Project Title : IoT-Based Hospital Bed Occupancy and Patient Vital Monitoring System with AI Anomaly Detection

1. Objective

The objective of this project is to design an IoT-enabled smart hospital system that automatically monitors bed occupancy and patient vital signs in real time and detects abnormal health conditions using AI, thereby improving patient safety, hospital resource utilization, and response time.

2. Drawbacks of Existing System

- **Manual Bed Monitoring -** Traditional hospitals rely on staff to manually check bed occupancy, leading to delays and human errors.
- **Reactive Healthcare -** Existing systems mostly trigger alerts after vitals cross thresholds instead of predicting abnormalities in advance.
- **Scalability Issues** - Many monitoring systems cannot efficiently handle 100+ concurrent devices in real-time.
- **Network Reliability Problems** - Wi-Fi-only systems fail during congestion or outages, risking data loss

3. How the Drawbacks Are Overcome

- Pressure sensors automatically detect bed occupancy.
- LSTM-based AI model predicts abnormal vitals before critical conditions occur.
- InfluxDB time-series database efficiently handles high-frequency sensor data.
- CoAP protocol with 5G fallback ensures reliable low-latency communication even during network failures.

4. Novelty of the Project

- AI-based predictive anomaly detection instead of simple threshold alerts
- Combined bed occupancy + vital monitoring in a single system
- Scalable architecture supporting 100+ IoT devices simultaneously
- Use of CoAP protocol with 5G fallback for healthcare-grade reliability

5. Input → Output (One Line)

- Input: Pressure sensor data (boolean), Pulse rate & SpO_2 (integer/float)
- Output: Bed occupancy status, real-time vitals, AI-generated anomaly alerts

6. **Dataset(s)**
    - Type: Real-time sensor data + medical time-series data
    - Source: ESP32 + MAX30100 sensors and publicly available physiological datasets
    - Size: Continuous streaming data (GB-scale time series)
    - Access: Real-time ingestion via IoT nodes and stored in InfluxDB

7. **Planned Workflow (Step-by-Step)**
    - Sensor data collection using ESP32 and MAX30100
    - Data transmission via CoAP protocol
    - Storage in InfluxDB time-series database
    - Preprocessing and normalization of vital signals
    - LSTM-based anomaly detection model
    - Visualization and alerts on central PostgreSQL-based dashboard

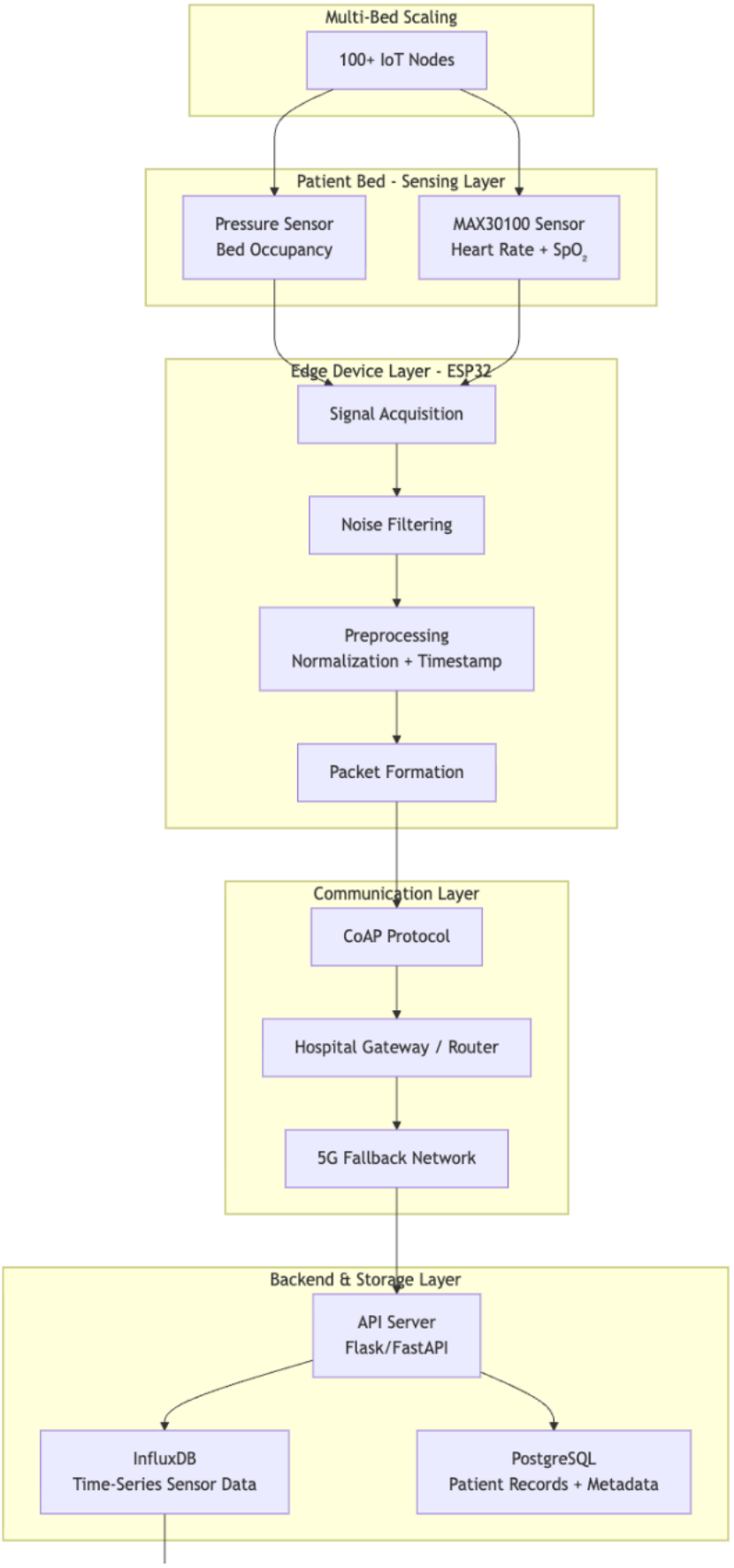
8. **Proposed Architecture (Explanation)**
    - The system follows a layered architecture:
    - IoT Layer: ESP32, pressure sensors, MAX30100
    - Network Layer: CoAP protocol with 5G fallback
    - Data Layer: InfluxDB (time-series) + PostgreSQL
    - AI Layer: LSTM model for abnormal vitals prediction
    - Application Layer: Real-time monitoring dashboard and alerts

