A BOTTOM UP SENSOR TESTBED

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Bachelor's degree in Computer Science
Year: 2014

Outline

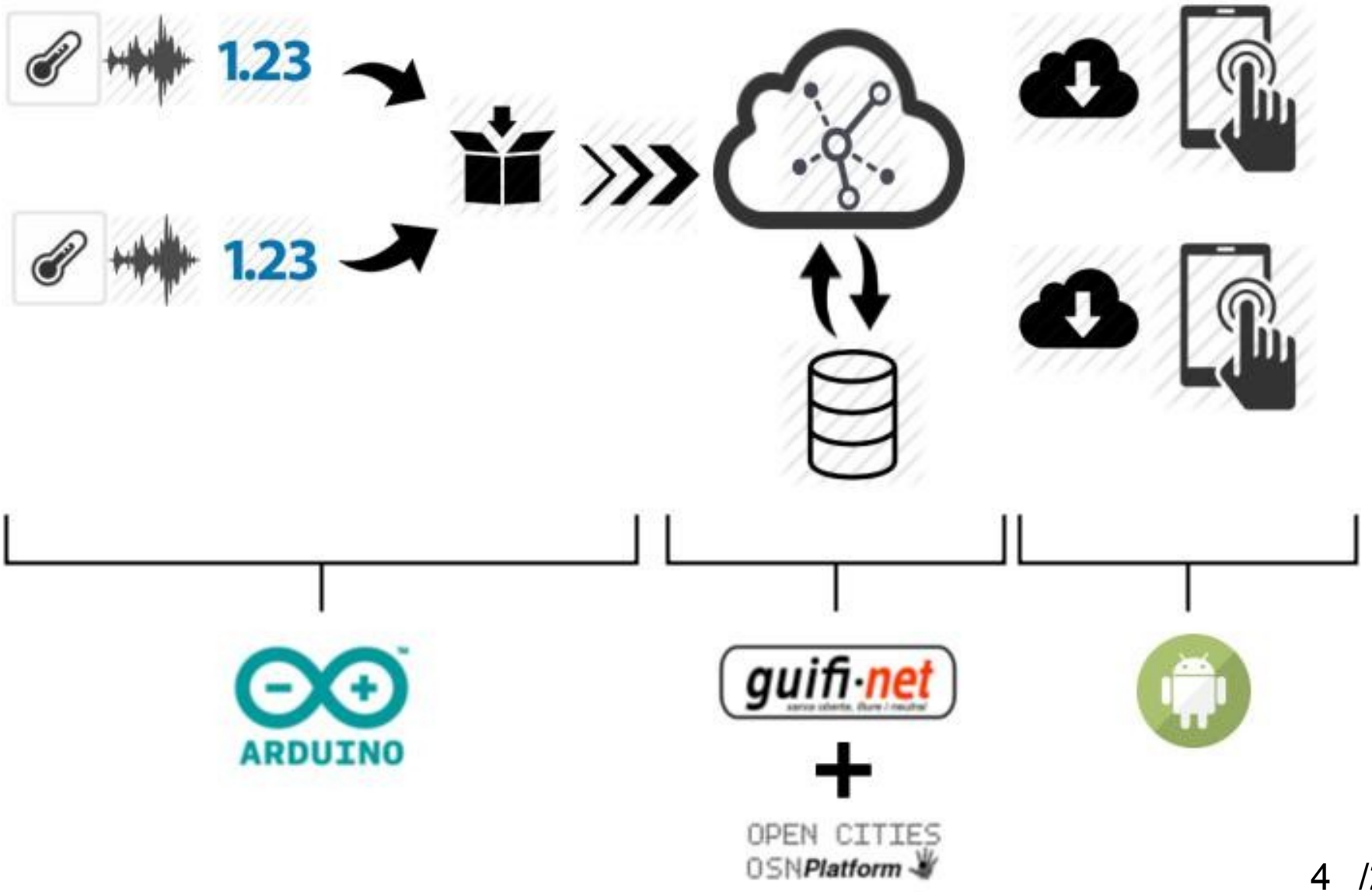
- Introduction
- State of the art
- Technologies
- Testbed
- Conclusions
- Future Work

INTRODUCTION

- The goal is to gather sensor data, store it as opendata, and visualize it.

