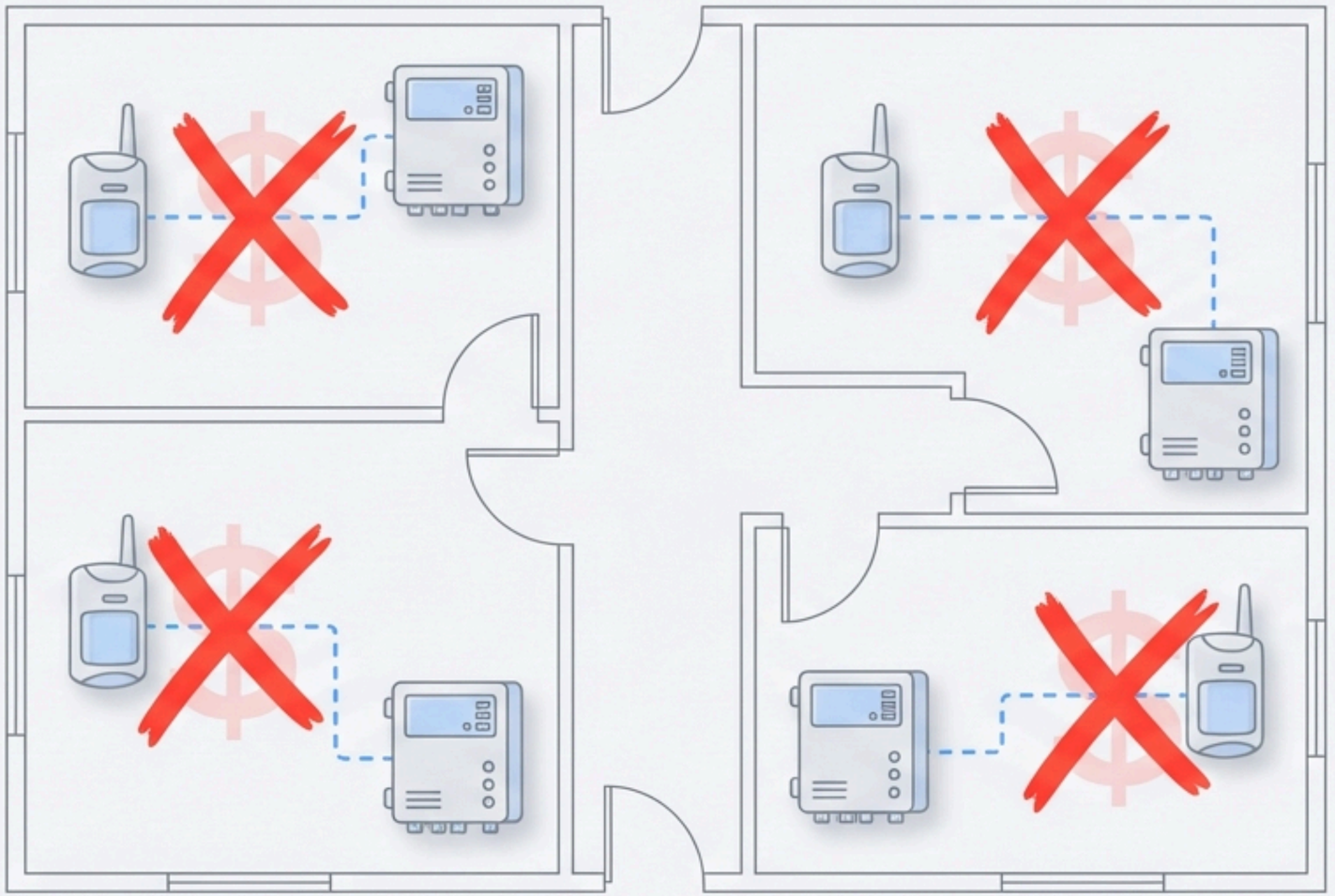
Smart Intruder Alert System (SIAS)

