



# AutoSense

## Analytics

*A data collection company utilizing vehicle mounted sensors*





# PROBLEM STATEMENT



1

Lack of available data for **Urban Infrastructure**, needed for deployment and maintenance decisions

2

Network **blind spots**, weak signal strength, incorrectly positioned antennas

3

Not enough data for **road quality** and **roughness**, **unsafe roads** in need of maintenance

# AUTOSENSE ANALYTICS

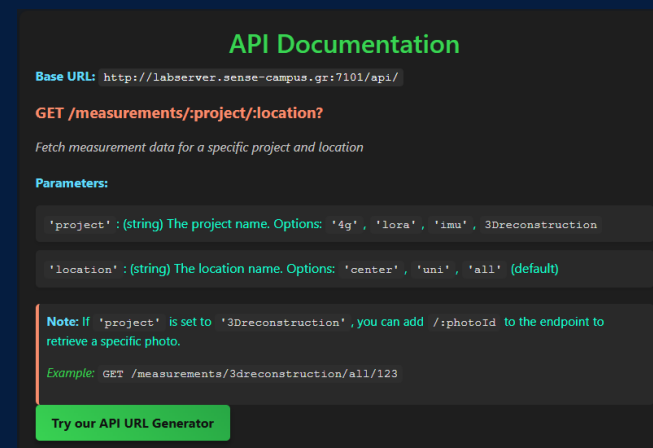
Deploy sensors on moving vehicles to collect real-time mobile data across various routes



Centralized Data Integration Platform offering unified and complete data presentation and analysis



On-demand data collection

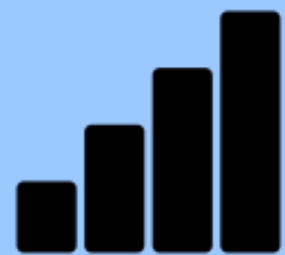


Adaptation of IoT Technologies





# COMPLETED PROJECTS



## Signal RSSI Mapping

Measuring:

**4G** (4G hat for Rpi)  
**LoRa** (Arduino)  
**WiFi**

Providing:

- Detection of **dead signal spots**
- Creation of **signal coverage heatmap**



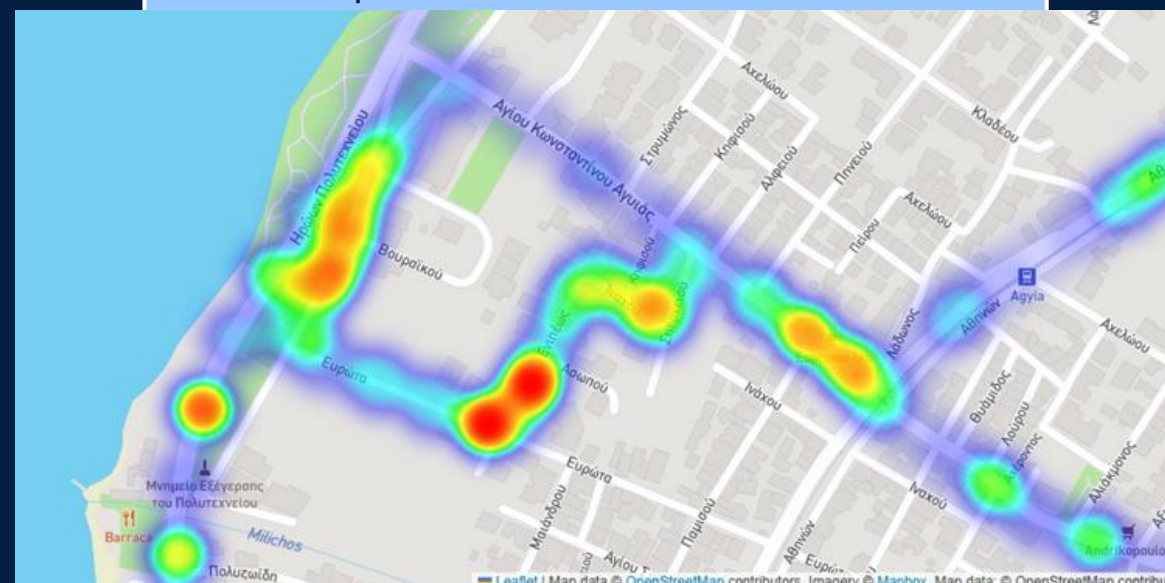
## Road Roughness

Detecting:

**Road roughness** detection using IMU  
connected to RPi

Providing:

- Creation of road roughness heatmap, pointing the potholes
- Use photos for visual confirmation



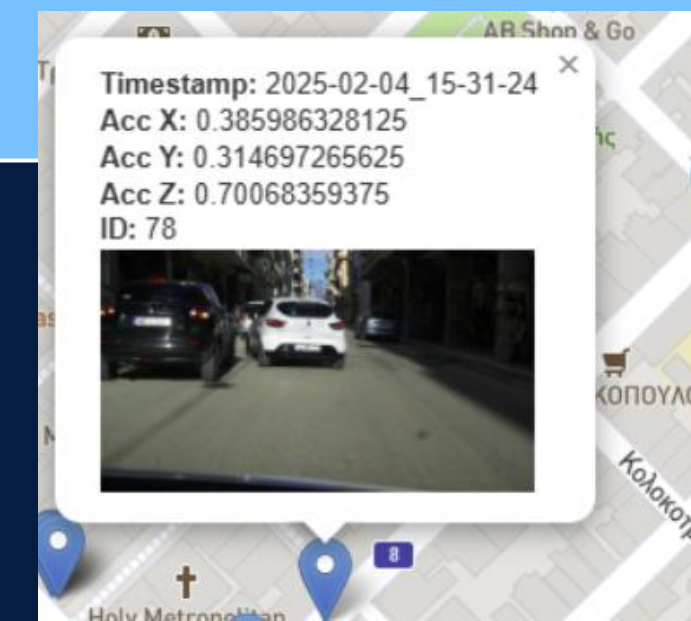
## Image Collection

Collecting:

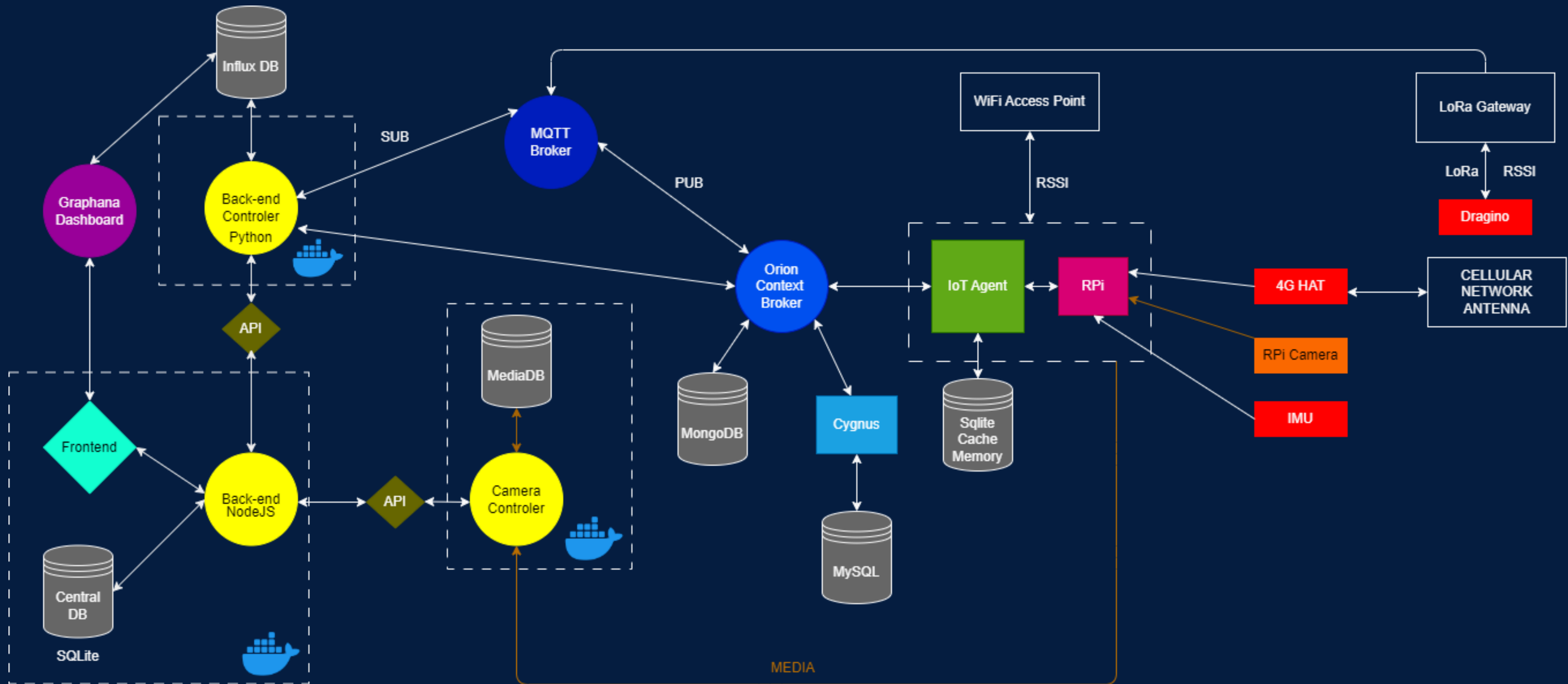
**Images** from RPi camera  
**IMU** Measurements  
**GPS** position

Providing:

- Information from the images collected and confirmation of data analysis results

