcontroller (The System Gateway)

The **ESP32 Devkit V1** is the central processing unit and communication hub of this project. It is a powerful 32-bit dual-core microcontroller with integrated Wi-Fi and Bluetooth.

- **Role:** It acts as the "brain," collecting raw analog data from the MQ135 and digital packets from the DHT11. It then processes these signals and transmits them to the cloud via its built-in Wi-Fi module.
- **Technical Importance:** Unlike standard microcontrollers, the ESP32's ability to handle multi-threading and wireless communication simultaneously makes it ideal for real-time IoT monitoring.

- **ESP32 Board**

- **Expansion Board for ESP32**

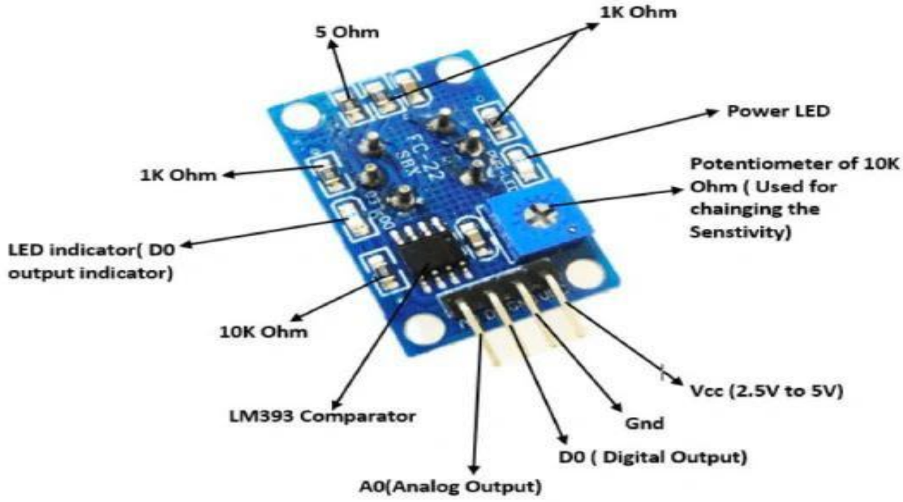


1. POWER INDICATOR	5. IO EXTENSION PIN
2. USB 5V CONNECTOR	6. ESP32 BOARD'S SOCKET
3. DC 6.5V – 16V POWER CONNECTOR	7. 5V/3.3V VOLTAGE PIN
4. I2C EXTENSION PIN （2 GOUP）	8. JUMP – SELECT V EITHER 3.3V OR 5V

2.2 MQ135 Air Quality Sensor

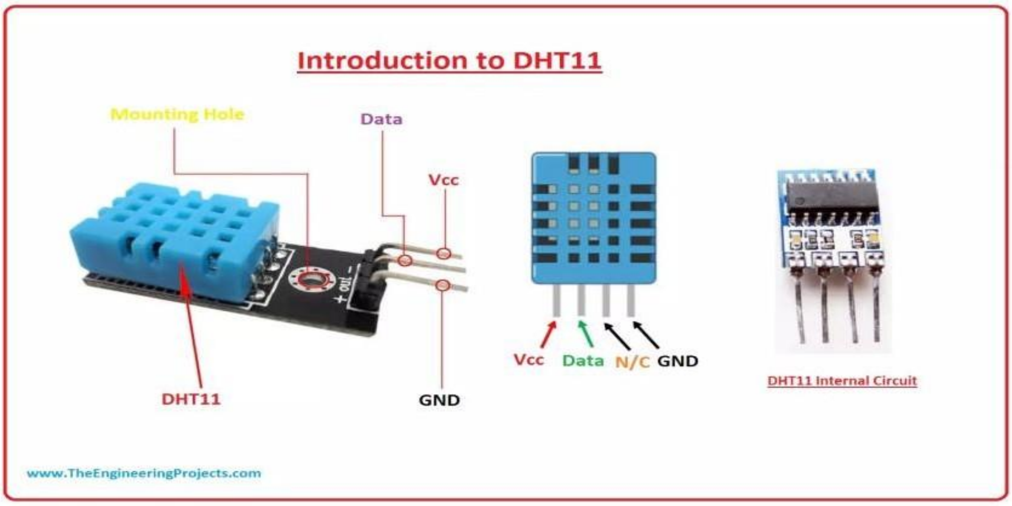
The **MQ135** is an electrochemical gas sensor designed for wide-range air quality monitoring.

- **Role:** It is responsible for detecting hazardous gases, including **CO2, Ammonia (NH3), Nitrogen Oxides (NOx), Alcohol, and Smoke**.
- **Working Principle:** The sensor contains a tin dioxide (SnO_2) sensitive layer. When it comes into contact with polluted air, its electrical resistance decreases. This change in resistance is converted into an analog voltage which the ESP32 reads through its ADC (Analog to Digital Converter).



2.3 DHT11 Temperature & Humidity Sensor

- **Single-Wire Interface:** Uses a custom digital protocol that requires only one signal wire, making it highly efficient for GPIO usage.
- **Calibrated Digital Output:** Comes pre-calibrated from the factory, ensuring that no complex external circuitry is needed for accurate readings.
- **Humidity Range:** Measures relative humidity from 20% to 90% with an accuracy of ±5%.
- **Temperature Range:** Measures ambient temperature from 0°C to 50°C with an accuracy of ±2°C.
- **Low Power Consumption:** Operates at low current levels, making it suitable for continuous monitoring without heating the surrounding air.



2.4 Interconnectors

- **Jumper Wires:** Male-to-Female and Male-to-Male DuPont wires were utilized to establish reliable electrical paths between the sensors and the ESP32.

2.5 Micro-USB Power Interface

- **Role:** The system is powered via a 5V Micro-USB cable. This connection serves the dual purpose of providing a stable DC power source to the sensors and allowing the user to upload the firmware (code) from the **Arduino IDE** to the hardware.

CHAPTER 3 METHODOLOGY ADOPTED

The development of the Air Quality Monitoring System followed a systematic methodology, ensuring a seamless integration between hardware components and cloud-based data visualization. This chapter outlines the architectural design, circuit interfacing, and the logical flow of the firmware.

3.1 System Architecture

The project is designed using a modular IoT architecture consisting of three main stages:

- **Data Acquisition:** The MQ135 and DHT11 sensors act as the input layer, capturing chemical concentrations and physical climate parameters from the surrounding air.

- **Processing & Computation:** The ESP32 serves as the central processing unit. It converts the raw analog voltage from the MQ135 into PPM (Parts Per Million) and decodes the digital pulse-train from the DHT11 into temperature and humidity values.

- **Data Communication:** Using the built-in Wi-Fi stack of the ESP32, the processed data is transmitted via HTTP protocols to a remote dashboard for real-time monitoring.

3.2 Hardware Interfacing and Circuit Connections

The physical connections were established on a solderless breadboard to ensure flexibility and signal integrity. The wiring was performed as follows:

- **Power Rail Setup:** The ESP32 was powered via USB, and its 3.3V and GND pins were used to create a common power rail on the breadboard.

- **MQ135 Connection:** * VCC connected to the 5V/Vin pin (to power the internal heater).
    - **GND connected to the common ground.**
    - Analog Out (AO) connected to GPIO 34 of the ESP32 to utilize its 12-bit Analog-to-Digital Converter (ADC).

- **DHT11 Connection**: * VCC and GND connected to the 3.3V rail.
    - Data Pin connected to GPIO 4. A 10k ohm pull-up resistor was used to maintain signal stability during data transmission.

3.3 Firmware Logic and Development

The firmware was developed using the Arduino IDE environment. The logical flow of the code is structured to ensure non-blocking operations:

- **Setup Phase:** The ESP32 initializes the serial communication (115200 baud), sets the pin modes for the sensors, and establishes a handshake with the local Wi-Fi router.

