

CO326 Group Project

Group E : Occupation and Access Control

Group Members

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Tasks

- Task 1** Read data from sensors | Send to MQTT Server
- Task 2** Read data from MQTT Server | Take decisions | Control actuators
- Task 3** Read data from MQTT Server | Display status on SCADA
- Task 4** Take inputs from the SCADA | Send to MQTT Server
- Task 5** Process Controller : Operating | Optimizing | Algorithms
- Task 6** Store MQTT Data, Commands, Events in the Database
- Task 7** Display the data in the database in Web Interface
- Task 8** Data Analytics: Prediction | Optimization | Correlation

Introduction

A. Occupancy Control

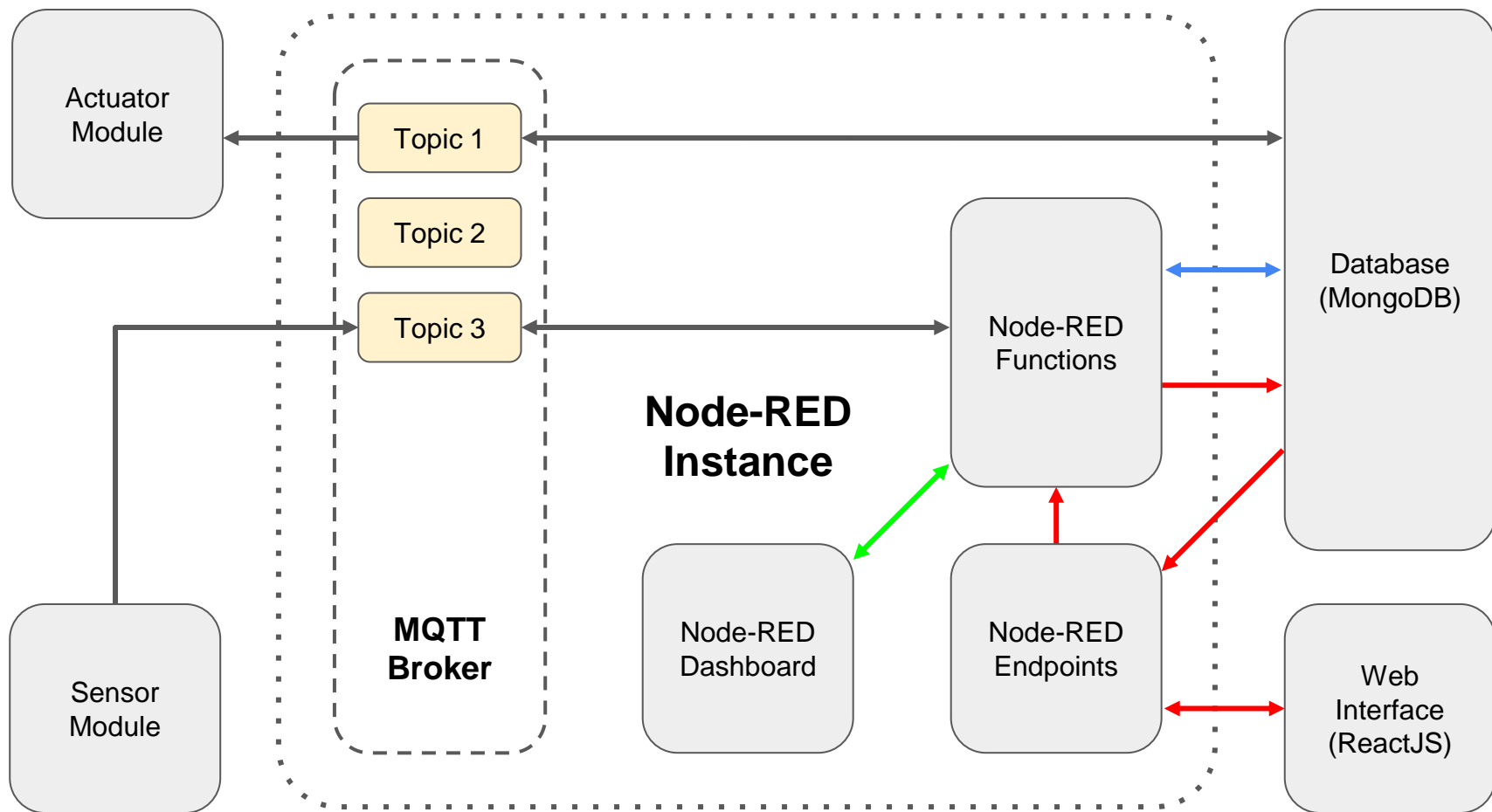
- **Automated Process** to control Human Interactions and Security
- Crowded and Busy area → Inefficient working / learning environment
- COVID-19

