IoTSSC Proposal

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1 Introduction

To develop this design, we decided to frame the room occupancy problem by considering all the possible impressions a person leaves on a room. This has allowed us to work from the bottom-up and establish all that could feasibly be captured with the sensors available. With this model, we are confident we can capture room occupancy rates to a high degree of accuracy.

2 Design

2.1 Embedded Device

Room occupancy will be measured by multiple embedded devices :

- Door PIR sensors: One micro-controller with two PIR sensors near the door to measure occupants leaving and entering the room.

- Seated PIR sensors: N micro-controller with M PIR sensors facing seating areas where:

    - N is the number of workspaces.
    - M is the number of chairs at each workspace.

We aim to cover both the occupancy of seated persons as well as non-seated persons. Using the door sensor allows us to establish a tight range of occupants which can be reinforced by the detection of users at workspaces. The door PIR sensors are intended to have an overlapping sensing area, covering the interior and exterior of the door. The chair sensors build up a heat map of the usage of seating in the room: detecting when a person is sitting down and for how long.

2.2 Android App

The app is intended to act as a conduit between the sensors and the cloud; alongside providing user feedback about the state of the devices and status of data collection from a given room. The app will provide a *Gather data* button to request data from the devices.

2.3   Cloud Analytics

We will use BigQuery to house the data forwarded by the android app, aggregating this data with custom SQL queries. Google Data Studio will be used to visualise interesting insights into the data.
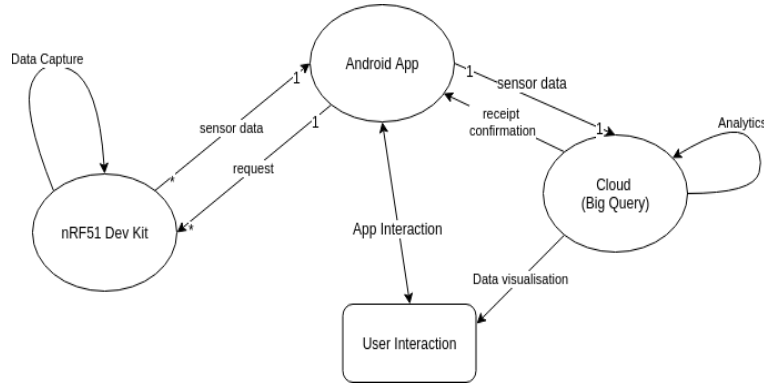
2.4   Communications

Figure 1: System State Diagram

The android app will connect to the embedded device(s) over Bluetooth. By adopting a unique naming convention, the app will be able to distinguish between other Bluetooth broadcasting devices and ours. The data will be transmitted over Bluetooth in an encrypted state.

The app will then transmit data to the cloud to be stored in the BigQuery Table. Optionally, the app may provide some data aggregation between the many embedded devices.

3   Resulting Data

In using Door PIR Sensors, we can establish whether a person is leaving the room for example, by measuring the order of the sensors being triggered: interior, both PIRs and exterior. This will allow us to perform occupancy counting [?], as to how many people are in the room.

By using the Seat PIR Sensors, this might allow limited occupancy tracking around the room and limited event and behaviour detection. For instance, the system could employ tracking on situations where seated persons switch seat locations. Additionally, it could detect events such as tutorials in rooms: where often a collection of people enter and sit down, but one person is still standing.

As a result, our insights could include information such as average room occupancy, room hotspots, average time spent on computers, the percentage of users who use a workspace.

3.1 Limitations

Some limitations of our proposed solution are that it cannot perform occupancy tracking for individuals who are standing. This means the resulting data visualisation is less impressive in rooms where the majority choose to stand. One way we could improve this is by extending our project with a CO_2 sensor or temperature sensor: to provide an additional metric for evaluating occupancy and, in a closed loop system, allowing the adjustment of temperature or air conditioning depending on the room occupancy level.

4 Technical Sub-goals

We have broken our design specifications into a list of technical sub-goals we will need to meet. This timeline takes into account both the time required for the technical aspects of the project and the presentations. Feedback on the feasibility of this timescale would be much appreciated.

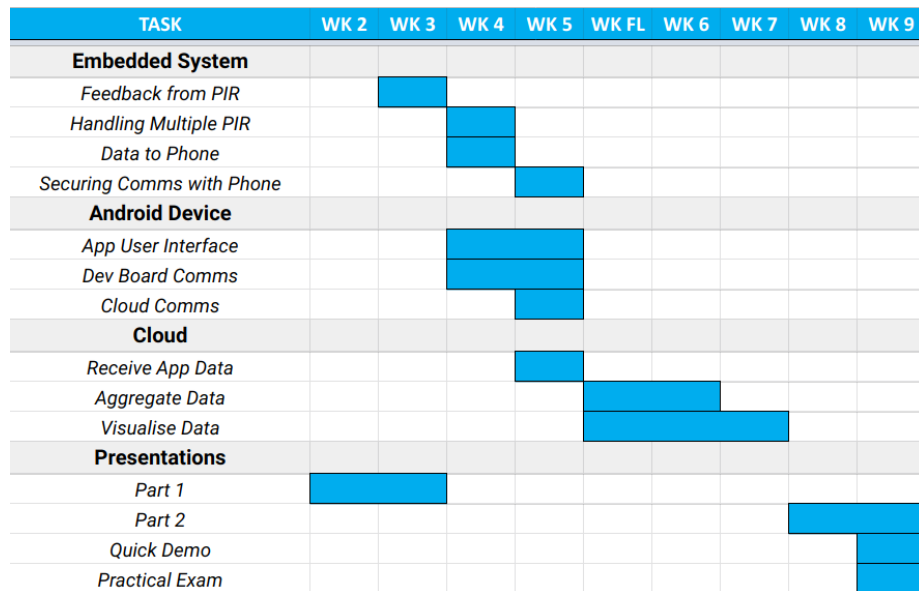| TASK	WK 2	WK 3	WK 4	WK 5	WK FL	WK 6	WK 7	WK 8	WK 9
Embedded System									
Feedback from PIR		■							
Handling Multiple PIR			■						
Data to Phone			■						
Securing Comms with Phone				■					
Android Device									
App User Interface			■	■					
Dev Board Comms			■	■					
Cloud Comms				■					
Cloud									
Receive App Data				■					
Aggregate Data					■	■			
Visualise Data					■	■	■		
Presentations									
Part 1	■	■							
Part 2								■	■
Quick Demo									■
Practical Exam									■

Figure 2: Proposed Timeline - Gantt chart