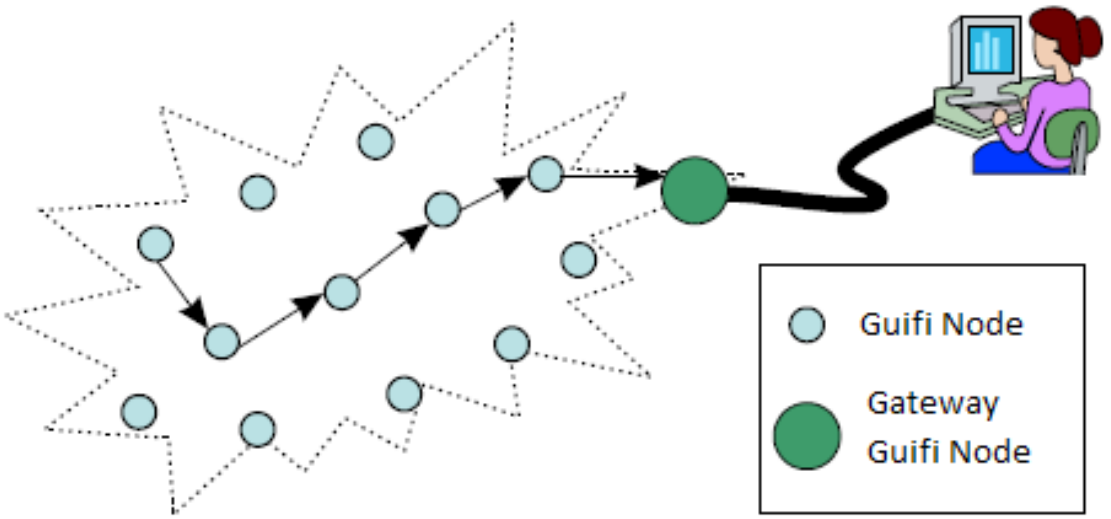
- Give the community a trace to improve their environmental conscience.

INTRODUCTION



INTRODUCTION
Wireless Sensor Networks

- A network composed of nodes.
- A node:
  - A sensor node will be attach to a Guifi node.
  - A node has equipped wireless technology to create ad-hoc networks.



INTRODUCTION
Bottom Up Broadband (BuB)

- BuB defines network design, deployment and operation initiatives driven by end user needs.
- These end users can be individuals, companies or institutions.
- In BuB, those that need the network are the ones that take the initiative and participate in the organization and funding of the project.

BuB FOR EUROPE

http://bubforeurope.net/

INTRODUCTION

- Sensor Networks can be founded by:
  - Government → Top-Down pattern.
  - Companies → Top-Down pattern.
  - Community → Bottom-Up pattern.

State of the Art
Smartcities

- A city capable of having real-time information.
- Amsterdam:
  - Flexible street lighting
  - Smart parking
- Santander:
  - Environmental monitoring
  - Traffic Intensity Monitoring

State of the Art
Companies

- Smartcitizen is a platform that offers a sensor board based on Arduino to monitor the environment.
- Libelium is an Internet of things platform provider, which supplies an open source sensor platform for the Internet of things.

Libelium Smart Water

State of the Art
Open Data

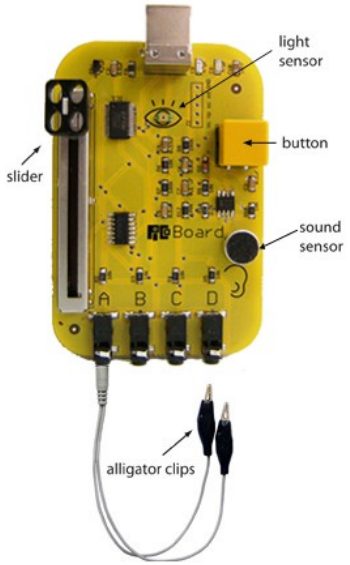
- The term Open data pursues the fact that certain types of data should be available for anyone to use, without any control mechanism, e.g. copyright.
- Opencities, Xively and Sentilo are platform that allow the user to upload and download data.