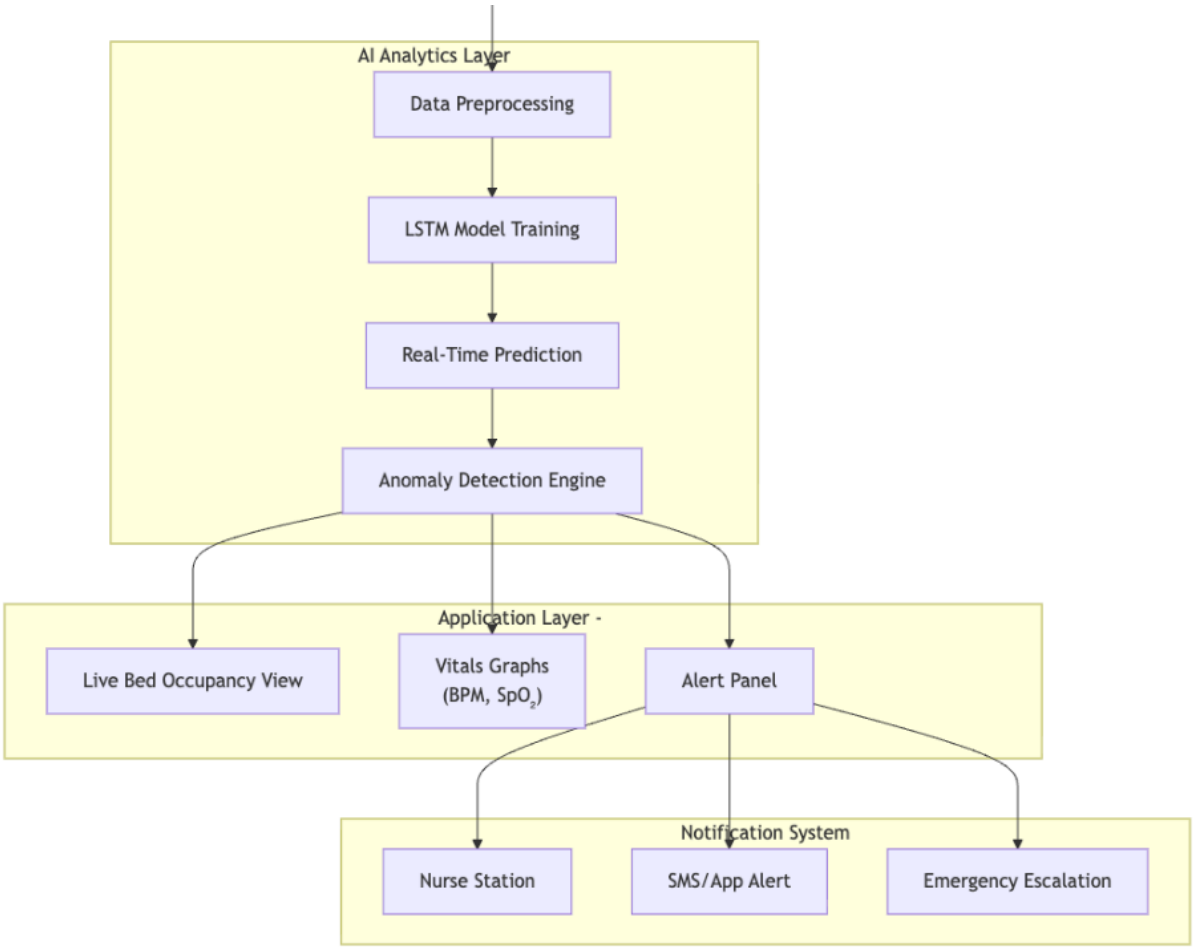
9. **Conclusion & Future Scope**

    This project provides a scalable, intelligent, and predictive healthcare monitoring solution.

    In the future, it can be extended to include ECG monitoring, cloud-based hospital integration, and federated learning for privacy-preserving AI.

10. Architecture Diagram





11. Team role document

Name	Roll No.	Role
Eashan Jain	RA2311027010198	Iot Hardware & Embedded System
Somay	RA2311026011129	Frontend & System Integration
Shankar Shivam	RA2311003011937	Networking & Backend System
Adarsh Kumar	RA2311003011799	Documentation