# R.O.M.

Room Occupancy Map

# The evolution of our project

**THE FIRST PRESENTATION**

Looking at the first presentation, we can see that there were:

- A lack of focus
- A goal that wasn't set
- An overall lack of metrics to better measure our progress

## OCCUPANCY

*"We want to count the number of people in a room"*

As you can see, our project has moved toward this direction to better suit the need for this kind of product in the market, the reasoning being mainly due to COVID-19 restrictions that buildings such as this university must respect.

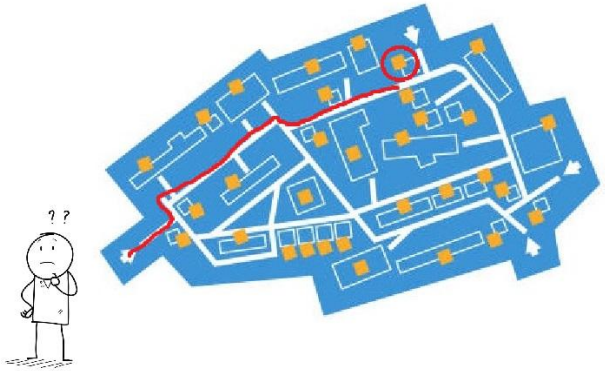
# Goals

## Economical cost

- Provide an alternative to current systems (implementing cameras), using cheaper components but reaching the same accuracy.
- We aim to reduce the cost by 75%, going from around 200$ to 50$


## Time Spending

- Reduce the time spent to find available workspace or free rooms in the building.
- Thanks to our map a person can save up to 50% of his time



# Requirements

- In order to completely achieve our goal, it's important to reach at least 90% accuracy in counting people (with this percentage varying depending on the maximum capacity of the room we are analyzing)

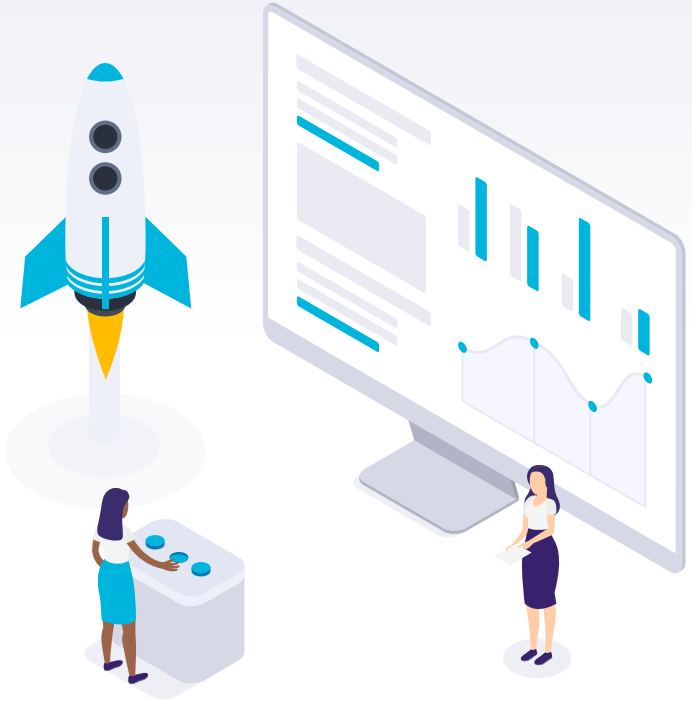
- To provide this functionality we need to have a real time map, updating in no less than 30 seconds

- The physical configuration of our system should be easy to set up and not invasive

