Air Quality Control through Bike Sharing Fleets

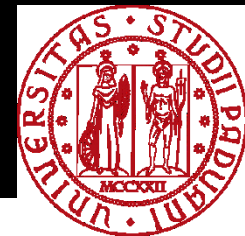Ciprian Voinea   *stefanciprian.voinea@student.unipd.it*

Armir Bujari   *abujari@math.unipd.it*

Claudio Palazzi   *cpalazzi@math.unipd.it*
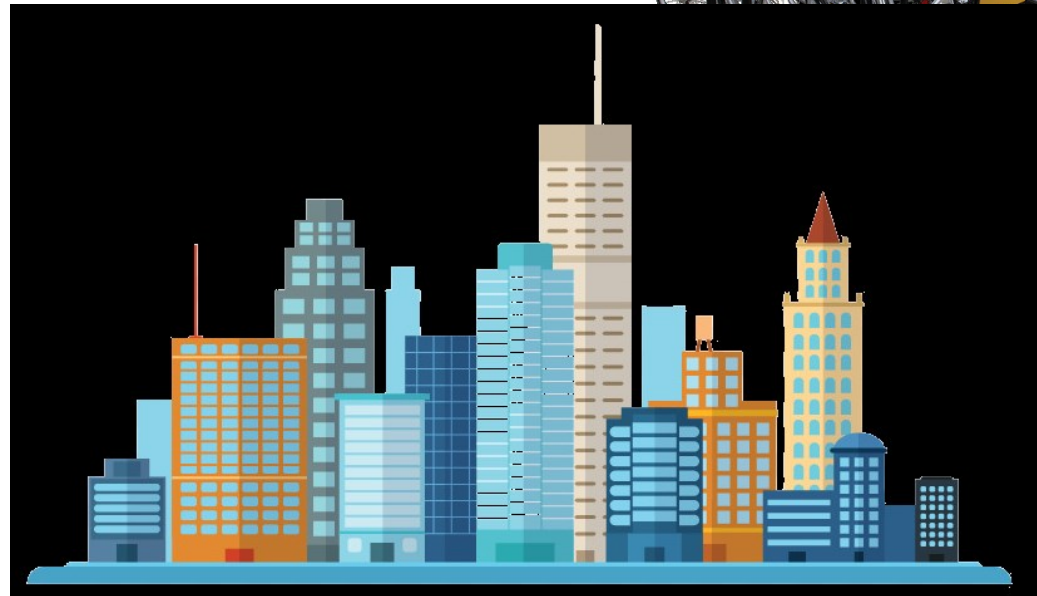
UNIVERSITÀ DEGLI STUDI DI PADOVA

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Summary

- Introduction
- ArduECO idea
- Prototype
- Conclusion

Evolving cities

- Smart mobility is a key enabler for well-being and quality of life in urban environments

- Through sensors and connectivity present on our means of transportation we can pervasively collect data and elaborate them both locally and remotely to generate new services beneficial for the community

- This can foster more sustainable and aware behaviors in citizens, improving their daily activities

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Air Pollution

- Air quality and pollution has a major role in human health and life quality

- Air pollution is one of the main issues in urban scenarios, with half of the population living in cities and an increasing trend of migration from rural areas to urban ones

- Air quality should hence be pervasively monitored to provide key information needed for careful mobility planning

- Centralized solutions are currently the most used to assess the air pollution, but they only collect data in the approx

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Bike sharing

- Smart means of transportation are more and more popular

- Bike sharing is already used to improve mobility in our cities while data about their use is collected and elaborated to generate information