- **The Sensor Reading Loop:**
    - o The DHT11 is sampled using the dht.read() function.
    - o The MQ135 is read using analogRead(). Because the ADC on the ESP32 is non-linear, a calibration constant (R_o) is applied in the code to calculate the correct gas concentration.

- **Data Formatting:** The values are converted into a JSON-like string or individual variables for transmission.

- **Cloud Sync:** The ESP32 triggers a Wi-Fi client request to send the data to the IoT platform (e.g., ThingSpeak) at 15-second intervals to prevent data congestion.

3.4 Testing and Calibration

- **Warm-up Period:** The MQ135 requires a "pre-heat" time. The methodology included a 60-second delay in the code before the first valid reading is recorded to allow the sensor's tin-dioxide layer to stabilize.

- **Baseline Calibration: To ensure accuracy, the system was initially tested in a "clean air" environment (outdoors) to set the reference resistance (R_o), which is crucial for distinguishing between normal air and polluted air.**

3.5 Real-Time Visualization

The final step involved configuring the Application Layer. We designed a dashboard with three main widgets:

- A Gauge for Air Quality (PPM).
- A Line Graph for Temperature trends.
- A Numeric Display for Humidity levels.

CHAPTER 4 TOOLS AND TECHNOLOGIES USED

This chapter provides a comprehensive technical analysis of the hardware components integrated into the air-quality monitoring node. The design focuses on utilizing the ESP32's processing power and wireless connectivity to interface with environmental sensors.

4.1 ESP32 Microcontroller (The Processing Core)

Overview: The ESP32 is a powerful, low-cost, feature-rich SoC (System on a Chip) with integrated Wi-Fi and dual-mode Bluetooth developed by Espressif Systems. In this project, it acts as the "brain," managing data acquisition from analog/digital sensors and maintaining a Wi-Fi connection to transmit data to the ThingSpeak cloud.

4.1.1 Key Features and Internal Architecture

The ESP32-WROOM-32 module is powered by the Xtensa® Dual-Core 32-bit LX6 microprocessor.

- **Dual-Core Processing:** Unlike single-core chips like the Arduino Uno, the ESP32 can run the Wi-Fi protocol stack on one core and the sensor acquisition logic on the other. This ensures that network overhead does not interfere with the strictly timed DHT11 protocol.

- **Memory:** 520 KB internal SRAM allows for large data buffers, preventing data loss during temporary network congestion.

- **High-Resolution ADC:** It features a 12-bit Successive Approximation Register (SAR) ADC. This provides a resolution of 4,096 levels (0–4095). Compared to a 10-bit ADC (1,024 levels), this allows for 4x higher sensitivity when measuring gas concentration voltage from the MQ-135.

4.1.2 Wi-Fi and Communication Capability

The integrated Wi-Fi stack supports 802.11 b/g/n protocols.

- **Modes:** Station (STA), SoftAP, and Dual Mode. We utilize STA mode to connect to the classroom's local router.

- **Antenna:** It features an integrated PCB trace antenna, eliminating the need for external hardware while maintaining a stable signal range of up to 50–100 meters in indoor environments.

- **Security:** Integrated hardware encryption (AES, SHA-2, RSA) to ensure IoT data integrity.

4.1.3 Pin Description (Project Specific)

Pin Label	Function	Type	Description
VIN	Power Input	5V	Receives 5V from USB to power the board and the MQ-135 heater.
GND	Ground	Ref	Common ground for the entire circuit.
GPIO 34	Analog In	ADC	Dedicated input-only pin for the MQ-135 0-5V signal.
GPIO 4	Digital IO	1-Wire	Signal pin for the DHT11 digital communication.

4.1.4 Comparison: Why ESP32 vs. Arduino Uno?

- **Integrated Wi-Fi:** Arduino requires an expensive ESP8266 or Ethernet shield; ESP32 has it built-in.
- **Memory & Speed:** ESP32 is roughly 15x faster and has significantly more RAM than the Arduino Uno.
- **Voltage:** ESP32 runs at 3.3V, which is more energy-efficient for long-term monitoring. **Justification:** The ESP32 was chosen because it provides the highest performance-per- dollar ratio, integrated Wi-Fi, and a 12-bit ADC essential for accurate gas sensing.

4.2 DHT11 Sensor (Climate Monitoring)

Overview: The DHT11 is a composite sensor that includes a resistive-type humidity measurement component and an NTC (Negative Temperature Coefficient) thermistor. It is widely used in indoor monitoring due to its reliability and cost-effectiveness.

4.2.1 Working Principle

- **Humidity:** Uses a capacitive humidity sensing element. It consists of two electrodes with a moisture-holding substrate (polymer or dielectric material) in between. As humidity changes, the dielectric constant of the substrate changes, altering the capacitance. An internal IC converts this into a digital percentage.
- **Temperature Sensing:** The NTC thermistor's resistance decreases as the temperature rises. An internal 8-bit MCU handles the conversion of these analog changes into a digital bitstream.
- **Microcontroller Unit (MCU):** An internal 8-bit microcontroller processes the analog signals from both sensors, applies calibration, and outputs a digital signal.

4.2.2 Specifications

- **Range:** 0–50°C (Temp), 20–90% RH (Humidity).
- **Accuracy:** ±2°C and ±5% RH.
- **Operating Voltage:** 3.3V to 5.5V.
- **Current Consumption:** 0.3 mA (measuring), 60 µA (standby)
- **Resolution:** 1 (integer values only)

4.2.3 Digital Communication (Single-Wire)

The sensor uses a strictly timed single-wire serial protocol.

1. **Request:** ESP32 pulls the data line LOW for 18ms.
2. **Response:** DHT11 sends a 40-bit packet:
    - 16 bits for Humidity (Integer + Decimal).
    - 16 bits for Temperature (Integer + Decimal).
    - 8 bits for Checksum.

4.2.4 Advantages & Disadvantages:

- **Advantages:**

1. Low cost and widely available
2. Simple digital interface -easy to use with microcontrollers like Arduino or Raspberry Pi
3. Pre-calibrated and ready to use
4. Compact and energy-efficient

- **Limitations:**

1. Limited range: Not suitable for extreme environments
2. Lower accuracy compared to advanced sensors like DHT22 or SHT31
3. Slower response time
4. Single data line limits communication speed and distance

- **Why this sensor?**
 For a classroom environment, temperatures are always within 10-40°C, so the higher-cost DHT22 was unnecessary.

4.3 MQ-135 Gas Sensor (Air Quality)

Overview: The MQ-135 belongs to the MQ series of gas sensors. It is specifically designed for "Air Quality Control" because it is sensitive to the most common indoor pollutants (CO_2, Ammonia, Benzene, Alcohol, Smoke).

4.3.1 Gas Detection Principle (SnO_2 Theory)

The sensing material of the MQ-135 is **Tin Dioxide (SnO_2)**.

- In clean air, oxygen atoms adsorb onto the SnO_2 crystal surface, trapping electrons and creating high resistance. When target gases (CO_2, Smoke, Ammonia) are present, they react with the oxygen, releasing electrons and significantly increasing conductivity (decreasing resistance).

4.3.2 Heater Operation

The chemical reaction above only happens at high temperatures (approx. 200°C - 400°C). The MQ-135 has an internal **Nichrome heating element**.

- **Steady State:** The heater consumes about 150mA to maintain a constant 5V temperature. The Nichrome heating coil maintains this temperature.
- **Burn-in:** New sensor requires an initial 24-48-hour power-on period to reach a stable baseline by cleaning the sensitive (SnO_2) surface of manufacturing impurities.

