Overview of the Research activities of the

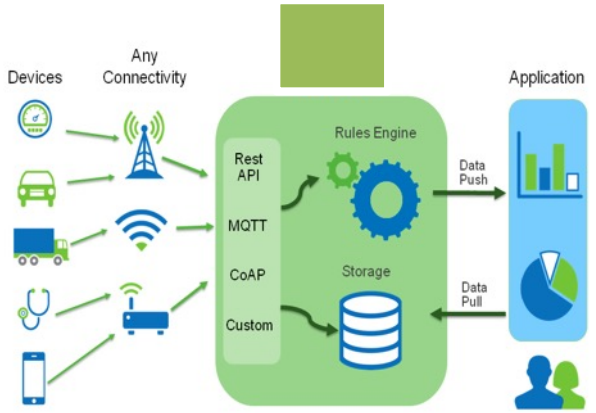
September 2023

GRC GRUPO DE REDES DE COMPUTADORES

Communication Support for Mobile Wireless Systems
Protocols + Applications

Drone-based Networks

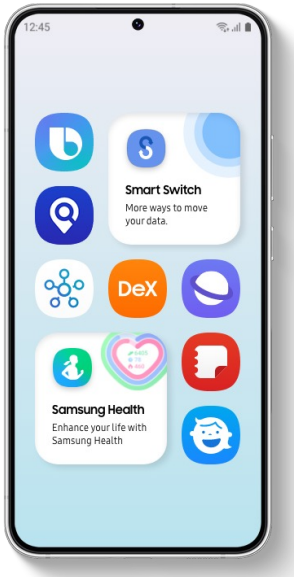
Internet of Things



Intelligent Transport Systems

Data analysis / Digital Twins

Our work methodology



* **Building demonstrators** typically based on smartphones, single-board computers (e.g., Raspberry Pi) or microcontrollers (e.g., ESP32), GPUs, …
* Evaluate proposals through **simulation and analytical modelling**

Nvidia Jetson Xavier K$

- ✓ Low Power and Low Performance.
- ✓ Is it enough? -> No, at the moment.
- ✓ Virtualization tech. may help.

