

SQL Database for IoT Device Management in the NHS

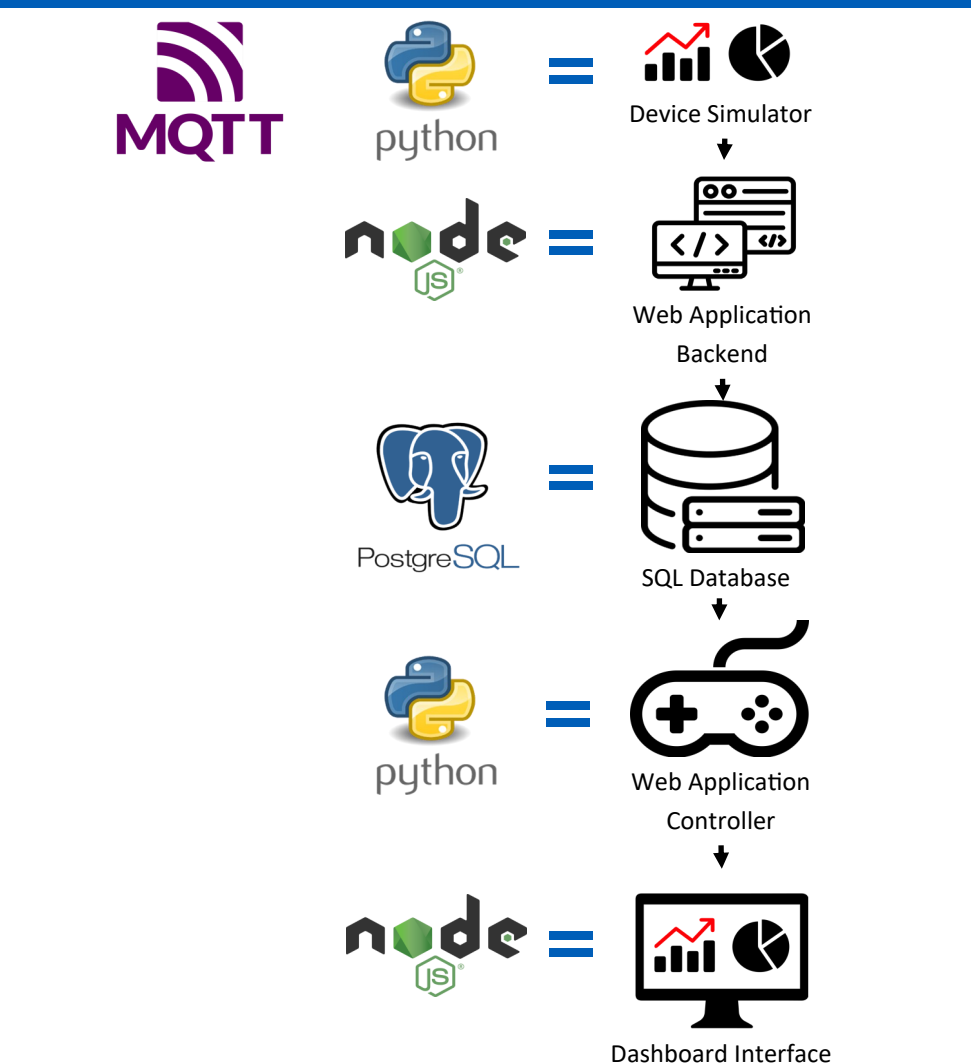
Introduction

The adoption of Internet of Things (IoT) technologies in the healthcare sector has transformed how medical institutions operate; enhancing patient care, hospital management, and medical device tracking. The National Health Service (NHS) in the United Kingdom has integrated various IoT devices such as wearable health monitors, smart infusion pumps, connected ventilators, and RFID-tagged assets, to improve operational efficiency and patient outcomes. These devices generate vast amounts of real-time data which, if effectively managed, can provide critical insights into patient health trends, equipment status, and predictive maintenance. However, the efficient management of this data presents significant challenges.

Research Overview

The Research outlines the structured and methodical approach taken to develop and evaluate an SQL database for managing IoT devices within the NHS. The chapter begins by defining the research design, grounded in a post-positivist philosophy that values empirical evidence and testing. A mixed-methods strategy is employed, combining qualitative reviews of NHS policies, GDPR, and best practices with quantitative stress testing and performance analysis. The research process follows a clear sequence: from literature review and problem formulation, through system design and implementation, to evaluation. Tools such as PostgreSQL, Python, SQLAlchemy, and security testing utilities like Wireshark are used to simulate NHS environments and validate the database. Data collection includes both primary (simulated IoT logs) and secondary sources (documents and prior studies), while triangulation ensures the reliability of findings by using multiple data types and analytical lenses. Ultimately, the methodology ensures that the developed solution is secure, scalable, and effective in a real-world healthcare setting.

System Design



Aim & Objectives

Aim

This project aims to design and implement an SQL database to store, manage, and query data from IoT devices deployed within the NHS.

Objectives

- Review relevant literature and detail the research methodology
- Present the design and implementation of the SQL database
- Design the SQL database for managing IoT devices in NHS hospitals, implementing relationships between medical devices, patients, and hospital staff.
- Ensure data integrity, security, and efficient query performance.
- Provide insights through SQL queries for device status, usage, and predictive maintenance.
- Examine the testing and evaluation process
- Discuss overall findings, provide conclusions and recommendations for further research and development.
- Reflect on the project

Design and Implementation

The final system's purpose is to receive signals from IoT devices.

The original design was to receive location data to track them, however because this proved too difficult it was decided to simplify the design and shift to a different , but equally important angle.

- The Device simulator, as the name suggests, simulates real-time updates that an IoT device could send, e.g; battery statuses, Wi-Fi connectivity, medical issues, any errors in the device, etc.
- The Web Application Backend is what receives the data sent from the IoT devices and sends the parsed data to the Database as it cannot do this itself.
- The SQL Database is where the Backend sends all of it's information. It is sorted into the relevant columns (Device ID, Status and Timestamp).
- The Web Application Controller is responsible for pulling the data out of the Database, by getting the latest signals based on the Timestamp Column and sending it to the Dashboard to be displayed.
- The Dashboard Interface is created using HTML, and the data it receives from the Web App Controller is just inserted into the relevant positions.

Latest Device Status

Device ID	Status	Timestamp
1	Battery Low	2025-06-27T17:09:31.710321
2	Disconnected	2025-06-27T17:09:26.707430
3	Disconnected	2025-06-27T17:09:16.731213

Fig. 1: Dashboard Layout

Testing and Results

While the original goal of real-time location tracking proved infeasible due to both technical and environmental limitations, the revised project achieved a functional and extensible backend system for monitoring IoT device statuses. The decision to pivot toward status-based tracking reflects industry realities and allowed for the demonstration of full-stack IoT communication, storage, and visualization pipelines. The experience also reinforced the value of adaptive design, modular development, and systematic debugging in full-stack system engineering.