A. Access Control

- **Authentication** and **Authorization**
- Safety of the Company Property and the People
- While protecting People's Identity

Main Features

- Identify the people who entered the room - **Authentication**
 - Either RFID or Security Code
- Permit the people access rooms - **Authorization**
- Keep a count of people in each room in each floor
- Provide **real time reports** on attendance → *Node-RED Dashboard*
- Provide comprehensive reports / analytics on **past data** → *Web Interface*
- Provide occupancy details for Control, HVAC and Safety groups



Hardware Components



ESP32



RFID
Reader



16 x 2 LCD



Ultrasonic
Sensor

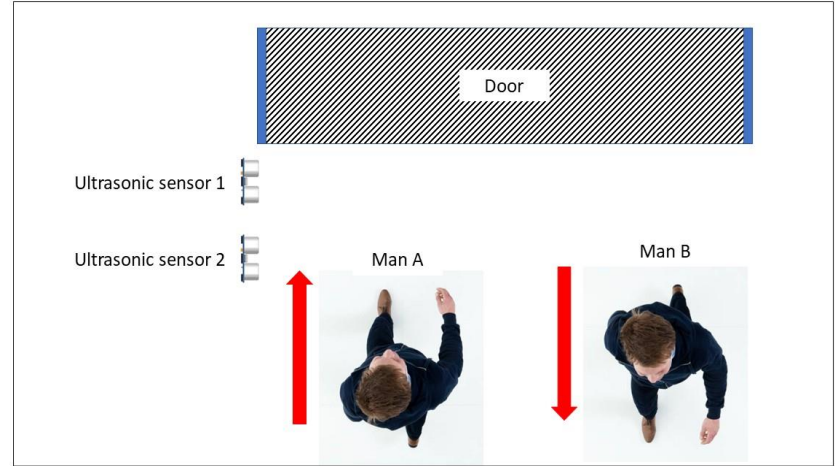
- The control unit should be capable of **Wireless Communication**
- The control unit should be consistent of high number of **General I/O pins**

- 2 Ultrasonic Sensors are used to determine the **Direction of the Motion**
- Less Power Consuming Elements