Scalable Multi-Room IoT Security

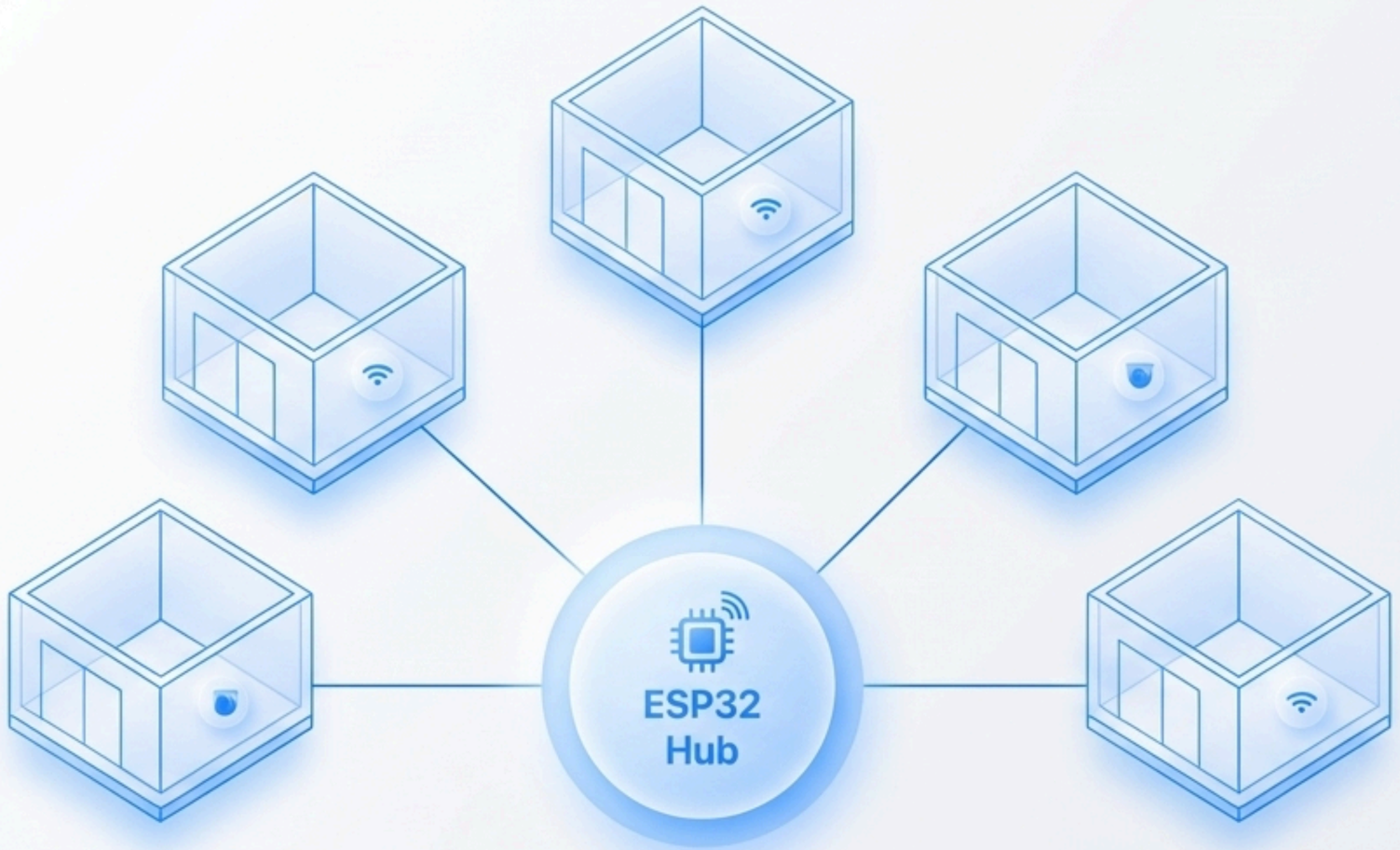
- Centralized IoT Building Security.
- Real-Time Multi-Zone Monitoring.
- High-Efficiency End-to-End Pipeline.

