JUNE 2025

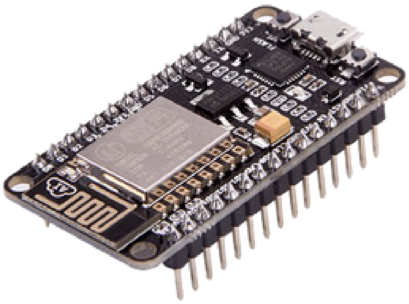
ROOM OCCUPANCE MONITORING SYSTEM

BY LALDJI KHALIL AND
BOUCHEMLA CHERIF OSMANE

OVERVIEW :

this project aims to make a way for shop owners to track traffic into their physical shop and get data from it.
the implementation involved the esp32 mcu, firebase and python for the user interface.

WEEKLY / DAILY



hardware overview

we are using the esp32 to receive and send data to FB and 2 IR sensors for a single door
if IR A has a rising edge then IR B has a rising edge,we count that as an entry therefore we increase the people count and vice versa

Why the esp32 ?

- Built-in Wi-Fi
- Firebase Support
- Affordable and Readily Available
- Plenty of community support and tutorials online

what is firebase ?

Firebase is a Backend-as-a-Service (BaaS) platform provided by Google that helps developers build and scale applications faster by handling many backend tasks for them. A Firebase backend provider simply refers to Firebase itself, acting as the backend infrastructure for your app or system, including IoT projects.

fire base is useful because they provide in their free plan a real time database.

real time database

The Firebase Realtime Database (RTDB) is a cloud-hosted NoSQL database provided by Google Firebase, designed to store and sync data between clients in real-time.
Firebase RTDB stores all data as a single JSON object (tree structure).

```
{
  "room": {
    "people_count": 4,
    "logs": {
      "-NxA1...": {
        "time": 1720000000,
        "action": "entered",
        "count": 4
      },
      "-NxA2...": {
        "time": 1720003000,
        "action": "exited",
        "count": 3
      }
    }
  }
}
```

software used

you can program the esp32 by using the platform io extension in vs code
you can also use the arduino ide but for this report we will show codes and instructions from pio but its not that different

WIFi library :

This is the built-in ESP32 Wi-Fi library provided by the Arduino core for ESP32. It allows your microcontroller to connect to a Wi-Fi network main functions of this library :

- Connects the ESP32 to a Wi-Fi network (WiFi.begin(ssid, password))
- Checks connection status (WiFi.status())
- Retrieves IP address and MAC (WiFi.localIP())

the firebase ESP client library

we are going deep into this library since its the one responsible for the communication between firebase and the esp

Firebase.RTDB.setInt(&fbdo, path, value)

this functions sends an integer value to the database with a given path

Firebase.RTDB.setString(&fbdo, path, value)

Writes a string value to the Realtime Database at the specified path

Firebase.RTDB.pushJSON(&fbdo, path, json)

```
FirebaseJson json;
json.set("action", "entry");
json.set("time", millis());
json.set("count", 3);
Firebase.RTDB.pushJSON(&fbdo,
"/room/logs", &json);
```

Pushes a new JSON object into a list-like structure in the database. Firebase automatically generates a unique key for each entry
so every json sent is unique

FirebaseData fbdo;
tThis is the primary object used for all interactions with the Realtime Database. It holds data retrieved from Firebase, stores the result of operations, and provides access to error message

for the rest of the explanation you can check the code it is documented

config.token_status_callback = tokenStatusCallback;

When your ESP32 uses Firebase Authentication (even anonymous auth), it gets an ID token to prove it’s allowed to read/write data.
This token has an expiration time (usually 1 hour), after which it needs to be refreshed automatically.

the token status callback function provides real-time feedback on the authentication token status, such as:

- When the token is being requested
- When it is refreshed successfully
- If an error occurs while refreshing it

so we are registering the tokenStatusCallback in the FirebaseConfig object,

firebase setup :

to set up firebase for the esp32 you only have to signup and create a realtime data base
set up your rdb and make sure the Authentication method is anonymous

there are several youtube videos detailing how to create this database

python gui :

a python code was used for :

- get data from the sensor and display them to the user
- export the data as a csv file

we used the Tkinter library to make a simple gui and the and the firebase_adnin library to get data

conclusion:

this was a simple intro to iot with the esp32 for us and it was overall an informative experience