Installation of the Hardware Modules

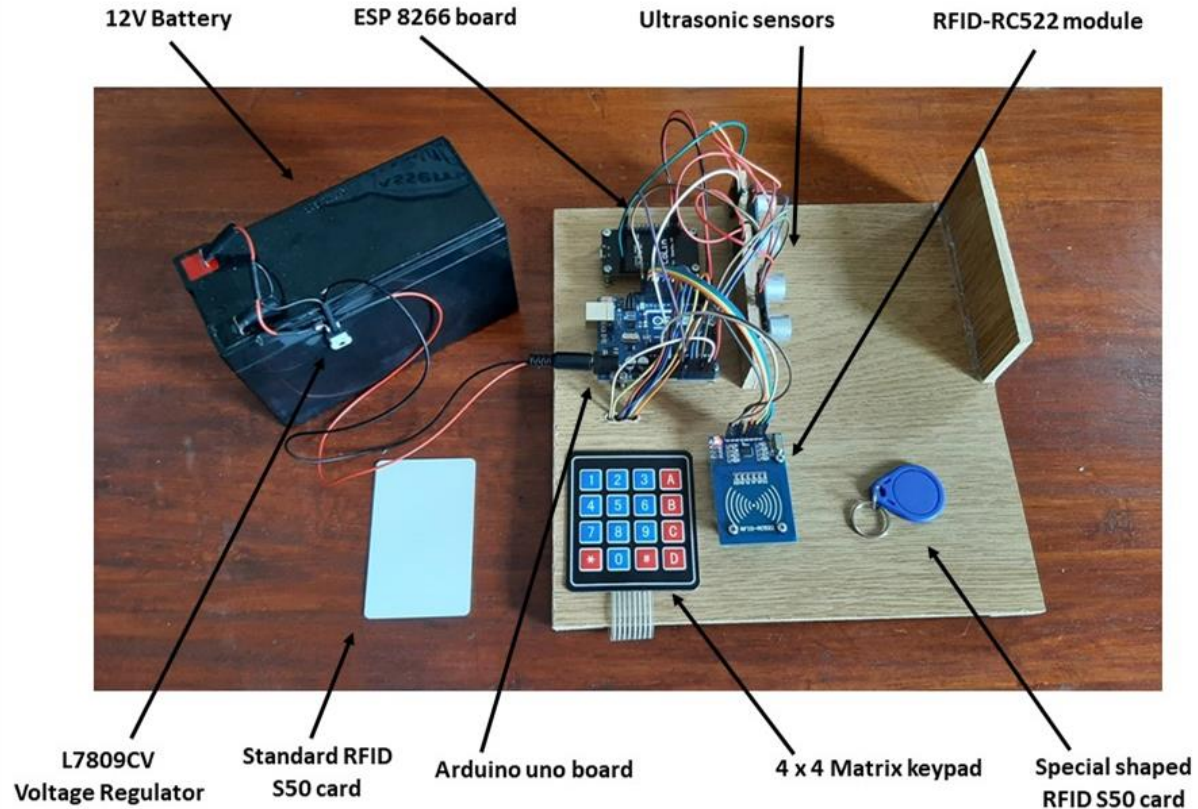


RFID / Keypad Reading Module

