HealthSync: IoT System for Real-Time Monitoring of Vital Signs

Bachelor's Degree in Telecommunications and Computer Engineering
Integrated Telecommunications Project - 2024/2025

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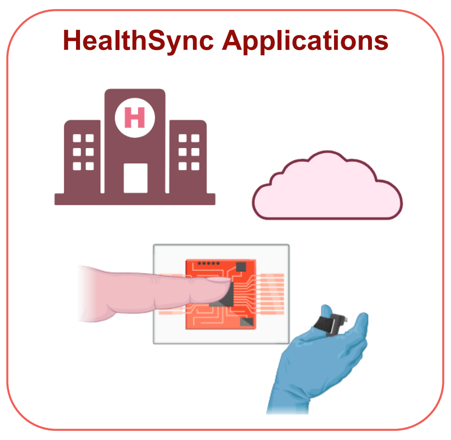
Introduction



Problems

Vital signs monitoring is often limited to clinical settings
Lack of real-time alerts for patients at home

Proposed Solutions

IoT system enabling continuous remote monitoring
Personalized alerts sent to healthcare professionals and caregivers

Why HealthSync ?

HealthSync addresses these challenges by integrating IoT, MQTT, and secure dashboards to enable continuous physiological data tracking

Main Goal

To build a secure IoT system for real-time remote monitoring of vital signs with role-based dashboards

Methods

Sensor
Communication
Processing
Interface

Step 1 – Acquisition

1 — Wearable sensors measure temperature, heart rate, SpO_2 and motion

Step 2 – Transmission

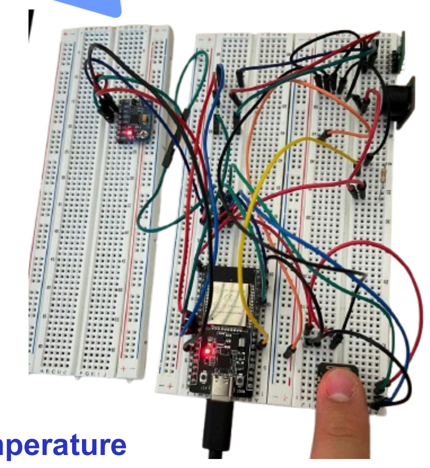
2 — ESP32 device transmits data wirelessly using the MQTT protocol to the central broker

Step 3 – Processing

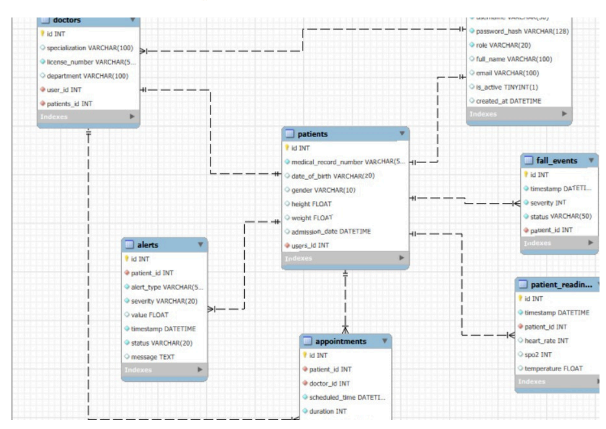
3 — A Node.js backend processes data, detects anomalies, and stores it in a MySQL database