State of the Art
Sensor Boards

- Some options for the sensor node:

Arduino YUN

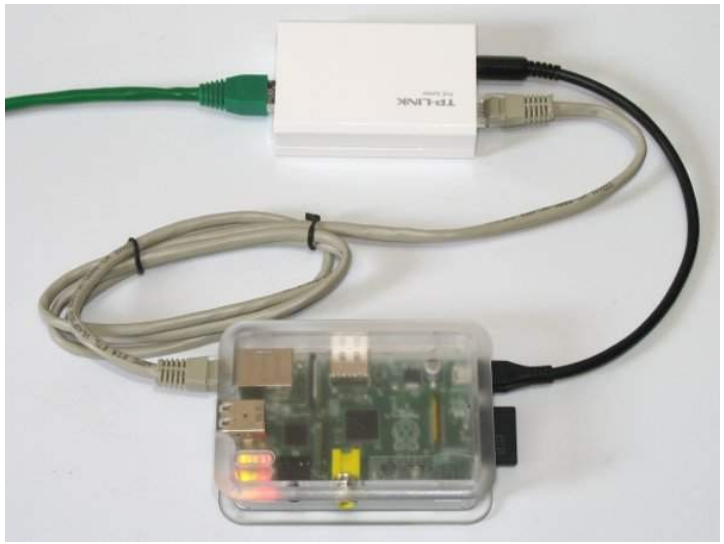
Raspberry Pi model B



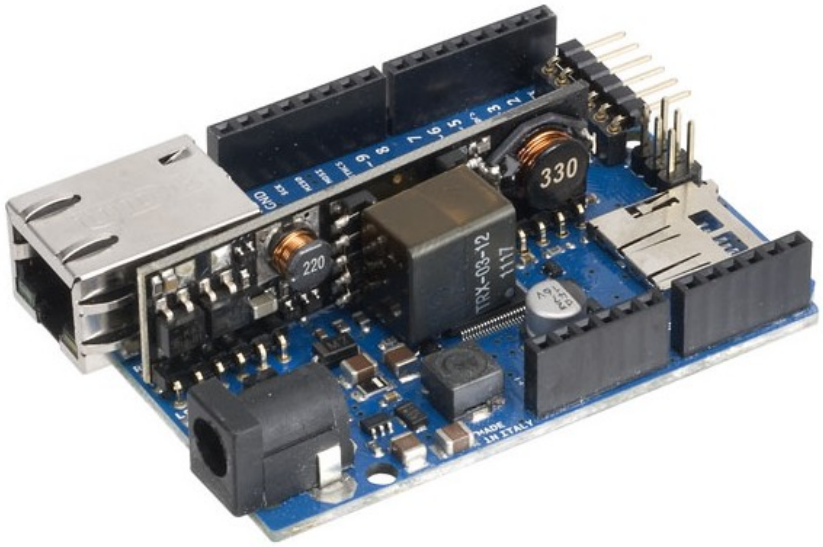
Picoboard

Technology
Sensor Boards

- The first step was to choose the board:
  - Power, CPU and Communication.
  - Size.
  - Openhardware.
  - Power over Ethernet.