Traditional Security Systems are Fragmented & Costly



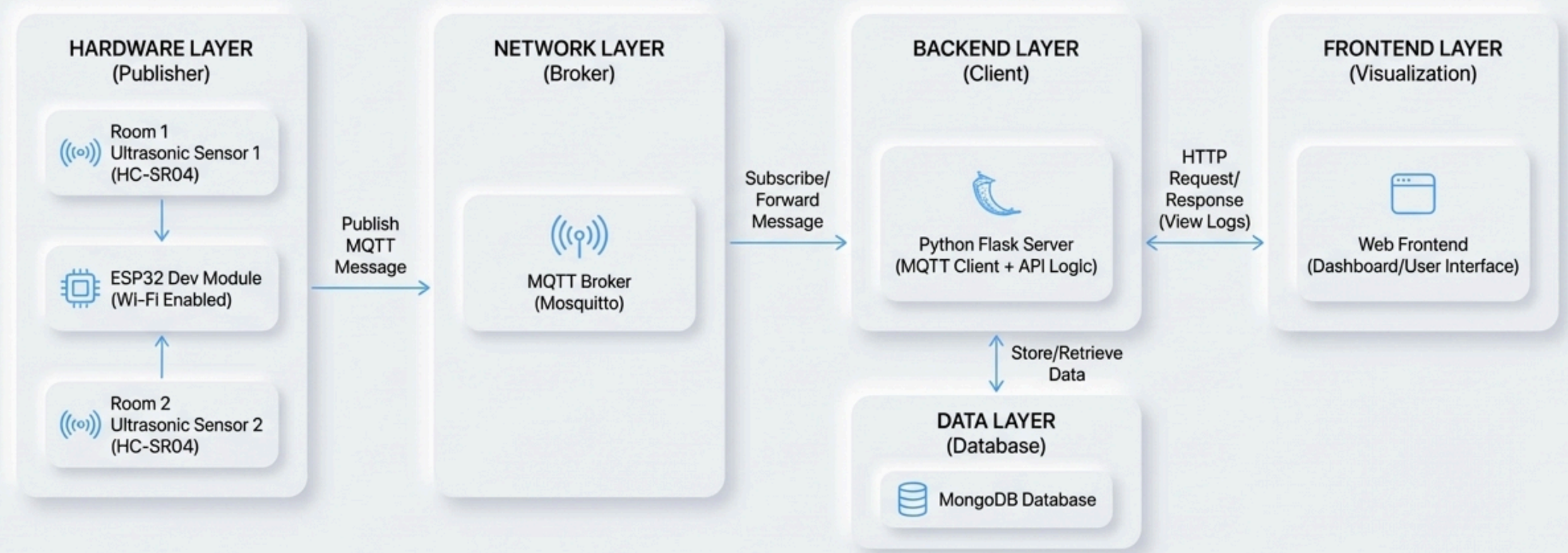
- High Unit Costs: Traditional systems require a dedicated "brain" per room.
- Data Fragmentation: Managing multiple, separate sensor apps is difficult.
- Scalability Barriers: Extensive wiring and hardware required for full coverage.

The SIAS Edge: Centralized Intelligence for Maximum Efficiency



- **Unified Building Hub:** A single system manages sensors across all rooms.
- **Centralized Processing:** One ESP32 processes multi-room data simultaneously.
- **Minimum Hardware, Maximum Coverage:** A zero-waste, cost-effective design.