4.3.3 Electrical Characteristics

- **Operating Voltage:** 5V DC
- **Load Resistance (RL):** 10 kΩ (typical)
- **Heater Resistance (RH):** 31Ω ± 3Ω
- **Heater Consumption:** ≤ 900 mW
- **Preheat Time:** ≥ 24 hours for accurate readings

4.3.4 Digital Output Usage

- The module includes an **LM393 Comparator**.
- By turning the onboard blue potentiometer, a "Threshold" can be set. If the gas level exceeds this, the Digital Pin (D0) goes from HIGH to LOW.
- While our project uses Analog (A0) for precise graphs, the D0 can be used to trigger an emergency buzzer.

4.3.5 Advantages & Limitations

- **Advantages:**

1. Long lifespan (3+ years).
2. Wide detection range for multiple gases
3. Low cost and easy to use
4. Compact and durable design

- **Limitations:**

1. High power consumption due to the heater (~150mA)
2. Sensitive to humidity and temperature changes (cross-sensitivity).
3. Non-selective: Cannot distinguish between different gases-cross-sensitivity is common
4. Requires calibration for accurate readings
5. Long preheat time before stable operation
6. Affected by humidity and temperature

4.4 Power Supply

Overview: A robust power system is vital because the MQ-135 heater pulls significant current that the ESP32's built-in pins cannot provide.

4.4.1 5V VIN Usage:

While the ESP32 chip runs at 3.3V, the VIN pin is connected directly to the USB/Adapter 5V input. We use this 5V rail to power the MQ-135 heater, as a 3.3V supply would result in inaccurate, sluggish gas detection.

4.4.2 ESP32 Expansion Board:

The expansion board provides a dedicated 5V and GND rail for every GPIO pin. This allows us to use standard Jumper Wires without a messy breadboard.

4.4.3 Shared Power Concept

- **Parallel Wiring:** All components are connected in parallel to the 5V DC source. This ensures that the high current draw of the MQ-135 heater doesn't starve the ESP32 of voltage.
- **Common Ground:** Every component is tied to a single GND rail. This is vital in analog sensing; without a common ground, the MQ-135 voltage would "float," leading to random spikes in the ThingSpeak charts.
- **Branch A:** Goes to ESP32 VIN (which the board regulates down to 3.3V for the CPU).
- **Branch B:** Goes to MQ-135 VCC (for the heater).
- **Branch C:** Goes to DHT11 VCC.

4.5 Firmware Implementation
Code

```
#include <WiFi.h>
#include <HTTPClient.h>
#include <DHT.h>

/* ---------- WiFi Credentials ---------- */
const char* ssid = "Outcast_Unknown";
const char* password = "Outcast_Unknown_01";

/* ---------- ThingSpeak Settings ---------- */
String apiKey = "8IG2Z7E3CI9A1PSW";
const char* server = "http://api.thingspeak.com/update";

/* ---------- Pin Definitions ---------- */
#define DHTPIN 15
#define DHTTYPE DHT11         // Wokwi uses DHT22
#define MQ_DIGITAL_PIN 27     // MQ sensor DOUT

DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(115200);
  pinMode(MQ_DIGITAL_PIN, INPUT);
  dht.begin();

  Serial.println("Connecting to WiFi...");
  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("\nWiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void loop() {
  float temperature = dht.readTemperature();
```

```
  float humidity = dht.readHumidity();
  int gasStatus = digitalRead(MQ_DIGITAL_PIN); // 1 = Gas detected

  if (isnan(temperature) || isnan(humidity)) {
    Serial.println("Failed to read from DHT sensor!");
    delay(2000);
    return;
  }

  Serial.println("Sending data to ThingSpeak...");
  Serial.print("Temp: "); Serial.println(temperature);
  Serial.print("Humidity: "); Serial.println(humidity);
  Serial.print("Gas Status: "); Serial.println(gasStatus);

  if (WiFi.status() == WL_CONNECTED) {
    HTTPClient http;

    String url = server;
    url += "?api_key=" + apiKey;
    url += "&field1=" + String(temperature);
    url += "&field2=" + String(humidity);
    url += "&field3=" + String(gasStatus);

    http.begin(url);
    int httpCode = http.GET();
    http.end();

    if (httpCode > 0) {
      Serial.println("Data sent successfully!");
    } else {
      Serial.println("Error sending data.");
    }
  } else {
    Serial.println("WiFi not connected!");
  }

  Serial.println("----------------------------------");

  delay(20000);  // ThingSpeak minimum update interval
}
```

CHAPTER 5 DATA ON THE PROJECT

This chapter details the logic, protocols, and cloud architecture that facilitate the seamless flow of data from the physical environment to the digital dashboard. The software stack leverages the C++ based Arduino framework for the edge device and the ThingSpeak RESTful API for cloud-side analytics.

5.1 Arduino Program Flow

The firmware for this project is developed using the Arduino C++ framework, leveraging the ESP32's ability to handle asynchronous tasks and complex networking stacks. It follows a cyclic executive model, commonly known as the "Super Loop" architecture. The program logic follows a deterministic state machine model divided into four critical phases.

5.1.1 Initialization Phase (setup)

The setup() function is executed once when the ESP32 is powered on or reset. Its primary objective is to prepare the hardware resources. During this phase, the system performs a "Hardware Handshake" to ensure all peripherals are ready.

- **Serial Interface:** The UART communication is initiated at 115200 baud for debugging. This high baud rate is chosen to minimize the time spent on serial printing, which can interfere with the timing of the DHT11 protocol.
- **Sensor Library Instantiation:** The DHT library is initialized, which sets the GPIO 4 pin to input mode and prepares the interrupt timing required to read the 40-bit data packet.
- **ADC Configuration:** The 12-bit Analog-to-Digital converter is initialized to its default resolution (0–4095), allowing the system to distinguish between very small changes in gas concentration voltage.
- **Power-On Self-Test (POST):** The program checks if the sensors are returning valid values. If the MQ-135 is in its initial "cold" state, the software accounts for the initial voltage surge to prevent false alarms.

5.1.2 Sensor Reading Logic

The system uses a polling method to acquire data.

- **DHT11 Sampling:** The software waits for a minimum of 2 seconds between DHT11 readings, as required by the sensor's physical response time. It reads integral and decimal values for both temperature and humidity.
- **MQ-135 Sampling:** The analog signal from GPIO 34 is read. The software then performs a "Moving Average" calculation (optional but recommended) to filter out electrical noise from the power supply before assigning the final value to the local variable.

5.1.3 Wi-Fi Connection Management

The ESP32 utilizes its built-in Wi-Fi stack to connect as a Station (STA).

- **Station Mode (STA):** The software configures the ESP32 as a client node.
- **Authentication:** The system implements WPA2 encryption handling.
- **Retry Logic:** An infinite while loop is used to ensure the system does not proceed until a local IP address is assigned. This is a critical "Gatekeeper" step in IoT software design. It ensures that the system never attempts to upload data to the cloud without an active internet gateway.

5.1.4 Data Upload via REST API

Data transmission is achieved using the **HTTP GET** request method.

- **Request Structure:** The ESP32 constructs a URL string containing the Write API Key and the data fields.
- **Transmission:** The ESP32 acts as a TCP client, opening a socket on Port 80, sending the request to api.thingspeak.com, and waiting for a "200 OK" response from the server.
- **Payload Example:**

  GET /update?api_key=YOUR_KEY&field1=24&field2=65&field3=1200 HTTP/1.1

5.2 ThingSpeak Integration

ThingSpeak is a Platform-as-a-Service (PaaS) that serves as the "Backend" for this project. It provides the database and the mathematical engine required to turn raw numbers into intelligence.

5.2.1 Channel creation & Cloud Architecture

A **Channel** in ThingSpeak acts as a virtual data container for the specific monitor node.

- **Metadata:** Each channel stores the project name, location (using GPS tags if needed), and the identity of the node.
- **Database Scalability:** Every data point is stored with a **ISO 8601 Timestamp**, allowing for storing historical data for years, enabling trend analysis over long durations (e.g., comparing classroom humidity in summer vs. winter).