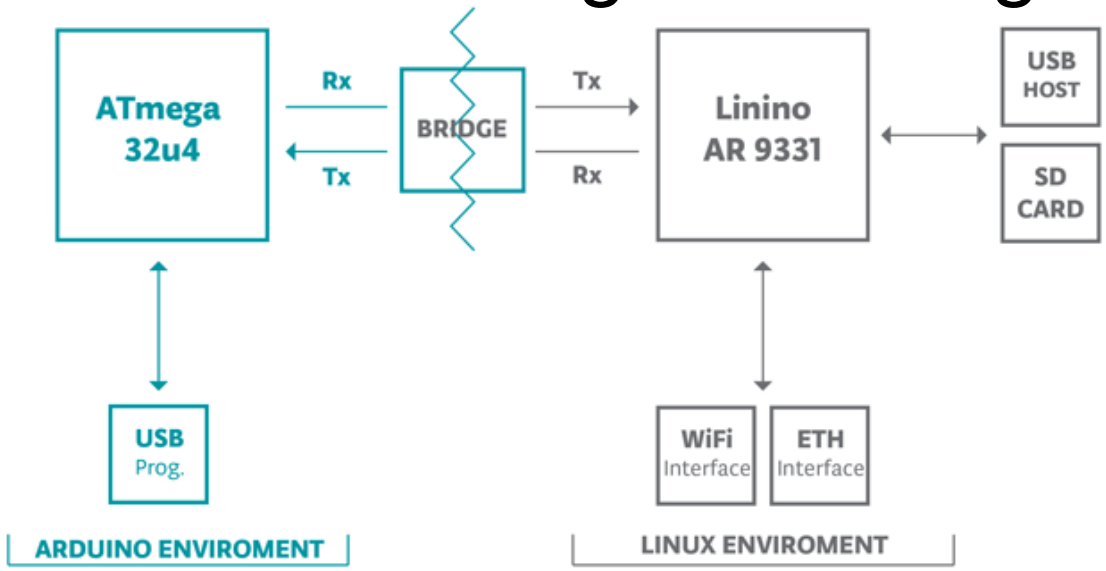
Raspberry Pi with PoE



Arduino Ethernet with PoE

Technology
Arduino Yun

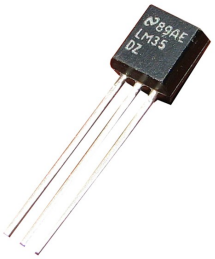
- Microcontroller board with one processor and one microcontroller.
- Has an Ethernet and WiFi module.
- Arduino sketches can communicate with the Linux processor through the Bridge library



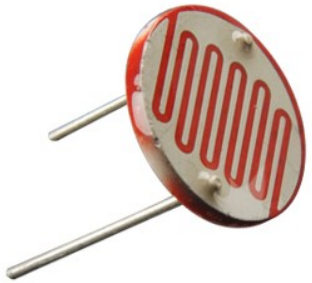
Arduino YUN Bridge

Technology
Sensors

- The goal is to analyze the environment.
- These sensors measure the aspects that may be more useful for citizens:

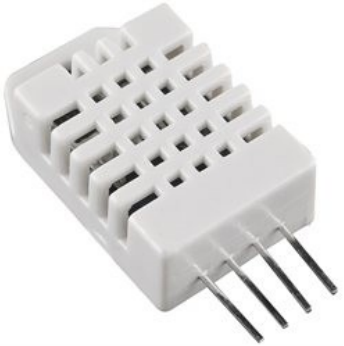


Temperature



Light

Noise



Humidity

Air Quality

Technology
Upload Sensor Data

- Upload the data from the sensors to a platform so that everyone can access them.
- A GeoJSON message includes data from the 5 sensors.
- A Python script has been used to upload this message.


```
{
    "type": "FeatureCollection",
    "name": "dummy",
    "timeStamp": "2014-06-12T08:54:59.424Z",
    "features": [
        {
            "type": "Feature",
            "tags": [
                "red",
                "tall",
                "cheap",
                "upf"
            ],
            "geometry": {
                "type": "Point",
                "coordinates": [
                    2.18946,
                    41.403809
                ]
            }
        }]
}
```


GeoJSON message

Technology
Community Network

- Is a network created and used by a community.
- Guifi is a network created by people interested in building an open, free and neutral network infrastructure.
- Guifi is the network where the Arduino nodes will be deployed.

Guifi Nodes

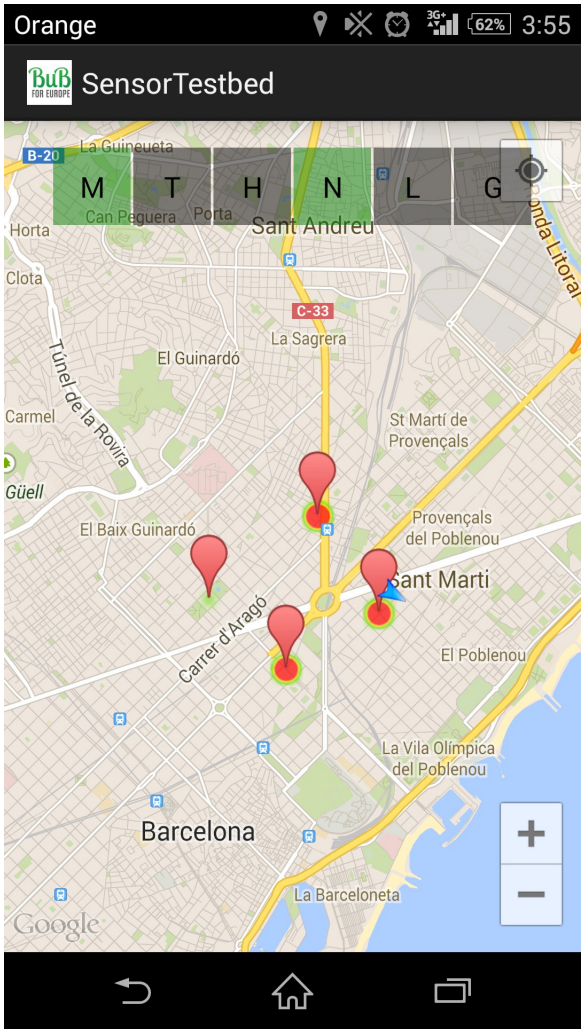
Technology
Storage Resource Broker

- The entity that stores the sensor data and is between the sensor network and the android App.