A Four-Layer Architecture for Seamless Data Flow

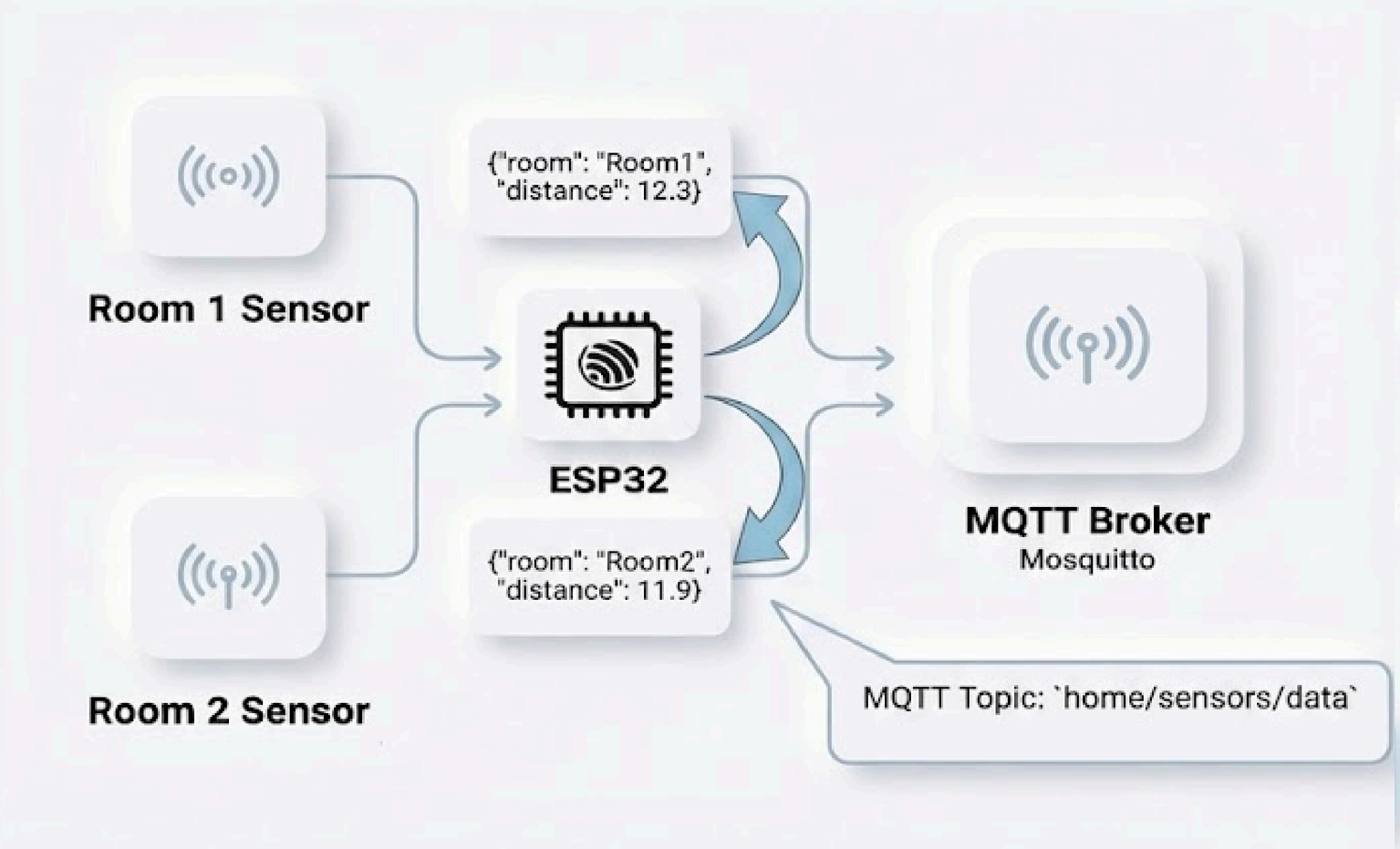


- Layered Framework: Hardware, Network, Backend, and Frontend.
- Seamless Integration: Data moves from physical sensor to user interface.
- Modular by Design: Easily scalable by adding new sensor nodes.