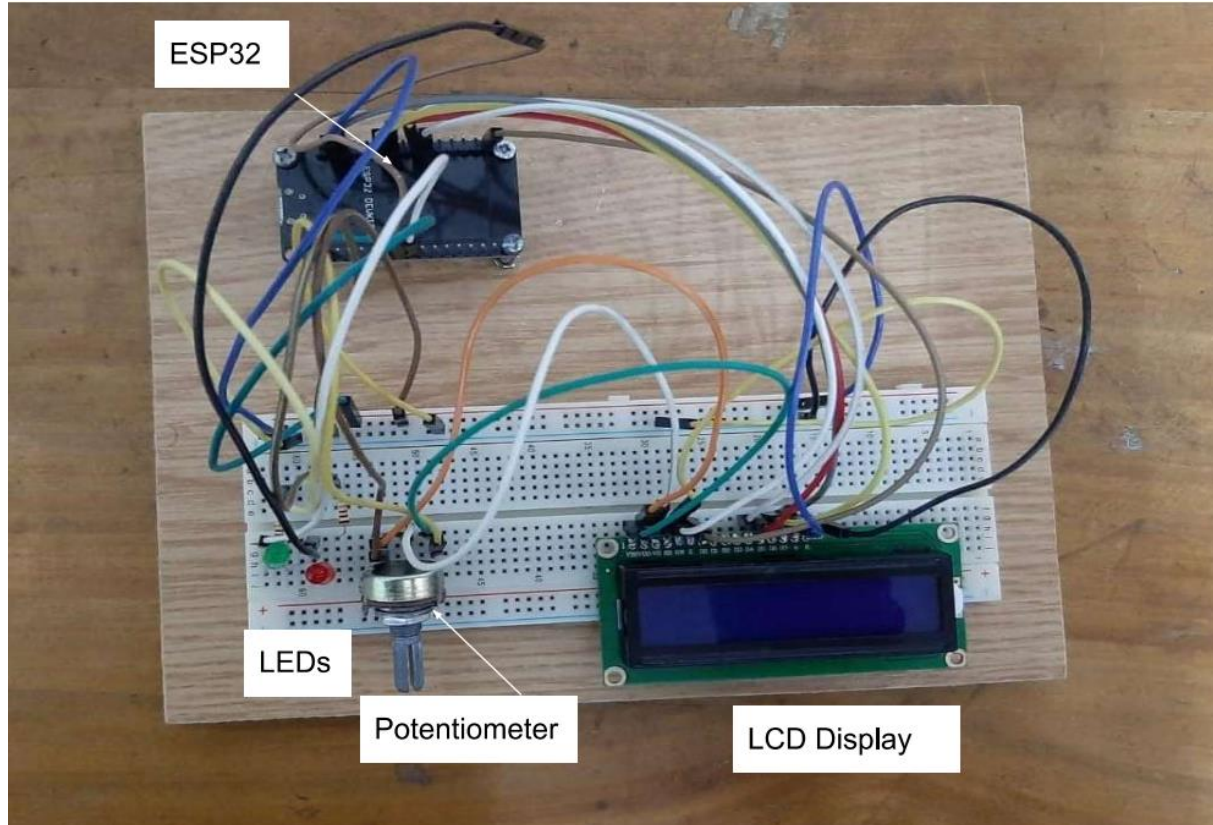


Occupancy Counting Element

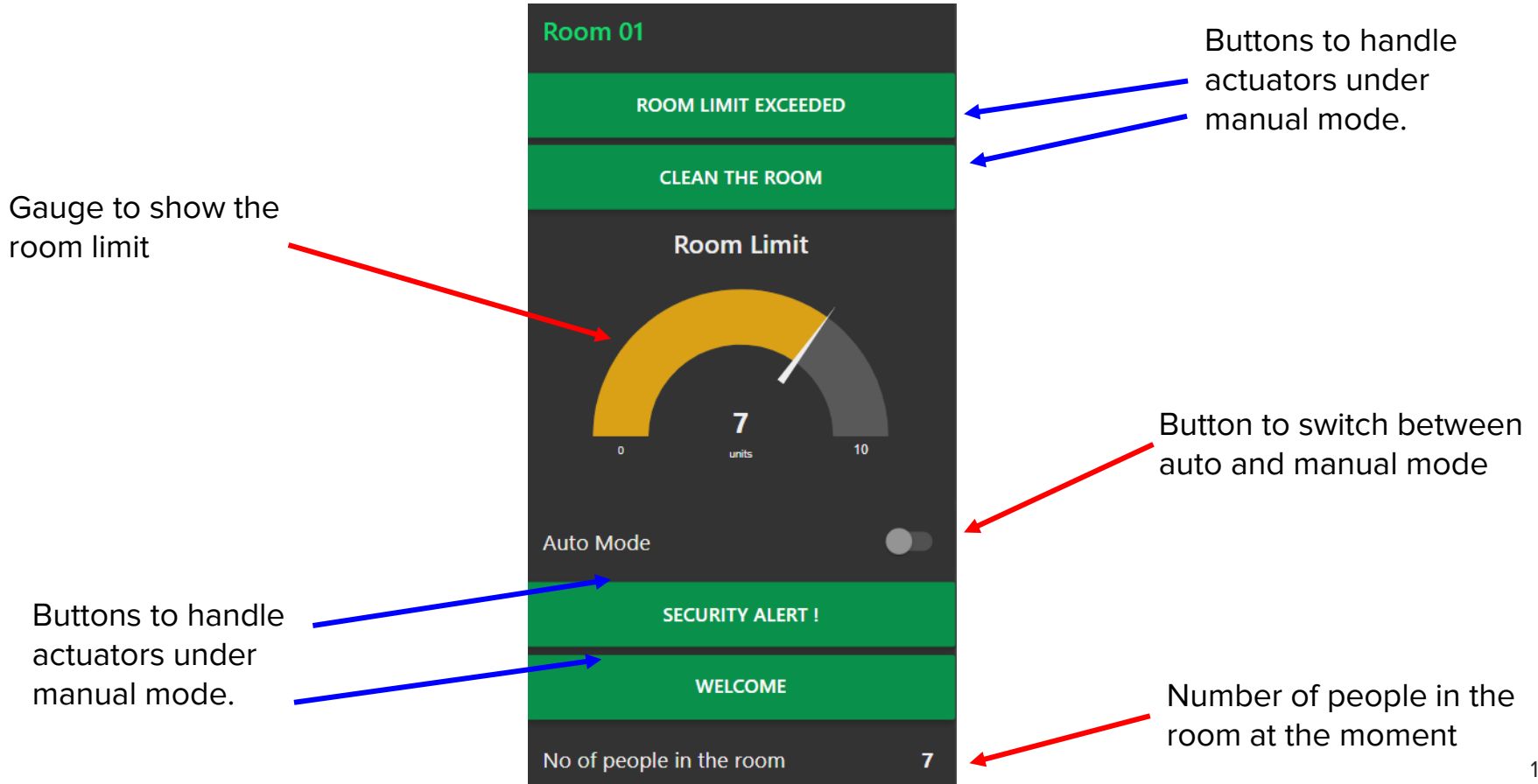
Prototype of the Sensor Module