- Information increases the citizens' awareness and foster virtuous mobility

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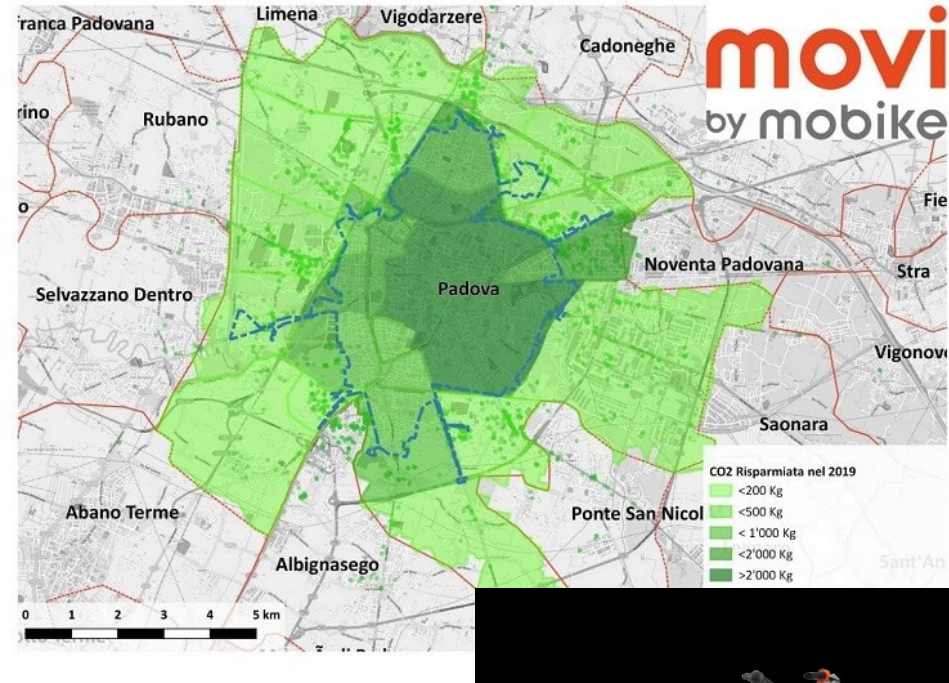
Coronavirus, cycling and air

During the coronavirus crisis, cycling has proven to be a resilient transport mode which is also beneficial for public health

Governments incentivize the purchase of bicycles and scooters

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Take advantage of bikes

So much untapped data, bikes are already
connected to a large network

Equip bikes with a kit of sensors

Share or use georeferenced pollution
data to plan future trips

Monitor personal exposure
to air pollutants

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ArduECO is a wireless IoT device combing *open source hardware* and *software*

Detects the amount of CO in the air, sends this value in the cloud and *analyzes the level of pollution in the air*
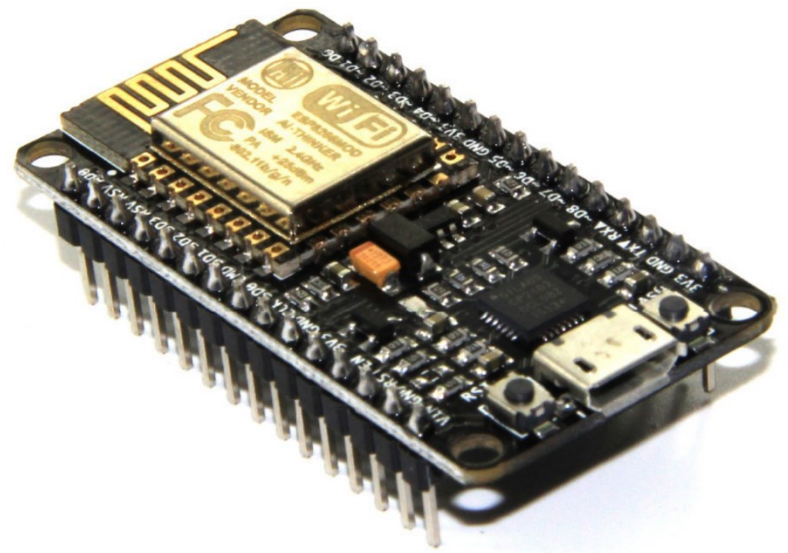
The *goal* is to have a device small enough that fits on shared transportation methods

