

The SMART Box of AURA Project

Presented by Alberto Nicoletti



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Introduction to AURA

- **Overview:** incorporate IoT technology within urban green furniture
- **Key Features:**
 - incorporated vegetation.
 - monitor environmental quality parameters (pollution, and traffic).
 - low-cost commercial components (COTS).
- **Purpose:** monitor the environmental quality while also contributing to pollution reduction



Architecture Overview

Hardware

- **IoT Architecture:**
 - **Sensor Modules:** Temperature, Humidity, PM2,5/10, barometer, CO/CO2 (and others), ground temperature/humidity.
 - **Connectivity:** Wi-Fi and Bluetooth.
 - **OTA Updates:** Allows for remote firmware upgrades.
 - **Power Supply:** Equipped with a battery and a solar panel for charging (as well as scheduled sleeping via RTC)
- **Data Collection and Impact:** Gathers real-time data for environmental analysis, improving air quality, and reducing urban heat.



Architecture Overview

Software

1. Setup Phase:

- **Hardware Connections:** Initialization of I2C, SPI, and other protocols.
- **Network Setup:** Wi-Fi and Bluetooth connectivity.

2. Sensor Operations:

- **Warm-up/Calibration:** Prepares sensors for accurate measurements.
- **Data Polling:** Collects and aggregates sensor data.

3. Data Transmission: Sends data to both the server and an MQTT broker using JSON format.

Open Source Libraries:

- [Arduino Client for MQTT](#)
- [NTPClient](#)
- [WiFi Library for Arduino](#)
- [Arduino Timezone Library](#)
- [Adafruit Unified Sensor](#)
- [Seeed Studio XIAO Series](#)
- and more...

Data Collection

Aggregation Server Responsibilities:

- 1. Data retrieval:** relevant data collection
 1. data from various devices.
 2. data from public APIs (Civil Protection, ARPA, Meteorological Stations)
- 2. Storage:** Data is stored inside a *JSON Data Lake*
- 3. Historical Data Creation:** Builds *data history* for trend analysis.

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    "cn": "BSAV01_9004"
  },
  {
    "gn": "Aura",
    "n": "BME688",
    "gnl": "Aura",
    "nl": "Sensore BME688",
    "pv": {
      "athmospheric_pressure": {
        "n": "Pressione atmosferica",
        "v": 1004.4,
        "u": "hPa"
      },
      ...
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        "n": "Data",
        "v": "1729084327000"
      }
    }
  },
  ...
]
```

Data Display

- **Web App:** Developed using JavaScript, [Bootstrap](#), HTML, CSS.
- **Features:**
 1. **Real-Time Sensor Data:** current state from the biofilter sensors
 2. **Historical Data:** display trends through graphs and charts.
 3. **External Data Integration:** insights from external public data providers (Open Weather APIs, Civil Protection,...)
- **User Centred Design:** provides an intuitive interface for stakeholders.



Criticità oggi

Per rischio idrogeologico: Assenza di fenomeni significativi prevedibili / NESSUNA ALLERTA

Per rischio temporali: Assenza di fenomeni significativi prevedibili / NESSUNA ALLERTA

Per rischio idraulico: Assenza di fenomeni significativi prevedibili / NESSUNA ALLERTA



Advantages & Extensions

- **Impact on Smart Urban Environments:**
 - AURA contributes to urban sustainability by improving air quality and reducing heat islands.
 - The **IoT Monitoring Network** provides insights for environmental and health-related risk assessments.
- **Open Source and IoT Synergy:** Leveraging ESP32 and open technologies allows fast, cost-effective development.
- **Opportunities:** Expand the AURA platform, enhance predictive analysis, and integrate more sensors for broader coverage, allow API access to the data produced.

For further questions and/or information contact

alberto.nicoletti@fos.it

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