OIZOM
REDEFINING RESOURCES

WHITE PAPER

Real-time pollution maps for Smart Cities

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Introduction

Massive-scale urbanization, industrialization, and population growth along with an increase in vehicular traffic and energy use have made urban air quality a global concern. The distribution of air pollution concentration over a large urban area predominantly depends on local emission sources and atmospheric flow conditions. However, urban areas are the centres of various activities having multiple and diverse pollutant sources emitting all kinds of air pollutants. Also, urban areas generate local microclimate conditions within cities, making urban air quality highly variable even over relatively smaller scales.

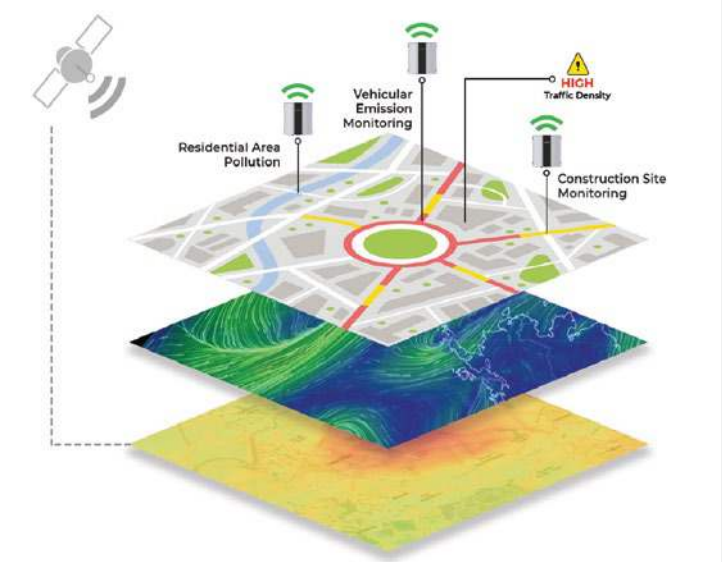
According to the World Urbanization Prospects report released by the United Nations, 54% of the total world population currently lives in urban areas and this number will reach 66% by 2050.

In order to maintain a healthy air environment, it is important to ensure availability of fine resolution air quality data and ability to visualize it at a neighborhood scale. The traditional approach of monitoring air quality at a few selected locations cannot provide such an accurate representation of total urban air quality. This gap can be bridged by deploying multiple low-cost sensor-based systems, which are compact and can be installed virtually anywhere, from a roadside to a terrace or a pole. Such additional data points facilitate the development of pollution maps for the cities. Generation of pollution maps helps in understanding the spatial distribution of pollutants, which also enable hotspot identification. Sensor-based systems measure pollutant concentration every few minutes, which makes them capable of providing high temporal resolution and real-time to near-real time pollution assessment. Unlike providing a snapshot of air quality at a particular location and time, real-time mapping provides a holistic spatio-temporal picture of urban air quality.

Real-time air quality maps help in capturing air quality fluctuations and aid in spotting sudden changes in air quality, investigate its cause, and follow up with action. It plays a very important role in improving public awareness by community-level actions to help people customize their behaviour and actions to reduce their exposure to pollution. Such a monitoring program supports the development of evidence-based and data-driven air quality management policies by enabling partnership with multiple stakeholders.

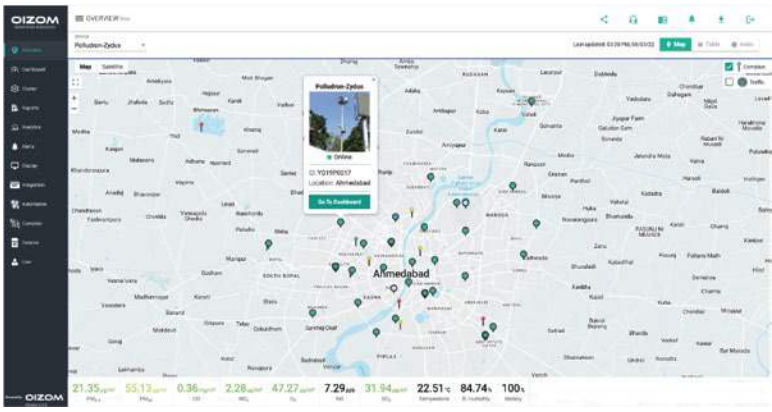
Map Generation

Maps are a convenient way to represent such phenomena that need to be understood on a geographical scale. Pollution maps represent the intensity of pollutants in a static or time-varying way using animated visualization in such a manner that is intuitively interpretable. The static air pollution maps are produced by considering long-term average air pollutant concentration and meteorological conditions. Such types of maps do not represent a temporal variation of air quality and are more useful for long-term air quality assessment. Real-time mapping of air quality provides great insights about spatio-temporal variation of air quality, which resultantly provides opportunity to take informed decisions and actions.