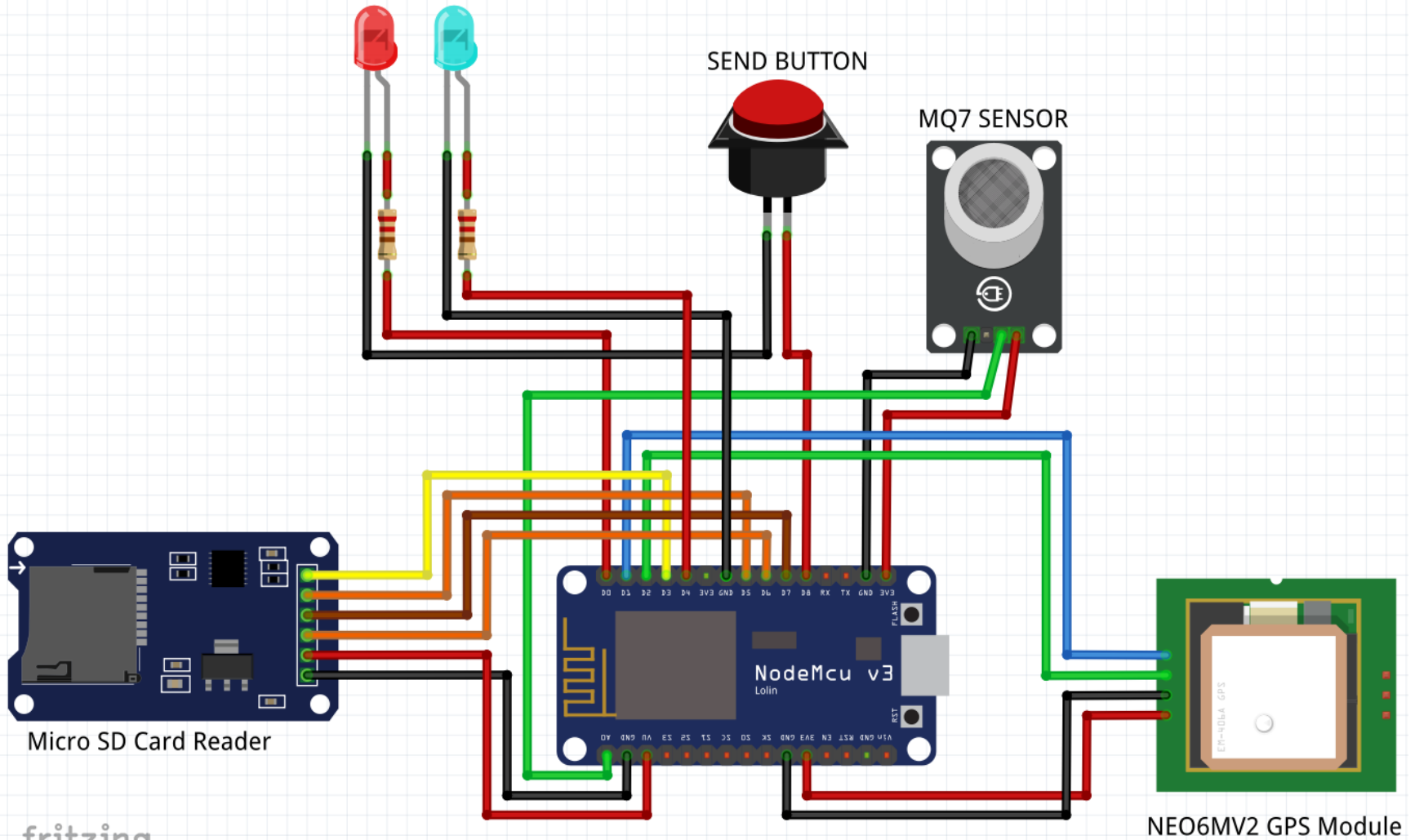

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Hardware

- **NodeMCU**: dev board based on ESP8266 chip
- **MicroSD** card reader: collecting and storing data
- **GPS** sensor: localizing the device
- **MQ** sensor: MQ-7

