ArduECO: real time and cheap air quality control for cities

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***Abstract*—Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.**

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***Index Terms*—Arduino, embedded, air-quality**

I. Introduction

More and more people around the world have started to understand the importance of air quality and how much having good air can influence our lives, both on the small and large scale. To have clean air, all of us have to do something to avoid polluting it.
A good example of this is the choice made by the government of Luxembourg, that listened to the needs of its people and made the first country in the world to offer nationwide free public transport for everyone.
But for short commutes, other vehicles (either powered by humans or by batteries) have started to arise and conquer cities, starting from the more classic bike (cite article), to the infamous electric skateboard to the more revolutionary electric scooter.
Since not everybody owns either of these green methods of transportation, companies like Mobike and MiMoto (cite websites) have seen the opportunity to get themselves in the market of shared transport, giving a pay-per-use solution for bikes, electric scooters and other similar vehicles. Each company with its own app, network infrastructure and smart devices aboard their vehicles, helping gather data like GPS (Global Positioning System) position, speed, time spent by the user, parking position in order to compute in on the cloud and output the cost of the ride and charge it to the client.
All this falls under the IoT (Internet of Things) paradigm, which, has become a well-described market with new ideas and business opportunities popping out every day. Among the data that is collected by these companies, there is none that regards air and pollution.
In this article, I would like to describe ArduECO, a simple cheap wireless device based on an Arduino-like board that is capable of gathering data from the previously described vehicles and sending it to the cloud, in order to be processed and displayed.
This paper is organized as follows:

- Section 2: Background and description of the problem
- Section 3: State of the art on smart devices that allow tracking pollution
- Section 4: implementation of the proposed solution
- Section 5: Conclusions

II. Background - Problem

Background
spiegare quali sono le particelle di inquinamento nell'aria
spiegare quali sono i sensori presenti sul mercato che possono rilevarle
tabella con sensori mq e differenze
come mai la scelta di implementarlo in quel modo

III. State of the art

State of the art non solamente della letteratura ma anche di quello che viene offerto sul mercato

IV. Proposed solution

The idea is to show how this kind of devices can be portable enough to install on bikes companies like mobike could use them on their own bikes in order to gather data

Dire che arduino open source anche dal punto di vista hardware

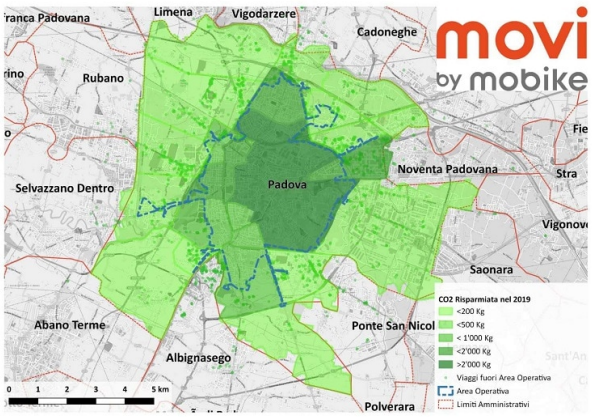

Fig. 1. Example of a figure caption. [**?**]

A. The circuit

The circuit that composes this project is made of four main components:

- *NodeMCU*: it's the hearts and brains of the device, this board is an open-source development kit based on the ESP8266 chip that allows for prototyping of IOT devices;
- *MicroSD card reader*:
- *GPS sensor*: onboard led that indicates when it acquired the position
- *MQ sensor*: as explained earlier the MQ sensor used in this project is MQ7 but it can easily be exchanged with other similar sensors that use the same board

It make detection by method of cycle high and low temperature, and detect CO when low temperature [9]

The other components are used for interacting with the user, as the leds and the button

In the possible improvements section i explain how the circuit can be improved

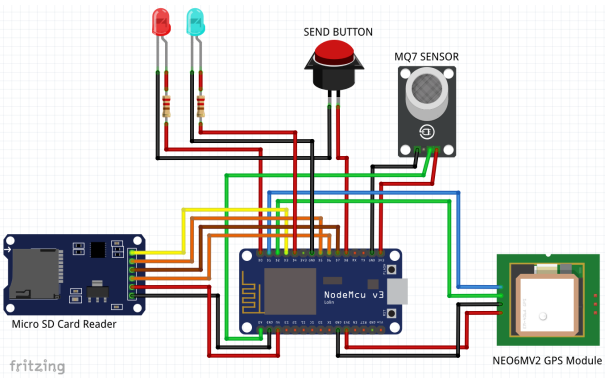

Fig. 2. Example of a figure caption.

B. The Arduino software

The reasons behind the choice of using Arduino's programming language instead of micropython [**?**] because of the large community behind.

The arduino programming language is composed by a setup function and a loop function in the setup i control

in the loop i check

C. The cloud

Use of MQTT server

snippet del json che arriva al server mqtt

```
{
    "id": "318",
    "air": "10.77",
    "lt": "45.39658",
    "lg": "11.88528",
    "dt": "260220.12283200",
    "tpc": "cocco"
}
```

D. Possible total cost

most of these parts are open source and can be found sold on

V. Results and Data Analysis

A. Test scenarios

1) Prototype test:

2) Real life implementation: State of the art

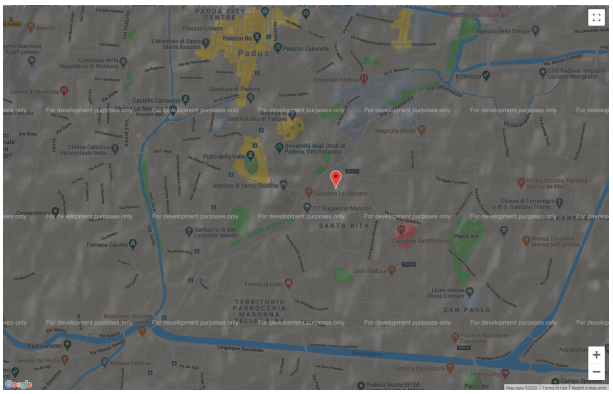

Fig. 3. Example of a figure caption.

VI. Future Improvements

In this section

A. Hardware improvements

There are various improvements that could be made to the circuit and the hardware used, for example in this project using one single air quality sensor could be seen as a drawback since we could take advantage of the cheapness of these sensors

It is possible to add multiple sensors by expanding the analog inputs using an *Analog to Digital Converter* (ADC)

that converts an analog voltage on a pin to a digital number. By converting from the analog world to the digital world, we can begin to use electronics to interface to the analog world around us. [10]

In case we would want to use another transmission medium instead of wifi we could think about switching boards and use an arduino leonardo or an arduino uno or whatever iteration possible

B. Software improvements

Supposed we use the same architecture we can improve the software such that instead of looking for the ap and snding the data only when the button is pressef it could be set such that

C. Cloud services improvements

In the development of this project I was forced by the we server host altervista.org to connect to the database only from within

connections within its domain

i was not able to allow the lambda to insert the data directly in the database, so I was forced to create an intermediate webpage to insert that data

for this reason a possible improvement could be

VII. Conclusions and future work

This paper describes the implementation of a wireless IoT system capable to gather data from air and send it to the cloud in order to be analyzed and displayed.

Acknowledgment

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks . . .”. Instead, try “R. B. G. thanks. . .”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

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