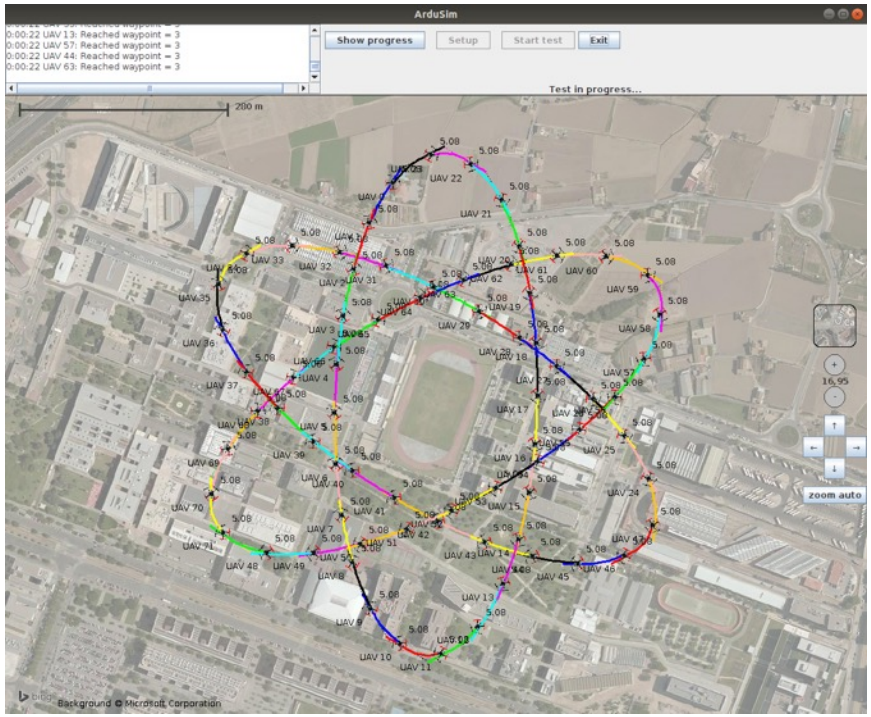
Coral Google 150 $

Nvidia Jetson Nano 100$

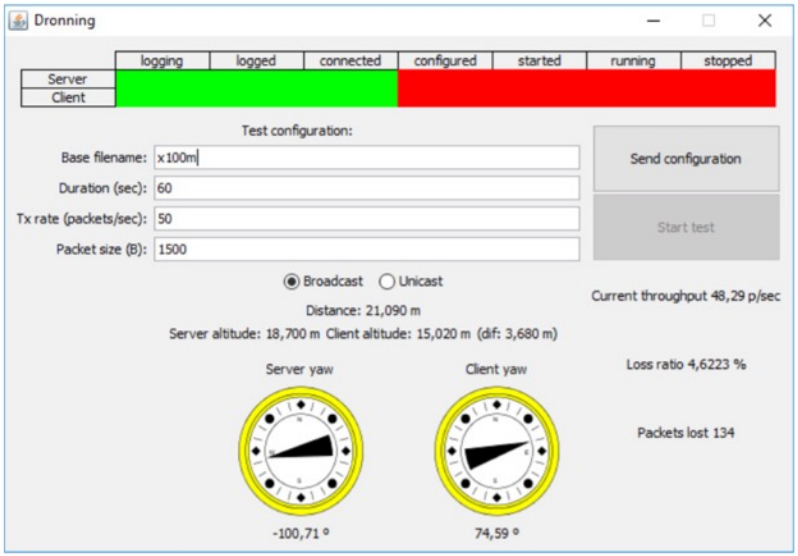
Drones based networks

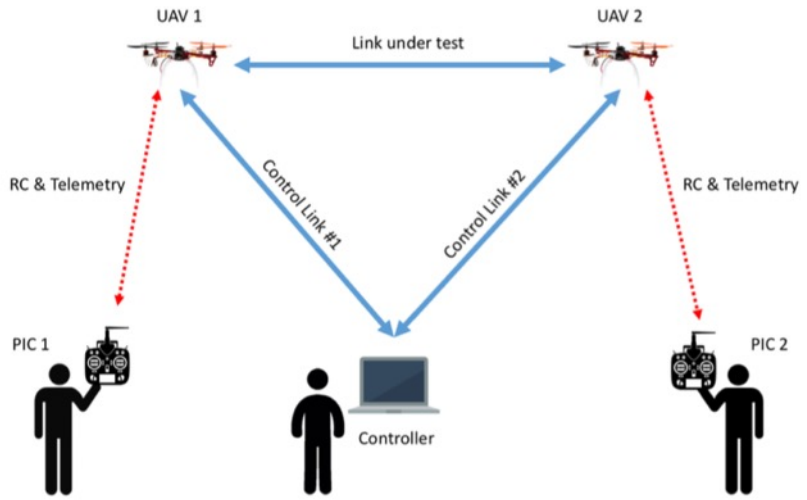
ArduSim simulator

- Available here: https://github.com/GRCDEV/ArduSim
  - based on **Ardupilot** (https://ardupilot.org/)
  - open-source autopilot software available
  - Communication based on **MAVLink** (https://mavlink.io/en/)
  - Allows direct portability of the code to real devices!!!