Total cost of roughly 7€

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Schematics

SEND BUTTON

MQ7 SENSOR

Micro SD Card Reader

NodeMcu v3
Lolin

NEO6MV2 GPS Module
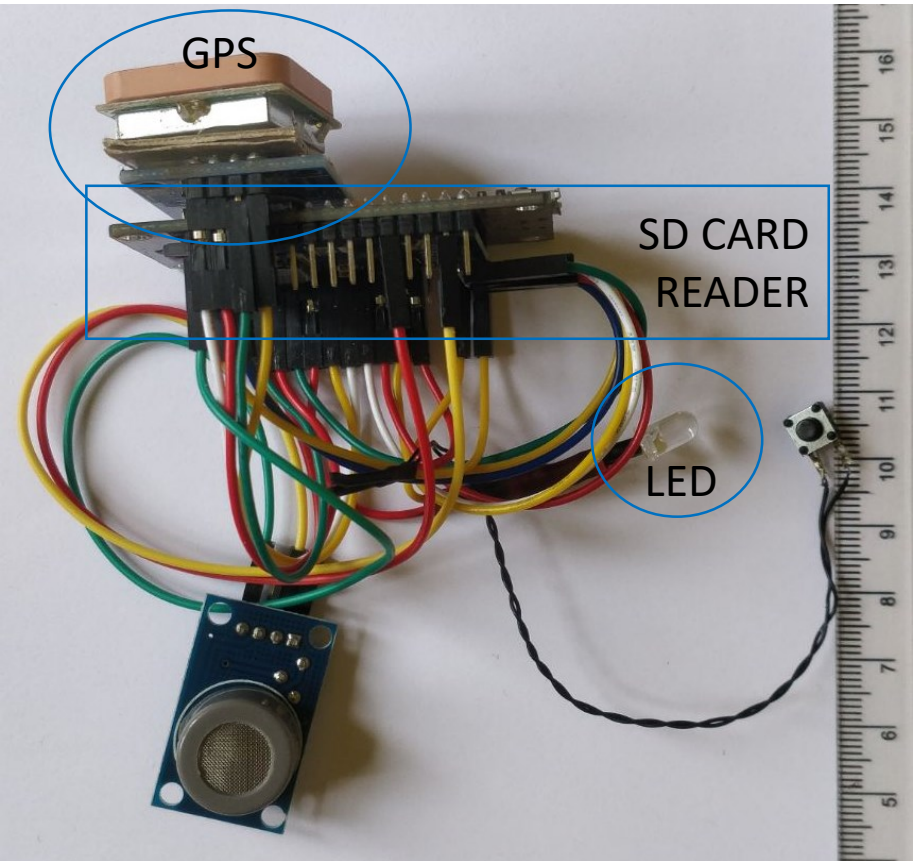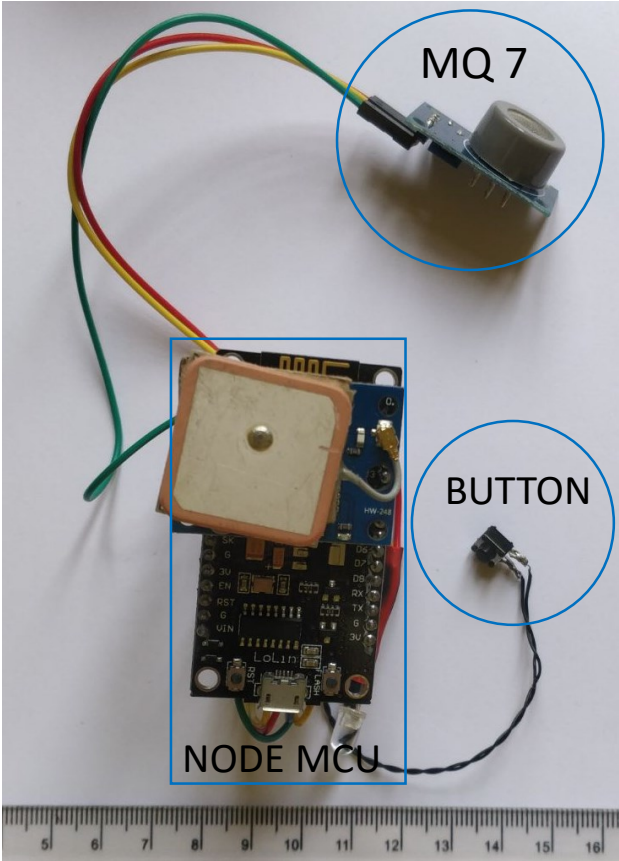
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Software