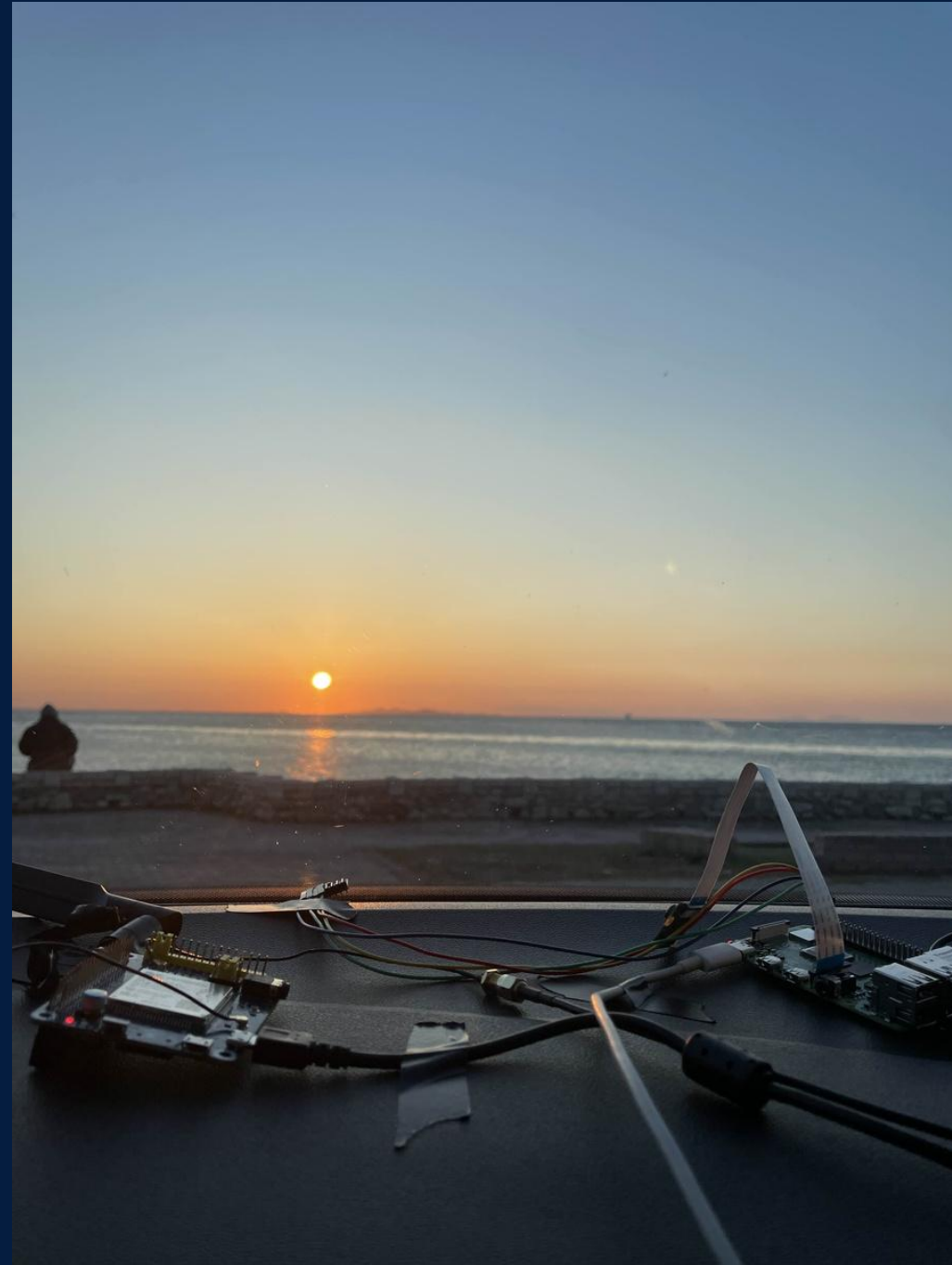


# FINAL ARCHITECTURE OVERVIEW





# HARDWARE AND SENSORS





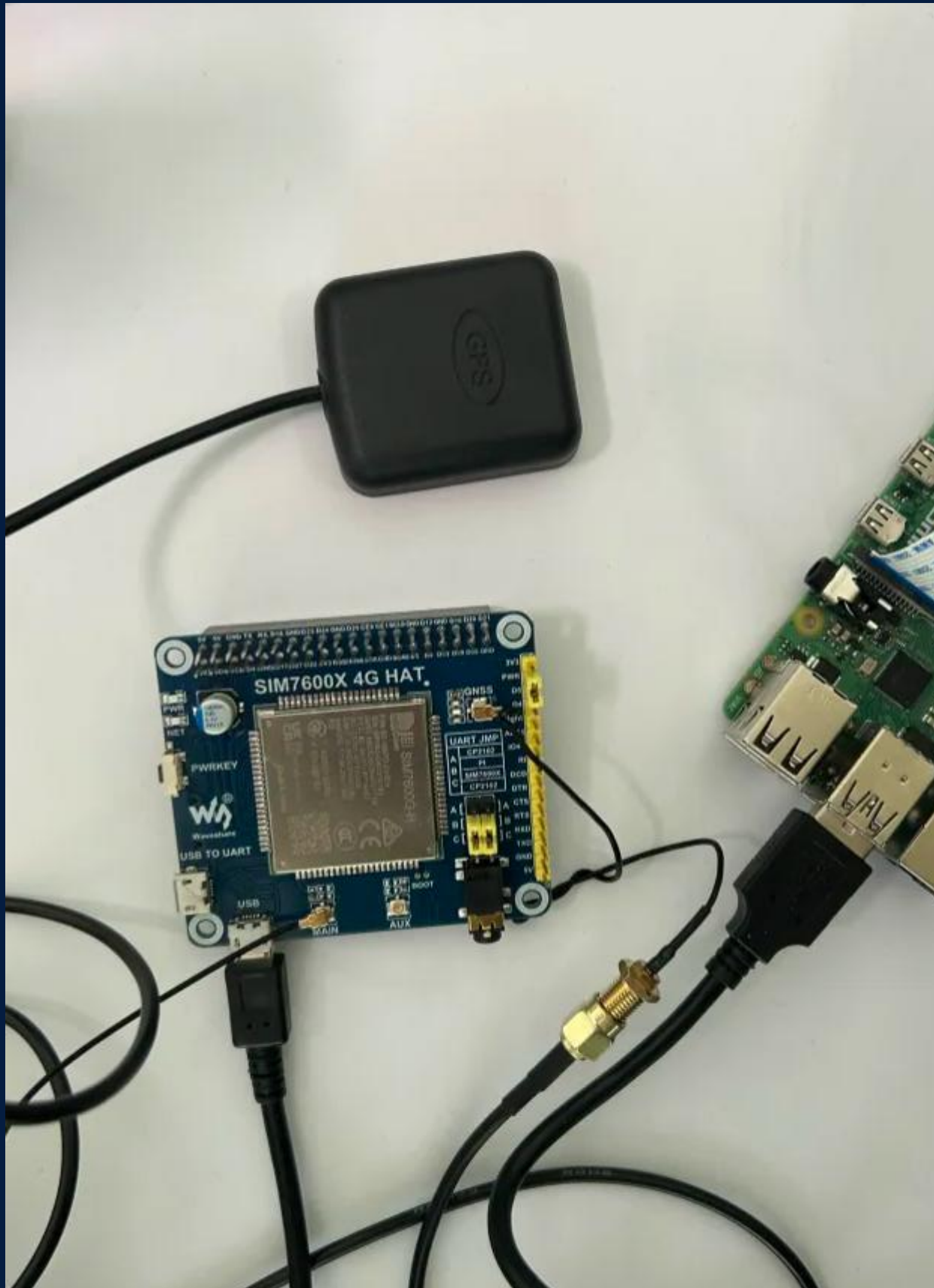
# 4G HAT

## Hardware and Data Collection

- Connected via USB port to Rpi
- Retrives GPS and 4G RSSI values of NOVA Cellular Network (AT Commands) and posts it to FIWARE

## GSM/4G LTE connection

- Enter APN for NOVA and start the data session
- Get the assigned IP address, gateway and DNS Servers
- Configure the Rpi Network Interface (assign the IP and set the default gateway) in order to route internet traffic through wwan0.
- Set Network Manager to manage the modem
- Create a saved 4G Connection



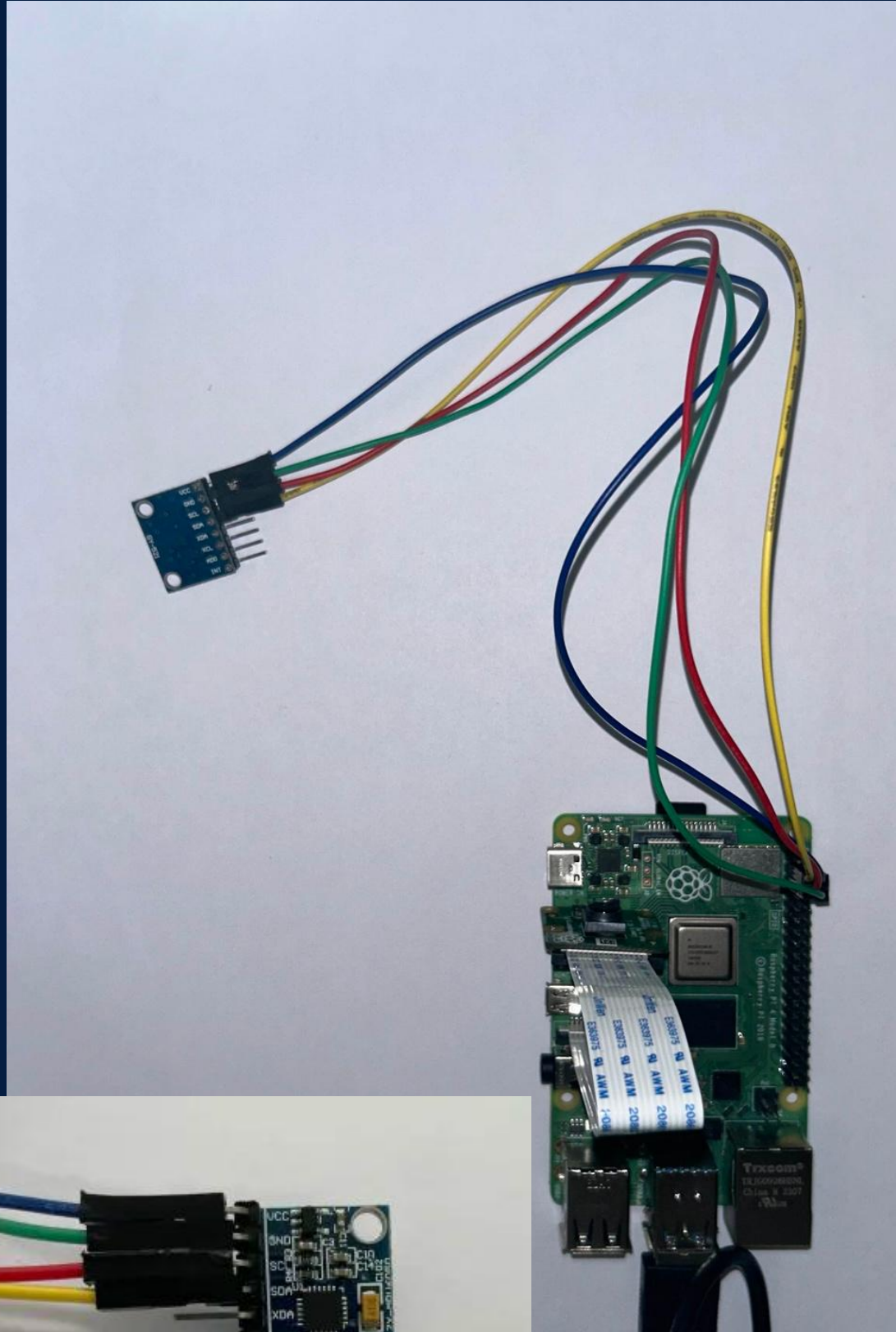
# IMU SENSOR

## Data Collecting

- Measuring the acceleration at x ,y ,z axis at a 20Hz rate
- Retrieving location, timestamp, speed, altitude from GPS Antenna every 2 seconds and posts it to FIWARE via 4G HAT, along with the accumulated acceleration measurements.

## Data Processing

- Keep only the z axis data, perform FFT for each window of 2 seconds (40 acc\_z values)
- Pass through Filter and keep only the >5 Hz frequencies
- Calculate Roughness Score by summarizing the absolute values
- Edge Processing can be implemented





# CAMERA

## Hardware and Data Collection

- Connected the camera via the Camera Serial Interface
- The IMU on the GPIO pins
- The 4G module, through USB
- Implemented threads to capture an image, collect 3-axis acceleration (IMU), GPS position (4G module) and post (HTTP) those to the Camera Controller via 4G.

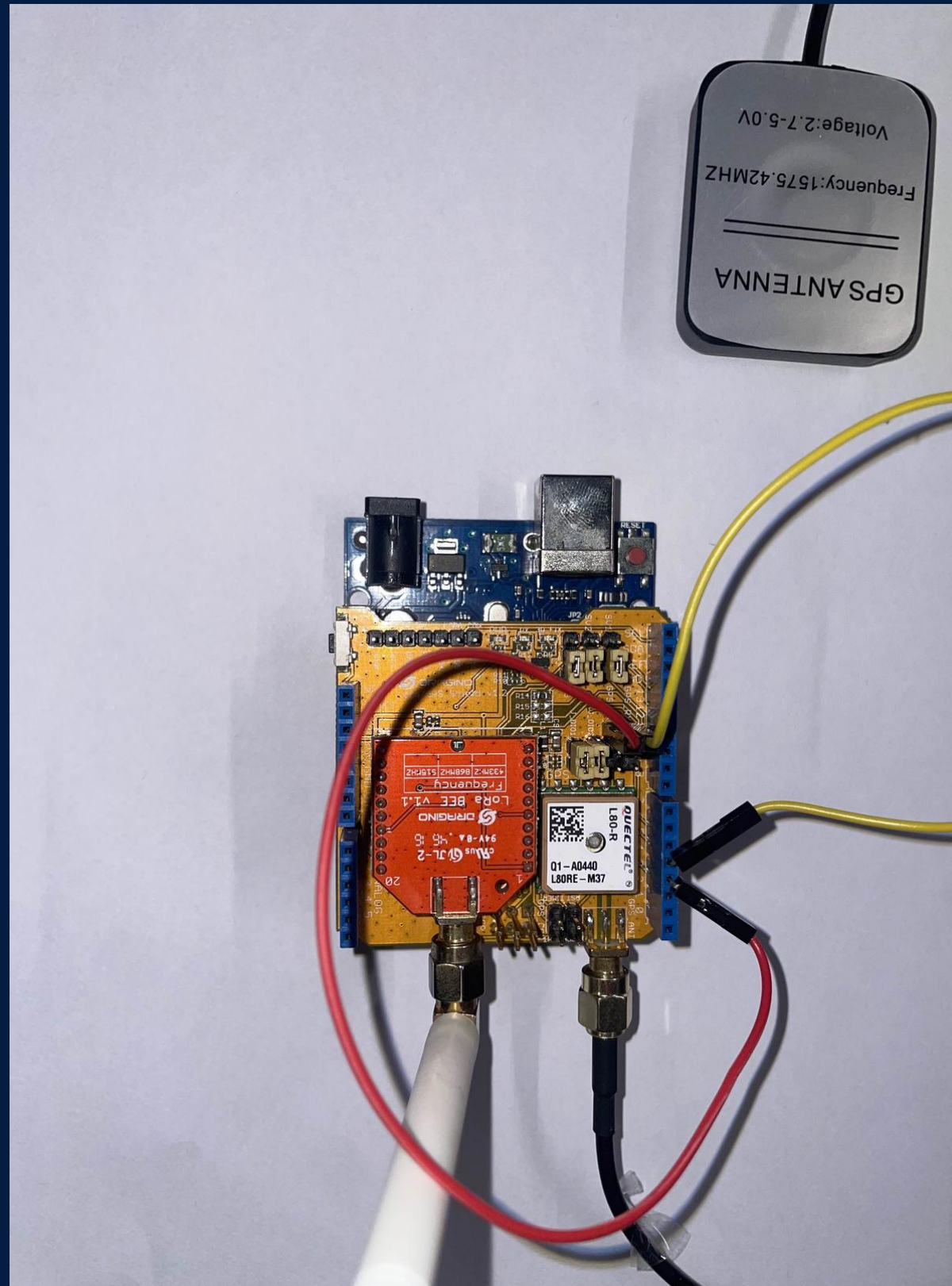
## Camera Controller

- Developed, containerize and hosted a Camera Controller
- Receives the image, extracts the metadata, stores the image and its corresponding data
- Provides an API, that offers access to the images