- Opencities is the opendata service that has been chosen:
  - The developers are at UPF, so the process of improving both projects (feedback, bug fixing, etc) can be fast and effective.
  - Easy API to upload and download the data.

Technology
Visualization Platform

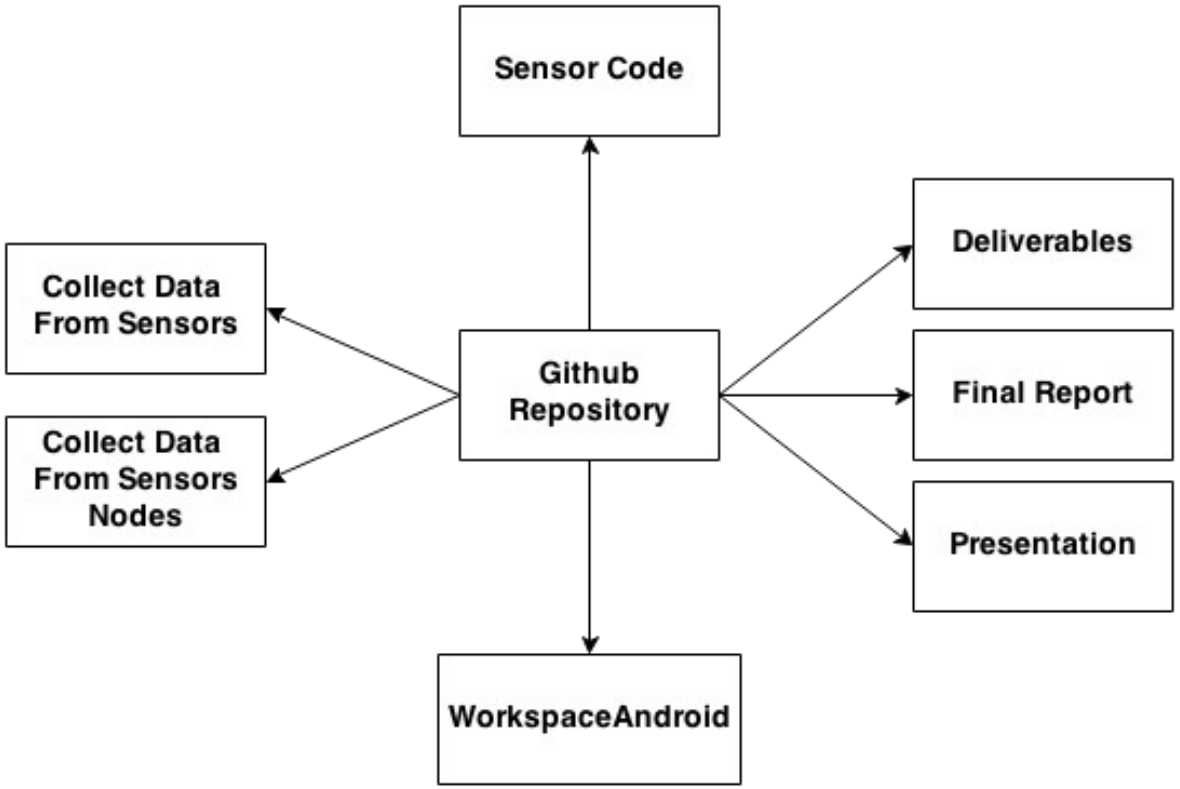
- A map is used to display the data.
- The goal is that a user checks it for a small period of time.
- The Android operating system has been chosen.