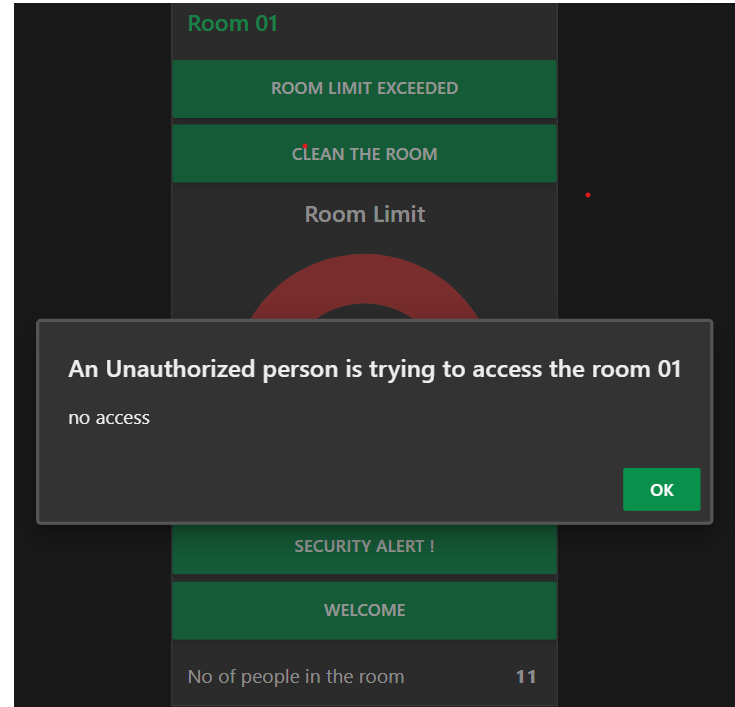
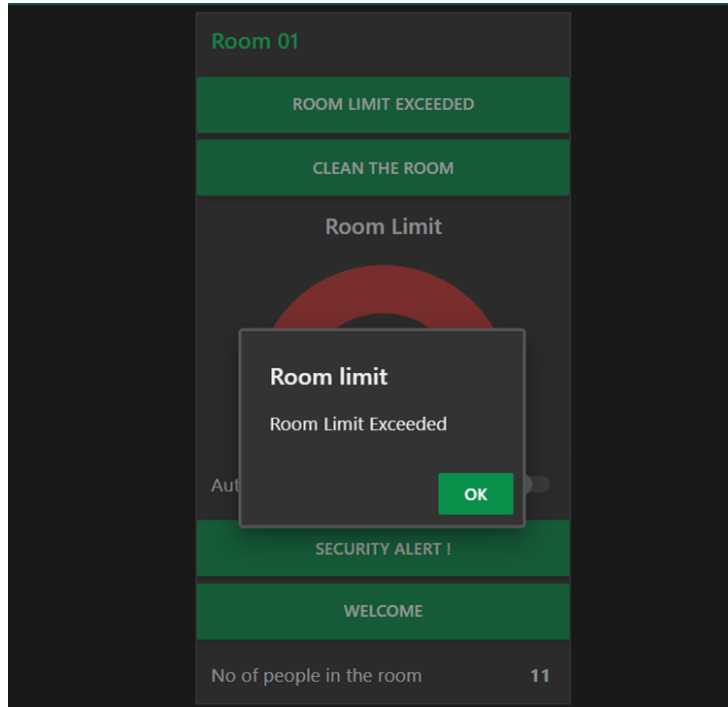
Prototype of the Actuator Module