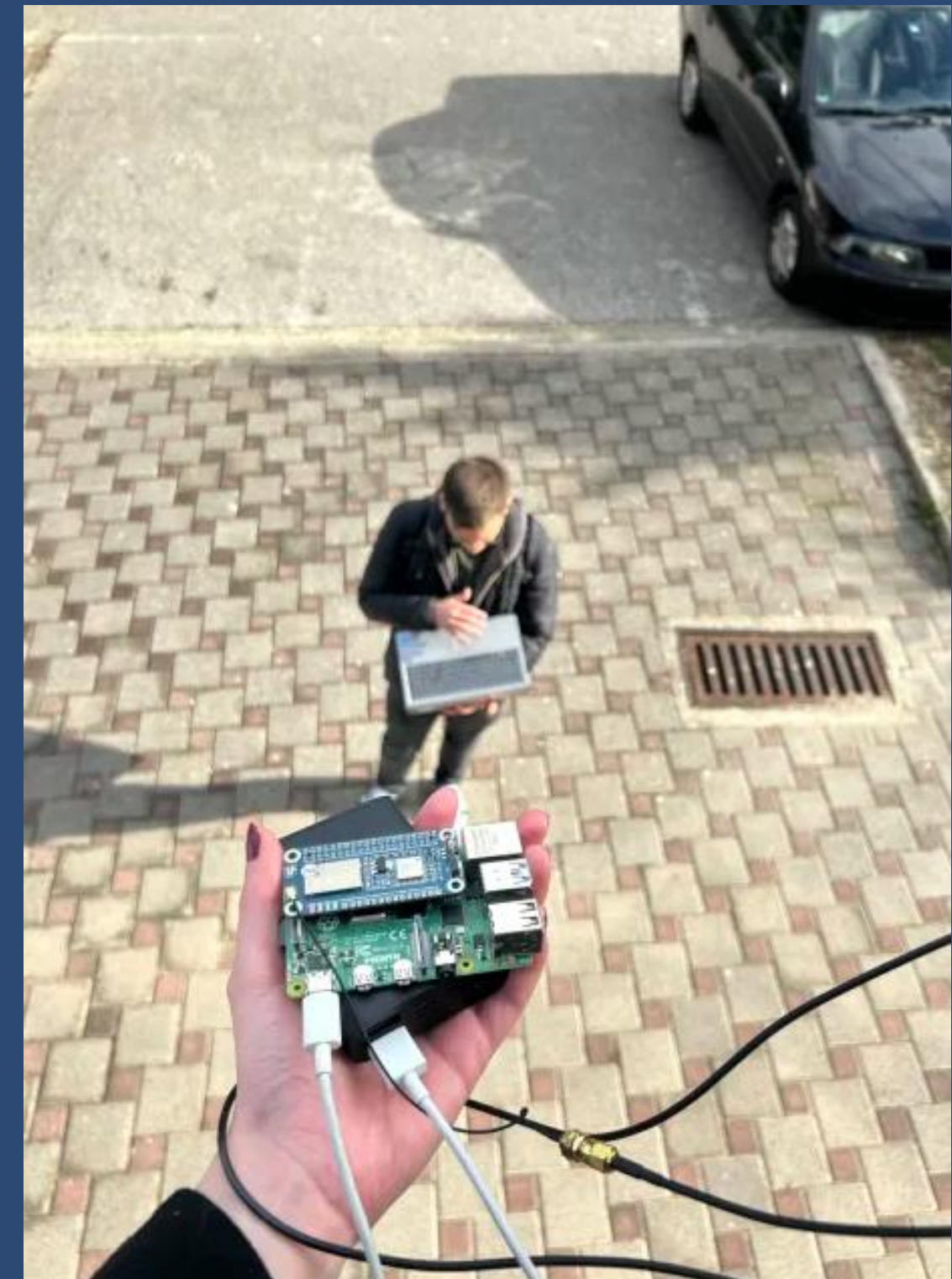
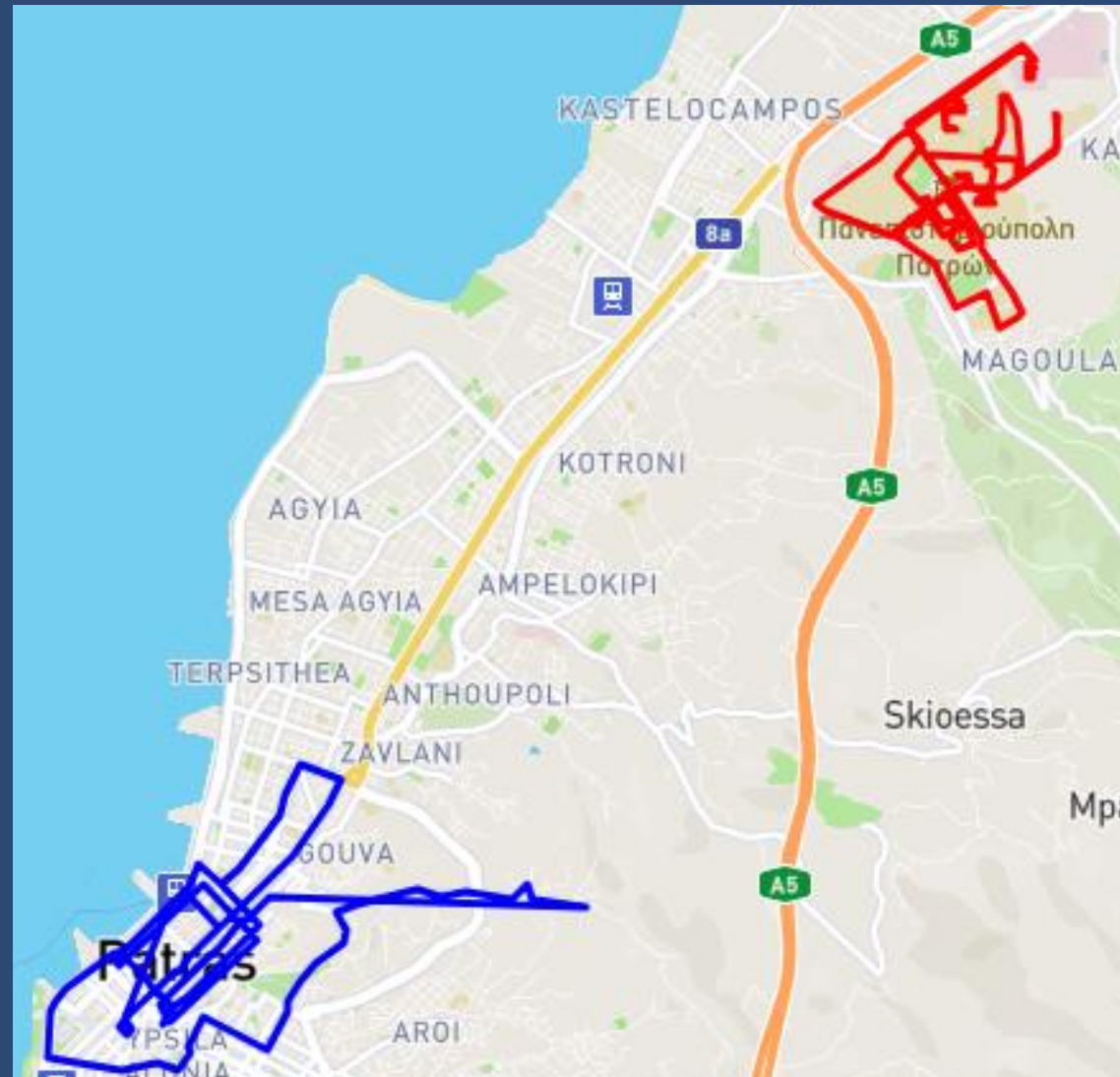
# LORA



- Using Arduino and Dragino for adding LoRaWAN connectivity
- A LoRa packet is sent from Dragino containing its current GPS location
- The LoRa antenna captures the LoRa signal and calculates the RSSI
- An MQTT notification is being published, containing GPS, Timestamp, LoRa RSSI
- Our backend controller has subscribed to the particular MQTT topic and posts the measurements to FIWARE



# REAL DATA COLLECTION AT CAMPUS AND CITY CENTER

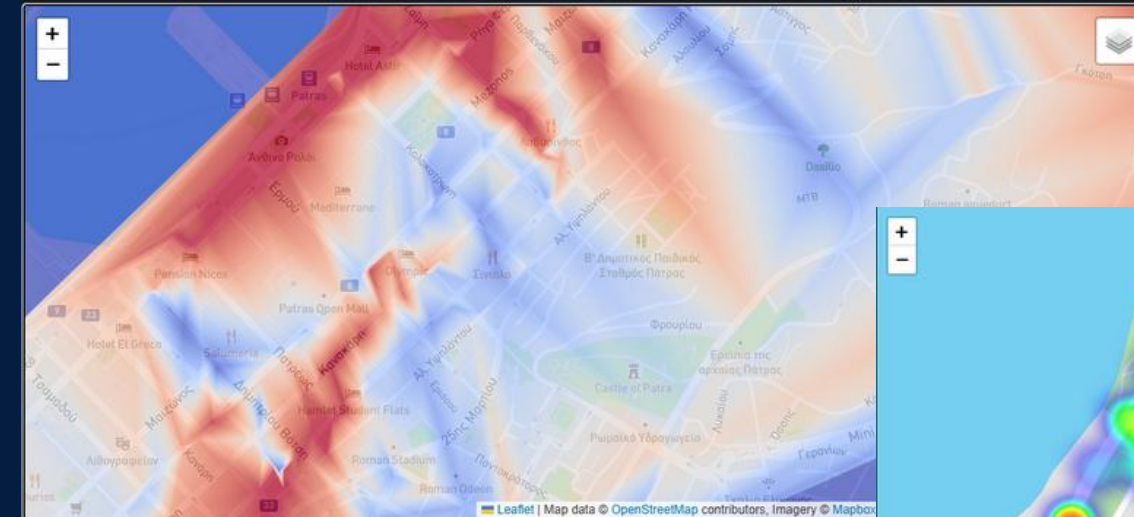




# CHALLENGES

1

RSSI Heatmap Generation



2

IMU Data collection and processing



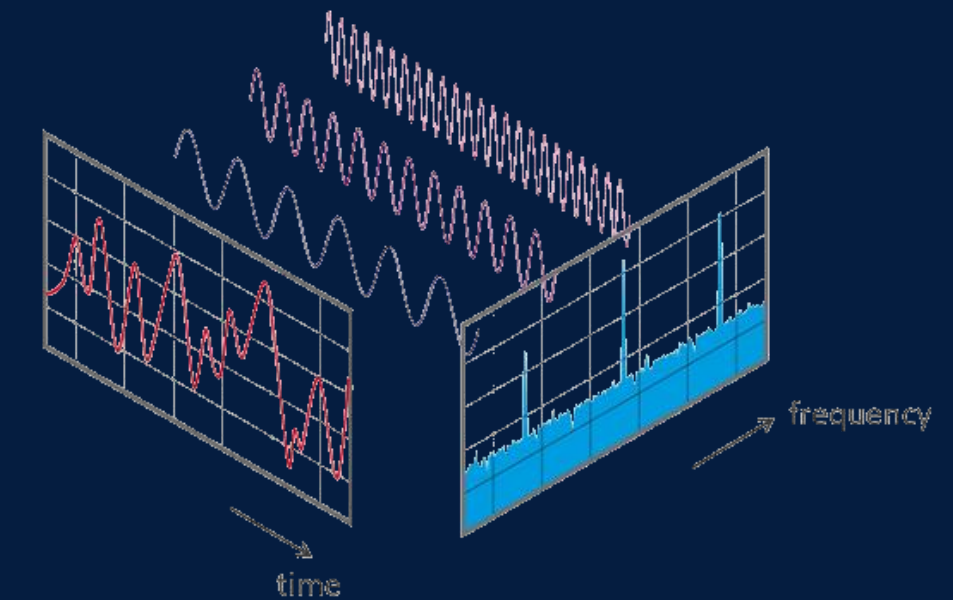
3

Combination of sensors (same interfaces)