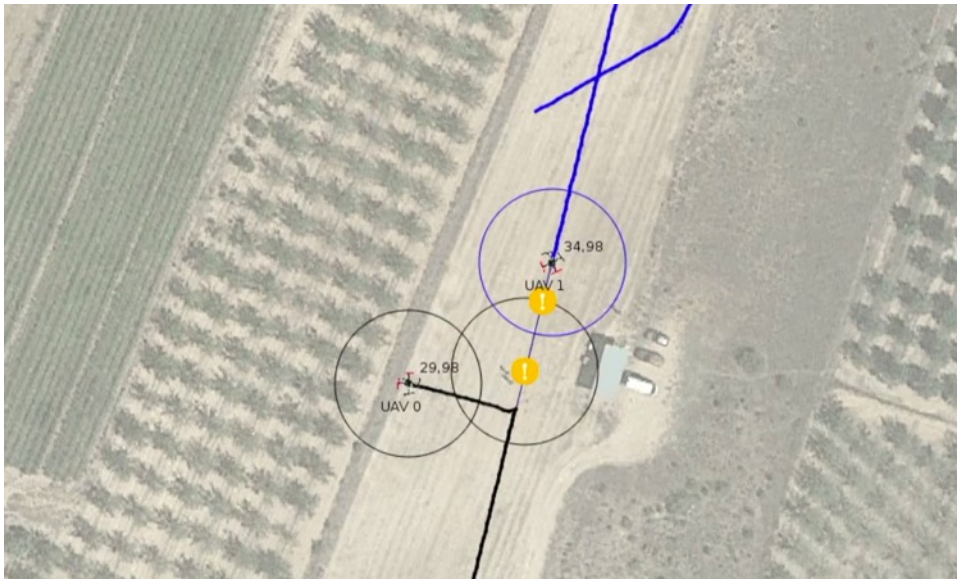
UAV-to-UAV communications

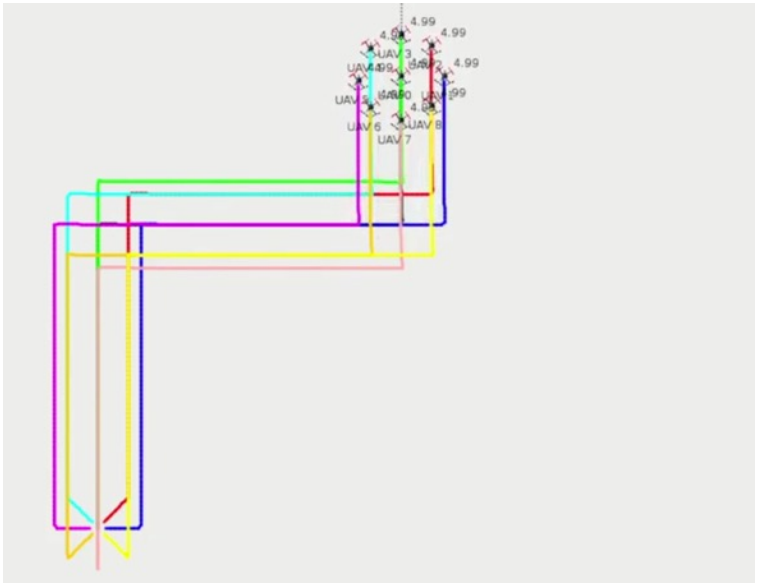


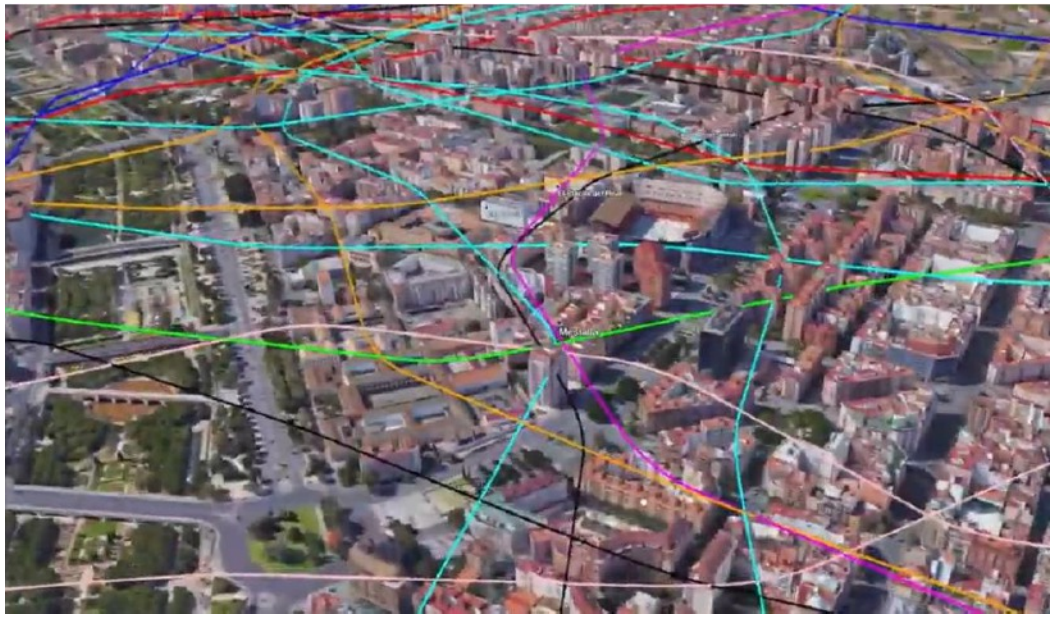


Autonomous AI swarm drone to help decision makers

Swarm Management





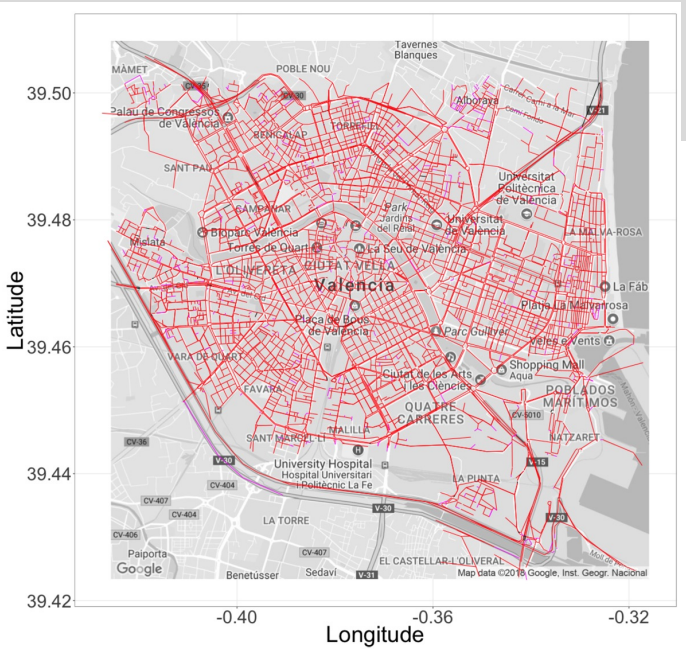


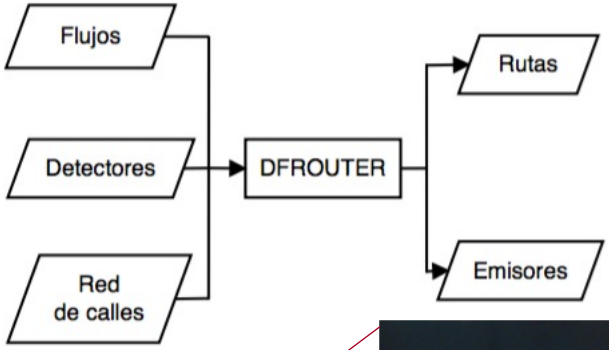
Drone as Access Points

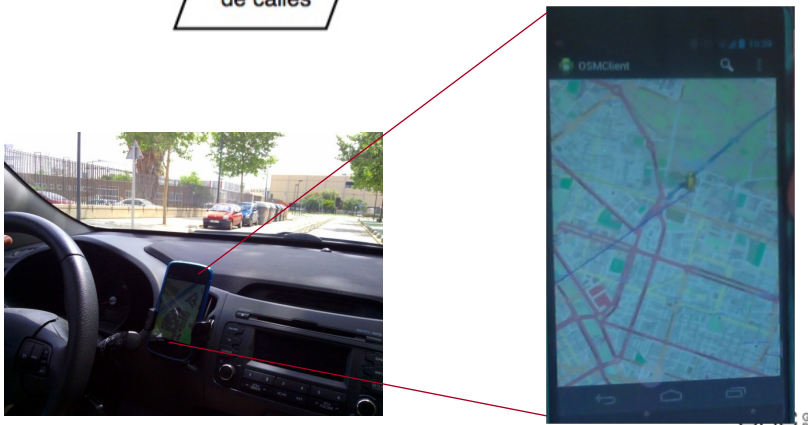
Intelligent Transport Systems (ITS)

ABATIS

- ABATIS Project: Centralized traffic monitoring and management
  - Based on:
    - Historic data
      - collaboration with Valencia City Council
    - Real time data
  - Adaptable towards achieving many different goals

