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REDEFINING RESOURCES

WHITE PAPER

Data Driven Environmental Automation

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Introduction

Environmental monitoring systems generate incredible amounts of data each day. The opportunity of putting such valuable data at work is missed if the data cannot be converted into timely actions. Automatic actions can be triggered in real-time by integrating environmental monitoring data with various mitigative systems such as dust suppression, odour control, air purification, etc. Through data-driven environmental automation, the authorities can take preventive measures and sustain air quality within permissible limits which improves environmental health. Industrial process control can also be improved which significantly improves industrial health and safety.

The 2017 McKinsey Study found that 50% of the work activities are already automatable using current technology and most of them are concentrated in manufacturing and industries.

Smart Automation: Data-Driven Actions And Decision Making

The process of collecting, analyzing data and taking data-driven actions has evolved with time and technology. Earlier systems required considerable human intervention, which usually resulted in inefficiency. The modern network based system integrates multiple and diverse objects of the whole operation and facilitates automatic data-driven actions. A diverse set of actions can be easily integrated and can be made automatic, including issuing warning, alerts and recommendations for workers, red-flagging hazardous systems, real-time updation of risk assessment, intensity regulation of mitigative systems etc. Threshold based trigger mechanisms can be programmed for smartly turning various systems on and off. Smartly optimized process and operation control saves operational costs and also reduces maintenance frequency significantly. Data-driven environmental automation saves valuable time and resources through real-time mitigative actions ensuring higher operational sustainability and improved environmental health and safety (EHS).

Tunnels And Parking Ventilation Automation

Air quality monitoring on the roadways, tunnels and basement parking ensures human exposure to vehicular emission is within the permissible limits. Tunnel and parking ventilation systems can be automated based on the pollution data acquired from such air quality monitoring systems. Automation of ventilation systems through particulate matter and gas sensing systems like Polludrone™ manages the air circu-lation and improves the air quality inside tunnels and multi-level parking facilities. Operations like automated ventilation rate by regulating fanspeeds, entry-exit vehicular control can effectively limit the exposure to high levels of pollution. In case of severe air pollution access to basement parking and tunnels can be restricted when required. Further, traffic accidents can be significantly reduced by integrating weather

and road condition data into Intelligent Transport Systems (ITS). In case of fire, changes in Carbon monoxide (CO) and temperature are monitored that cause the control system to regulate the fan speed for ventilation.

HVAC Automation for Critical Indoor Environment

Most of the executives surveyed by Institute for Business Value, IBM, responded that their organization performs above average using intelligent and data-driven automation.

Heating Ventilation and Air Conditioning – HVAC systems, are used at critical indoor spaces like, data-centres, hospitals, hotels, small to medium scale manufacturing industries, etc. Through HVAC, ventilation is implemented and air quality of the target space is maintained by providing fresh and clean air. It involves temperature control, oxygen replenishment, removal of moisture, odour, smoke, heat, dust, airborne bacteria, and various gases. It also ensures required air circulation by preventing stagnation of interior air. HVAC can be integrated with smart indoor environment monitoring for data-driven automation. However, HVAC systems are one of the most power intensive ones, and by the use of data-driven automation, and smart optimization, effective and efficient functioning with minimum possible power consumption can be ensured.

Air Purifier Automation

Indoor air quality describes how the air in an indoor space can affect a person's health, comfort, and ability to work. The degradation of indoor air quality is usually the result of poor ventilation, lack of fresh outside air, exposure from excessive dust or other air pollutants etc. Air purifiers are widely used nowadays to clean the indoor air by collecting particulate matters ($PM_{2.5}$, PM_{10}, PM_{100}) and harmful gaseous pollutants up to a certain extent. Air Purifiers can be smartly automated through highly accurate data acquired from the monitoring devices placed within the same space. Once the threshold level of air pollutant concentration is reached, the air purifiers get automatically switched on without human intervention. This reduces electricity and maintenance cost, and provides clean, fresh air for re-engaging to a productive environment.