Hardware Layer: The Sensing & Processing Core

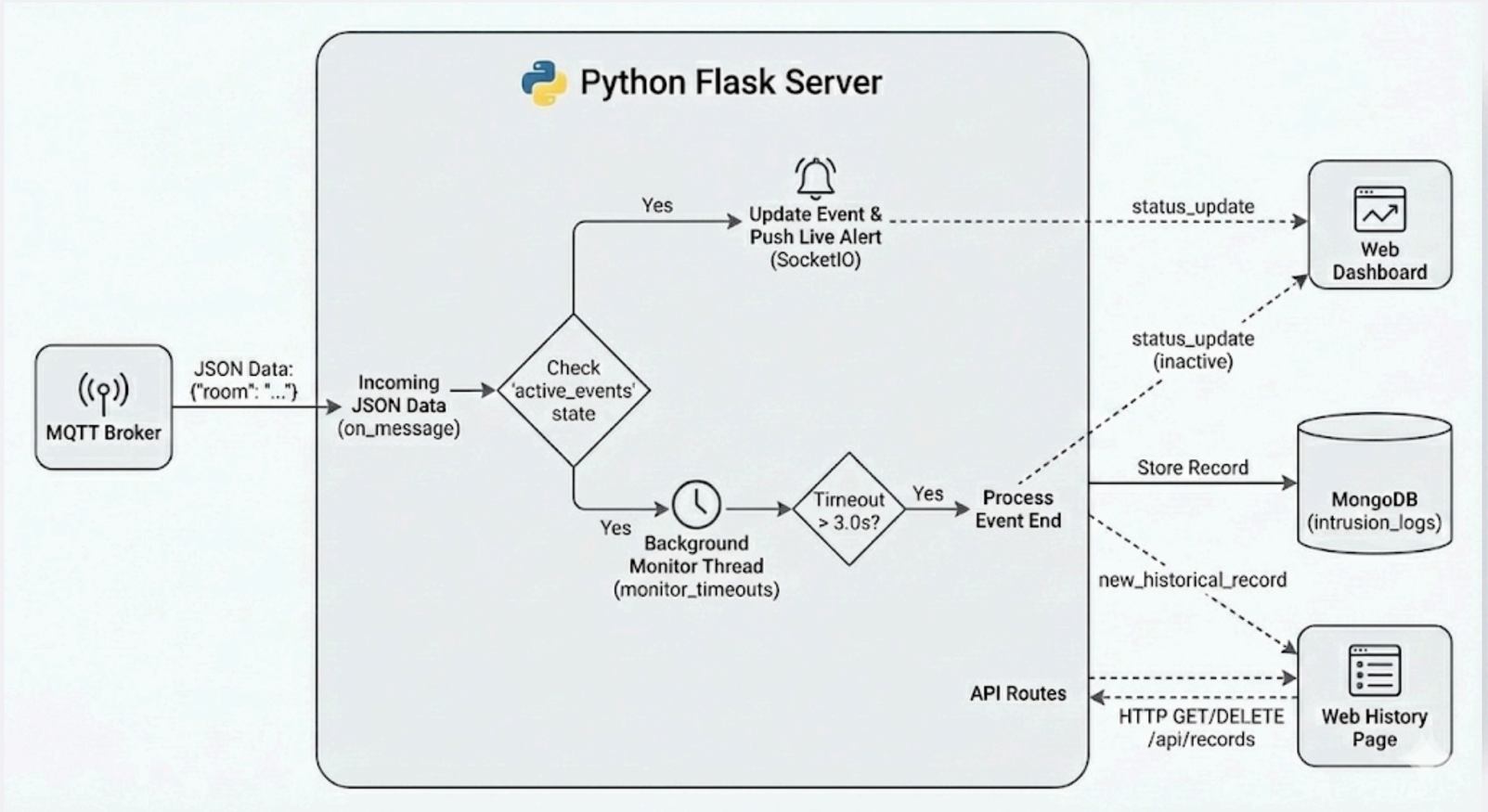
- **ESP32 Module**: The high-speed, Wi-Fi enabled controller for the system.
- **HC-SR04 Nodes**: Precision ultrasonic sensing for ‘Room 1’ and ‘Room 2’.
- **Targeted Detection Logic**: On-device code filters for intrusions under 15cm.