4

Measurement interruptions due to shutdown or connection loss



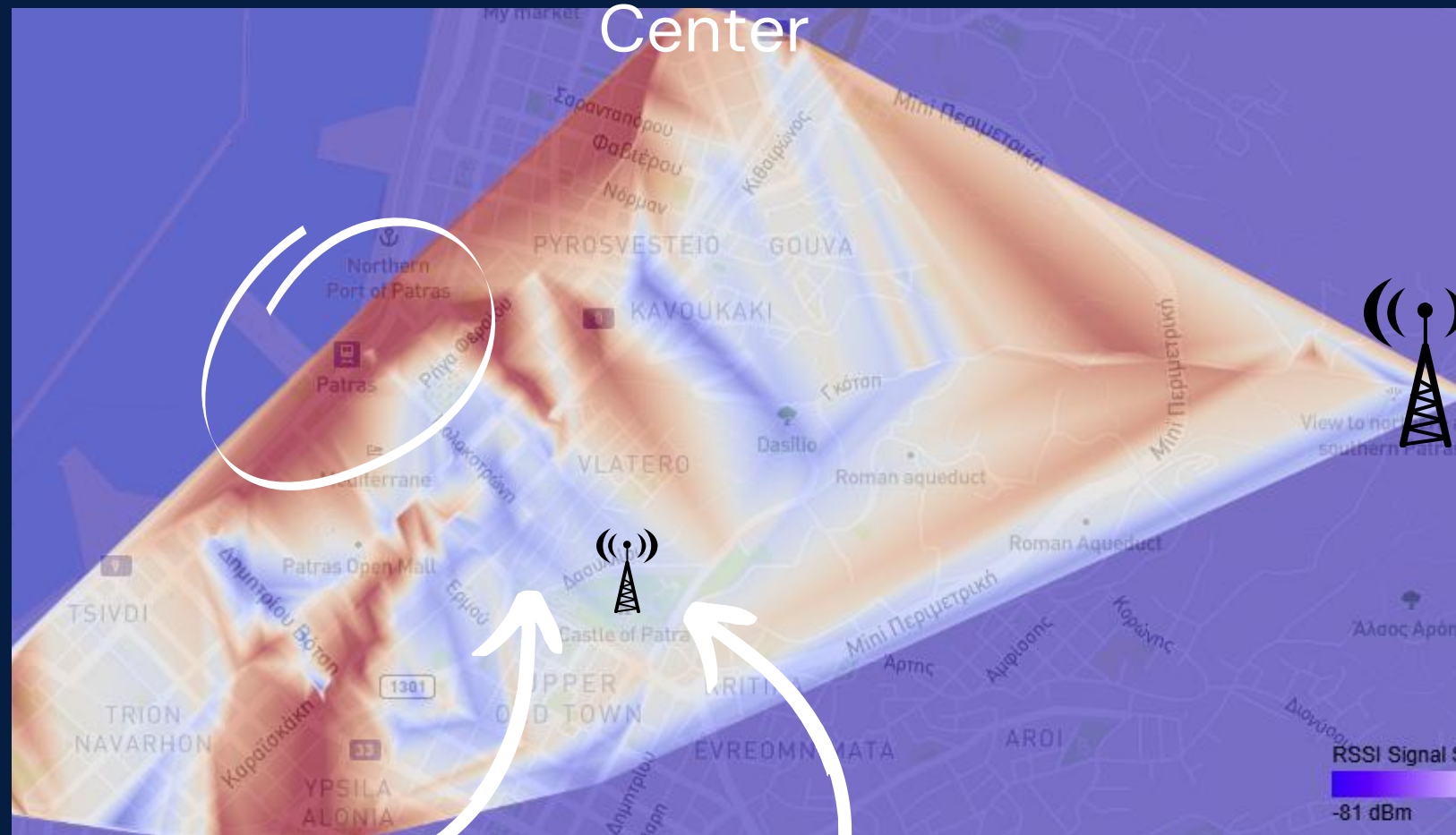


# 4G SIGNAL COVERAGE RESULTS

Using NOVA Cellular  
Network

## Patras City

### Center



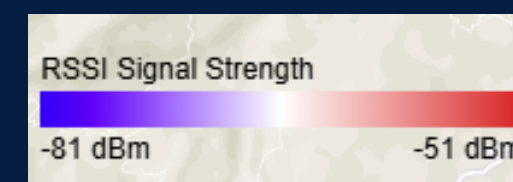
- Stronger RSSI at open space areas
- Weaker signal in the center due to buildings (shadowing, blocking)
- Dasilio Patras, despite the location of the antennas, weaker signal due to height differences (possible no LOS)

## University Campus



- Stronger 4G Signal at CEID (due to LOS)
- Weaker Signal between buildings (near BA weak)

RSSI (dBm)	Signal Strength
> -65 dBm	Excellent
-65 to -75 dBm	Good
-75 to -85 dBm	Fair
-85 to -95 dBm	Weak
< -95 dBm	Very Poor

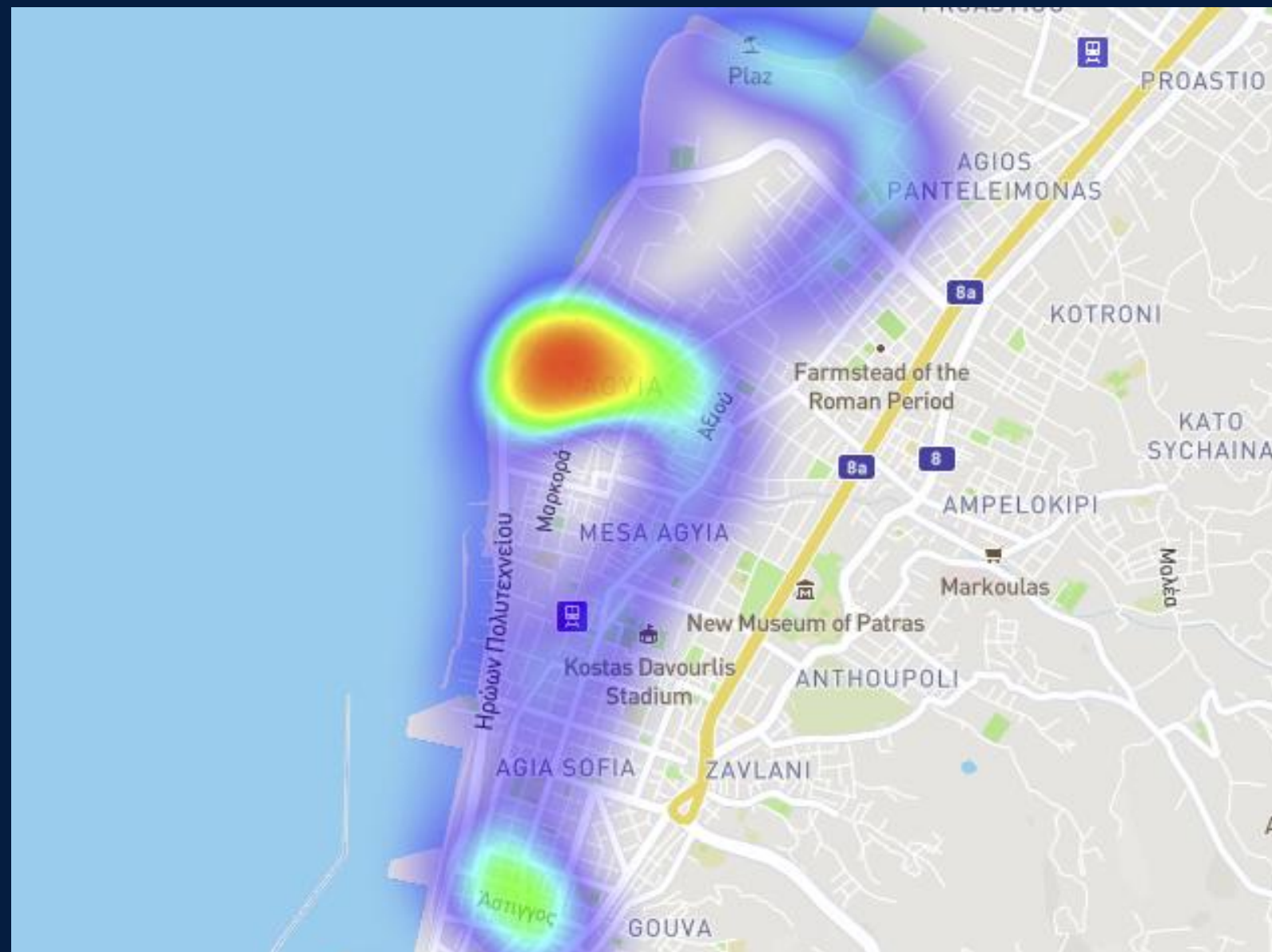




# ROAD DATA RESULTS

Confirmed by photos taken by Rpi Camera Hat

## Road Roughness Heatmap



## Road Roughness Score Points

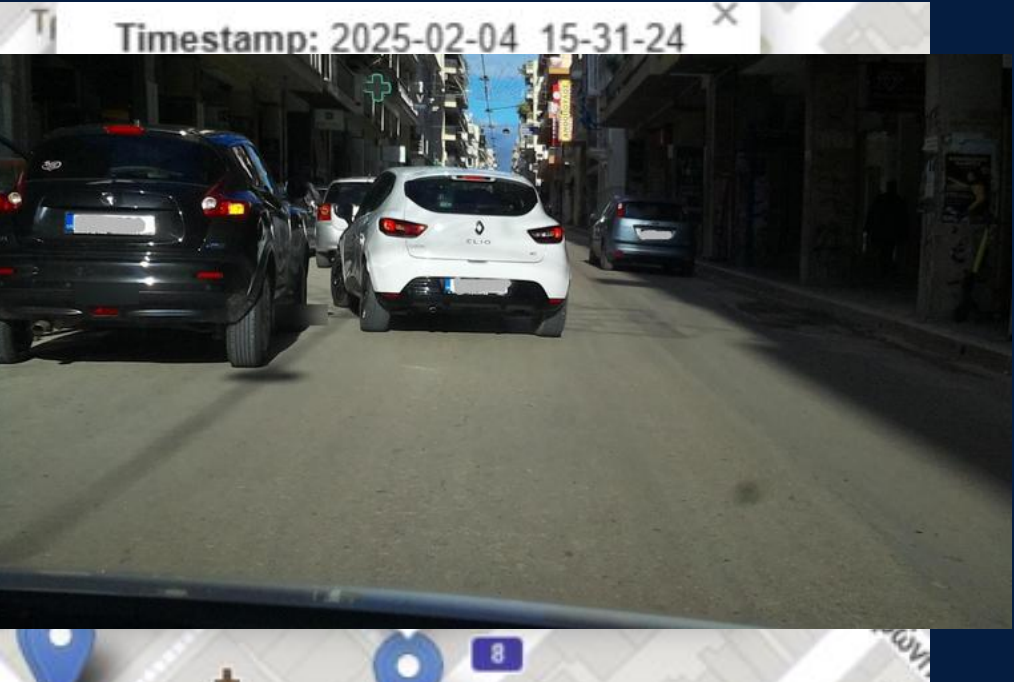
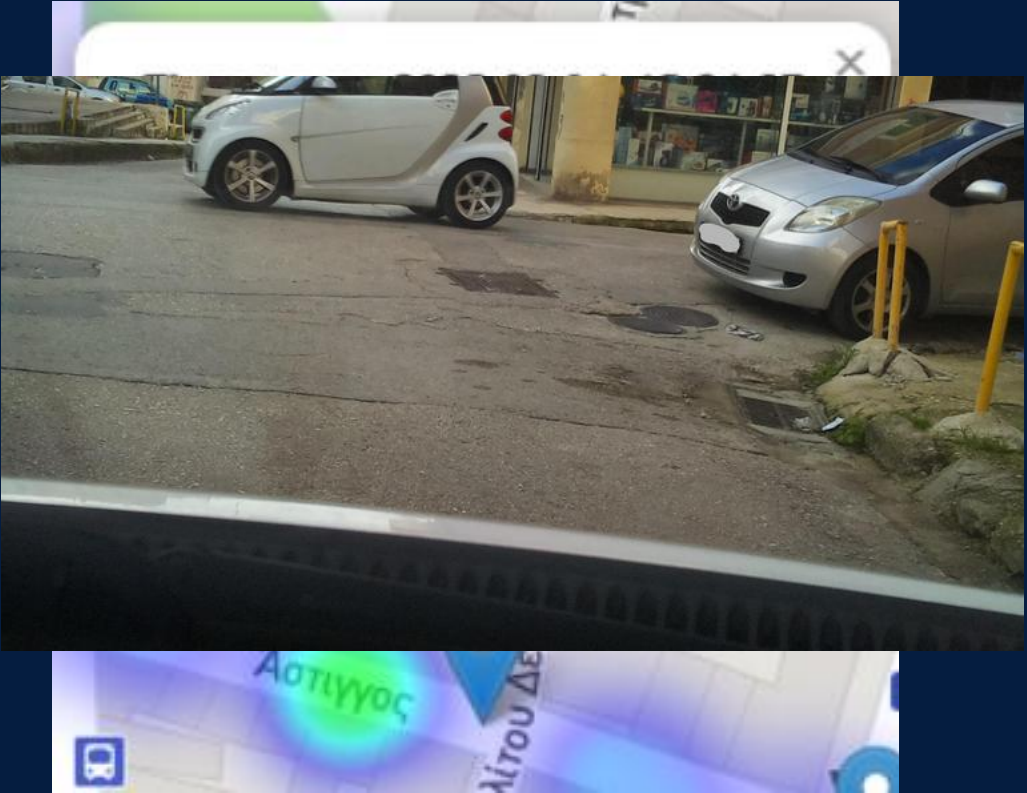
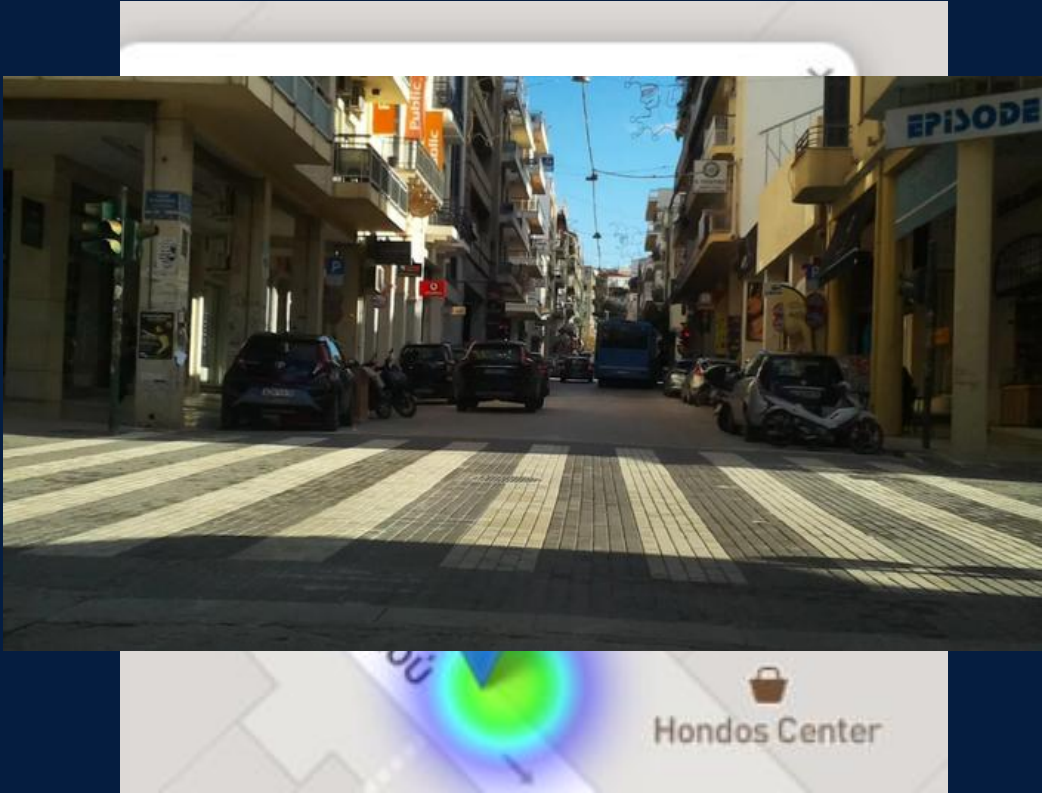


