System Description

The system is an IoT-based environmental monitoring solution using an ESP32 microcontroller. It reads temperature and humidity data from a DHT22 sensor and publishes the data to an MQTT broker over Wi-Fi.

The ESP32 connects to a Wi-Fi network and establishes a connection with a public MQTT broker (test.mosquitto.org). The sensor readings are taken periodically and converted into string format before being sent to specific MQTT topics:

- `sensors/temperature`
- `sensors/humidity`

This allows remote monitoring of environmental conditions in real time using any MQTT client.

Challenges Faced

During the development of this project, several challenges were encountered:

- **Wi-Fi Connection Issues:**
  Ensuring stable connection to the Wi-Fi network sometimes required retries and delays.
- **MQTT Reconnection:**
  Maintaining a persistent connection with the MQTT broker was challenging, so a reconnection function was implemented.
- **Sensor Reading Errors:**
  Occasionally, the DHT22 sensor returned invalid readings (NaN), which required validation checks before sending data.
- **Data Formatting:**
  Converting float values (temperature and humidity) into string format for MQTT publishing required using functions like `dtostrf()`.

Lessons Learned

This project provided valuable learning experiences:

- Understanding how IoT systems work using ESP32 and sensors.
- Learning how to use MQTT protocol for lightweight communication between devices.
- Handling real-world issues like connection failures and invalid sensor data.
- Improving programming skills in Arduino IDE and working with multiple libraries.

- Gaining experience in debugging and testing embedded systems.