Network Layer: Lightweight & Instant Data Transport



- **MQTT Protocol:** Optimized for low-bandwidth, high-speed IoT messaging.
- **Centralized Broker:** Mosquitto provides fast, reliable message handling.
- **Sub-Second Latency:** Ensures instant data transmission to the backend.

Backend Layer: Intelligent Event Processing & Logic



- **Python Flask Server:** Subscribes to MQTT topics and handles all logic.
- **Smart Event Filtering:** Distinguishes intrusions from fleeting motion.
- **Stateful Tracking:** An 'event' ends only after 3 seconds of inactivity.

Data Layer: Secure, Timestamped Intrusion Logging

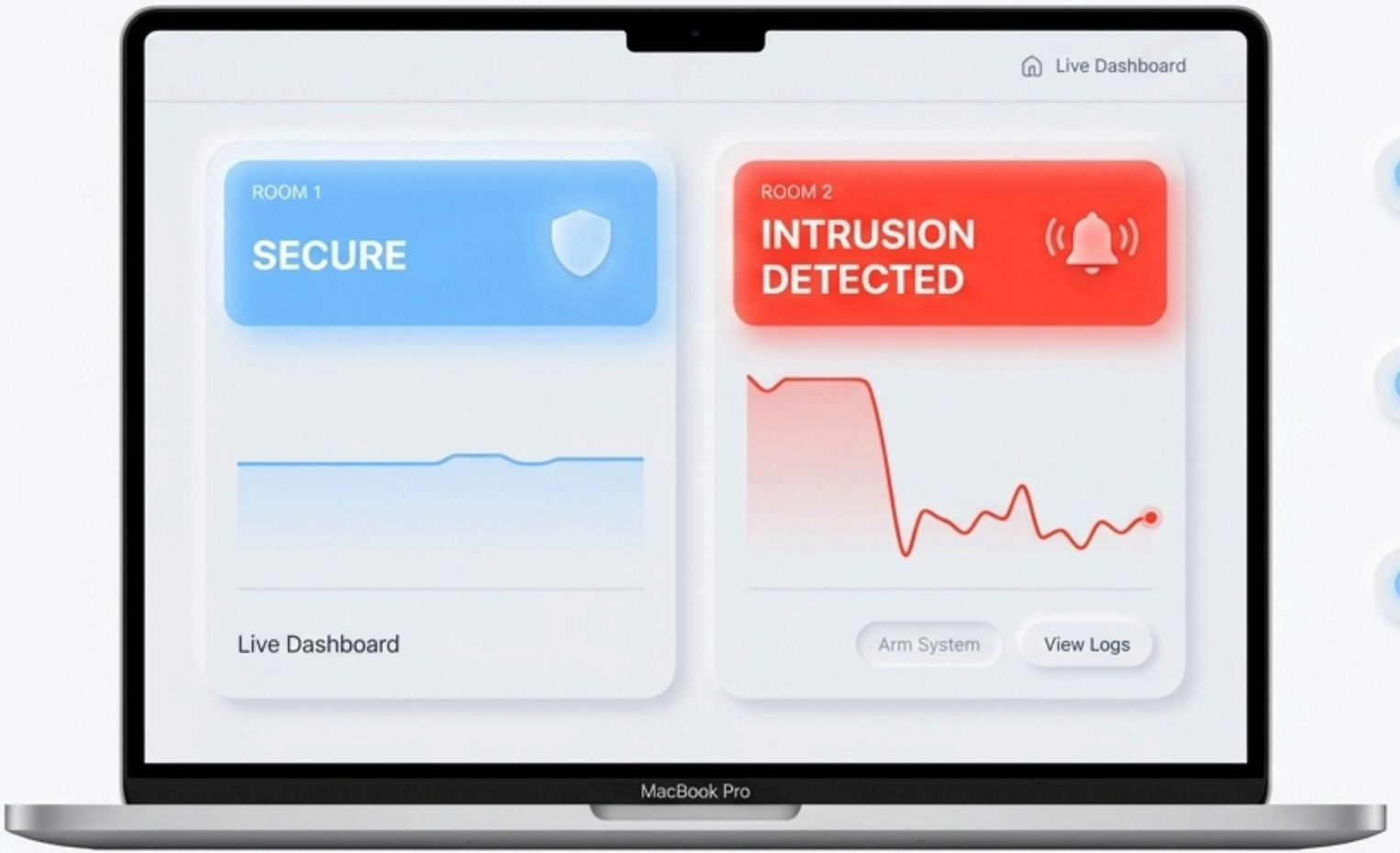
Store/Retrieve

mongoDB


```
{
  "room": "Room1",
  "start_time":"2023-10-27 14:30:15",
  "end_time": "2023-10-27 14:30:18",
  "nearest_distance": 8.7,
  "duration_sec": 3.0
}
```