Node-RED Dashboard

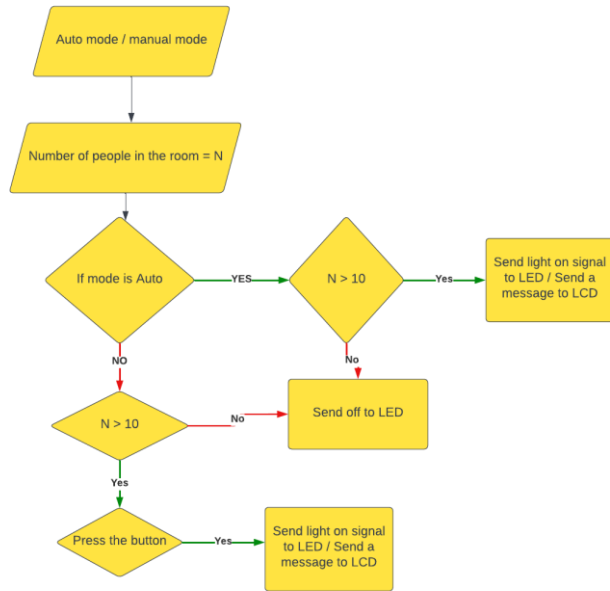


Node-RED Dashboard | Notifications

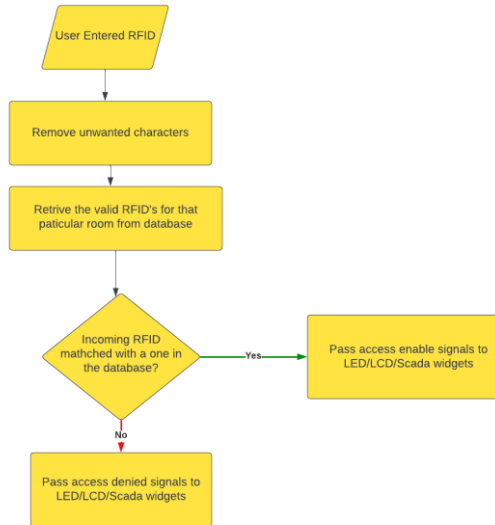


Process Control

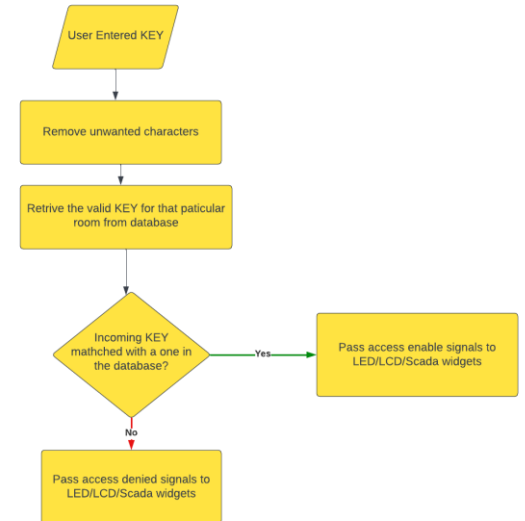
Threshold Maintenance



RFID Authentication



Keypad Authentication



Database and Data Handling

- The Database consists with 3 collections
 - 326_occupancy_room
 - 326_occupancy_rfid
 - 326_occupancy_keypad
- Notifies the other groups when a change happens
- RFIDs and Password
 - Each room has a unique password
 - Each room has authorized RFID list

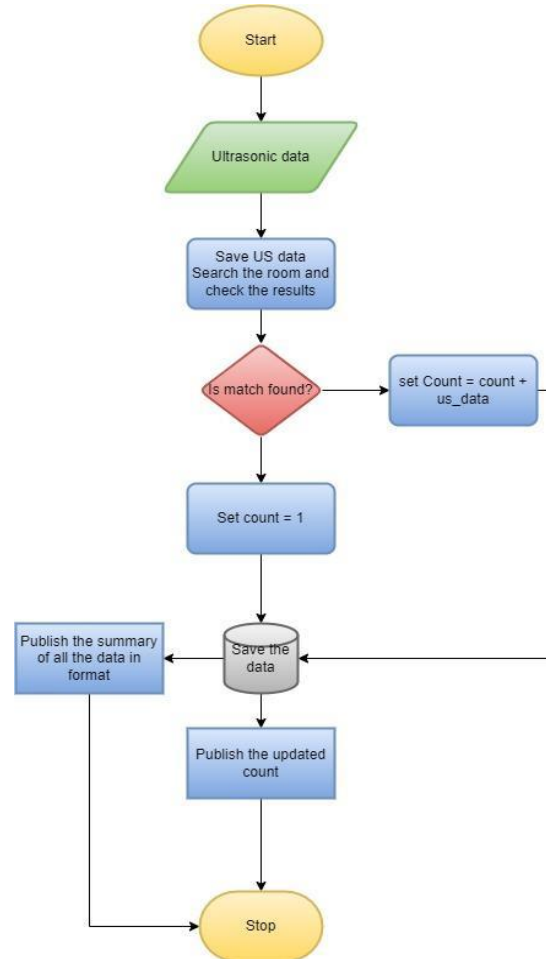
```
▼ 0: object
  _id: "634d91a90502e71145c61f53"
  floor_number: 0
  room_number: 1
  keypad: "456B"
```

```
room_number: 1
floor_number: 0
count: 4
last_update: "10/19/2022, 8:46:40 PM"
```

```
▼ 0: object
  _id: "634d1d500502e71145aee68b"
  floor_number: 0
  room_number: 1
  ▼ rfid: array[2]
    0: " 231 85 243 25"
    1: " 250 187 91 89"
```