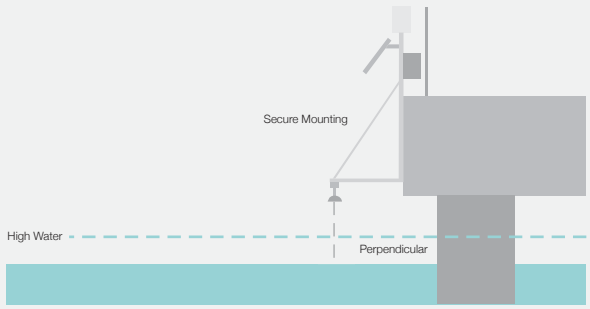
Case Study

Thermal power plants emit very high quantities of fly ash, sulfur dioxide (SO_2), carbon dioxide (CO_2), etc. Air purifiers installed at GMR Warora thermal power plant, Pune, India were automated using OIZOM's PolludroneTM to monitor the air pollutants and a threshold limit for pollutant concentration was defined. Critical hours were identified to automatically switch on the air purifiers. The automatic air purifier operation significantly reduced power consumption (operational cost) and also increased lifespan of the air purifiers (reduced maintenance cost).

Smart Weather Automation

Real-time measurement of meteorological parameters such as wind speed, wind direction, rainfall intensity, visibility, UV-radiation, light intensity, temperature, humidity, pressure etc can be utilised to trigger smart weather alerts to inform government authorities, residents and disaster management squads. Weather forecast

ing and prediction can also be achieved through such real-time monitoring data through trend analysis and machine learning algorithms. This can aid in taking precautionary measures to save lives and infrastructure damage especially during natural disasters such as floods.



Observing meteorological parameters at ports can help in making data-driven operational decisions such as controlling the cargo ships and fishing-boat traffic. Warnings can also be issued to vessels in boats in case of unfavourable sea conditions.

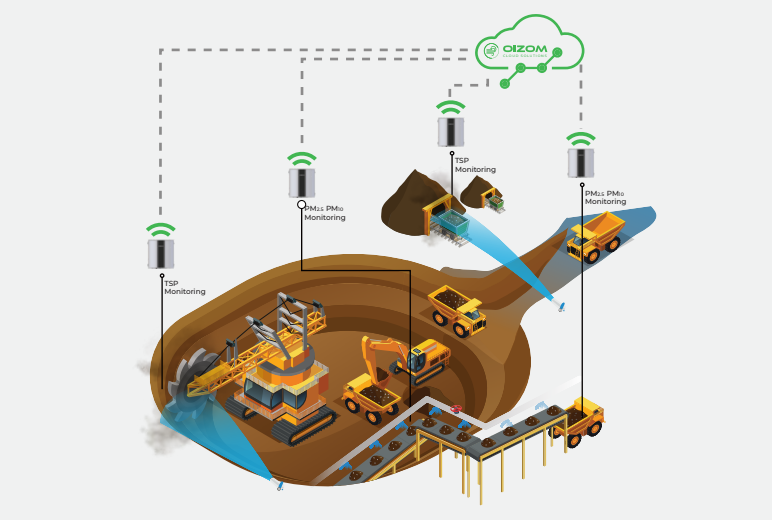
The Water Dam & Reservoir flow-control doors can be automated in-sync with the data from rising water levels in rivers combined with rainfall measurements. Similar techniques can be applied to automatically activate urban flood management systems.

Dust Control Management

Many industrial processes like automobile manufacturing industries, construction and mining sites, thermal power plants, etc emit very high quantities of particulate matter, mainly consisting of mineral, metallic, and wood dust. Such dust particles (1 to 100 µm) are predominant air pollutants, particularly at mining and construction sites. Prolonged exposure of workers and residents living in the proximity to such environmental conditions is attributed to cause serious health issues such as asthma, bronchitis, and other respiratory diseases. Particulate matter concentration at the site is continuously monitored and in case of excess dust emission, threshold concentration-based alarms can be triggered.

Using such triggers, a pre-existing dust suppression system like mist cannons, sprinklers, mechanical barriers, dust collectors, dust filters can be automatically activated for efficient control. With the help of wind speed and wind direction data, the direction of mist cannons can be dynamically changed automatically in real-time. All such dust suppression systems are deactivated as soon as the concentration limits are again well within limits, significantly saving power.

According to the Data Driven Development Report by the World Bank, data is a precious commodity, it helps in expanding markets, and improves competitive edge. It has immense development potential for businesses as decisions based on data can greatly improve economic growth and efficiency.



Case Study

Oizom deployed DustroidTM at an automobile workshop to automate and optimize the air purifiers, which measured all the particulate matters; PM_1, $PM_{2.5}$, PM_{10}, PM_{100}. It provided quantitative analysis for particle size distribution and concentration measurements and also helped to set up a threshold limit and identify the critical hours. The monitoring data was used to automatically switching air purifiers on and off. Smart optimization based on the data reduced the operational cost. Reduction in dust level also improved the health conditions of the workers.

