**Design and Evaluation of a RESTful API Gateway for Secure Integration Between ESP32 IoT Sensors and Firebase Cloud Services**

**Aim**

To design, implement, and evaluate a RESTful API Gateway that enables secure and scalable data integration between an ESP32-based environmental monitoring IoT device and the Firebase Realtime Database cloud platform.

**Objectives**

1. To select and configure an ESP32 device with DHT11/DHT22 sensors to collect temperature and humidity data, and establish a Wi-Fi-enabled HTTP interface for outbound communication.
2. To design and develop a lightweight RESTful API Gateway using Node.js and Express, to receive sensor data from the ESP32 and forward it to Firebase Realtime Database in a structured and secure format.
3. To implement security features in the API Gateway, such as HTTPS communication, JWT-based authentication, and input validation to protect against unauthorized access and malformed requests.
4. To test the system's performance and scalability by simulating various device loads and measuring latency, throughput, and API response under different conditions using tools such as Postman and Apache JMeter.
5. To evaluate and document the gateway’s functionality, limitations, and performance, comparing it with direct IoT-to-cloud approaches, and provide recommendations for small-scale IoT deployments.

**Gantt chart**

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| --- | --- | --- | --- | --- |
| Task | June | July | August | September |
| 1. Topic Finalization & Approval |  |  |  |  |
| 2. Introduction & Scope Definition |  |  |  |  |
| 3. Ethical Review Preparation & Submission |  |  |  |  |
| 4. Literature Review |  |  |  |  |
| 5. Aims & Objectives Finalization |  |  |  |  |
| 6. Methodology Design |  |  |  |  |
| 7. IoT Device & Firebase Setup |  |  |  |  |
| 8. API Gateway Design & Development |  |  |  |  |
| 9. Security Features Implementation |  |  |  |  |
| 10. Testing & Performance Evaluation |  |  |  |  |
| 11. Results & Discussion Writing |  |  |  |  |
| 12. Final Documentation |  |  |  |  |
| 13. Supervisor Feedback & Corrections |  |  |  |  |
| 14. Draft Submission (Required) |  |  |  |  |
| 15. Final Submission |  |  |  |  |