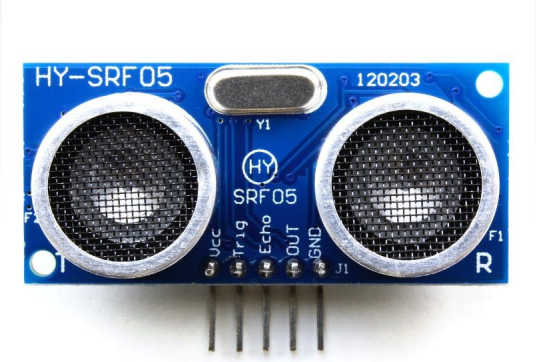
1

# Our system

- Sensors used
- Configuration

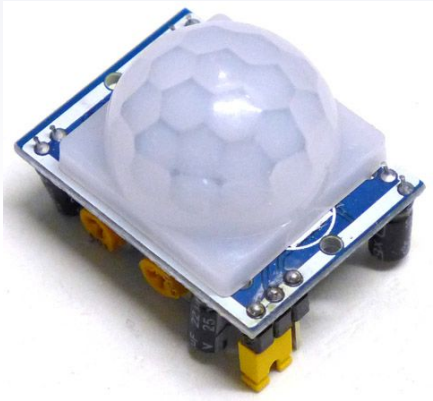


# The sensors used




SRF05
Ultrasonic sensor (x2)