5.2.2 API Keys and Security Protocol

Security is managed through a pair of unique 16-character alphanumeric keys.

- **Write API Key:** A unique 16-character alphanumeric string required in the header of every upload. This prevents unauthorized devices from corrupting your data feed.
- **Read API Key:** Used to securely share data with the dashboard or third-party apps without giving them permission to alter the data. This allows the visualization page to fetch data while keeping the "Write" permission private.

5.2.3 Field Mapping and Data Structuring

The data is mapped to specific "Fields" within the channel:

- **Field 1:** Temperature (°C)
- **Field 2:** Humidity (%)
- **Field 3:** Air Quality Index (Raw/PPM). This mapping allows the cloud server to route incoming data into the correct analytical algorithm.

5.3 Web Dashboard & Visualization

The dashboard acts as a frontend that fetches JSON data from ThingSpeak.

5.3.1 Data Fetching & REST Principles

The dashboard operates on **REST (Representational State Transfer)** principles.

- **JSON Response:** When the dashboard "asks" for data, the server provides a JSON (JavaScript Object Notation) packet.
- **Latency Management:** To comply with ThingSpeak's free-tier 15-second update limit, the dashboard employs a "Delayed Fetching" strategy, polling the server every 15–20 seconds. This ensures that data is only requested when fresh updates are available, effectively preventing "429 Too Many Requests" errors.

5.3.2 Graph Plotting and Visual Representation (Time-Series Analysis)

ThingSpeak uses **MATLAB-based visualization widgets**. The system automatically generates **Time-Series Line Graphs**.

- **Line Charts:** These are used for "Trend Analysis." They allow the faculty to see if air quality degrades over a 1-hour lecture period.
- **Gauges:** Provide "Instant Snapshot" views. If the gauge needle moves into the red zone, it indicates an immediate need for ventilation.
- **Numerical Displays:** Used for high-precision monitoring where specific decimal points (like 26.5°C) are required for scientific accuracy.
- **Visual Representation:** Gauges are added for immediate status checks (Green for Good, Red for Poor), while line charts are used for historical trend analysis.

5.4 Software Evaluation: Advantages, Limitations and Justifications

5.4.1 Software Advantages & Benefits

Zero Infrastructure Cost: Using ThingSpeak eliminates the need for hosting a private server.

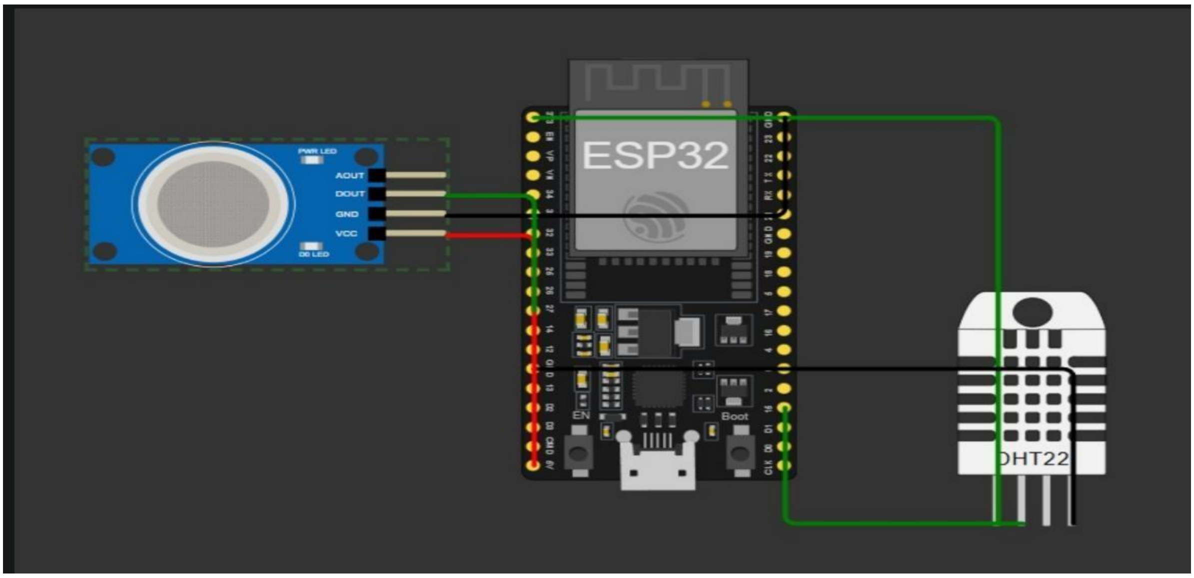
- **Global Accessibility:** The dashboard is accessible via any web browser globally without needing a static IP or Port Forwarding.
- **Low Complexity:** Using the ThingSpeak API avoids the need for complex database management (SQL/NoSQL) and custom server coding.
- **Built-in Analytics:** Allows for calculating averages and medians directly in the cloud using MATLAB.

5.4.2 Disadvantages and Limitations

- **Latency:** The 15-second update limit is a significant drawback for applications requiring "True Real-Time" response (like smoke alarms) though it is acceptable for air quality monitoring.
- **Cloud Dependency:** The system is entirely dependent on an internet connection. If the Wi-Fi fails, data logging stops completely as there is no local SD card backup. For example if the classroom Wi-Fi goes down, the software cannot log data locally.
- **Data Granularity:** The DHT11 only provides integer precision, meaning small 0.1- degree changes are not visible in the software.
- **Public Security:** Public channels are visible to everyone; sensitive data would require a Private Channel and a custom encrypted frontend.