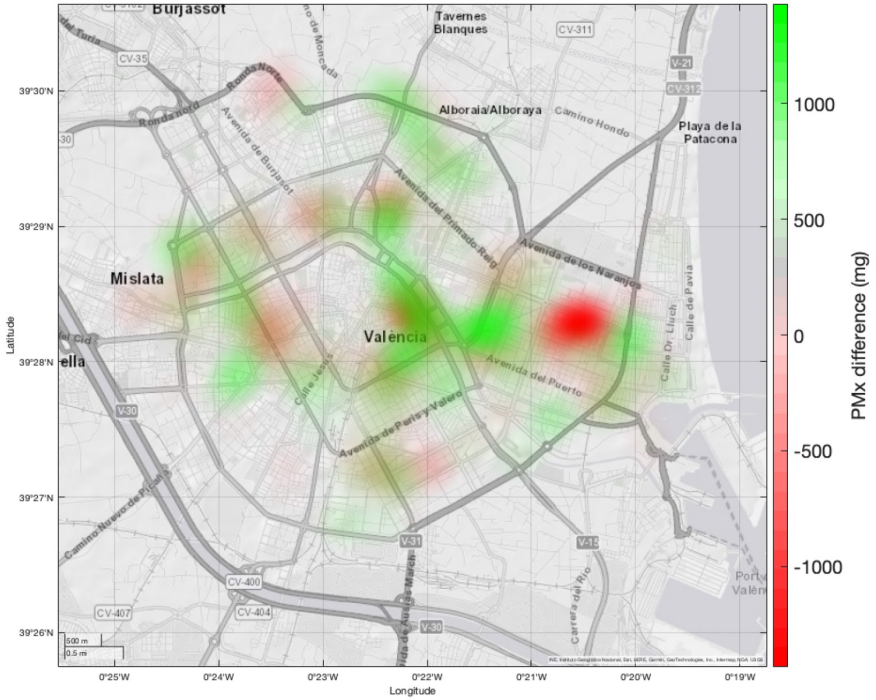




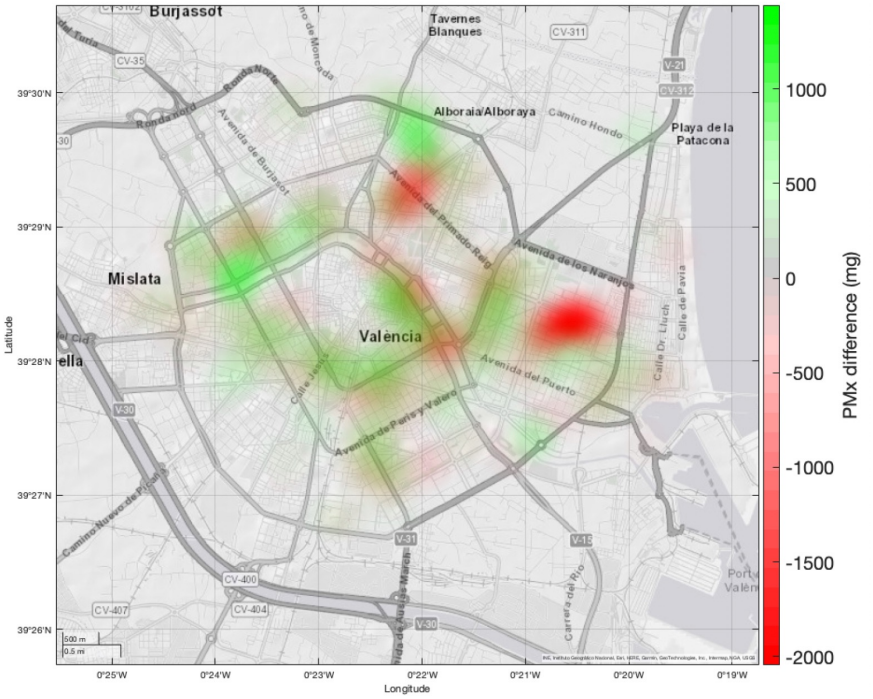


Differential heatmaps

- Full traffic isolation



- Partial traffic isolation



DrivingStyles

- Collection and analysis of the driving style patterns
  - Basic goal: providing energy-related behavior suggestions
- To be used by:
  - Fleet management
  - Insurance companies
  - City councils
  - …

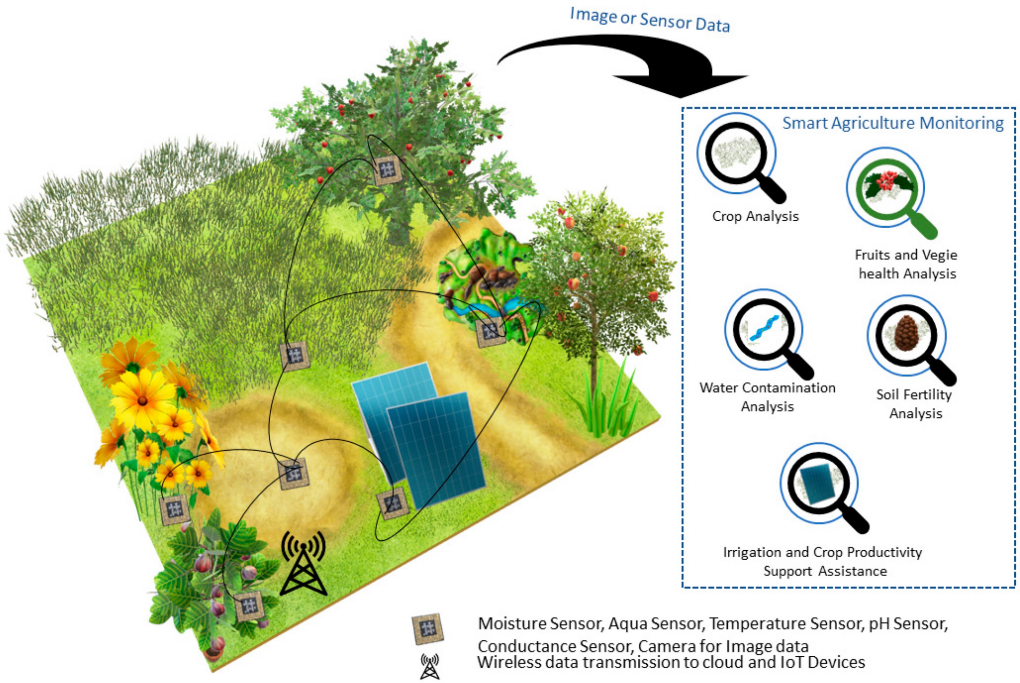
Available at:

Google play

http://www.drivingstyles.info

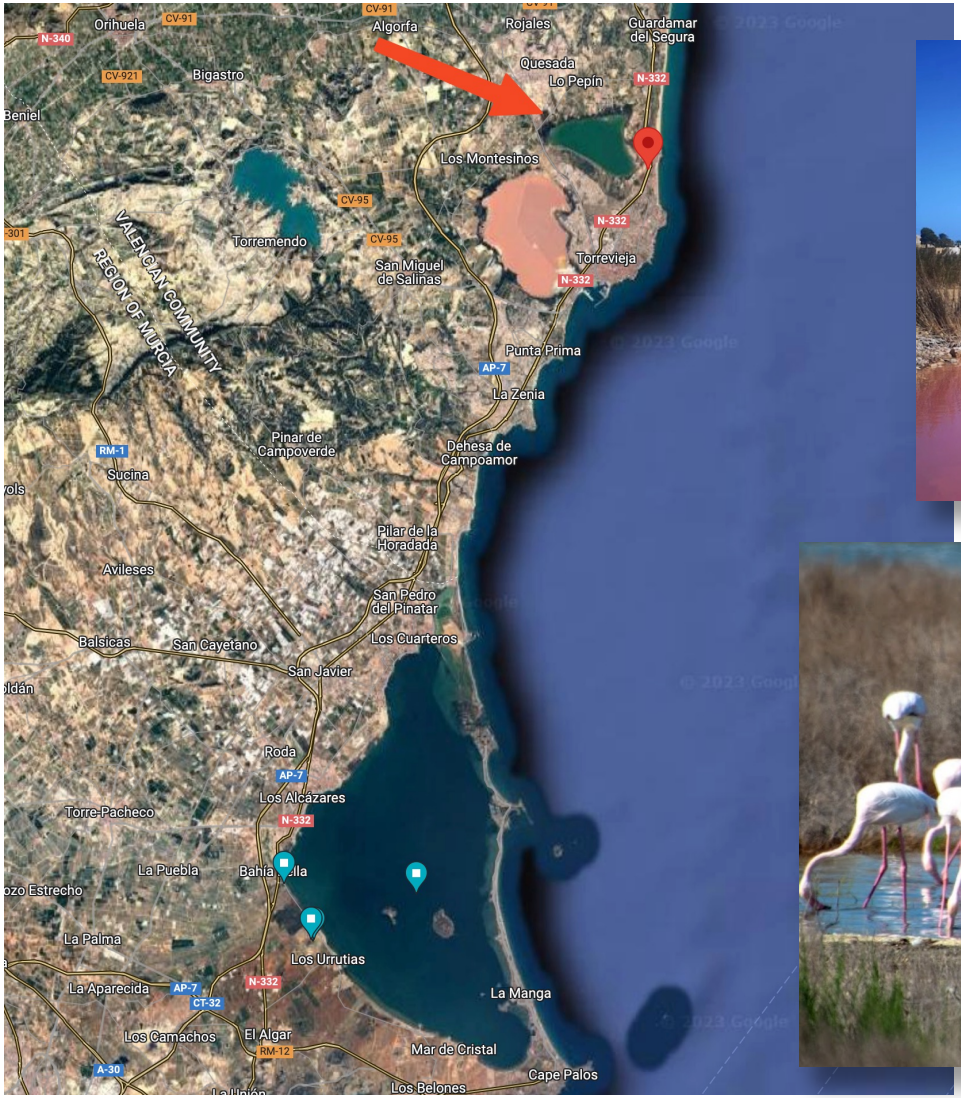
IoT for Environmental sensing

Environmental sensing refers to the tools and techniques designed to accurately observe an environment, characterize its quality, and establish characterizing parameters to quantify an activity's impact on that environment.



Environmental sensing typically deals with rural and extreme environments such as remote areas, forests, sea, or mountains.

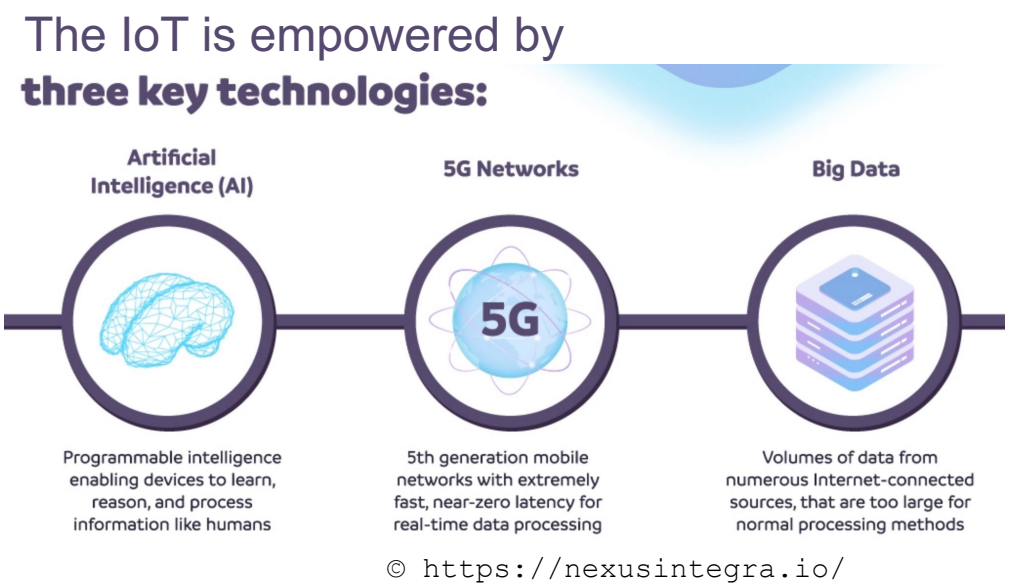
Natural Park of Las Lagunas de La Mata y Torrevieja