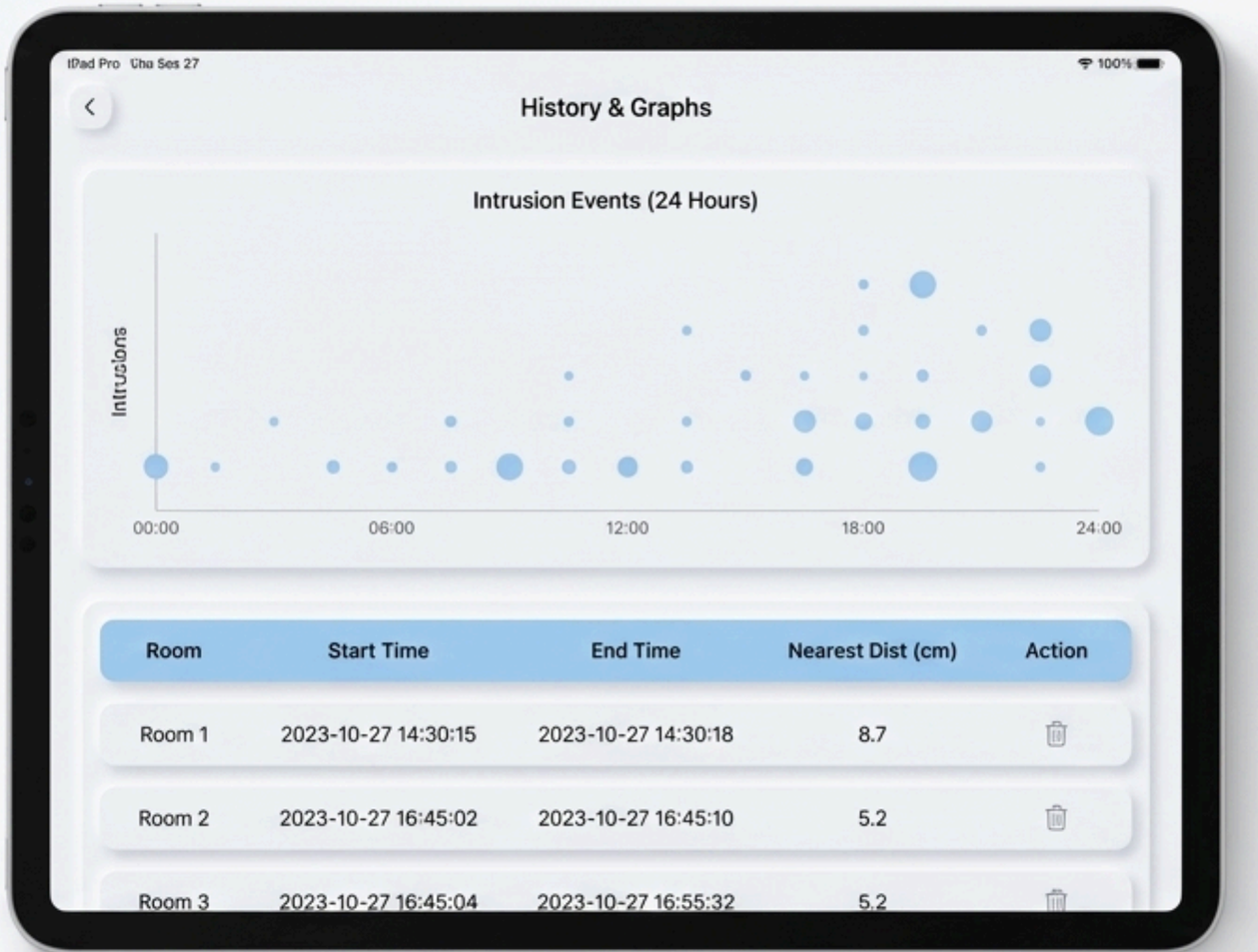

- **MongoDB**: Secure, scalable storage for all historical event logs.
- **Rich Data Records**: Captures room, duration, and proximity for each event.
- **API Accessible**: Historical data is served to the frontend via a REST API.

Frontend Layer: A Unified Command Center



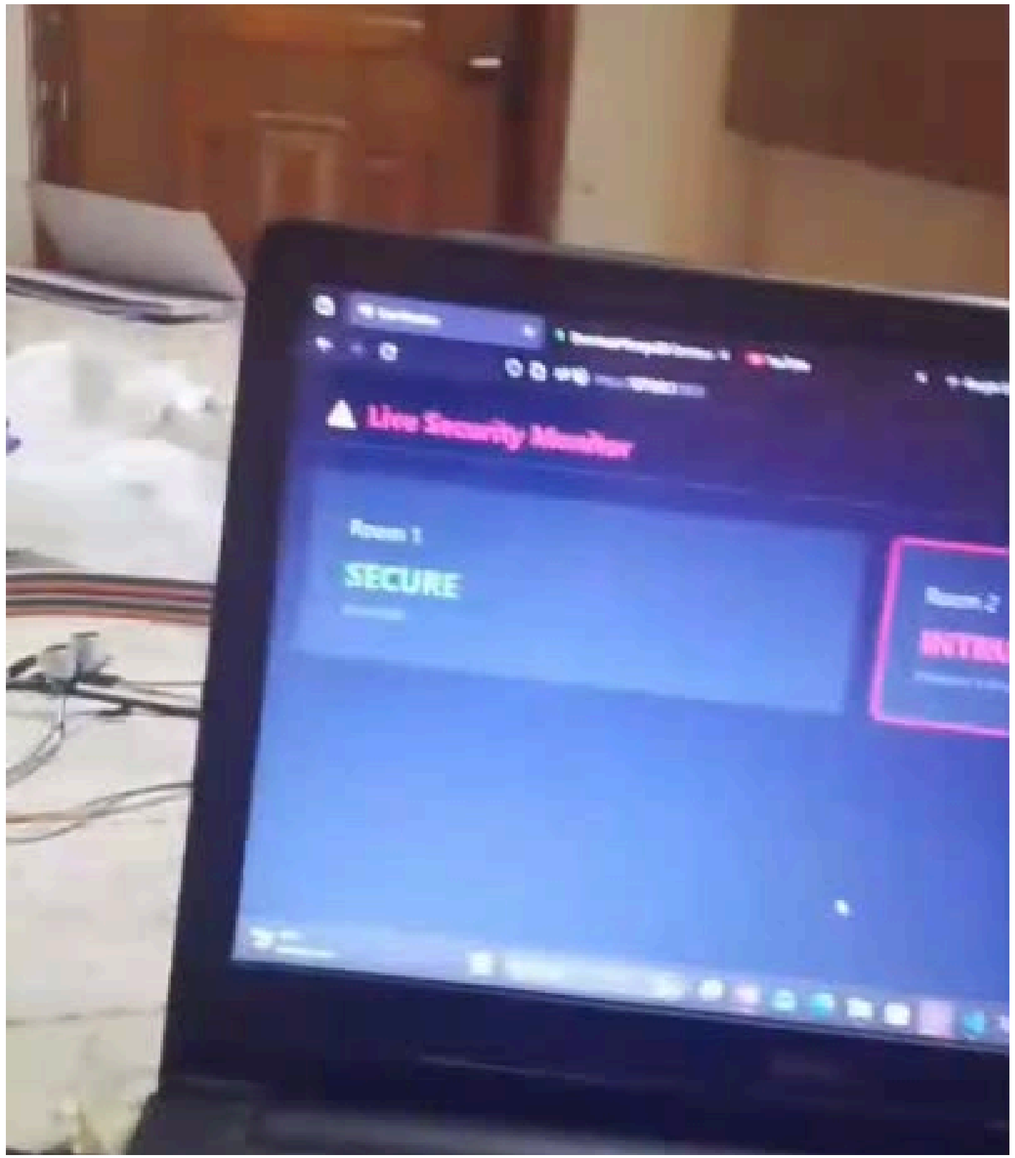
- **Universal Dashboard:** View the real-time status of every room on one screen.
- **Instant Visual Alerts:** Room status updates immediately via WebSockets.
- **Interactive Control:** Arm system for audio alerts with a single click.