## Image Confirmation at GPS locations

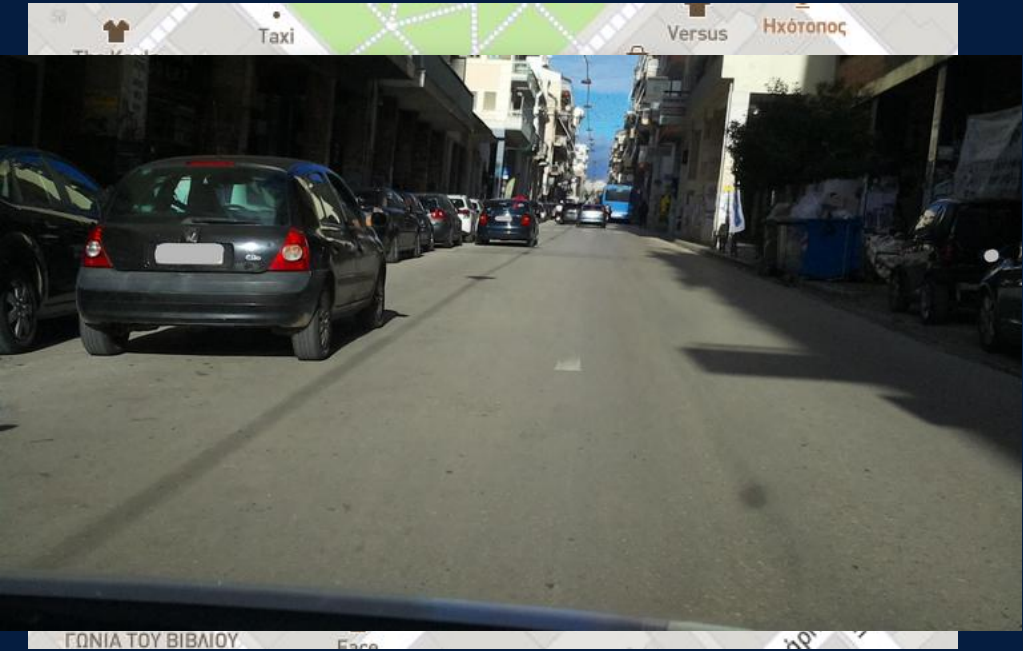
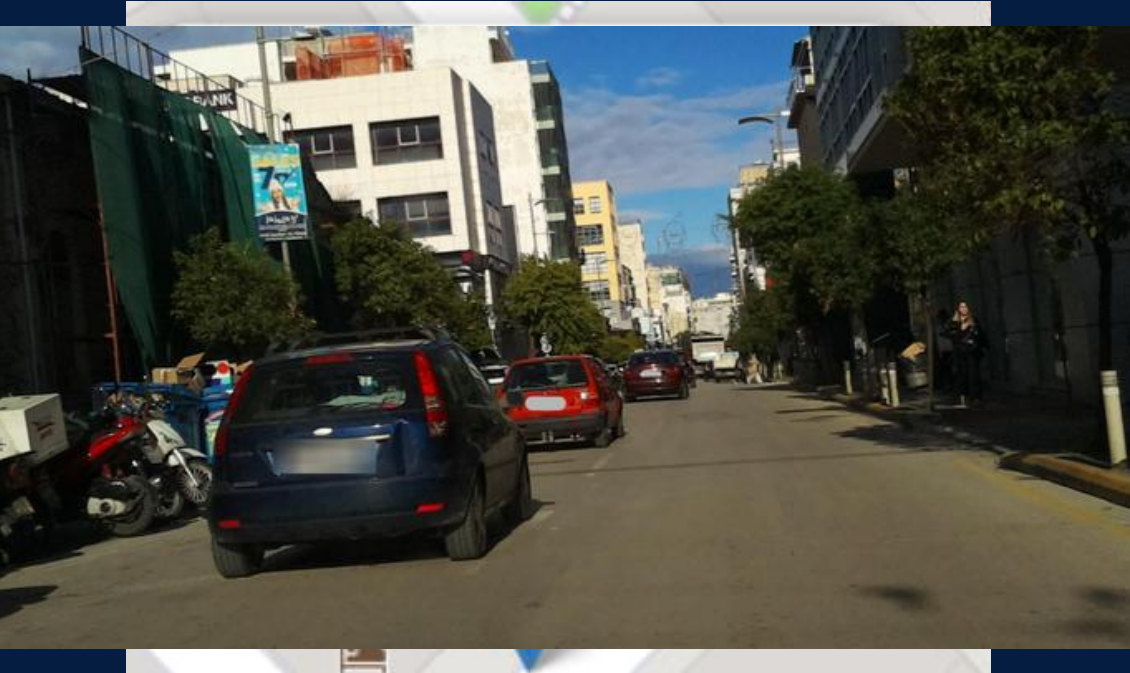
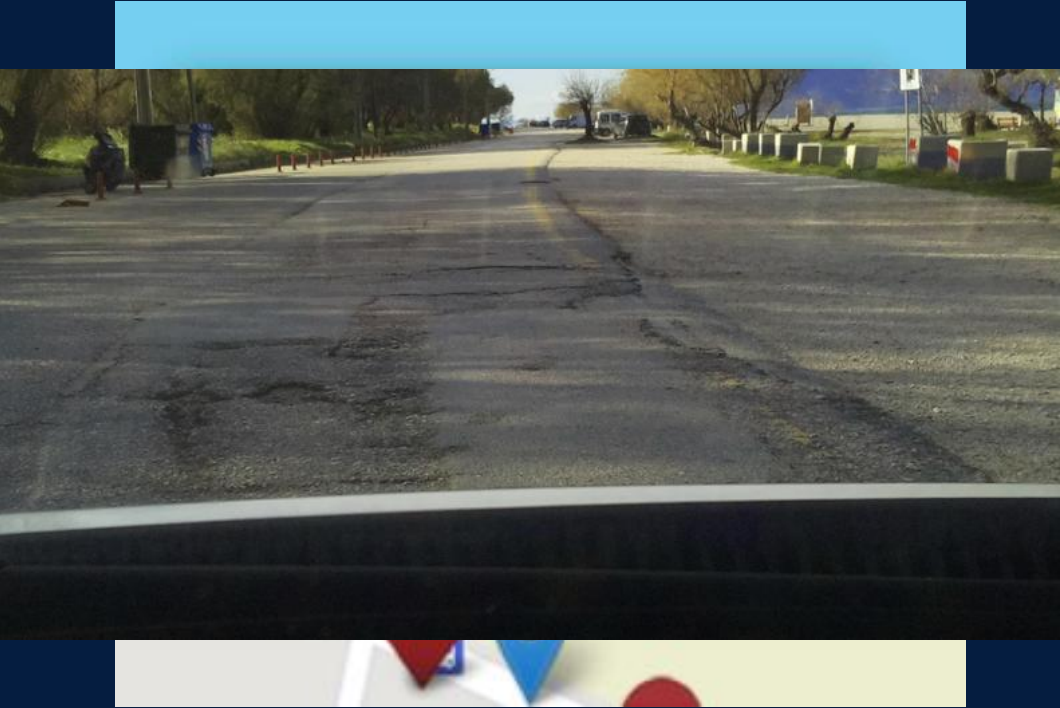


# ROAD DATA RESULTS

Confirmed by photos taken by Rpi Camera Hat

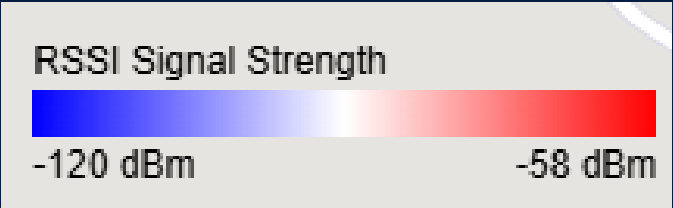
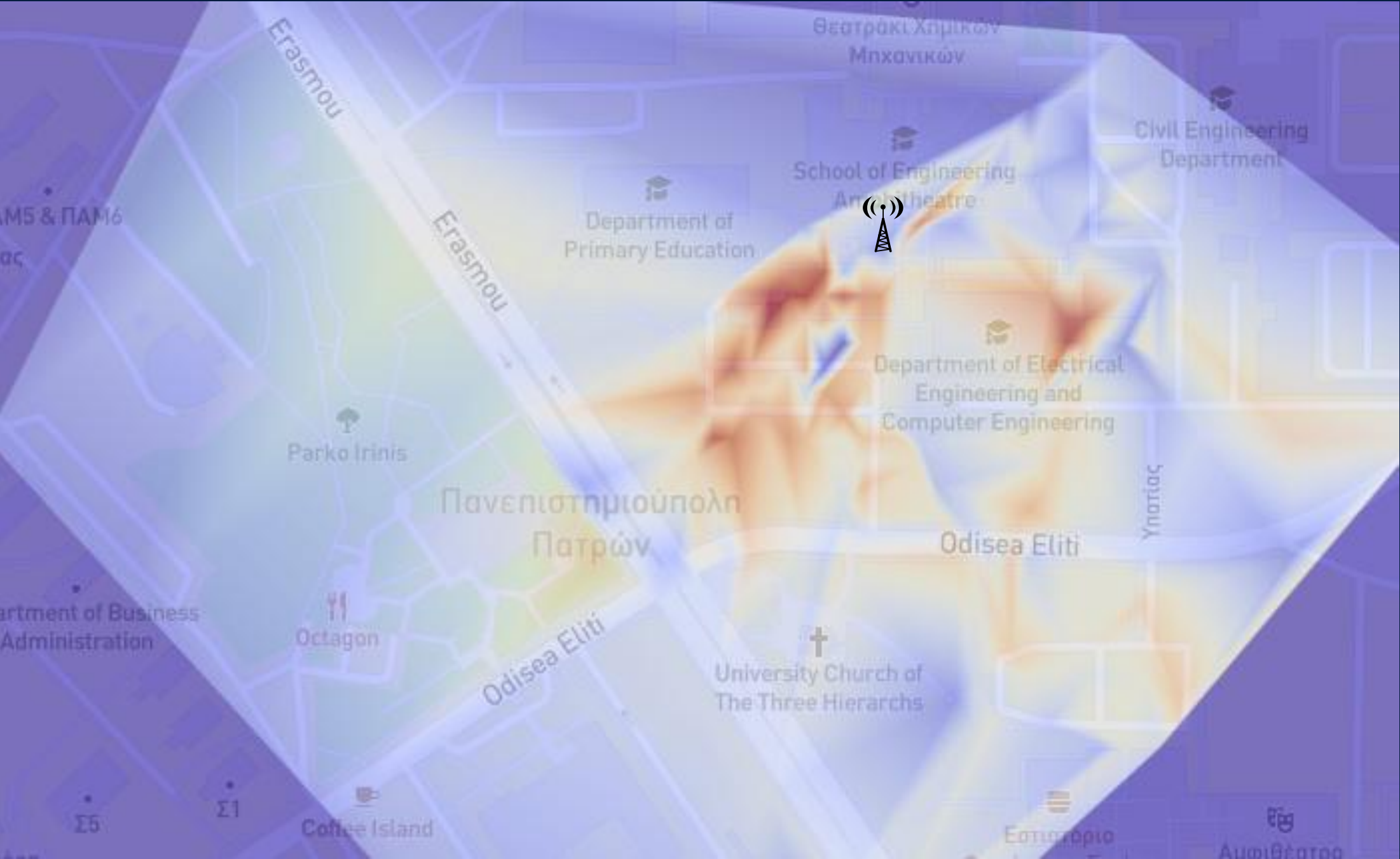


Korinthou Road: Double-parked vehicles





# LORA SIGNAL COVERAGE RESULTS



- Stronger LoRa Signal at ECE Parking (IoT Sensors)
- Weaker Signal near Political Engineering Building

RSSI (dBm)	Signal Strength
> -50 dBm	Excellent
-50 to -70 dBm	Good
-70 to -90 dBm	Fair
-90 to -110 dBm	Weak
< -120 dBm	Very Poor / Near Noise Floor