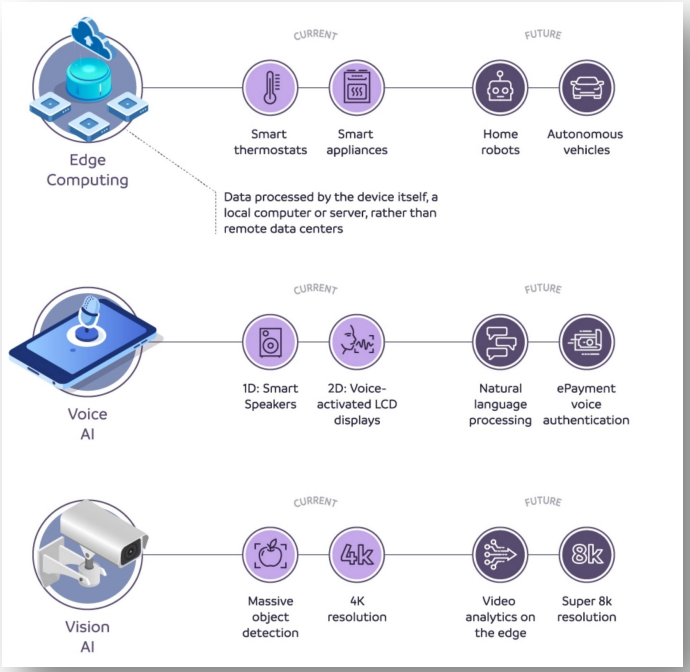


Mar Menor lagoon

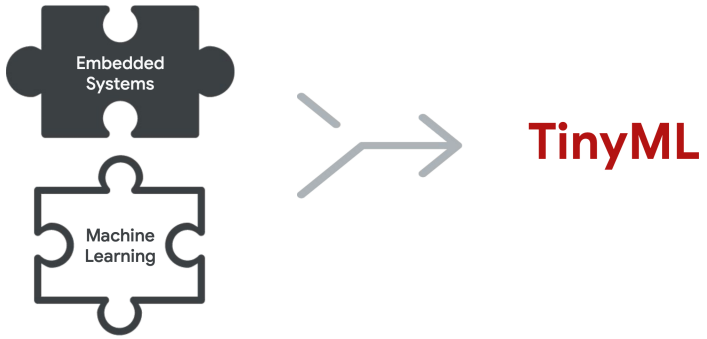
The Mar Menor is the largest saltwater lagoon in Europe, with a surface area of 135 km^2, a coastline of 73 km and a maximum depth of 7 meters.

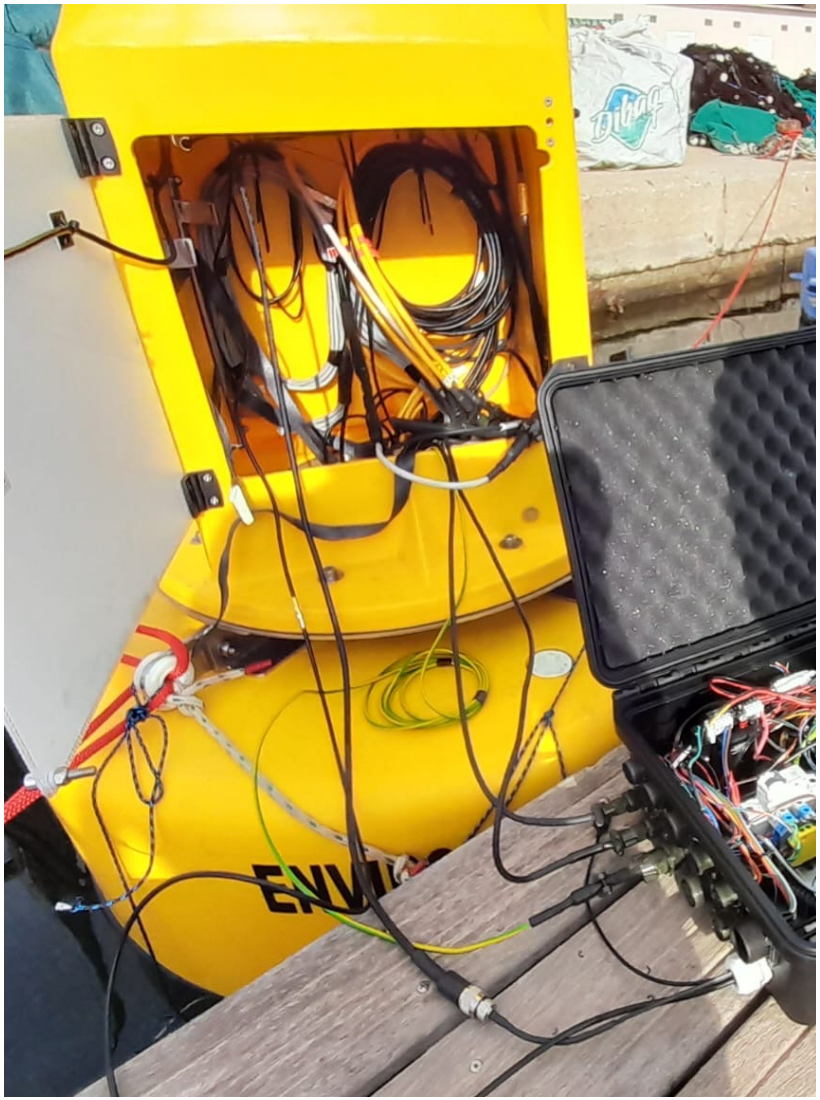
AIoT ("Artificial Intelligence of Things")