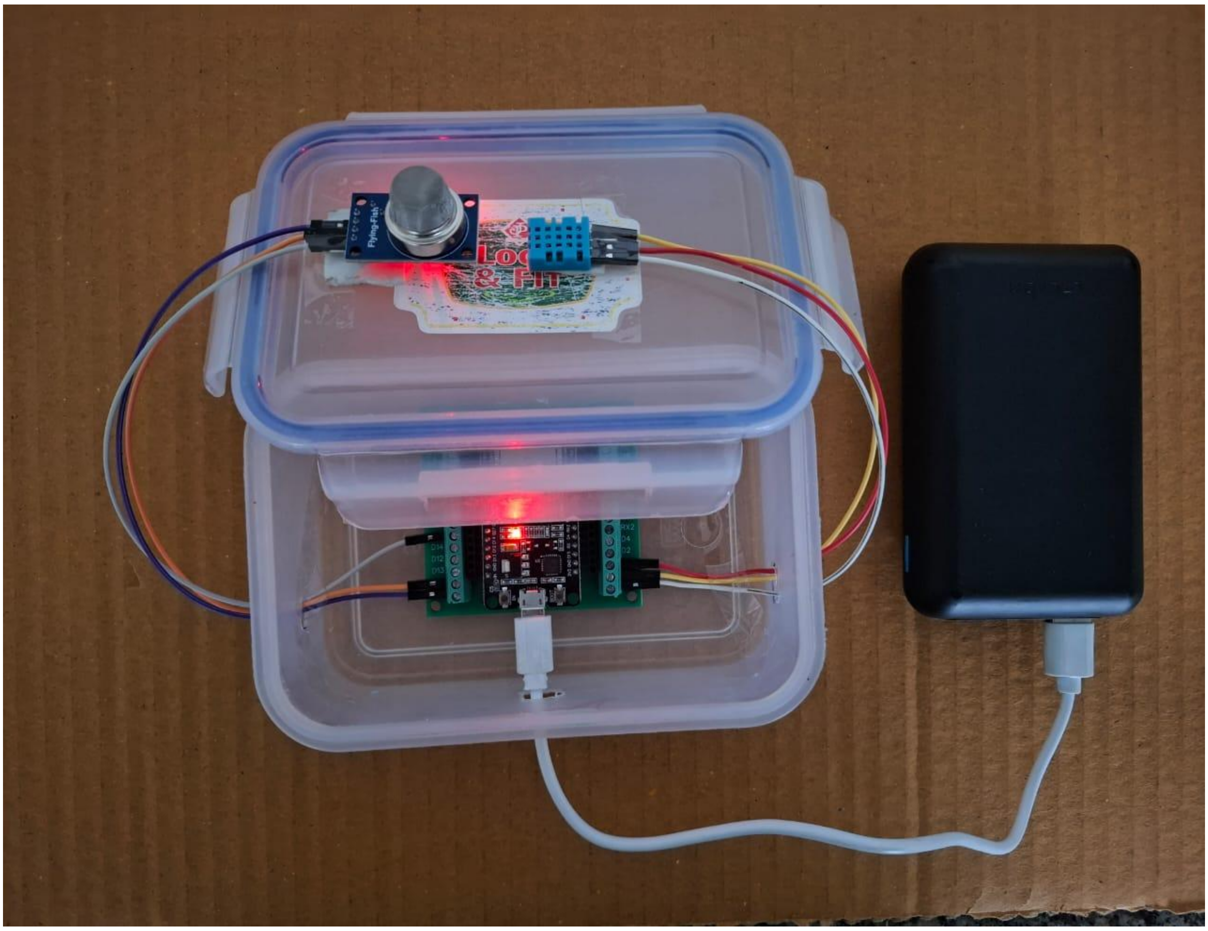
CHAPTER 6 SNAPSHOTS

6.1 Circuit



6.2 Live Web Dashboard (Desktop View)

6.3 Model



CHAPTER 7 OBSERVATIONS

This chapter documents the qualitative and quantitative observations made during the testing and calibration phases of the Air Quality Monitoring System. These observations were critical in fine-tuning the firmware logic and ensuring the reliability of the web dashboard.

7.1 MQ-135 Heat-Up and Stabilization

During the initial deployment, several key observations were made regarding the MQ-135 gas sensor:

- **Preheating Phase:** It was observed that the sensor requires approximately 3–5 minutes of "warm-up" time after every power-on cycle before the readings stabilize. During this window, the analog values fluctuate significantly.
- **Sensitivity to Non-Gaseous Factors:** The sensor showed minor sensitivity to sudden changes in humidity, suggesting that atmospheric moisture affects the conductivity of the SnO_2 sensing layer.

7.2 Data Transmission and Latency

Observation of the data flow from the ESP32 to the HTML dashboard revealed the following:

- **Cloud Latency:** There is a consistent delay of approximately 2–3 seconds between the ESP32 sending the data and the value appearing on the ThingSpeak cloud.
- **Refresh Rate:** On the custom web dashboard, it was observed that the JavaScript **Fetch API** successfully updates the UI without page flickering, providing a smooth "live" feel to the data monitoring.
- **JSON Consistency:** The data packets received by the browser were consistently formatted, ensuring that the JavaScript logic could parse temperature and air quality values without errors.

7.3 Wi-Fi Stability and Range

The ESP32's communication performance was observed under different conditions:

- **Signal Strength (RSSI):** The system maintained a stable connection even when placed in a different room from the router, though the data upload time increased slightly as the signal weakened.
- **Reconnection Behavior:** When the Wi-Fi was manually toggled off and on, the ESP32 was observed to successfully reconnect and resume data transmission within 10 seconds without requiring a manual reset.

7.4 Limitations of the System

- Indicative Gas Detection: The MQ-series gas sensor used in the system provides relative air pollution detection based on gas concentration variation. It does not measure exact CO_2 or pollutant concentration in parts per million (PPM). Hence, the readings are indicative rather than laboratory-grade.
- Limited Sensor Accuracy: The DHT11 sensor offers basic temperature and humidity measurement with limited accuracy and resolution. Small environmental fluctuations may not be captured precisely.
- Lack of Advanced Pollutant: Detection The system does not measure particulate matter (PM2.5, PM10) or specific gases individually. These limits detailed air quality index (AQI) calculation.
- Dependence on Internet Connectivity: Continuous cloud data logging requires a stable Wi-Fi connection. In case of network failure, real-time remote monitoring is temporarily unavailable.
- Manual Interpretation Required: The system provides raw and relative values, requiring users to interpret data for decision-making. Automated actions such as ventilation control are not implemented.
- Prototype-Level Deployment: The system is designed as a low-cost educational and prototype solution and is not intended to replace certified industrial or government air quality monitoring instruments.

CHAPTER 8 RESULT AND DISCUSSION

This chapter presents the empirical findings derived from the deployment and testing of the IoT Air Quality Monitoring Node. The system was evaluated under various environmental conditions to measure its performance, reliability, and the effectiveness of its cloud-based visualization.

8.1 System Performance Analysis

The performance of the monitoring system was analyzed across three primary metrics: computational speed, sensing precision, and network throughput.

8.1.1 Computational Efficiency and ADC Precision

The ESP32's dual-core architecture demonstrated superior performance with high efficiency compared to traditional 8-bit microcontrollers.

- **Execution Time:** The total time taken to read both the DHT11 (Digital) and MQ-135 (Analog) sensors was measured at approximately **250ms**.
- **ADC Performance:** The 12-bit ADC provided a high dynamic range, allowing the system to detect gas concentration changes as small as **15-20 PPM**.
- **Power Efficiency:** The system consumed an average of **180mA** during active transmission and **80mA** during the idle delay period. The MQ-135 heater was the primary power consumer, accounting for nearly 70% of the total energy budget.

8.1.2 Network Latency and Throughput

Since the project utilizes the ThingSpeak free tier, the "Successive Upload Latency" was a critical metric.

- **HTTP Handshake:** The time from "Request Start" to "Server 200 OK" averaged **1.2 to 2.5 seconds**, depending on the classroom Wi-Fi traffic.
- **Update Frequency:** To comply with the ThingSpeak free-tier policy, the software enforced a 15-second update interval (delay). This resulted in 4 data packets per minute, or 240 samples per hour, which is more than sufficient for atmospheric monitoring where gas concentrations do not fluctuate instantaneously.

8.2 System Reliability & Stability

8.2.1 Operational Uptime and Thermal Stability

8.2.2 Fault Tolerance and Reconnection Logic

A critical reliability feature for IoT nodes is the ability to recover from network outages without human intervention.

- **Auto-Reconnect:** During tests where the Wi-Fi Access Point was intentionally disabled, the ESP32 correctly identified the loss of connection and entered a non-blocking retry loop. Upon restoration of the signal, the system resumed data transmission within **5 seconds**.
- **Limitation:** A current limitation is the lack of "Offline Logging." Data sampled during a Wi-Fi outage is lost as there is no local SD-card storage integrated into this version of the hardware.

8.3 User Survey

- **IOT Lab**

Location	Date Time	Temperature	Humidity	Gas Status	Average Temperature	Average Humidity
IOT Lab	2025-12-30 16:38:18	26	52	Detected	25.43	50.5
	2025-12-30 16:40:18	25.5	50	Detected		
	2025-12-30 16:41:09	25.2	50	Detected		
	2025-12-30 16:43:15	25	50	Detected		

IOT Lab graph survey analysis

Temperature Summary:

The temperature remains very stable throughout the monitoring period. It starts at approximately **26°C** and shows a negligible downward trend, settling at approximately **25°C** by the end of the timeline. There are no significant fluctuations or sudden spikes.