# LIVE DEMO

1

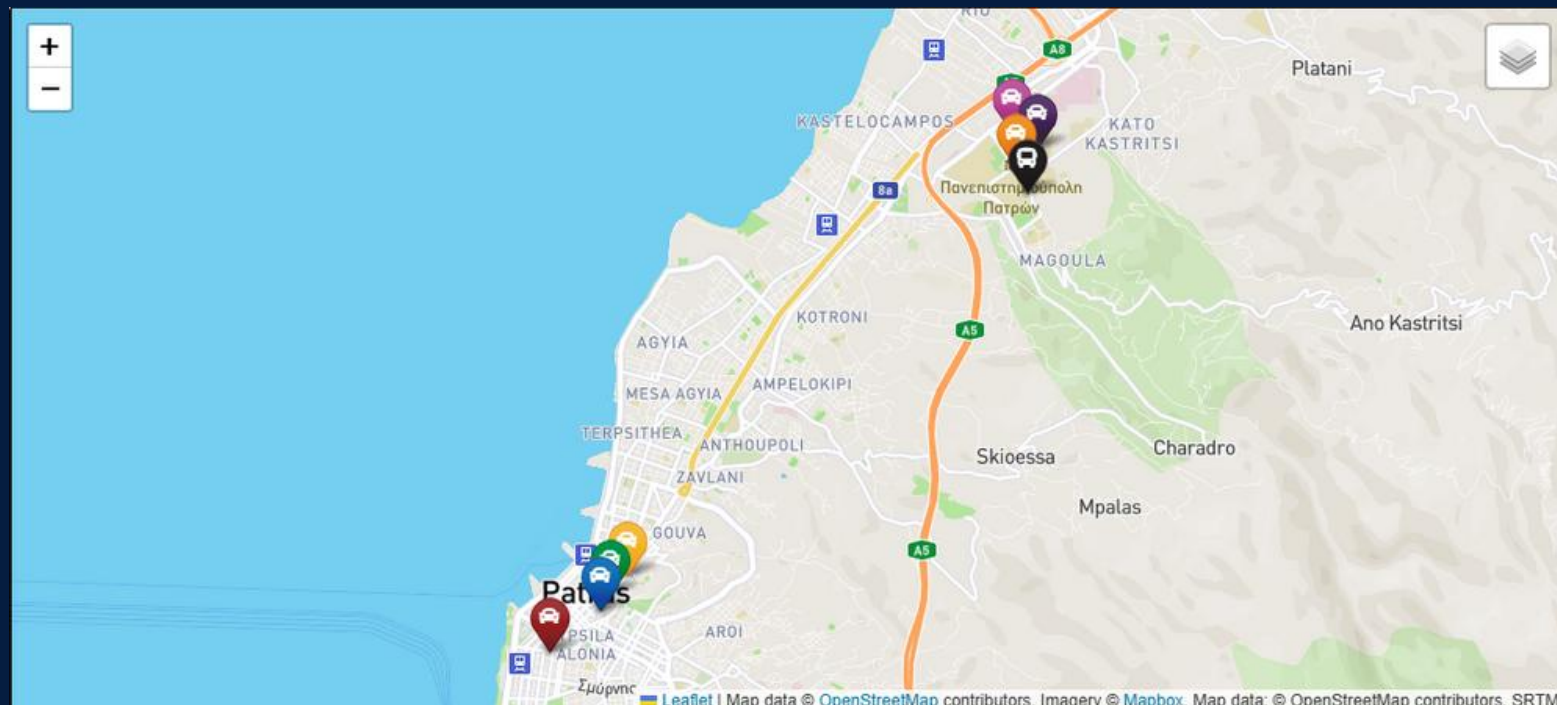
Simulation of 7 cars

2

Fake data generator, based on our real measurements

3

Parametric, customizable Dashboard and Live Map



# WEBSITE: STRUCTURE AND FEATURES

<http://labserver.sense-campus.gr:7101/>

1

## Company Website (publicly accessed)

- Info/Contact etc.
- Login/Register

## Admin Portal

- Manage users and projects
- Monitor Live Status
- Access to all projects

2

3

## Client Portal

- Monitor the projects they are enrolled
- Customizable Preferences (Light/Dark theme)

## Dashboards and Heatmaps

- Custom Dashboards and Heatmaps are embedded on the website page of the corresponding project

4

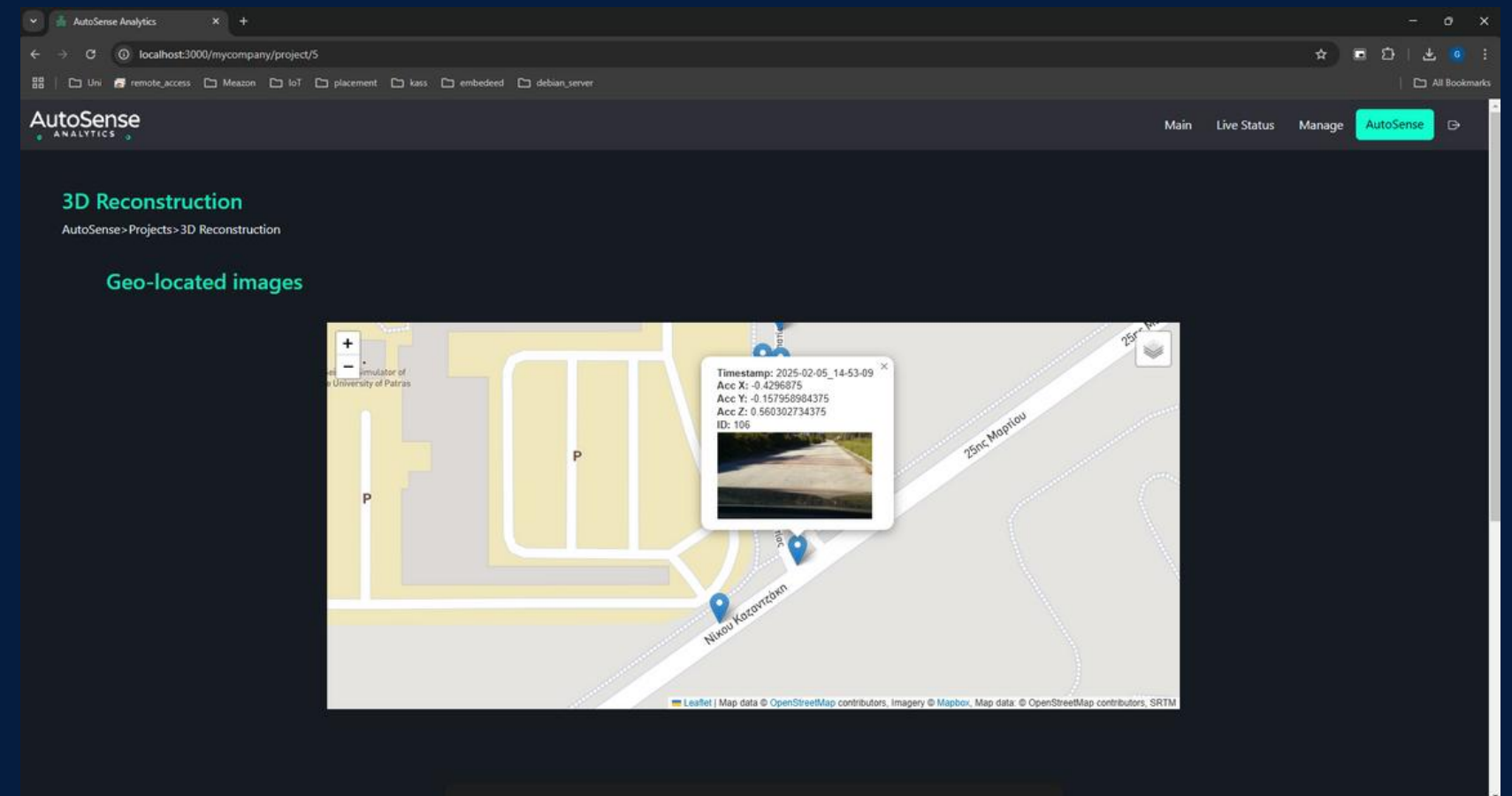
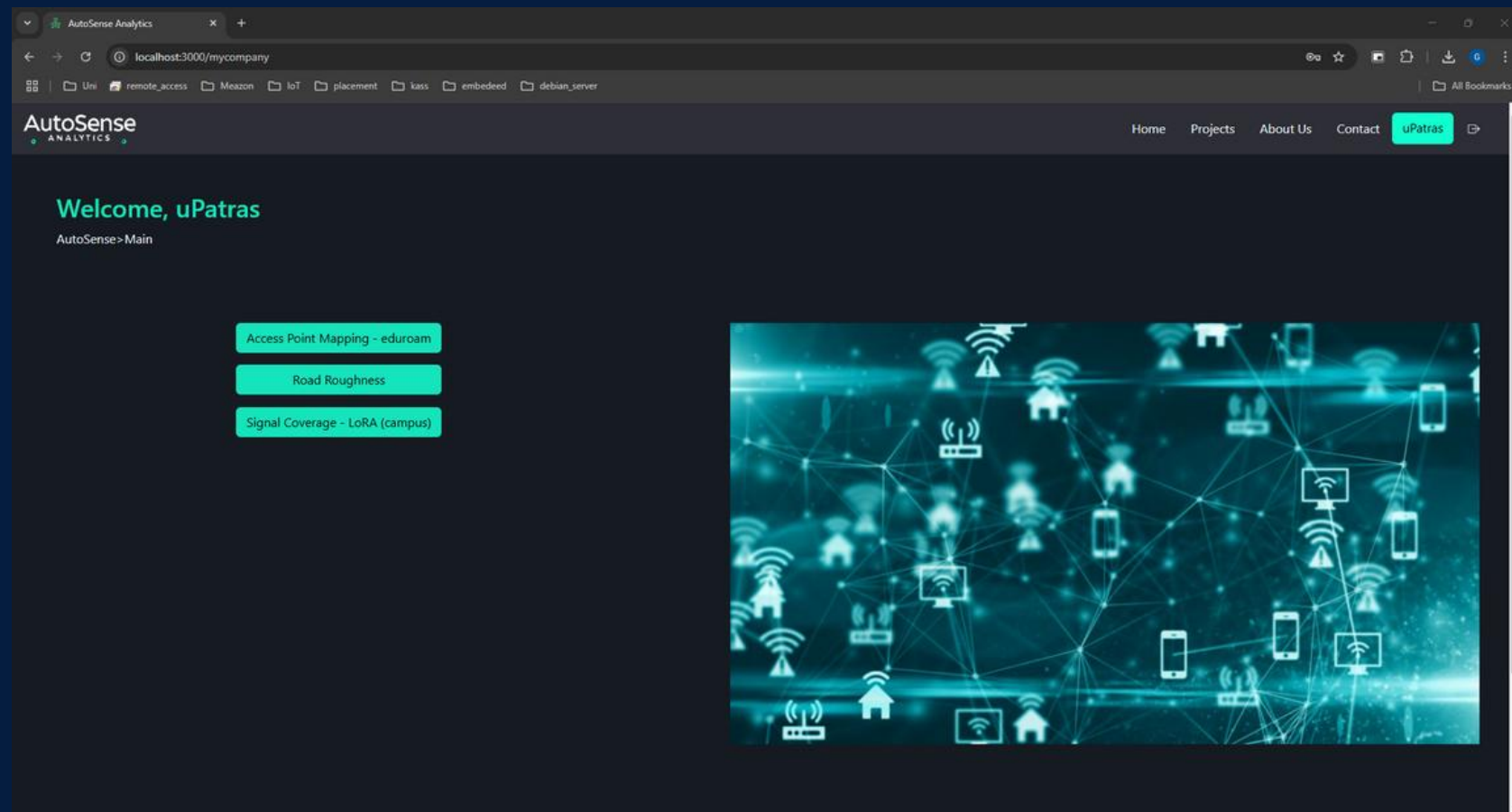
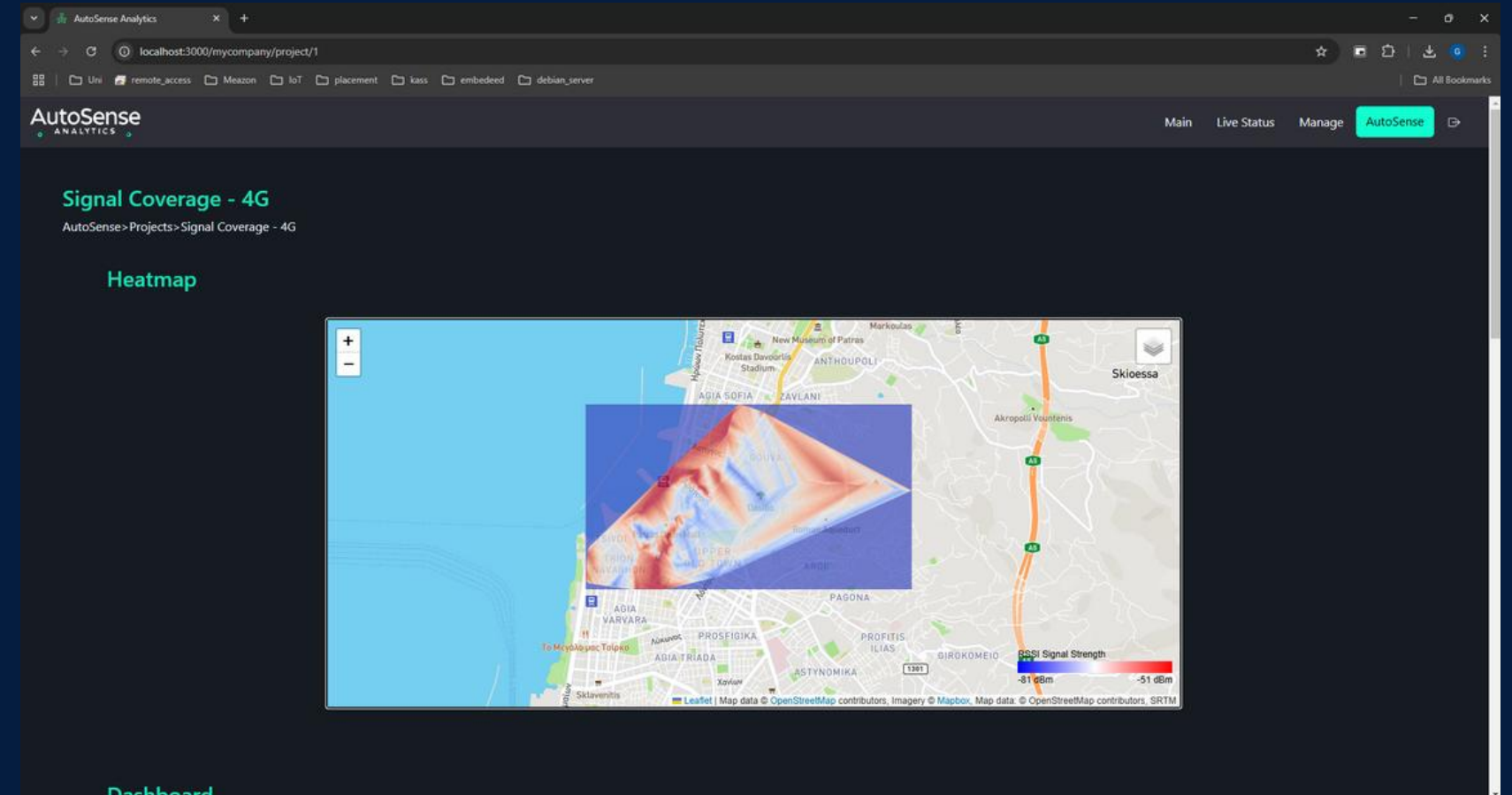
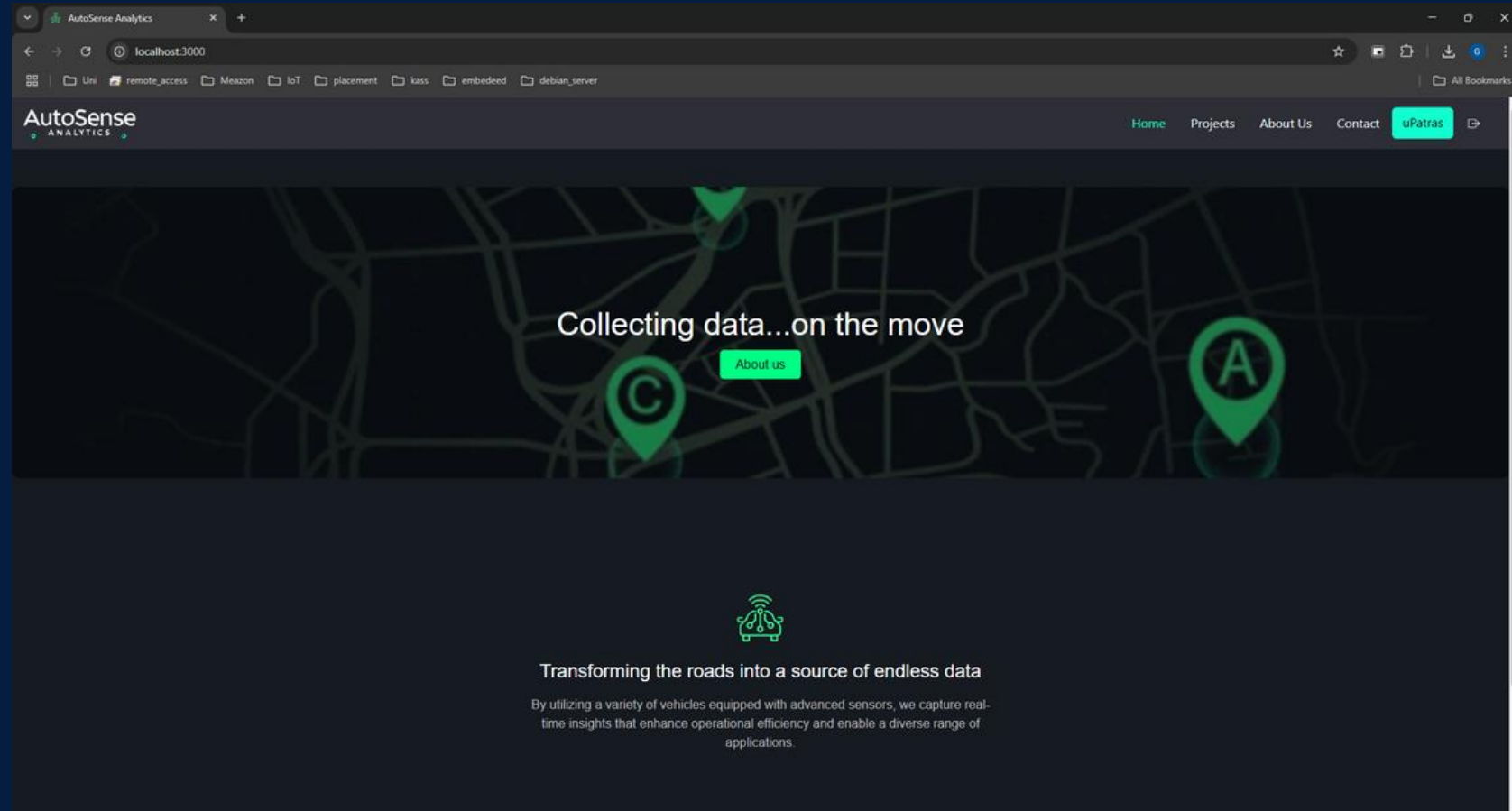
5