Real-time pollution maps can be easily plotted by simply interpolating air quality data from multiple monitoring locations. However, such maps are not a true representation of the spatial variation of pollutants. For a more accurate and dynamic representation of pollutant distribution, ambient air quality data is fed into an air quality model. Output maps of these models report real-time air quality through an interactive map. Owing to their capability of incorporating secondary data such as traffic data, meteorological data, terrain information, local built-environment, etc. in real-time, they are also known as dynamic maps. Models integrated with machine learning and artificial intelligence are also capable of effectively predicting air quality. Based on these predictions, preventive measures can be taken to avoid deleterious effects of air pollution on human life, flora & fauna, and infrastructure.

An exhaustive ambient air quality monitoring network is required to generate sufficient input data for the models to generate accurate pollution maps. India's Central Pollution Control Board (CPCB) recommends at least one monitoring station for every 10-20 km² of area. However, this guideline is effective only to assess urban background pollutant concentration levels. For hyperlocal real-time ambient air quality monitoring, a network having one monitoring station for every 4 km² is recommended.



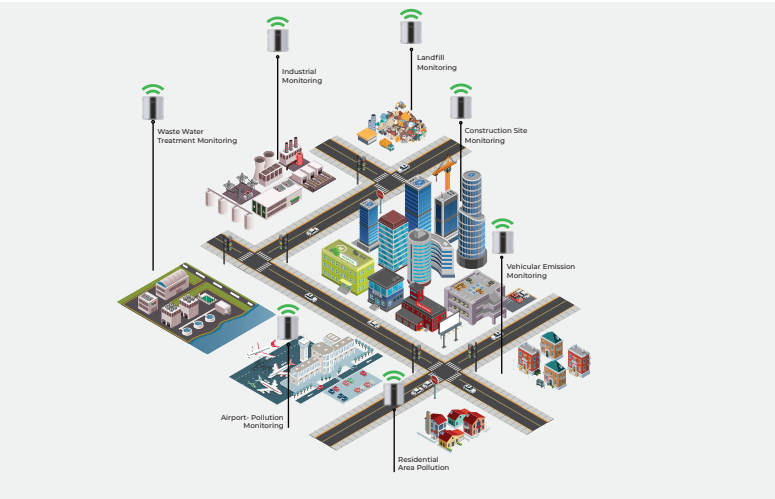
Conventional monitoring stations are too expensive to deploy at such spatial density. Sensor-based monitors are economical and are capable of providing required spatially dense representation in real-time. Dynamic air pollution maps with the spatial resolution as good as 100 x 100 m can be generated and updated constantly on an hourly or bihourly basis. The software can also be programmed to update maps automatically every time when pollutant concentration changes for say, 5-10%.

Oizom provides a platform to measure real-time air quality and integrate it with smart-city dashboards. These systems measure air pollution in real-time and develop a holistic picture of pollution distribution by also incorporating multiple datasets such as traffic flow. Oizom provides their customers API to enable cross-platform integration to third-party statistical softwares, GIS and mapping services such as Google Earth, Google Maps, ArcGIS, ESRI Dashboard, QGIS, Here, TomTom, Mapbox, etc.

Data Visualisation

The purpose of the mapping air pollution data is to provide easily interpretable information to the user. For general purposes, the most common type of heatmap is based on the AQI. However, based on the purpose of monitoring, different

layers can be added to the base map. As meteorological data is recorded at the monitoring sites, a layer of temperature, rainfall, wind speed, wind direction, and relative humidity can be added. Pollutant specific maps can be provided to regulate the ambient air quality and issue warnings or red flags whenever the permissible limits are breached. Additional analyses such as anomalies, indices, standard deviation, etc can also be calculated and represented as a heat map to understand the spatiotemporal trends of air quality.



Real-time air monitoring coupled with demographics, hospital information, epidemiological and clinical data, help in shaping data-driven public health policy. It can be coupled with other models to predict the effect of air pollution on human health. High spatial density and fast response measurements from real-time air quality monitors facilitate source attribution of pollutants, based on which informed urban planning is possible. It thus becomes a valuable tool for practitioners in the areas of real estate and provides valuable and actionable insights to avoid potential pollution exposure risk and also in property valuation.