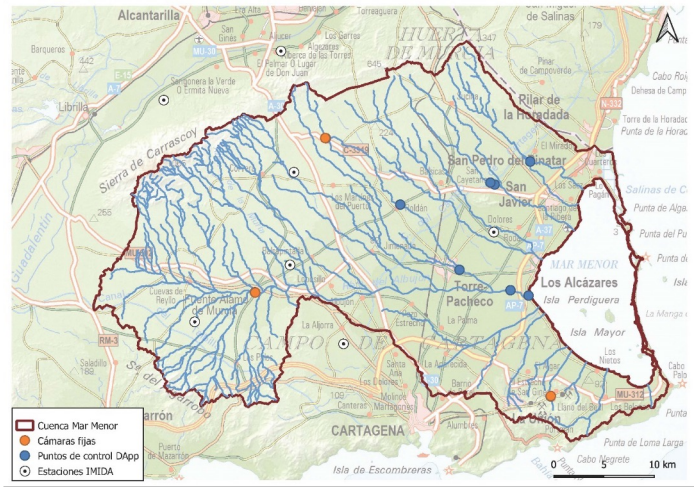


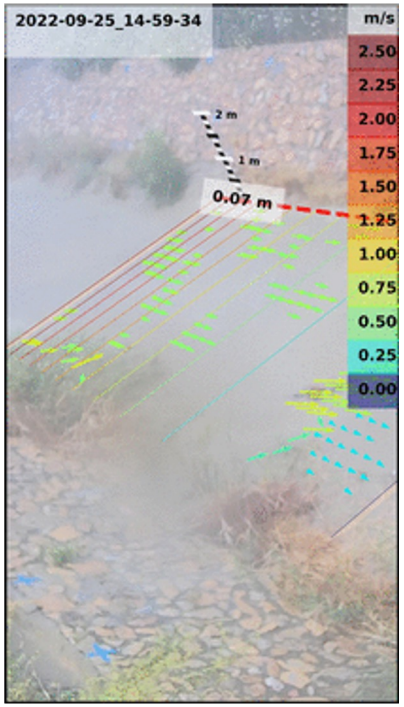
"Tiny machine learning (TinyML) is a fast-growing field of machine learning technologies and applications including algorithms, hardware, and software capable of performing on-device sensor data analytics at extremely low power consumption, typically in the mW range and below, enabling a variety of always-on ML use-cases on battery-operated devices."





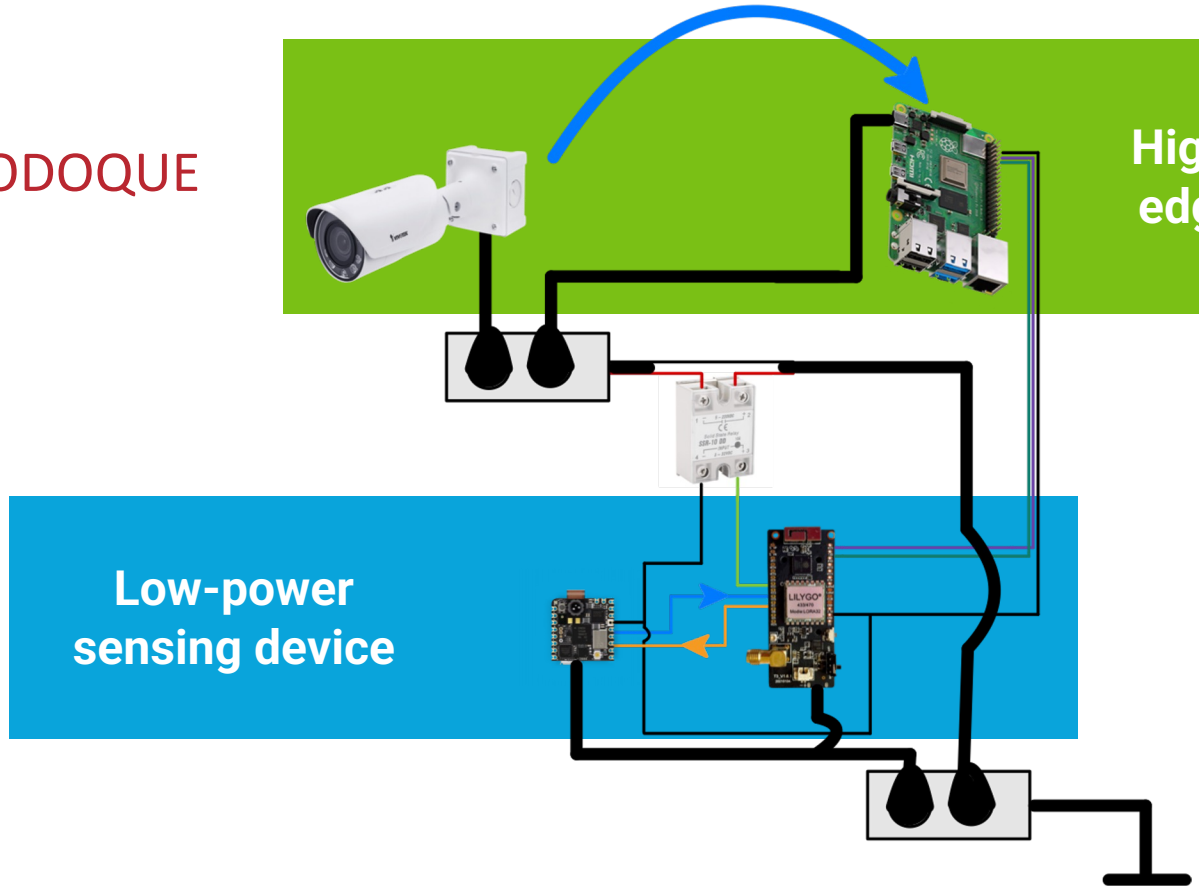
Cameras


Alcantarilla
Librilla
Sierra de Carrascoy
Pilar de la Horadada
San Pedro del Pinatar
San Javier
Torre-Pacheco
Los Alcázares
Isla Perdiguera
Isla Mayor
MAR MENOR
CARTAGENA
Isla de Escombreras
Cuenca Mar Menor
Cámaras fijas
Puntos de control DApp
Estaciones IMIDA
0
5
10 km