Android App

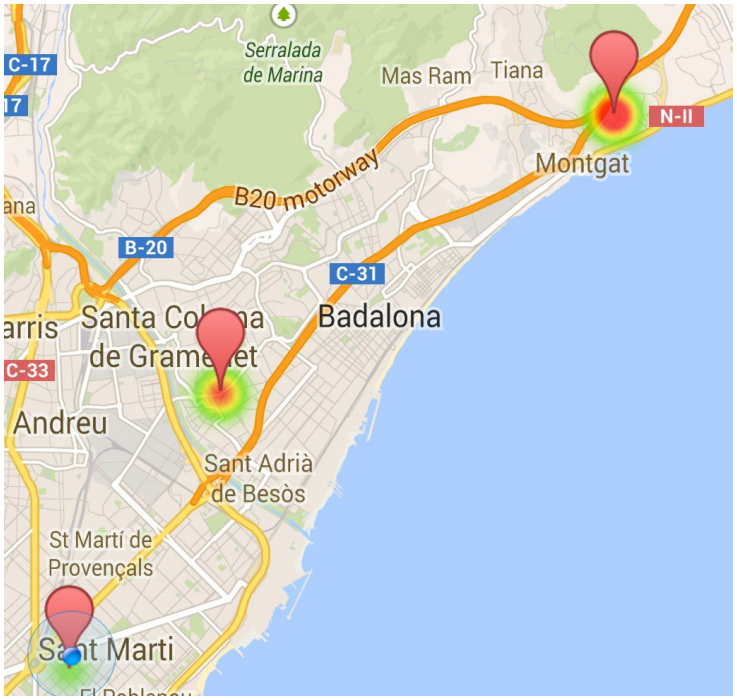
Repository

- All the code, report, figures, etc have been stored in a public repository.
- Github.com/SergioAlmendros



Testbed

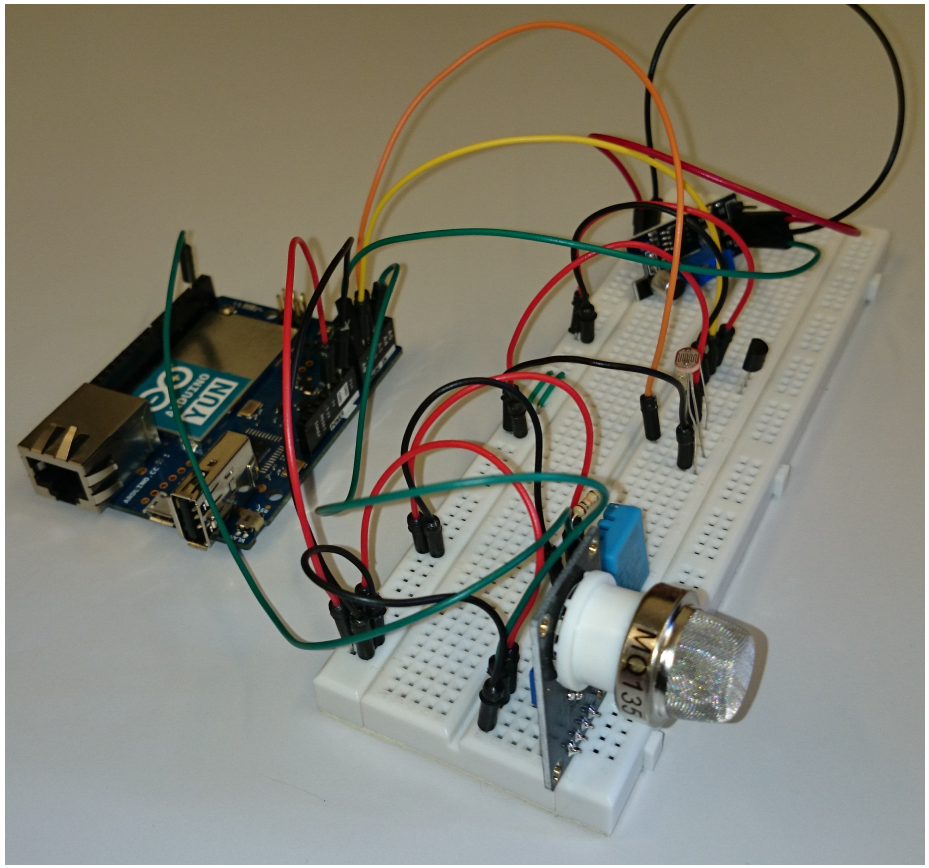
- A Testbed is a platform for experimentation of new technologies, scientific theories...
- For this project, three nodes had been deployed:



Testbed Nodes

Testbed
Sensor node Prototype

- It is composed of an Arduino YUN, and a breadboard with all the sensors.