Importance Of Real Time Air Quality Maps In Smart Cities

The most simplistic and elegant definition of a smart-city can be “The integration of technology into a strategic approach to sustainability, citizen well-being and economic development.” The primary aim of smart-cities is to create a better living space by applications that can augment swift identification and resolution of any exigency even before it arises.

- Intelligent traffic system and smart transportation.
- Smart environmental (essentially air, water and solid waste pollution) management.
- Smart utility supply.
- E-governance and citizen charter.
- Public safety

Oizom’s Offerings

Oizom offers comprehensive and scalable solu

tions for real-time environmental monitoringand analytics. The data generated are integration-friendly to various cross-platform applica-tions, bringing together multiple stakeholders to provide data-driven solutions for smart-cities.

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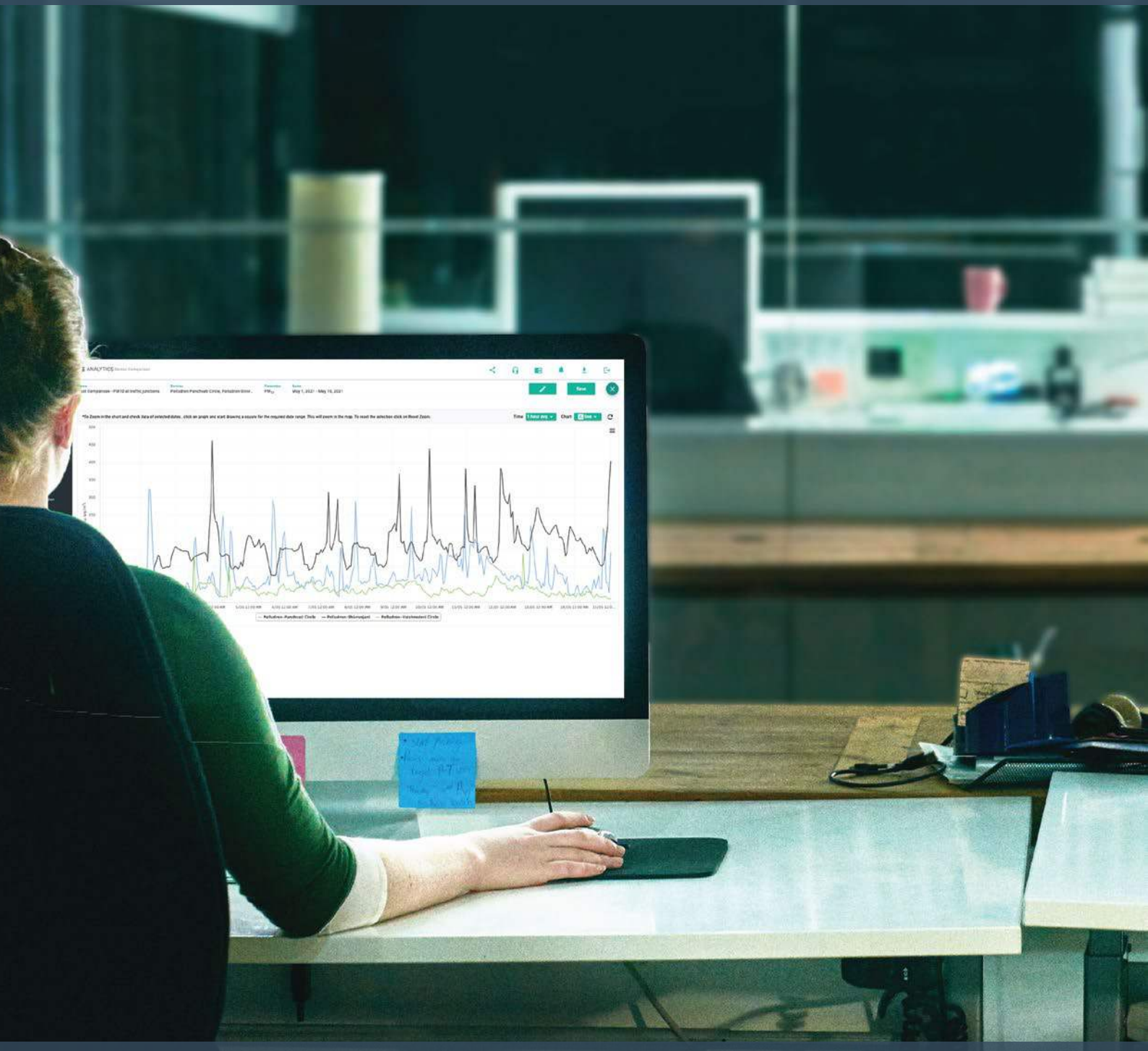

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