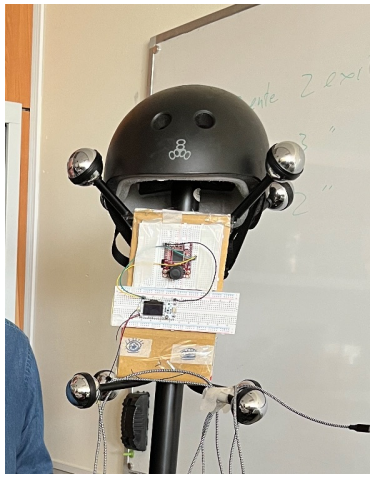

2022-09-25_14-59-34
m/s
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
2 m
1 m
0.07 m

Cameras and some TinyML

BODOQUE



Person counting and classification



AlLoRa

2023 IEEE 20th Consumer Communications & Networking Conference (CCNC)

A modular and mesh-capable LoRa based Content Transfer Protocol for Environmental Sensing

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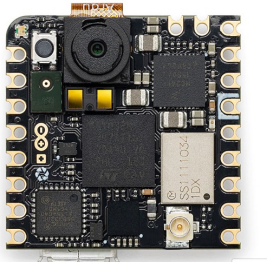
https://github.com/SMARTLAGOON/AlLoRa



Digital Twins

- Both use a **digital twin strategy** to allow researchers, stakeholders and policy-makers to collect, visualize and analyze data in a more cost-effective way, and to create more precise models and predictions to support better decision making.

Integrating data from multiple inter-related sources

Physical Sensors

Telegram

reddit

RSS

Social sensors

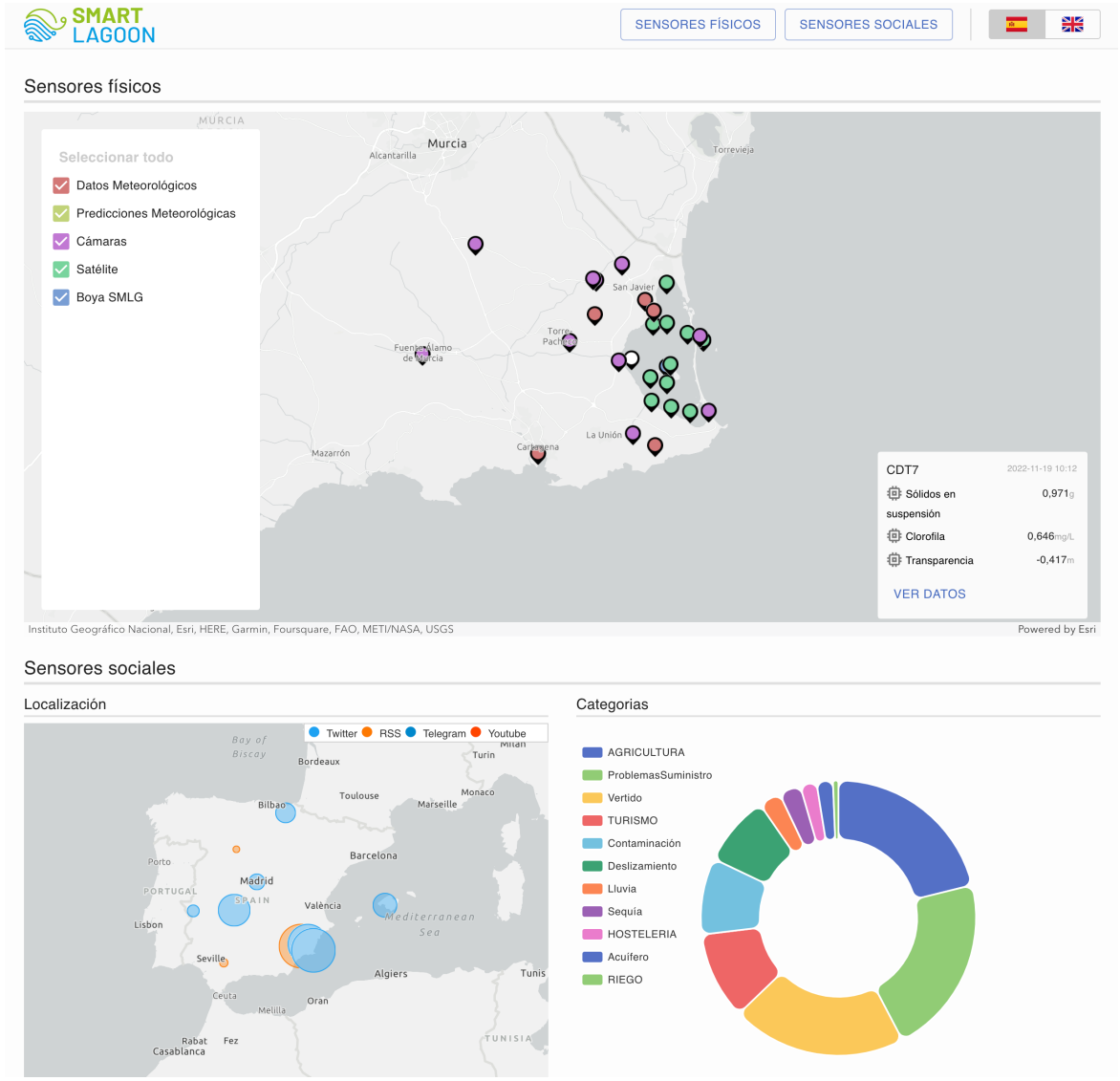
Remote sensing

Citizen science

Crowdsourcing

Digital twin

Our current digital twin



SensingTool (Citizen Science)