- ***Arduino C++:*** talking with sensors and saving data to SD card (json format)

- ***AWS IOT:*** MQTT server that requires certification from the device

- ***AWS Lambda:*** Sending data to database

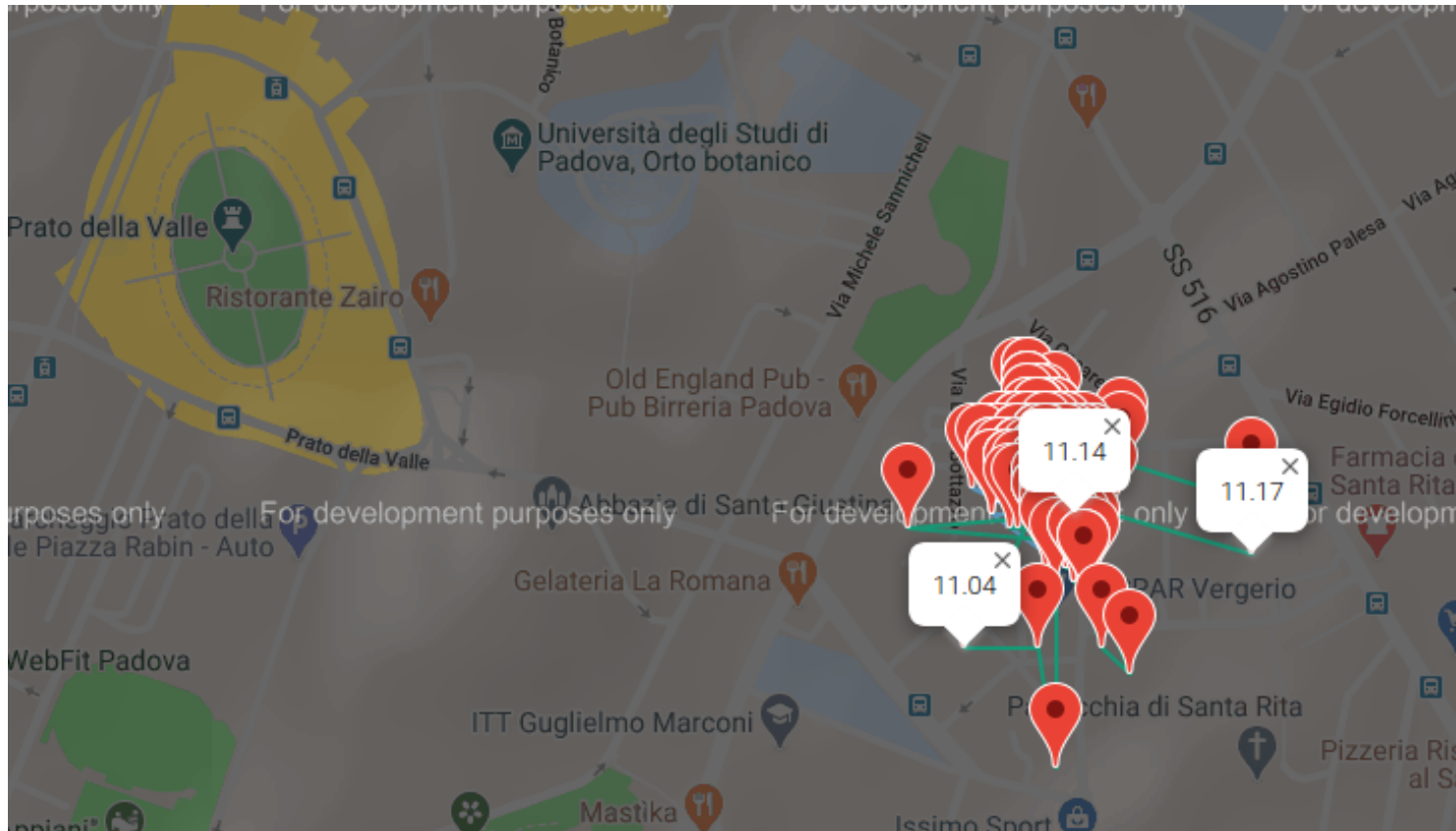- ***Altervista:*** display GPS markers via Google maps API