Step 4 – Visualization

4 — Web and mobile dashboards display real-time and historical health data for each user role



sensor/ID/temperature
sensor/ID/heart_rate

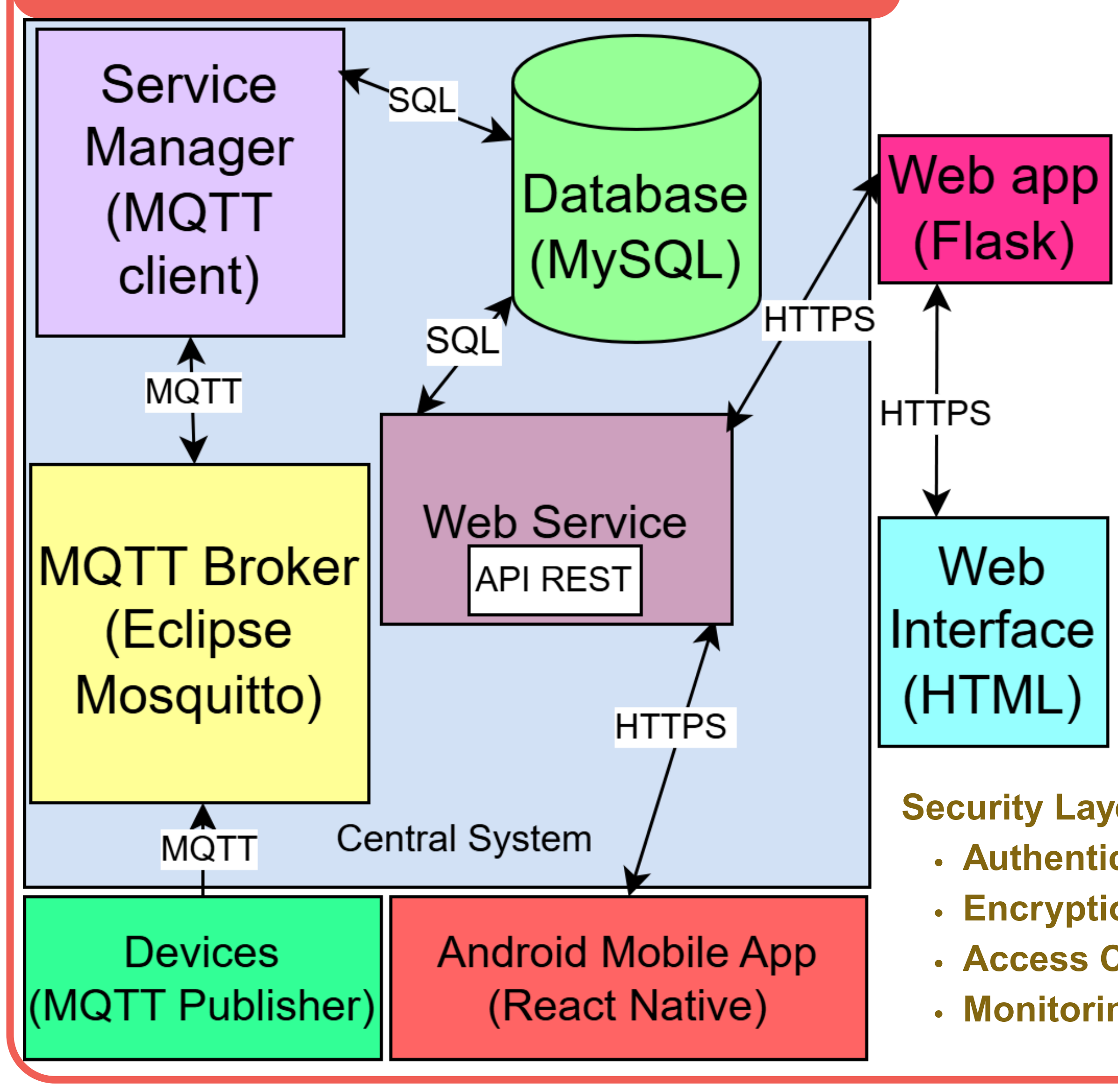


Admin
Doctor
Patient

Key Functionalities

- Real-time alerts
- Historical data visualization
- Role-specific interfaces

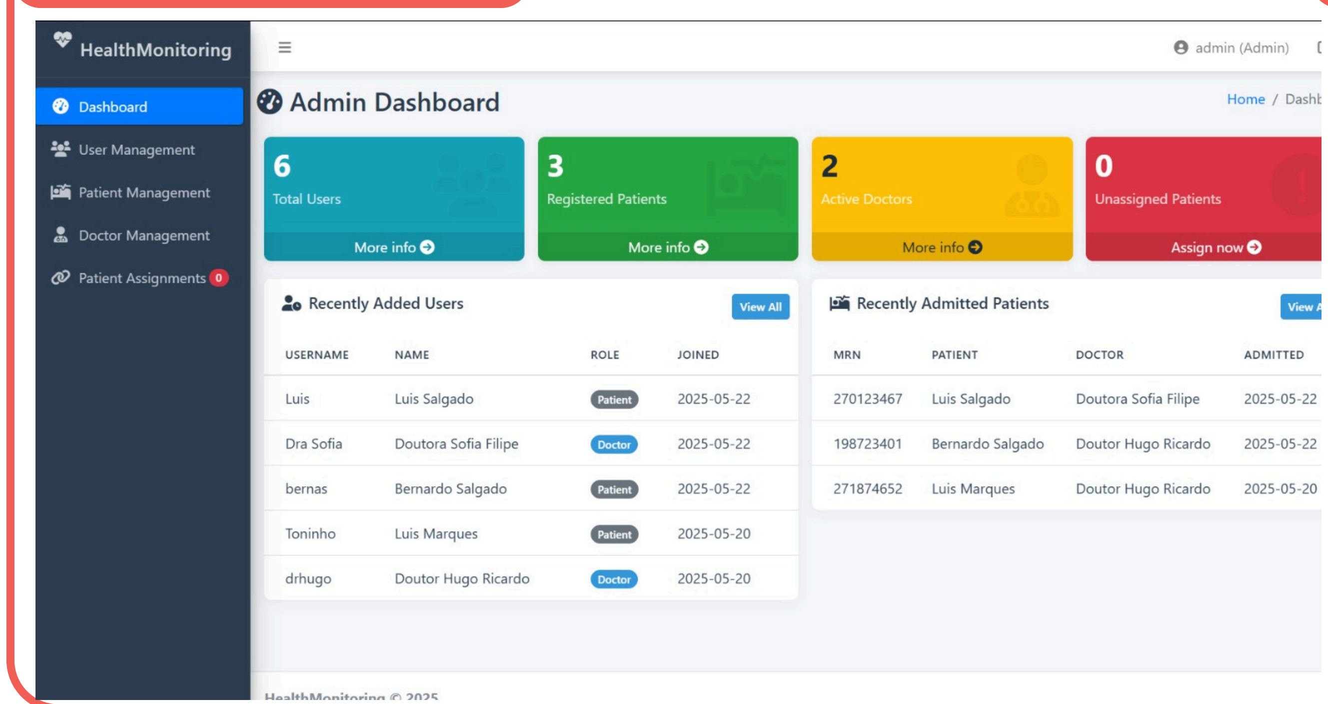
Architectural diagram



Security Layer

- **Authentication:** Token-based (JWT via OAuth2)
- **Encryption :** AES-256 + TLS 1.3
- **Access Control:** Role-based (admin, doctor, patient)
- **Monitoring:** ELK stack for logging and system audit

Dashboard



Results

Performance Tests:

- Avg latency: 480 ms (sensor → dashboard)
- Load test: 100 devices, 92% CPU

Usability Feedback:

- Patients understood the alerts
- Clinicians praised dashboard clarity

- **Security Tests (OWASP ZAP):**
- No critical vulnerabilities
- Three medium-risk issues resolved

Validated through Simulation

Conclusions

HealthSync is a reliable, modular, and scalable system for real-time remote monitoring of vital signs. Its architecture supports secure communication, role-based access, and personalized dashboards. The solution is well-suited for home care and clinical telehealth contexts. **Future work** will include clinical validation and regulatory integration.

Acknowledgments

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