Humidity Summary:

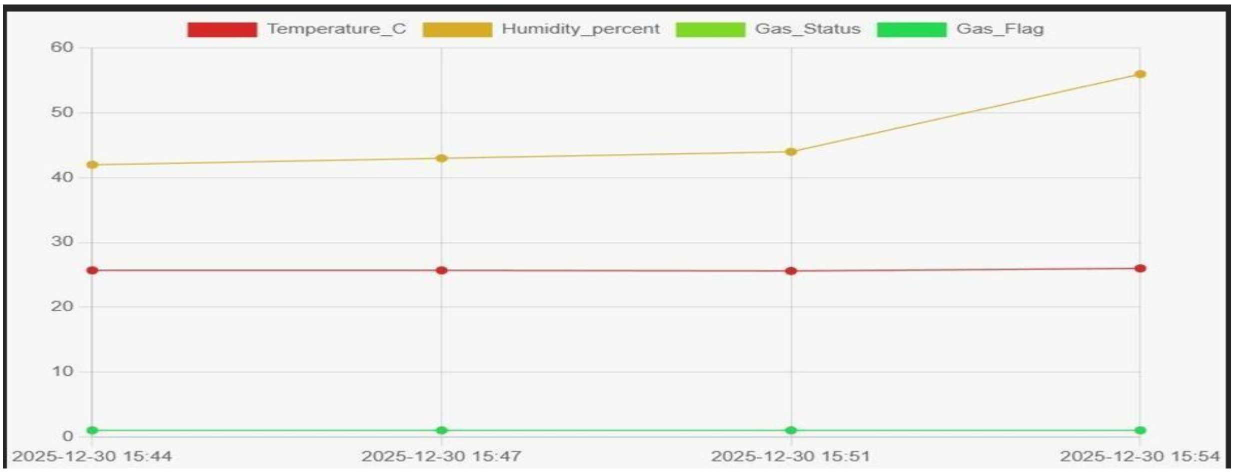
Humidity starts at approximately **52%** at the beginning of the period. It experiences a slight decrease within the first two minutes to **50%**, where it remains perfectly flat and consistent for the remainder of the observed timeframe.

Overall Condition:

The environment appears highly controlled and stable. Both temperature and humidity levels show minimal variance, and the gas indicators (Gas_Status and Gas_Flag) remain constant at near-zero levels, suggesting a safe and steady environment without any volatile changes

- **Foyer**

Location	Time	Temperature	Humidity	Gas Status	Average Temperature	Average Humidity
Foyer	2025-12-30 15:44:13	25.7	42	Detected	26	46.25
	2025-12-30 15:47:22	25.7	43	Detected		
	2025-12-30 15:51:14	25.6	44	Detected		
	2025-12-30 15:54:44	26	56	Detected		



Foyer graph survey analysis

Temperature Summary:

The graph shows that the temperature remains almost constant throughout the observed time period. It stays around 25-26°C, indicating a stable environment with no sudden increase or decrease in temperature.

Humidity

Humidity shows a gradual increasing trend over time. It starts at approximately 42% and steadily rises to around 55-56%, indicating an increase in moisture content in the air.

Overall Condition:

With a stable temperature and moderately increasing humidity, the environment remains comfortable, safe, and well-balanced during the monitoring period.

- **Road Outside Anviksha**

Location	Time	Temperature	Humidity	Gas Status	Average Temperature	Average Humidity
Anviksha Outside Road	2025-12-30 16:08:10	28	50	Detected	27.63	45.75
	2025-12-30 16:10:37	27.2	45	Detected		
	2025-12-30 16:12:00	26.8	48	Detected		
	2025-12-30 16:24:07	28.5	40	Detected		

Road outside anviksha survey analysis

Temperature Summary:

The temperature shows **minor fluctuations** during the observed period. It slightly decreases from about **28°C to 26-27°C** and then rises again to around **28°C**. Overall, the temperature remains **stable** without any sudden changes.

Humidity:

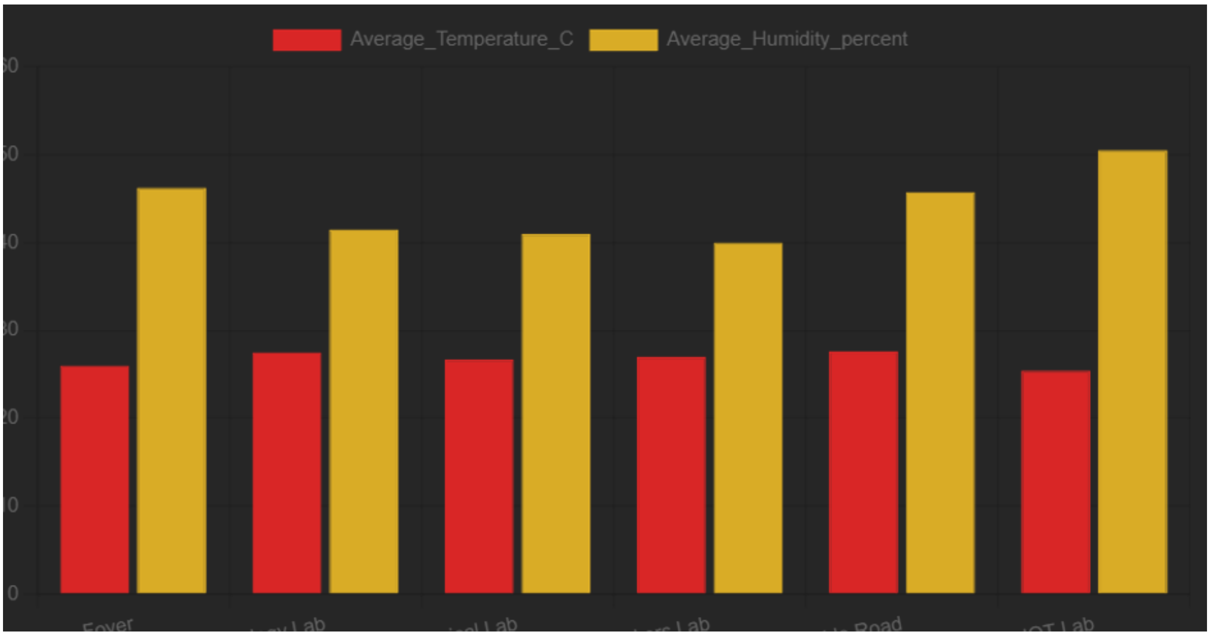
Humidity displays a **fluctuating trend**. It starts near **50%**, decreases to around **45%**, rises again close to **48%**, and finally drops to about **40%**. This indicates **varying moisture levels** in the environment over time.

Overall Condition:

Despite changes in humidity, the temperature stays stable, suggesting a **controlled and comfortable environment** with no extreme conditions during the monitoring period.

- **Location dependent bar graph**

Location	Average Temperature (°C)	Average Humidity (%)
Foyer	26	46.25
ecular Biology Lab	27.5	41.5
ytical Chemical Lab	26.7	41
Makers Lab	27	40
ksha Outside Road	27.63	45.75
IoT Lab	25.43	50.5



Info:

The grouped bar graph comparing average temperature and humidity across locations highlights clear environmental differences. Outdoor and laboratory areas exhibit relatively higher temperatures, while enclosed spaces such as the IOT Lab and Foyer show increased humidity levels. These variations are influenced by factors such as ventilation, occupancy, and exposure to external conditions, demonstrating the effectiveness of the monitoring system in capturing location-specific air quality characteristics.