Historical Analysis: Review & Audit Past Events

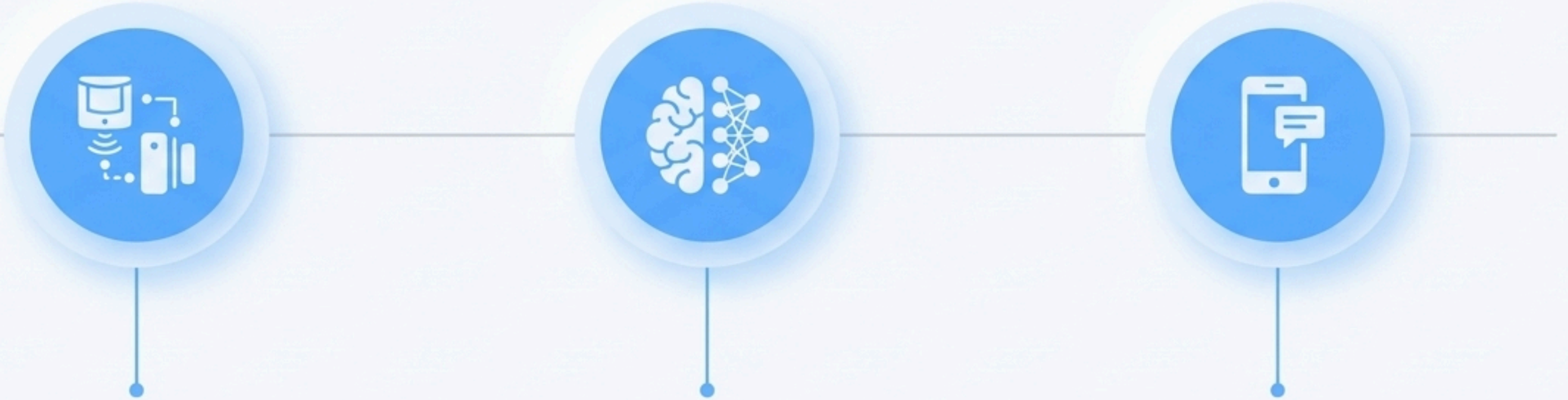


- **Comprehensive Log Table:** Review detailed records of all past intrusions.
- **Data Visualization:** Scatter plot for identifying patterns in security events.
- **Full Record Management:** Securely delete outdated or irrelevant logs.

Live Demo



Future Roadmap: The Evolution of SIAS



- Sensor Fusion: Integrate PIR (motion) and magnetic (door/window) sensors.
- Intelligent Alerts: Implement machine learning to reduce false positives.
- Mobile Command: Develop native iOS/Android apps for push notifications.

Technical Foundations & References

Our project is built upon robust, industry-standard technologies and documentation.

Core Protocols & Standards

- MQTT Essentials - HiveMQ
- HiveMQ Public MQTT Broker

Hardware & Microcontroller

- ESP32 Technical Reference Manual - Espressif Systems
- PubSubClient Arduino Library

Software & Backend

- Flask Web Framework Documentation
- Eclipse Paho MQTT Python Client
- MongoDB PyMongo Driver Documentation