Database

Update Count Process



Data Analytics and Optimizations

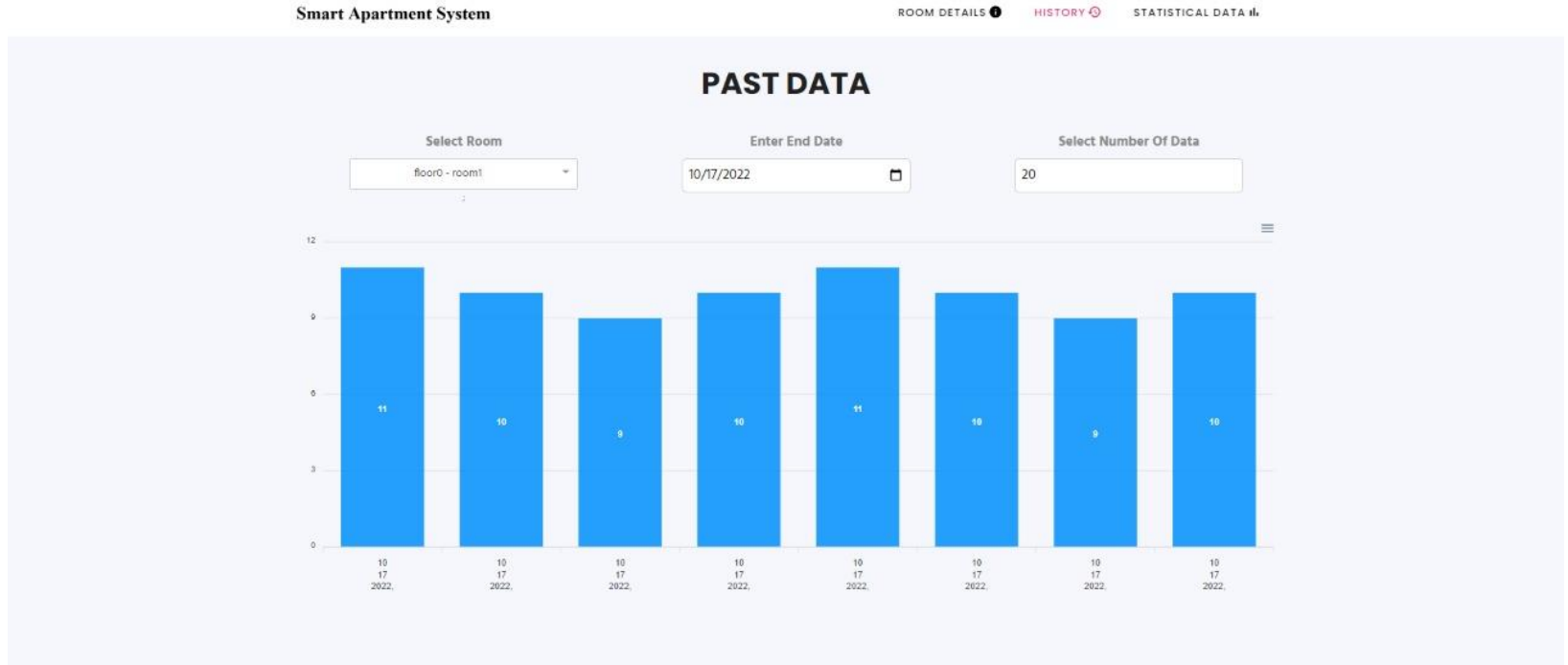
Generating a **Time Series dataset** extracted from MQTT messages

- Will be used to **build the ML Model** which predicts the congested rooms
- These information will be displayed in the **Web Interface**, so that the users can have a clear proper understanding of the **congestion throughout the day**