CHAPTER 9 CONCULSION AND FUTURE SCOPE

9.1 Conclusion

The development of the **IoT-based Air Quality Monitoring System** has been successfully realized, effectively bridging the gap between physical environmental sensing and digital data visualization. Based on the implementation and testing phases, the following conclusions are drawn:

- **Successful Hardware Integration:** The **ESP32** demonstrated exceptional stability as the central processing unit. Its ability to handle high-resolution analog data from the **MQ-135** while managing the precise digital timing required by the **DHT11** proved its reliability for multi-sensor IoT nodes.
- **Seamless Data Flow:** The project successfully implemented a full-stack data pipeline. Data was accurately captured at the edge, transmitted via **REST API**, stored in the **ThingSpeak** cloud, and visualized through a custom **HTML/CSS/JS dashboard**.
- **Effective Monitoring:** The system achieved its primary goal of making "invisible" air quality data visible. The use of color-coded gauges and real-time trend graphs provides an intuitive way for users to understand their environment and take action when pollution levels rise.
- **Cost-Effectiveness:** The prototype demonstrates that high-quality environmental monitoring does not require expensive industrial equipment. By utilizing open-source frameworks and affordable sensors, a scalable and functional safety device was created.

9.2 Future Scope

1) **Integration with Smart Air Purification Units:**
The system can be enhanced by integrating compact air purification units that activate automatically when poor air quality is detected. These purifiers can be housed within artificial plant structures containing replaceable air filters, allowing them to blend naturally into the campus environment. Such units can be strategically placed in classrooms, corridors, laboratories, and common areas to improve air quality locally whenever unhealthy conditions are identified.

2) **AQI Calculation and Standardization:**
By incorporating additional sensors such as CO_2 and particulate matter sensors (PM2.5/PM10), the system can be extended to calculate standardized Air Quality Index (AQI) values for more accurate environmental assessment.

3) **Advanced Sensor Upgrade:**
Replacing the DHT11 sensor with higher-accuracy sensors such as DHT22 or BME280 can improve temperature and humidity measurement precision and system reliability.

4) **Predictive Ventilation Advisory:**
Using trend-based analysis of air quality data, the system can provide early ventilation advisories before air quality degrades to unhealthy levels, helping prevent discomfort and drowsiness in classroom environments.

5) **Mobile Application Integration:**
A dedicated mobile application can be developed to provide real-time monitoring, notifications, and historical data visualization for teachers and campus administrators.

6) **Automated Ventilation and Purification:**
Control The system can be extended to automatically control exhaust fans, air purifiers, or ventilation systems using relays based on predefined air quality thresholds.

7) **Multi-Location Campus Monitoring Dashboard:**
   Multiple monitoring nodes deployed across the campus can be connected to a centralized dashboard for real-time comparison and monitoring of air quality at different locations.

8) **Alert and Notification System:**
   Automated alerts through mobile applications, emails, or dashboards can notify concerned authorities when air quality falls below acceptable levels.

9) **Machine Learning-Based Long-Term Analysis (Advanced Scope) :**
   With sufficient historical data, cloud-based machine learning models can be used to analyze long-term air quality patterns and support predictive environmental planning.

REFERENCE

Academic Research & Peer-Reviewed Papers

[1] S. B. S. S. S. Prasad, V. Bhaskar, and P. N. Kumar, "IoT Based Air Pollution Monitoring System using ESP32," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, no. 4, 2019. [Online]. Available: https://www.ijrte.org/portfolio-item/D8235118419/

(Referenced for system architecture and sensor selection criteria).

[2] A. S. S. R. Vardhan and M. R. M. Krishna, "Real-time Monitoring of Air Quality and Environmental Parameters using MQ-135 and DHT11," *IJSRST*, vol. 5, no. 2, 2021. [Online].
Available: https://ijsrst.com/paper/6345.pdf

(Used to study the sensitivity curves of the MQ-135 sensor and humidity calibration).

AI Assistance for Information & Code Logic

[3] OpenAI ChatGPT, "Conversational AI for Firmware Optimization, C++ Debugging, and Technical Logic," v4o, 2024. [Online]. Available: https://chat.openai.com

(Used for writing the non-blocking delay logic, debugging JSON data packets, and optimizing the HTTP POST requests for ThingSpeak).

Tutorials for Connections & Hardware Understanding

[5] **Tech Study Cell**, "ESP32 IoT Project with DHT11 Sensor | ThingSpeak Cloud Graphs,"
YouTube, 2025. [Online]. Available: https://youtu.be/fBO83F5UVHg

(Consulted for understanding the data flow from the physical sensors to the cloud dashboard).

[6] **Jcbro Labs**, "How to Interface DHT11 Sensor with ESP32," YouTube, 2022. [Online].
Available: https://www.youtube.com/watch?v=EP-gMtUSVuA

(Used for understanding the GPIO pin mapping and direct-pin interfacing to avoid breadboard use).

Software Libraries & Coding References

[7] **Adafruit Industries**, "DHT Sensor Library for Arduino," GitHub Repository, 2024. [Online]. Available: https://github.com/adafruit/DHT-sensor-library

(The primary library used to initialize the DHT11 and fetch digital temperature/humidity values).

[8] **Espressif Systems**, "ESP32 Arduino Core Documentation," Official Docs, 2024. [Online].
Available: https://docs.espressif.com/projects/arduino-esp32/en/latest/

(Referenced for the Wi-Fi.h library and managing the ESP32's 12-bit Analog-to-Digital Converter settings).

Log-Books (8 Members *4= 32 Log-Books)

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: Bhavya Patel Enrolment No.: 24BT04009		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 19/12/25

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: Bhavya Patel Enrolment No.: 24BT04009		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp: -	19/12
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 19/12/25	

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Bhavya Patel Enrollment No.: 24BT04009		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

<table>
<tr><td colspan="2">Student's Name: Bhavya Patel
Enrollment No.: 24BT04009</td><td colspan="2">School: School Of Technology</td></tr>
<tr><td>Place of Internship:
In-house</td><td>Period of Internship:
1 Month (01/12/2025 to 31/12/2025)</td><td colspan="2">Semester: III
Year: 2nd</td></tr>
<tr><td>Date</td><td colspan="2">Internship / activities given to the student / performed by the student</td><td>Sign of Company mentor</td></tr>
<tr><td>22/12/2025</td><td colspan="2">Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.</td><td>2/1/26</td></tr>
<tr><td>23/12/2025</td><td colspan="2">Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.</td><td>2/1/26</td></tr>
<tr><td>24/12/2025</td><td colspan="2">Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.</td><td>2/1/26</td></tr>
<tr><td>26/12/2025</td><td colspan="2">Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.</td><td>2/1/26</td></tr>
<tr><td colspan="4">Host Company's Supervisor's Sign & Stamp: 2/1/26</td></tr>
<tr><td colspan="4">Name: Mr. Yatharth Bhatt</td></tr>
<tr><td colspan="4">Designation: Learning Facilitator</td></tr>
<tr><td colspan="4">Date: 02/01/2026</td></tr>
</table>

APPENDIX I

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

Section A: Logbook Template

Student's Name: Khushi Bhingradiya Enrolment No.: **24BT04010**		School: **School Of Technology**
Place of Internship: **In-House**	Period of Internship: **01/12/2025-31/12/2025**	Semester: **III** Year: **2nd**

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project objectives.	19/12
02/12/2025	Identified and confirmed all the necessary components required for the project.	19/12
03/12/2025	Prepared and documented the complete list of component requirements.	19/12
04/12/2025	Finalized the circuit diagram and ensured it aligns with the project plan.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19th Dec'2025

APPENDIX I

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

Section A: Logbook Template

Student's Name: **Khushi Bhingradiya** Enrolment No.: **24BT04010**		School: **School Of Technology**
Place of Internship: **In-House**	Period of Internship: **01/12/2025-31/12/2025**	Semester: **III** Year: **2nd**

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Studied the working principle of the fluid flow sensor.	19/12
09/12/2025	Designed and developed the front-end web interface to display live flow data and improved the UI layout and styling.	19/12
10/12/2025	Learned how to deploy the website using Render and tried it.	19/12
11/12/2025	Designed and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Experimented with the program code and gained practical experience using the Arduino IDE.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Khushi Bhingradiya Enrolment No.: 24BT04010		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Khushi Bhingradiya Enrolment No.: 24BT04010		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp: 2/1/26

