How Smart Cities are Using Scentinal to Map Air Quality

Introduction

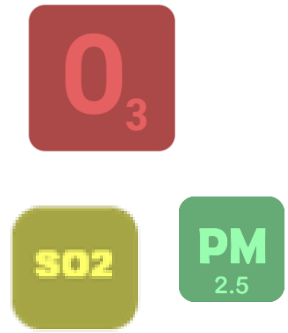
According to the World Health Organization (WHO), more than 5.5 million people worldwide die each year as a result of air pollution. Many of these deaths occur in large cities, where exhaust from cars, factories, power plants and other industries fills the air with hazardous pollutants. WHO issued in 2005 the air quality guidelines (AQG) with the intent to support actions to achieve an air quality that protects public health worldwide. Special mention in the AQG is given to specific pollutants that should be addressed to improve the air we breath. These pollutants are Ozone (O3), Particulate matter, Nitrogen Dioxide (NO2) and Sulphur dioxide (SO2) that can be encountered easily in all cities and are generated by urban activities.

Traditionally ambient air quality is measured by fixed regulatory monitoring stations to achieve high accuracy in measuring pollutant concentrations at that specific points. Environmental regulators rely on exposure assessment techniques to calculate "spatial" predictions of pollutant concentration for urban areas using limited data gathered from these monitoring stations. Even though data is highly accurate, it is spatially limited due to the high cost of these type of AQM stations.

Air pollution exposure assessment techniques have helped to address the limitations of data coverage but still fall short of accurately calculating local pollutant levels. Limitations of these approaches include that they are spatially coarse with resolutions falling between 1 km^2 to 10 km^2 and cannot characterize fine scale gradients below 1 km^2 that drive population exposure to local emissions such as traffic, construction sites and local industrial pollutants. Dispersion models and CTMs involve high grade of uncertainty as they require emission data that commonly represents a snap-shoot of emissions from the sources.

In response to a growing concern about the effects of air pollution. Cities such as Singapore, Barcelona, London, and San Francisco, have improved their efforts to measure air quality using compact air quality monitors that cost a fraction of a traditional AQM stations. Using this data, cities can map areas of high concentration of pollutants, track changes over time, identify pollution sources, analyze potential interventions, and even further, to provide a baseline for future urban plans.

Urban air quality and pollutants



Many pollutants affect the air of a metropolis. Ground-level ozone (O3) and fine particulates (PM2.5 and PM10) are identified as the most relevant pollutants for a pervasive air quality monitoring system, based on they effect on human health and their variations in concentrations within short distances.

Ground-level ozone is a threat for the respiratory system and lung function. Long exposure to O3 can involve health problems such as asthma and bronchitis. Moreover, the respiratory diseases due to O3 can anticipate death. Many studies highlight the risks for human health due to exposure to O3.

Particulate is very dangerous for human health. The inhalation of fine particulate matter can cause respiratory system problems such as asthma, lung cancer, respiratory disease, gestation problems (such as birth defects and premature delivery), and cardiovascular disease. Moreover, long-term exposure to particulate matter such as PM2.5 and PM10 increases risks of premature mortality, similarly to O3.

Other urban pollutants such as sulfur dioxide (SO2) and Nitrogen dioxide (NO2) are associated with combustion processes and are generally found in the atmosphere in close association with other primary pollutants, including ultrafine particulates. They are itself toxic and precursors of O3.

Green Smart City

A smart city is an urban area that uses different types of electronic data collection sensors to supply information which is used to manage assets and resources efficiently. A smart city may therefore be more prepared to respond to challenges than another with a simple "transactional" relationship with its citizens.

Smart cities leverage technology to improve the performance of public services and to create huge economic benefits. Examples of these benefits can be improvements in water management, waste management, parking, lighting and others.

A Smart City Platform (SCP) is a control panel for integrating city services an creates added value greater the sum of its parts. The SCP is integrated by data sources, data analysis and information. Sources of data are used to feed the SCP through a variety of input sources such as citizens, smart sensors, real-time systems, processed data and legacy systems.