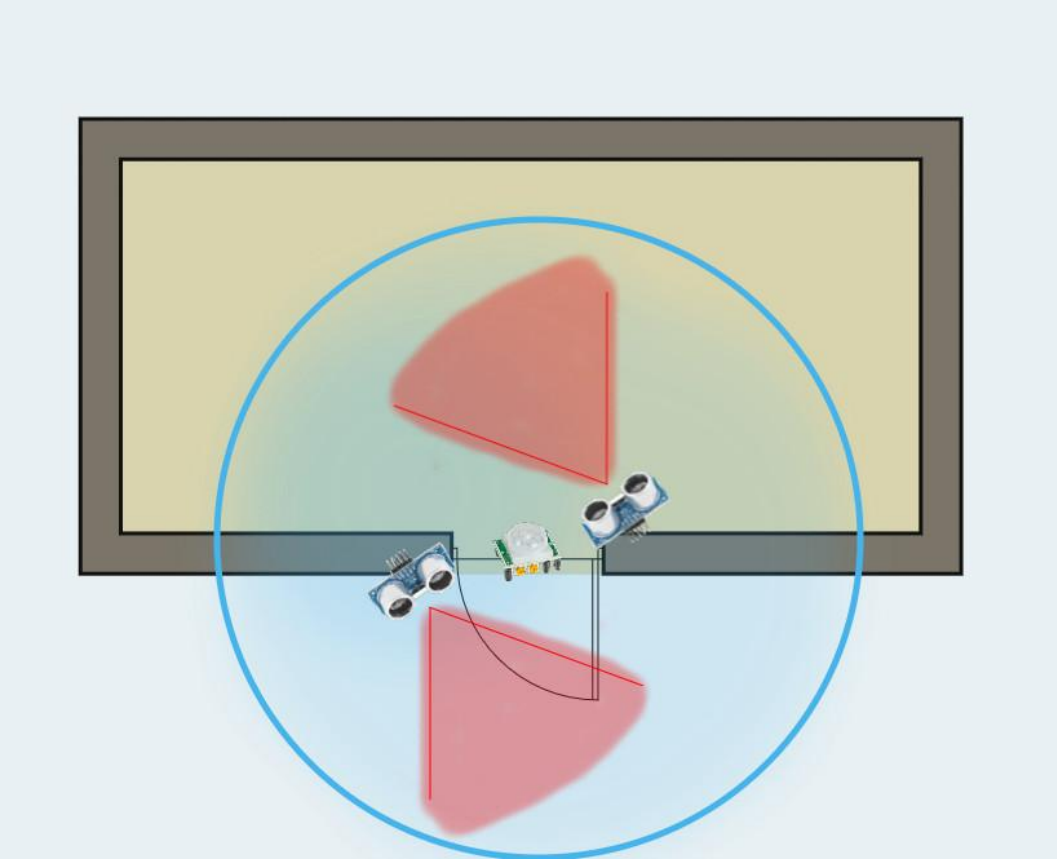
- Range: 1 cm - 4 mt
- Max Angle: 30°



HC-SR501
Motion sensor

- Radius: 3 - 7 mt
- Field of view: 110°

# THE CONFIGURATION

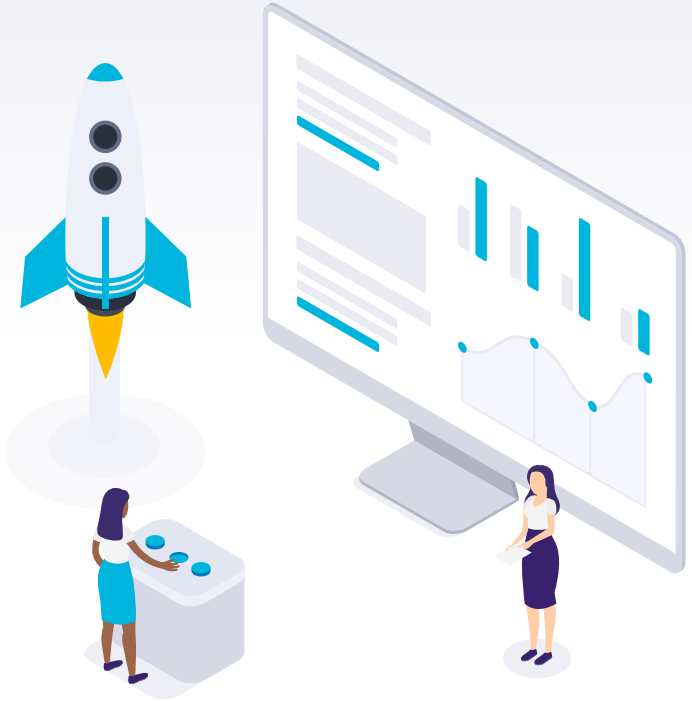


This is the first configuration that we plan to test

2

# Technical constraints

- Energy consumption
- Network utilization



# Energy consumption

| | mA |
|---|---|
| SRF05 | **50** |
| HC-SR501 | **65** |
| STM32 run | **0.137/MHz** |
| STM32 sleep | **0.024** |
| ESP-01S wifi-module | **50/15** |

Total power needed:

No assumption made, everything on the board is running

0.8 W

Actual use:

Under the assumption that the PIR sensor goes off for 30 minutes every hour, and that the board sleeps through the non working hours we get that a standard 10000 mAh battery would last for:

Approx. 10 days

Due to us working with the datasheet, we didn't include the mA needed to power the board. Once a USB multimeter will be available, the calculation will be updated.

# Energy consumption

## BATTERY

- The main advantage of running on battery is the simple installation.
- However, as we can see from our calculation, the battery consumption is still pretty high

## ELECTRICAL GRID

- A dedicated installation can be costly, especially when it is done to every room in the building.
- However, changing the batteries often is also a cost.

Batteries should be changed too often for every room in the building, the maintenance cost outweighs the installation cost of attaching it directly to the electrical grid.

# Network utilization

- Due to being in a building, we assume that we have a working wifi in every room. As such, we can connect directly to the internet with a wifi-module.
- We plan to send to the mqtt broker every data obtained in intervals of 500ms
  - (The reasoning being that 0.5s is low enough so that in the event of multiple people passing in a line, the data is mainly about a single person, while it's also high enough to not congest the network)
- The bit-rate of the wifi protocol ranges from 0.1 mb/s to 1 mb/s, so the bandwidth should be plenty enough
- Further testing to calculate the delay of the information appearing on the map is needed

# Sampling rate

- The walking speed of a person is on average 1.4m/s
- The range of our PIR movement sensor is 7 m, while the range of our ultrasonic sensor is 4m
  - This means that we have approximately 2.8 seconds to sample a person's movement
- We oversample and take a measurement every 100ms

3

# Future Plans

- Configuration experiments and measurements
- Solve technical problems

# Problems in counting people

A distinction needs to be made for people entering and exiting at the same time

How to count people that enter together?

Multiple entrances require multiple nodes

# Possibles configurations

Our main objective will be to experiment with several configurations, measure their accuracy and present our research highlighting  the differences between them.

# THANKS!

## Any questions?