Particulate Matter Control Unit

PCTO report

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1. PREFACE

Collaboration and scheduling

Collaboration

The project was born as a collaboration between CNR and ITIS Enrico Fermi in order to make the students work on interesting themes linked to the subjects studied in the years of high school.

Consiglio Nazionale delle Ricerche



Organization and scheduling

The project has been developed by Lorenzo Rutayisire and Alessandro Maria Gaudesi, 5^ H, during our free time at home with the support of our technical subjects teachers.



2. INTRODUCTION

The aim and the main structure

What is PMCU

The PMCU is an electronic box able to retrieve data about:

- humidity;
- temperature;
- particulate matter concentration;
- position.

This information is then collected in a server available at <u>pmcu.fermi.mo.it</u> and displayed in a user-friendly format.









HARDWARE

Manages the physical part of the project: microcontroller, sensors, modules and container.

FIRMWARE

It is the software which coordinates the behaviour of the sensors and modules in the microcontroller.

HARDWARE and FIRMWARE

3.

What's inside the PMCU

Dedicated RX/TX communication for DHT22

Hardware

USCI-UART multiplexing:

- SPS30;
 - SIM800L (adapted TX)
- GYGPS6MV.

with SO and S1 as selection bits.

DHT22 requires dedicated communication.

5V power supply:



SIM800L (adapted); SPS30.

3.3V power supply:





Firmware - Initialization



Firmware - Measuring loop



4. SOFTWARE

How data is managed



Server structure

Actually, in this structure the broker is incorporated in the server, so it is eventually composed of:

- MQTT broker;database;
- web server.

MQTT Broker Server Database Web server

Architecture - Broker and Database

Implementation:

Broker: Mosquitto (server)Database: MariaDB

paho mosouitto

Libraries on the web server:

Broker: Paho-MQTT (client)
Database: MySQLConnector



Architecture - Web Server

The web server, entirely written in Python, is composed of three parts:

- MQTT client (Paho MQTT);
- DB client (MySQL connector);
 - Web services, that provide HTML pages to clients and Websockets using the Python module Tornado.



Web services

Web pages needed:

- HTML code (for graphics and functioning);
- Javascript (for graphics, using Chart.js, and real-time refresh);
- CSS (using Bootstrap, for graphics).

On the web pages data are displayed in different ways using a map (OpenStreetMap), charts and tables (Chart.js).

Websockets have been used to create a HTTP-independent flow of data between server and client in order to permit the real-time update of the data displayed.

Authentication is implemented using JWT.





5. CONCLUSION

Acquisitions and links with the school subjects

Technical subjects



Skill and knowledge acquisition

Many skills have been developed while working on the project:

- Autonomous study;
- Ideas sharing;
- Balanced work partition;
- Comprehensive project exhibition;
- Detailed documentation developing;
- Problem solving;
- Dealing with contractor.









Thanks!

Any questions?

For further information visit <u>gitlab.com/pmcontrolunit</u> to read the official documentation of the project.



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