AWS IOT   +   AWS Lambda

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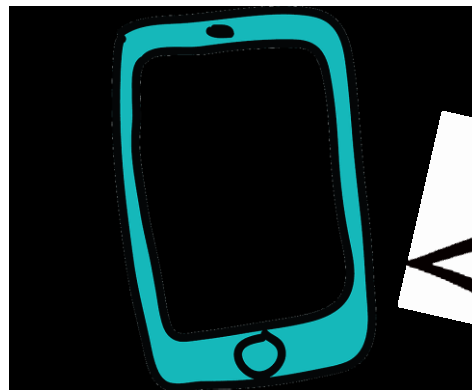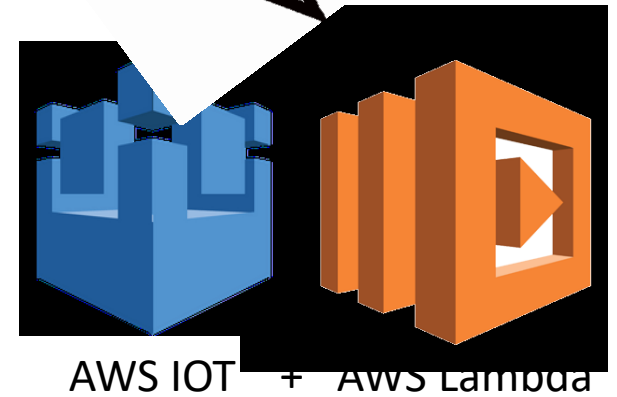
Final Device

Testing

Improvements

- *Hardware:* add multiple sensors via ADC, 3D print a case, change board, battery or dynamo

- *Software:* improved libraries for sensors integration

- *Connectivity:* add GSM module or LoRa

- *Cloud:* improve AWS integration with better Lambda functions, EC2 and Redis DB

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Conclusion

ArduECO is a proof of concept wireless IoT device capable of gathering data from air, analyze and display them to both citizens and municipalities

ArduECO uses an Arduino-like board (NodeMCU) with a built-in Wi-Fi to send in the cloud data recorded from an MQ-7 sensor for CO and a GPS module

After aggregation and elaboration, gathered data can then be displayed on a frontend map or used to generate smart services

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Future research extension

Quality and trustworthiness of data

Opportunistic networking

Data anonymity and privacy

Energy consumption

Extraction of mobility models

Data analysis

Data aware path generation

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Online material

This video presentation is available online:
https://www.math.unipd.it/~cpalazzi/ArduECO

Link to repository:
https://github.com/cipz/ArduECO

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