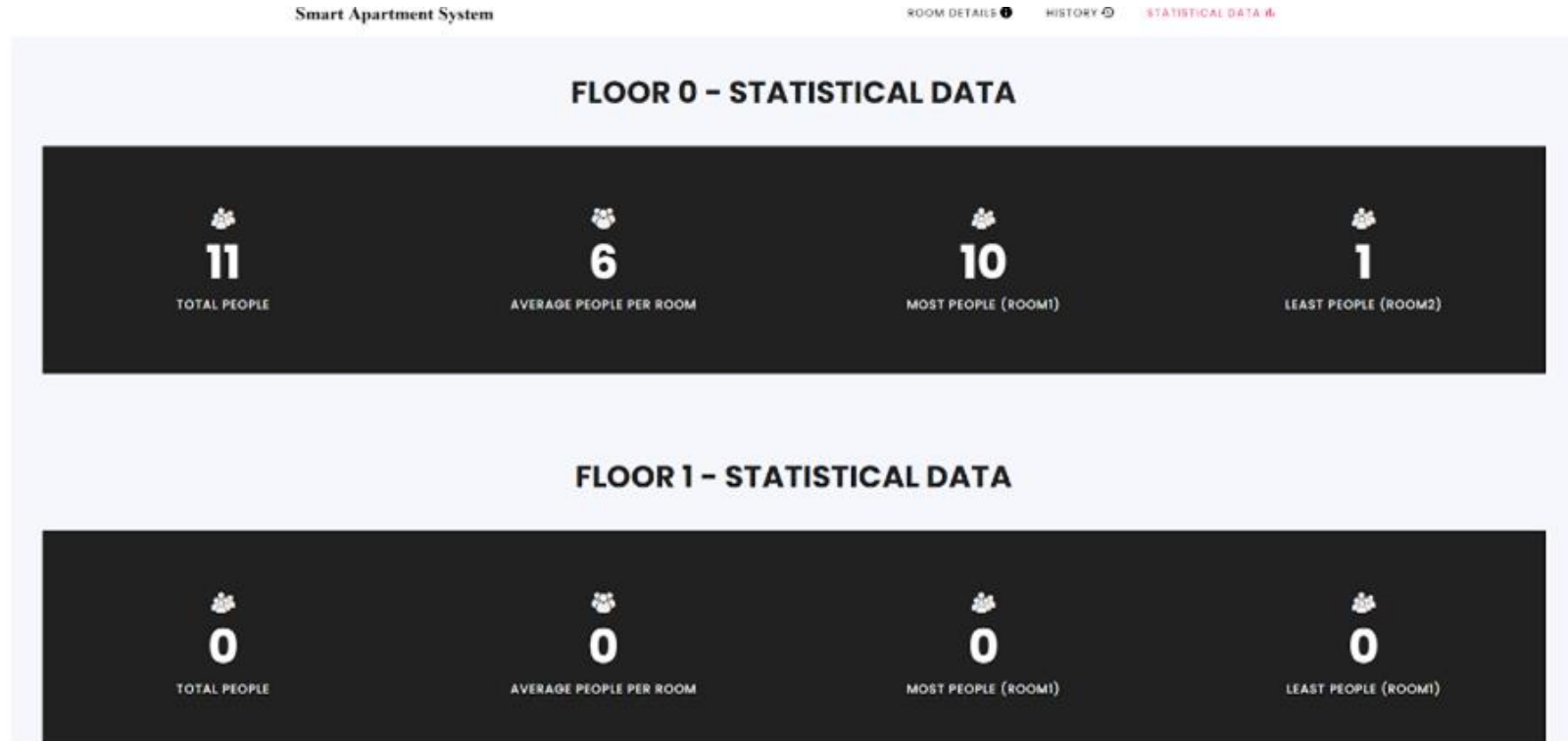
Creating and Maintaining some useful parameters to **manage people**

- *Total people in a floor*
- *Average people in a room*
- *Maximum people of the floor*
- *Minimum people of the floor*
- **People can be directed** from congested rooms to free rooms

Web Interface | Congestion throughout the day



Web Interface | Useful parameters to manage people



Web Interface

The **API** to extract data from the database. Mainly consists with 3 endpoints

- *Room details*
- *Past data*
- *Statistical data*

- API is implemented inside **Node-RED**
- Obtained responses from **Postman** to make sure the API is working properly

The **Web Page** to display the data

- Implemented using **ReactJS**
- There are 3 pages for room details, past data and statistical data.
- In room details page, summary of the apartment will be displayed
- In the past data page, past occupancy details will be shown as a bar chart
- There is an option to download the shown graph as a **png** or **csv**
- Shown In the statistical data page, statistical data for each floor will be displayed.

Future Implementations

- Actual Implementation of the Mechanical Door Lock
- ML model to **Predict Congestions** of rooms
- Extend Authentication further using **Facial Recognition**
- Improve the counting mechanism

Thank You!