## API

- API implementation and documentation for each project
- Easily accessible data (JSON Format)

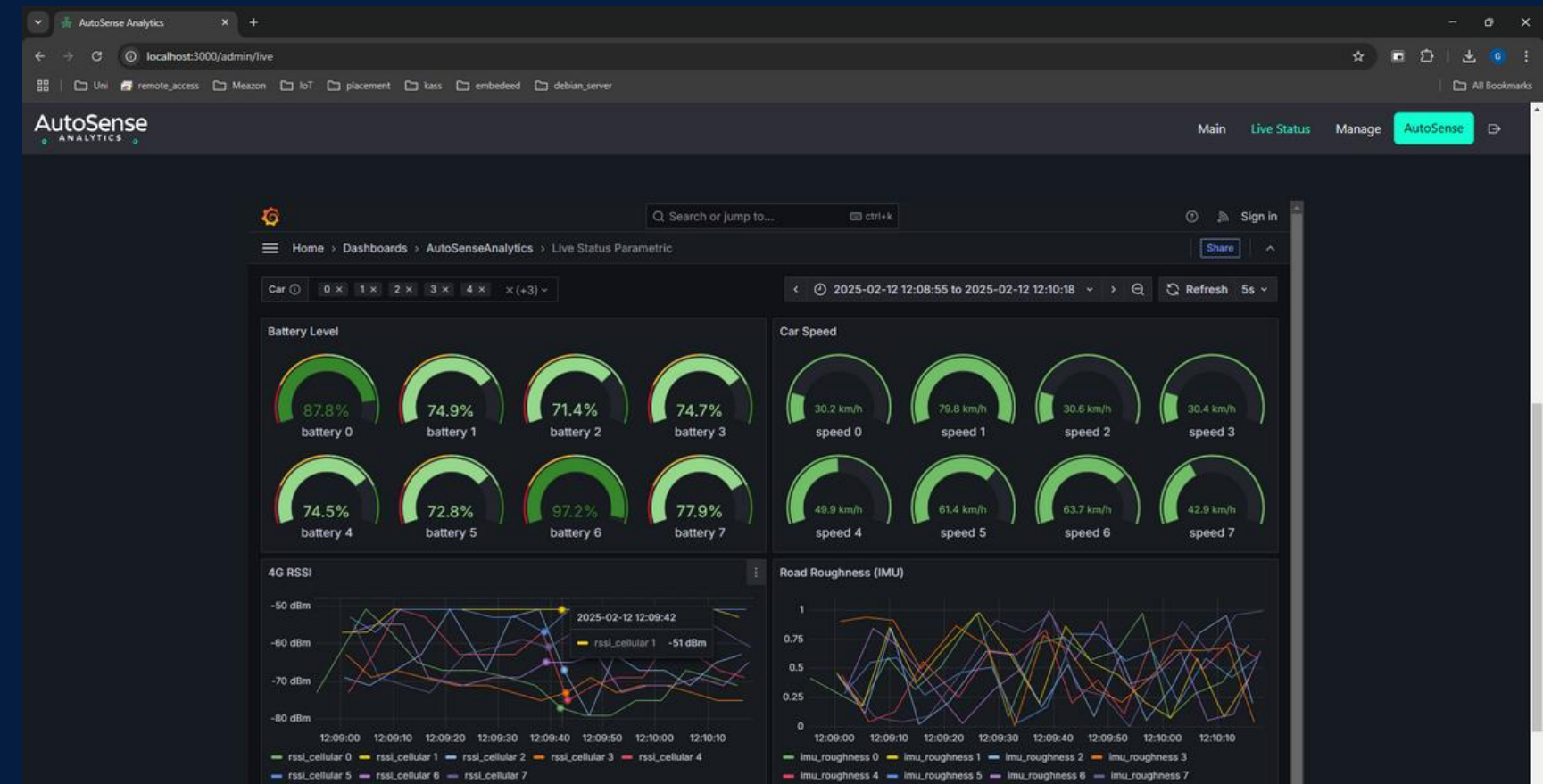
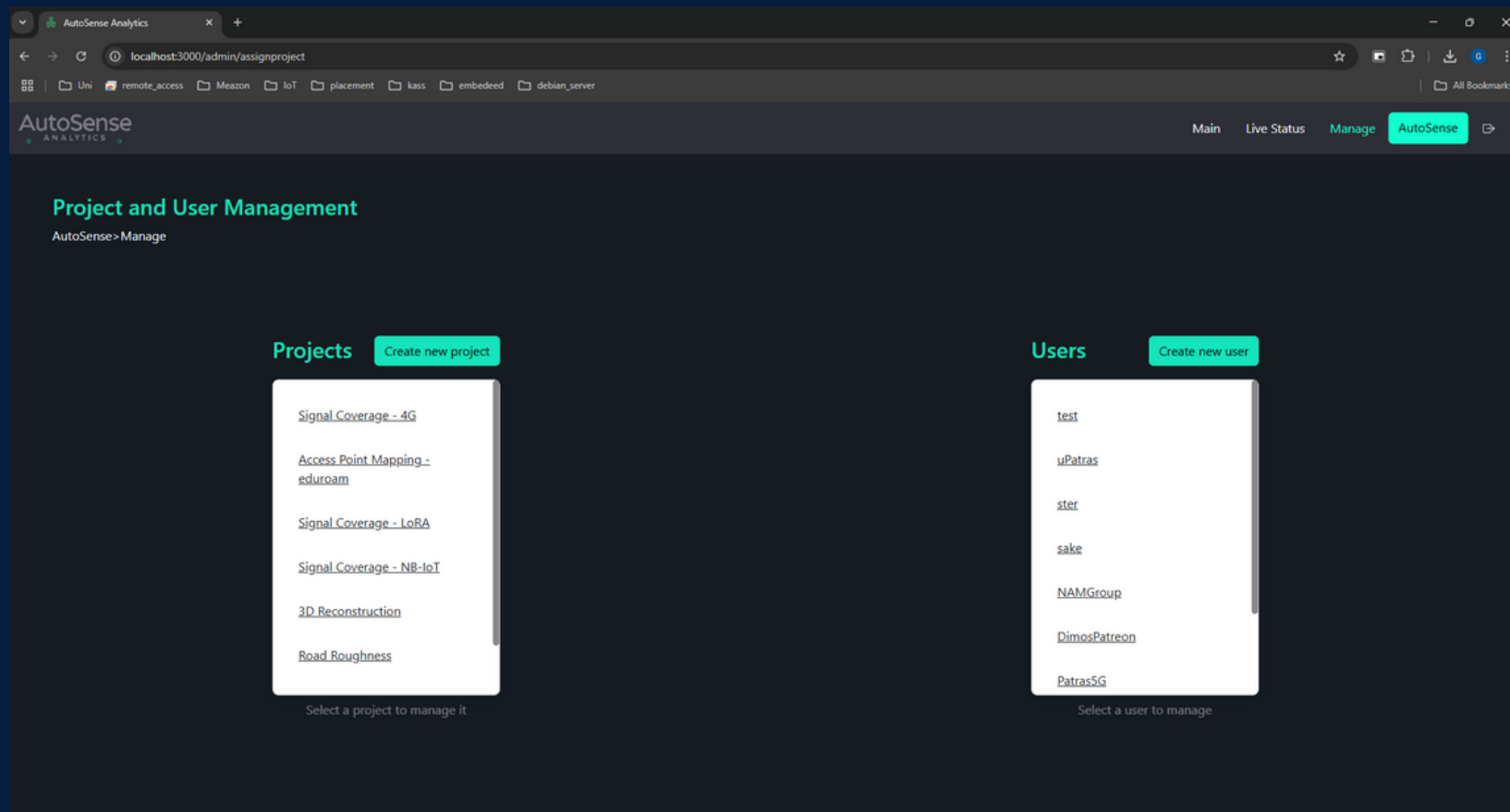
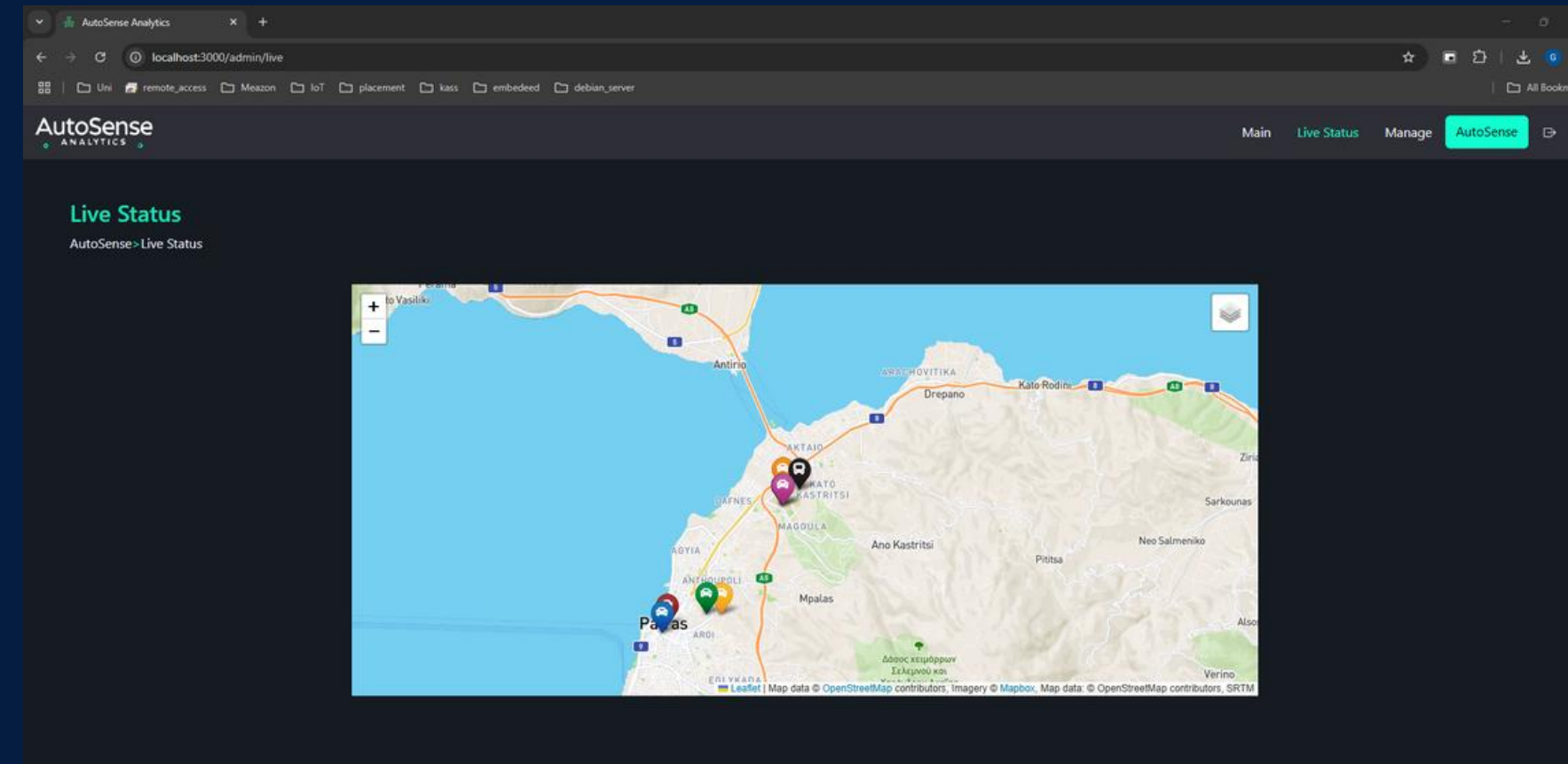
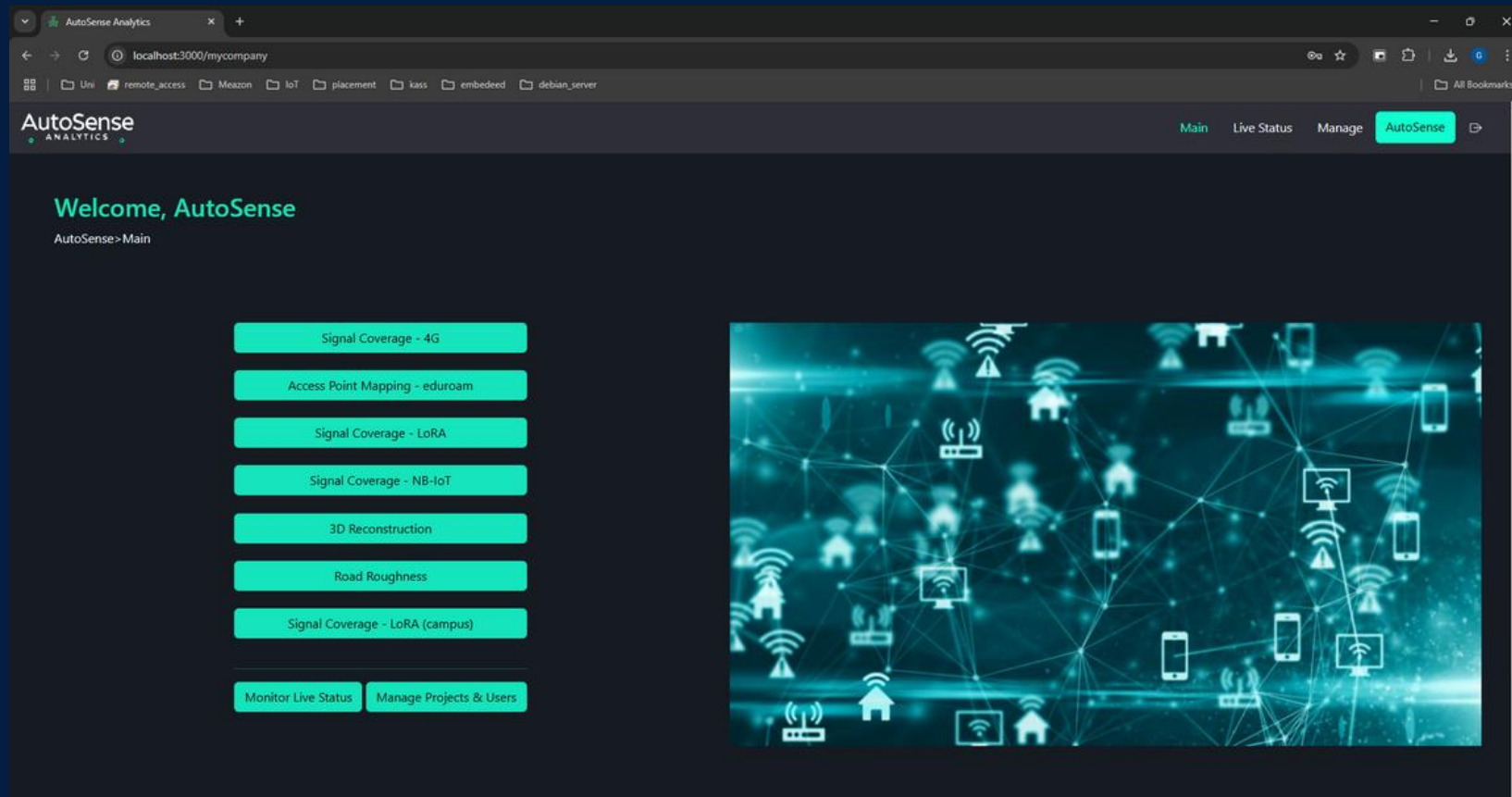