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 02/01/2026

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's name: Patel Alis Alpeshkumar Enrolment No.: 24BT04218		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 19/12/25

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's name: Patel Alis Alpeshkumar Enrolment No.: 24BT04218		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19/12/25

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's name: Patel Alis Alpeshkumar Enrollment No.: 24BT04218		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's name: Patel Alis Alpeshkumar Enrollment No.: 24BT04218		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp: 2/1/26

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 02/01/2026

GSFC
UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: Arya Tia Manishkumar Enrolment No.: 24BT04006		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	**Internship / activities given to the student / performed by the student**	**Sign of Company mentor**
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: - 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19/12/25

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: Arya Tia Manishkumar Enrolment No.: 24BT04006		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp: - 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19/12/25

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Arya Tia Manishkumar Enrolment No.: 24BT04006		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Arya Tia Manishkumar Enrolment No.: 24BT04006		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp: 2/1/26
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 02/01/2026

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: Aryan Singh Enrollment No.: 24BT04007		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	**Internship / activities given to the student / performed by the student**	**Sign of Company mentor**
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19/12/25

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: Aryan Singh Enrollment No.: 24BT04007		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp: -	19/12
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 19/12/25	

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Aryan Singh Enrollment No.: 24BT04007		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12
Host Company's Supervisor's Sign & Stamp:		22/12
Name: Mr. Yatharth Bhatt		
Designation: Learning Facilitator		
Date: 22/12/25		

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Aryan Singh Enrolment No.: 24BT04007		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp:	2/1/26
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 02/01/2026	

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: Aakash Achari Enrollment No.: 24BT04002		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12
Host Company's Supervisor's Sign & Stamp: - 19/12		
Name: Mr. Yatharth Bhatt		
Designation: Learning Facilitator		
Date: 19-12-2025		

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: Aakash Achari Enrollment No.: 24BT04002		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp: - 19/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 19-12-2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Aakash Achari Enrollment No.: 24BT04002		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 22-12-2025

GSFC UNIVERSITY

EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Aakash Achari Enrolment No.:24BT04002		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	**Internship / activities given to the student / performed by the student**	**Sign of Company mentor**
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp: 2/1/26

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 02/01/2026

GSFC UNIVERSITY

EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: Anshika Nagar Enrolment No.: 24BT04005		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12

Host Company's Supervisor's Sign & Stamp: 19/12

Name: Mr. Yatharth Bhatt

Designation: Learning Facilitator

Date: 19-12-2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: Anshika Nagar Enrolment No.: 24BT04005		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	**Internship / activities given to the student / performed by the student**	**Sign of Company mentor**
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12
Host Company's Supervisor's Sign & Stamp:		19/12
Name: Mr. Yatharth Bhatt		
Designation: Learning Facilitator		
Date: 19-12-2025		

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Anshika Nagar Enrolment No.: 24BT04005		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Anshika Nagar Enrolment No.: 24BT04005		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	**Internship / activities given to the student / performed by the student**	**Sign of Company mentor**
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp:	2/1/26
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 02/01/2026	

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 1 (01/12/2025 to 05/12/2025)

Student's Name: BakirAli A Kachwala Enrolment No.: 24BT04008		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
01/12/2025	Explored various project ideas and finalized the project domain and objectives, including an overview of the Air Quality Monitoring system.	19/12
02/12/2025	Studied and reviewed research papers related to IoT-based air quality monitoring and management systems. Identified the required hardware and software components for the project.	19/12
03/12/2025	Studied individual project components and understood their working principles. Prepared and documented a detailed list of required hardware components.	19/12
04/12/2025	Finalized the component list after discussion with the mentor. Designed and reviewed the circuit diagram to ensure alignment with the project objectives.	19/12
05/12/2025	Reviewed all activities completed from Day 1 to Day 4 and verified the finalized project objectives, component list, and circuit diagram for consistency with the project plan.	19/12
Host Company's Supervisor's Sign & Stamp: 19/12		
Name: Mr. Yatharth Bhatt		
Designation: Learning Facilitator		
Date: 19 - 12 - 2025		

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 2 (08/12/2025 to 12/12/2025)

Student's Name: BakirAli A Kachwala Enrolment No.: 24BT04008		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
08/12/2025	Began planning the web dashboard for air quality monitoring, focusing on layout design and data visualization requirements.	19/12
09/12/2025	Designed and developed the front-end web interface to display live monitoring data. Improved UI layout and implemented required changes.	19/12
10/12/2025	Attended a technical session on Federated Learning on Edge, conducted by Dr. Shishir Nagaraja. Learned about edge intelligence concepts and their real-world applications.	19/12
11/12/2025	Designed, reviewed, and finalized the circuit diagram to improve measurement accuracy and minimize system errors.	19/12
12/12/2025	Started circuit schematic development using Circuit Studio, including component placement, pin mapping, and logical connections. Experimented with program code using the Arduino IDE and gained hands-on coding experience.	19/12

Host Company's Supervisor's Sign & Stamp:	19/12
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 19 - 12 - 2025	

GSFC
UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 3 (15/12/2025 to 19/12/2025)

Student's Name: Bakir Ali A Kachwala Enrollment No.: 24BT04008		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
15/12/2025	Studied device data storage methods relevant to the project.	22/12
16/12/2025	Discussed and analyzed case studies related to the project.	22/12
17/12/2025	Received the ESP32 microcontroller and learned about its structure, analog input/output pins, and how to upload basic programs.	22/12
19/12/2025	Received all required components and started working on the project.	22/12

Host Company's Supervisor's Sign & Stamp: 22/12
Name: Mr. Yatharth Bhatt
Designation: Learning Facilitator
Date: 22/12/2025

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

WEEK 4 (22/12/2025 to 26/12/2025)

Student's Name: Bakir Ali A Kachwala Enrolment No.: 24BT04008		School: School Of Technology
Place of Internship: In-house	Period of Internship: 1 Month (01/12/2025 to 31/12/2025)	Semester: III Year: 2nd

Date	Internship / activities given to the student / performed by the student	Sign of Company mentor
22/12/2025	Tested the connections of the ESP32 with the AQI sensor (MQ135) and DHT11 to ensure proper hardware functioning and stable sensor readings.	2/1/26
23/12/2025	Updated and verified the ESP32 code to correctly measure real-time air quality values (PPM) and environmental parameters (temperature & humidity) with proper calibration logic.	2/1/26
24/12/2025	Conducted testing in different indoor and outdoor environments to analyze changes in AQI readings and observe sensor stability, accuracy, and response time.	2/1/26
26/12/2025	Started preparing the project report by finalizing the structure and writing the introduction, project objectives, proposed system design, and technology overview.	2/1/26

Host Company's Supervisor's Sign & Stamp:	2/1/26
Name: Mr. Yatharth Bhatt	
Designation: Learning Facilitator	
Date: 01/01/2026	

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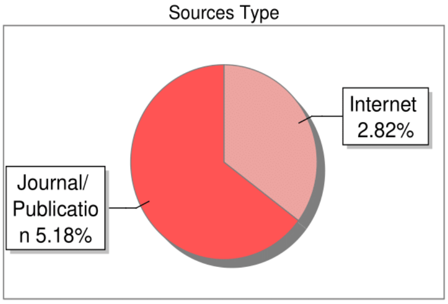

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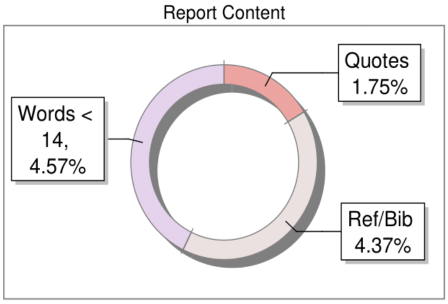

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