Landfill Fire Detection Automation

Landfill emits toxic and harmful gases such as methane (CH_4), carbon dioxide (CO_2), hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), sulfur dioxide (SO_2) etc. which poses a huge threat to public health. Apart from this, landfills are usually at a higher risk of fires. While surface fires are comparatively easy to manage as they can be detected visually, subsurface fires are difficult to detect.

Studies have suggested that sites with subsurface landfill fires have carbon monoxide (CO) concentration of more than 1000 ppm. An automatic fire extinguishing mechanism can be activated automatically when CO concentration breaches the stipulated concentration limit. Public health hazards can be minimized by sending alerts and warnings to residents in the proximity. Additionally, if fire cannot be controlled by an onsite fire suppression system, automatic distress calls to the fire department significantly reduce response time.

Technology will be a key enabler in improving efficiency and capacity of city services to improve waste and sanitation value chain.
-Smart Cities and Technology Expert, Accenture India.

Automation In Traffic Management

Effective and data-driven traffic management can significantly improve air quality and at the

same time make roads safer and clear of traffic jams. Reduction in visibility is one of the major reasons of traffic-related accidents around the world. Particulate matters ($PM_{2.5}$ -$_{10}$), smog, haze, etc. are responsible for this reduced visibility. Air monitors like PolludroneTM are placed on highways and major roads that measure particulates along with visibility. Water sprinklers integrated with the monitors are activated as soon as $PM_{2.5}$-$_{10}$ increases the threshold value and are remotely turned off as the PM level decreases. Visibility on the road can be monitored in real-time, and a warning can be issued to authorities when visibility reduces from a certain limit for example 2 km. Live visibility status can be reported on display boards and appropriate recommendations such as turning on headlights and foglights of vehicles can be issued. Speed limits can also be dynamically and automatically changed on highways to ensure better safety.

Automated Odour Control

Odour is a parameter of particular interest at the water, wastewater treatment plants, landfills, and industries such as paper-pulp processing industries, fertilizer industries, etc. Obnoxious odours of gases such as hydrogen sulfide (H_2S), ammonia (NH_3), methane (CH_4), methyl mercaptan (CH_3SH), etc is harmful to workers and also a nuisance to neighbourhood areas. Data-driven odour management is achievable by installing a dense network of real-time odour monitoring systems in and around the site.

With the help of meteorological data odour nuisance in the neighbourhood and within the site can be estimated by applying relevant predictive analytics. This helps to take preventive steps by initiating odour suppression on priority. Threshold limit can be set by plant authorities, according to which neutralizers can be put into action for efficient odour management.

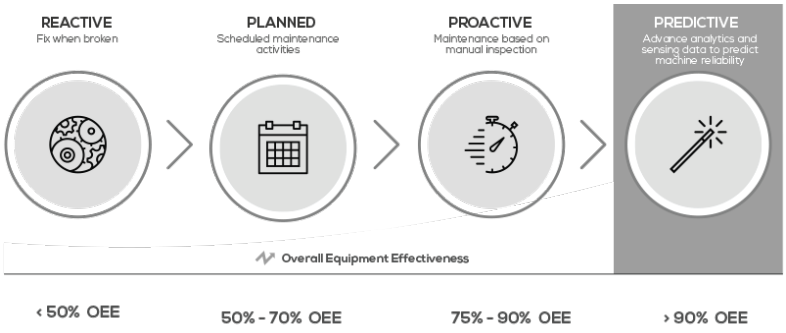
Manufacuring Process Automation

Industrial processes associated with manufacturing emits a diverse set of harmful air pollutants such as particulates from wood, stone, metal etc. These particulates either need to be collected or dispersed outdoors through ventilation and heavy exhaust outlet systems. These ventilation systems can be activated through real-time monitoring of air quality. Real-time monitoring can also initiate electric-static charge based dust collection systems.

Appropriate actions can be carried-out in case of material leakage through early warning signs. For example, in the powder-based food industry, the machines are required to shut down in a timely manner to settle the particulates and collect them out, otherwise it deteriorates the

indoor air, as well as reduces machine efficiency. Condition and fault detection also can be targeted based on the real-time data monitoring and the Overall Equipment Effectiveness (OEE) can be improved drastically.

Further, chemical and pharmaceutical industries, which produce hazardous gases, and also in industries which vents off excess methane gas, flares are provided in the exhaust stacks to burn down excess or accidently leaked gases. With real-time monitoring, automated flare operation can be achieved. Operational cost is reduced by significantly saving fuel through smart switch on-offs of flare.



According to a research conducted by Goldsmiths University, London, businesses augmented by automation achieved 31% higher financial performance, and 30% greater business performance than their non-augmented counterparts.

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