# Pollution Tracker, a preliminary proposal for an end-to-end environmental monitoring system

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***Abstract*—The environment surrounds any type of human activity and its quality has an effect on people's lives and health. At the same time, all human activities have an impact on the environment and therefore the environment could also become the means of "revealing" behaviors that could endanger the normal life of citizens.**

**The project presented in this paper aims to create a network of innovative "learning sensors" for indoor and outdoor use, able to detect abnormal and dangerous substances in water and in air and at the same time able to learn from the context.**

***Index Terms*—distributed systems, air and water monitoring, machine learning, IoT, smart cities**

## I. The proposal

In this proposal is presented a preliminary discussion of a distributed and IoT ready system conceived for air and water quality monitoring in a Smart City scenario. The system is conceived not only to monitor pre-defined substances in the environment, but also to discover new substances that may be placed on the market or available to criminal minds.

Starting from the observation that the dangerousness of some environmental conditions is strictly linked to the territorial diffusion of the pollutants, become necessary that sensors are many and widespread. This requirement often conflicts with the size and cost that characterize the commonly adopted sensors. It is necessary to have "new" sensors, with "new" context learning abilities which, however, are at the same time small, cheap and efficient. In this context at least two categories of users can be identified: the citizens and the public authorities. These users must have differentiated information because the consequent actions to be taken are different.

The project aims to create an integrated system with distributed sensors that: a) in the air are capable of detecting the presence of pollutants, (including fine and extra-fine particle).

b) in the water (also waste water) are capable to detect the presence of "dangerous" pollutants also to detect suspicious human activities in a particular context.

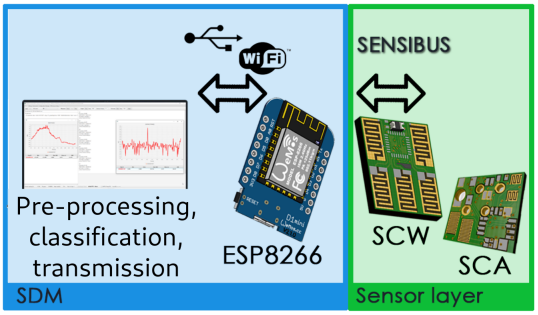


Fig. 1. The adopted acquisition and processing system

## II. The IoT ready devices

The sensing system is reported in Fig. 1 and is composed of a sensor layer, namely che SENSIPLUS chip with suitable functionalization, namely the Smart Cable Water/Air (SCW/SCA), and a communication/processing sub-system, namely the Sensiplus Deep Machine (SDM), hosted on a Micro Control Unit (MCU) [1]–[4].

SENSIPLUS is a proprietary technology of Sensichips developed in collaboration with the University of Pisa, Specifically, to work with air, water and waste water, the system has been customized by hosting it on two different printed circuit board endowed with both measuring and sensing capabilities.

The physical principle adopted to achieve the goal is the electrical impedance. By the analysis of the single components, it is possible to see: the SCW/SCA, endowed with suitable Interdigitated Electrodes (IDEs) metalized with different materials; the SDM composed of: (i) an ESP8266 MCU and (ii) a customized software conceived for preprocessing, classify and convey through TCP/IP the collected data.

## III. Architecture

A modular and highly configurable platform node has been designed and developed around the sensing platform as depicted in figure 2 to address the monitoring applications needs. The three layer architecture is organized in:

- the sensing devices: MCU with TCP/IP or LORA transmission capabilities controlling a single SCW/SCA chip
- a message broker based on MQTT publish/subscribe protocol
- a server devoted to store measures and generate RESTful API
- a client layer representing end users or other systems managed by public authorities

Data analysis and comprehension will be made both on the edge of the system (through the SDM that represents a kind of AI on the edge) and on the aggregated data collected from the cloud server realized in nodejs.

## IV. Acknowledgments

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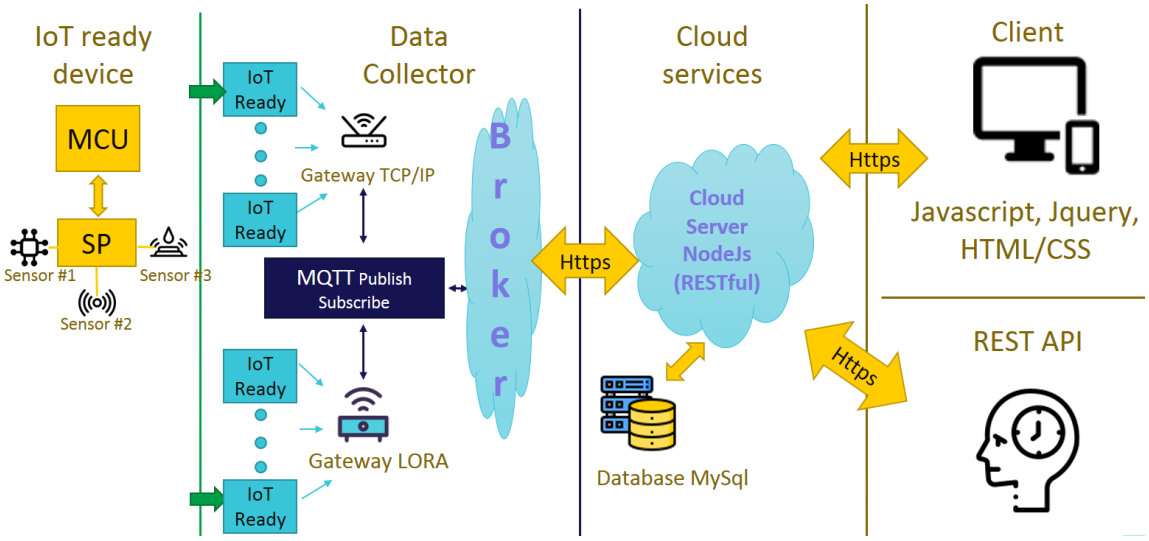


Fig. 2. The overall acquisition system