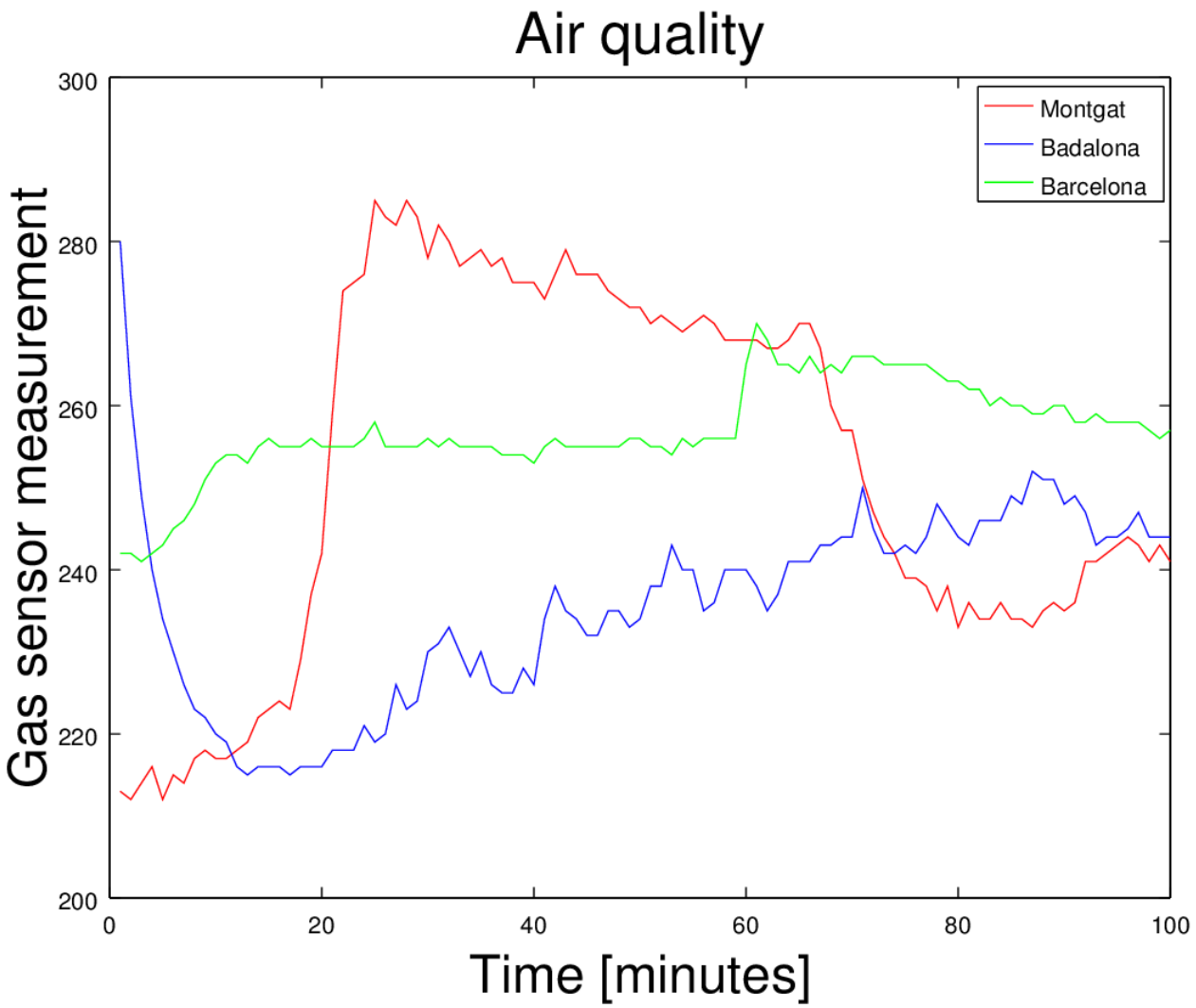


Node prototype

Testbed
Results

- A Sensor Network has been deployed.
- The data has been stored as opendata.
- A mobile application shows the data.
- Some graphs show the collected data.