# USER PAGES





# ADMIN PAGES





# API

## API Documentation

**Base URL:** `http://labserver.sense-campus.gr:7101/api/`

### GET /measurements/:project/:location?

Fetch measurement data for a specific project and location

#### Parameters:

'project' : (string) The project name. Options: '4g' , 'lora' , 'imu' , 3Dreconstruction

'location' : (string) The location name. Options: 'center' , 'uni' , 'all' (default)

**Note:** If 'project' is set to '3Dreconstruction' , you can add `/:photoId` to the endpoint to retrieve a specific photo.

*Example:* `GET /measurements/3dreconstruction/all/123`

[Try our API URL Generator](#)

## API URL Generator

#### Parameters:

Project:

4G

Location:

Center

[Generate API URL](#)

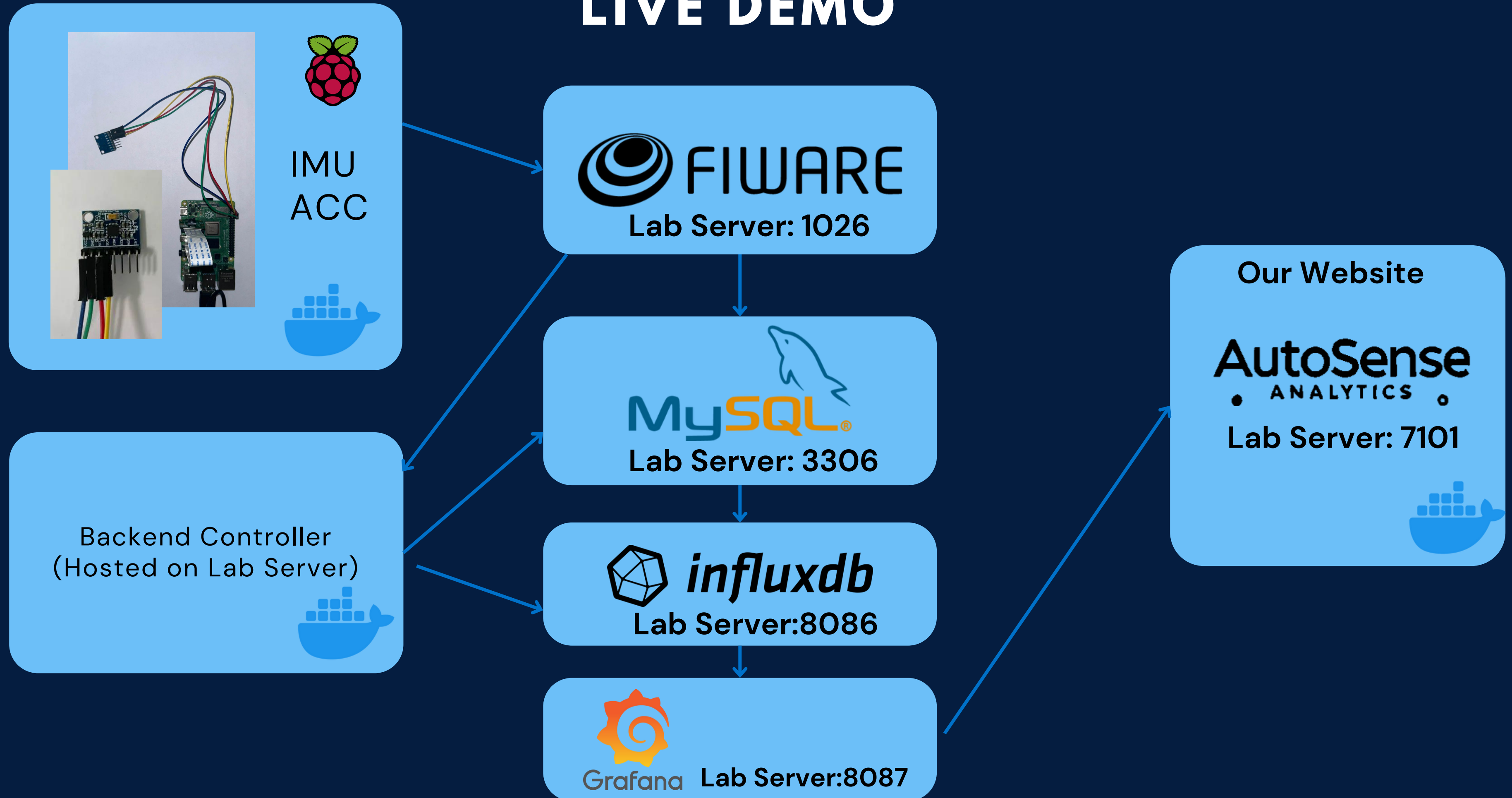
Generated API URL: <http://labserver.sense-campus.gr:7101/api/measurements/4g/center>

```
AutoSense Analytics
localhost:3000/api/measurements/4g/center

[
  {
    "_time": "2025-02-04T10:36:22Z",
    "altitude": -2.7,
    "latitude": 38.246739,
    "longitude": 21.73776,
    "rssi": -73,
    "speed": 7.5
  },
  {
    "_time": "2025-02-04T10:36:30Z",
    "altitude": -0.6,
    "latitude": 38.24651,
    "longitude": 21.737383,
    "rssi": -67,
    "speed": 12.3
  },
  {
    "_time": "2025-02-04T10:36:38Z",
    "altitude": 1.5,
    "latitude": 38.246201,
    "longitude": 21.736892,
    "rssi": -63,
    "speed": 12.8
  },
  {
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    "altitude": 5.5,
    "latitude": 38.246022,
    "longitude": 21.736665,
    "rssi": -57,
    "speed": 1.6
  },
  {
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    "latitude": 38.246032,
    "longitude": 21.736685,
    "rssi": -59,
    "speed": 0.6
  },
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    "latitude": 38.245883,
    "longitude": 21.736492,
    "rssi": -55,
    "speed": 1.5
  }
]
```



# LIVE DEMO





# TASK DISTRIBUTION



- **IoT Agent** and **FIWARE** communication
- Retrieving GPS coordinates from modules and combine them with RSSI values
- **LoRa, Camera, WiFi** configuration
- **IMU** and **edge processing** using fft, bandpass filters
- **4G measurements** and utilization of hat as a modem
- **Combination** of sensors and **communication** using **Threads**
- **Containerization** of Website, Controllers and host them on lab server using Docker



- **Local Data Base Storage** on RPi
- Back-end controller syncing data between **InfluxDB** and **FIWARE's MySQL DB**
- **FIWARE notifications** to **Back-end Controller**
- **Camera Controller**
- **Data analysis** and **representation** (e.g. heatmaps)
- **Grafana Dashboards** and **InfluxDB**
- **Live Demo** using **Real Data**
- **Web Development: Front-End, Back-End**

**Real Time Measurements**



# OUR PROJECT AVAILABLE ON



[GitHub](#)  
(Source Code)



[YouTube](#)  
(Video Demo)



[Website](#)



# OUR TEAM



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AutoSense  
Analytics

# Thank's For Watching

Connect with us.



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