Scentroid Technology for Smart Air Quality Monitoring

Scentroid's advance sensing technology allows smart cities to monitor multiple air quality parameters using an accurate yet compact monitoring station named Scentinal SL50. Scentinal can be configured with a variety of sensors to measure pollutants such as O_3, NO_2, SO_2, PM 2,5,10, and noise, to near reference accuracy. The lower cost of the unit, minimal required maintenance, and compact form has allowed cities to deploy numerous Scentinals to better understand local pollutant levels.

Scentinal does not only collect data and send it to the cloud-based platform, but it uses its built-in high-performance computing, to bring artificial intelligence in any street corner to warn authorities of rising pollutant levels, possible sources, and even prediction of pollutant levels for the next 48 hours.

Scentinal Deliver Accurate and Reliable Data for Citizens

The role of Scentinal in Smart cities is to provide accurate an reliable air quality data with an improved spatial and temporal resolution. Generally, air pollutants have strong spatial gradients over short distances as city planning configurations are not always ideal. Sources of pollution will be unevenly distributed, therefore the need for an increased number of monitors is ever growing. Beijing metropolitan area for example, has total of 23 regulatory monitoring stations distributed within 1,368 Km2 to assess air quality for more than 20 million inhabitants.

Scentinal provides near reference air quality monitoring that provides sufficient accuracy and data quality to complement the existing air quality regulatory stations with the advantage of reduced operating costs. The U.S. Environmental Protection Agency (EPA) has published the Air Sensor Guidebook EPA600/R-14-159, which defines how an instrument performs in comparison to Federal Reference methods or Federal Equivalent methods and defines an acceptable expanded uncertainty between 20% and 30% for these types of devices. Scentroid

instruments have been tested by various agencies including the Italian Research institute CNR and the accuracy has been recorded to be within 5-10% of reference stations. This amazing accomplishment has been the result of years of research and development conducted by Scentroid on areas of self-calibration, digital noise cancelation algorithms, and artificial intelligence.

Scentinal has the capability to work as Plug and Play device as it can be configured to work with any smart city platform. Scentinal will transmit data in real time with a dedicated API to allow rapid deployment into any smart city platform. This, allows seamless integration and scalability of the air quality monitoring network by easily logging the equipment ID into the smart city platform; Scentinal will be on-line once is powered ON and connected to the internet.

An intelligent workflow allows an automated machine-to-machine communication for predictive maintenance and calibration as required, this capability will be available at the user interface. Scentinal can be also configured with an alarm system to inform those locations when pollutants are exceeding the selected air quality thresholds. This will allow the user to visually detect the locations in which exceedances are occurring in real time.

Integrating an intelligent network of air quality sensors into a smart city, will allow to understand air quality data as it relies in traffic patterns, factory schedules and other human activities.

By publishing all data collected using the Scentinal intelligent monitoring stations will serve as baseline to address air quality health related issues such as asthma, or to increase life expectancy including other associated benefits such as improvements in urban planning to reduce traffic pollution or to properly relocate industry hubs to minimize impacts of industrial operations.

The backbone of any SCP will rely in communications to transmit data gathered by hundreds of thousands of devices. Scentinal can be configured to fulfill any communication requirement, from Wireless communication such as LORA to 4G infrastructures, making it an ideal instrument for SCP seamless integration.

Scentinal network was designed to be controlled remotely across the existing network infrastructure, therefore monitoring sensor health, firmware upgrades, and remote calibration is a matter of only a few clicks.

Sensor accuracy and precision

Scentroid accuracy and precision has been tested against FEM (Federal Equivalent Method-USEPA). Accuracy an precision is calculated by examining the slope and y-intercept of a linear regression equation. Scentinal results showed comparable results to the FEM monitor with expanded uncertainty <10%. This accuracy is achieved using a variety of techniques new to the industry. Scentroid's Patented self-calibration technology meets USEPA-600/R-12/531 protocol and allows the system to conduct a full calibration of its sensors every 12 hours similar to the most sophisticated Gas Chromatography based instruments. Other advancements include Scentinal's hybrid sensing that combines multiple sensing technologies into a single reading using advance artificial intelligence algorithms for greater accuracy and reliability. To learn more about how Scentinal is changing what we expect from compact air quality stations, visit www.scentroid.com or email info@scentroid.com