Testbed
Results

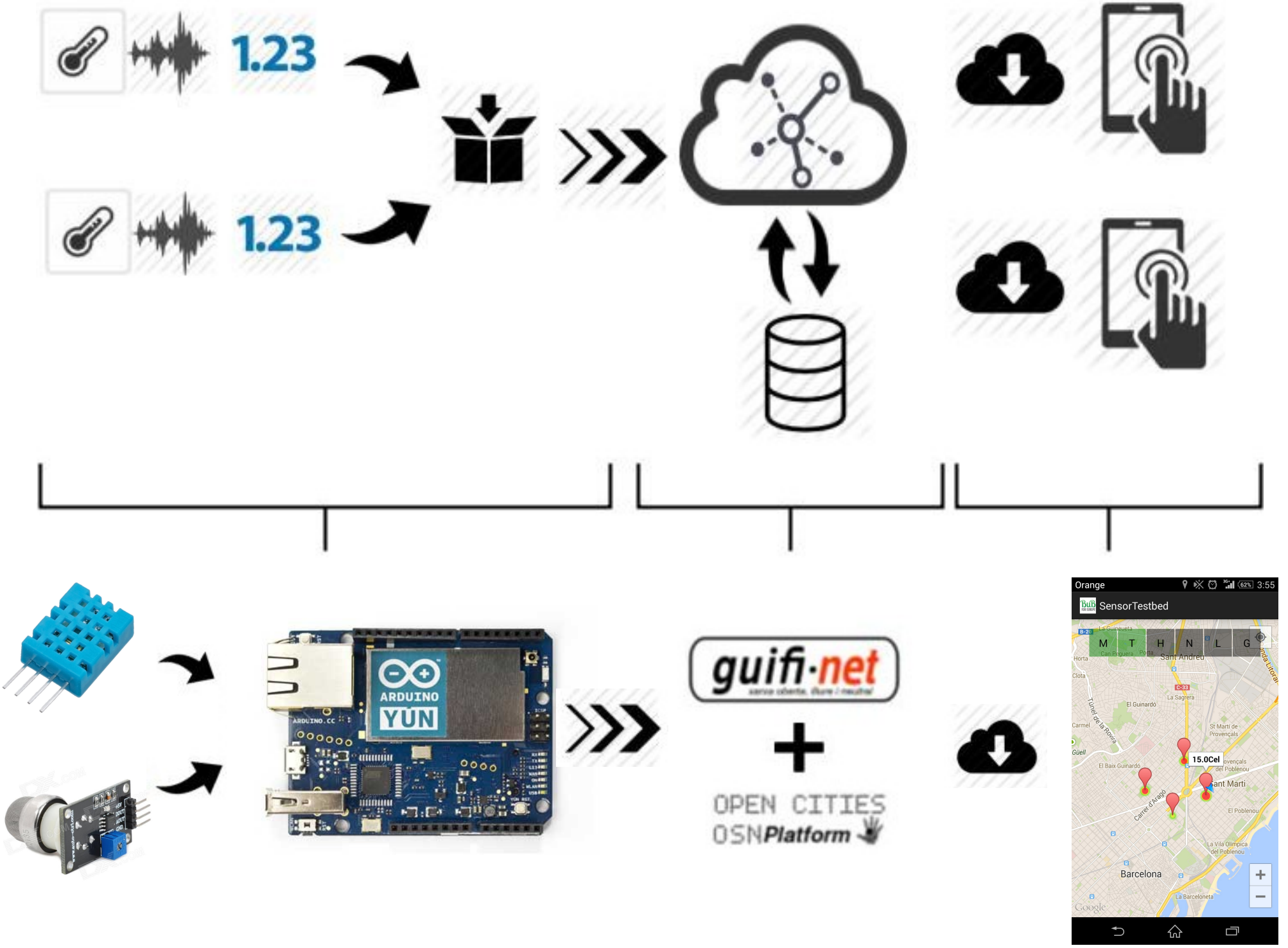


Conclusions

- The deployment of the sensor network has been successful.
- It has been shown that anyone can deploy their own network in an inexpensive way.
- A mobile application has been developed to serve as an example.
- The project satisfied the goals presented at the start.

Future Work

- Build a prototype.
- Make the Arduino Power over Ethernet.
- The mobile application showed some issues.
- Show how the data changes during a period of time.
- Disseminate the project.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ARDUINO
YÚN
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