Washington University in St. Louis
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# REAL-TIME AIR AND WATER QUALITY MONITORING WITH AI-BASED DATA ANALYSIS AND LOW COST SENSORS

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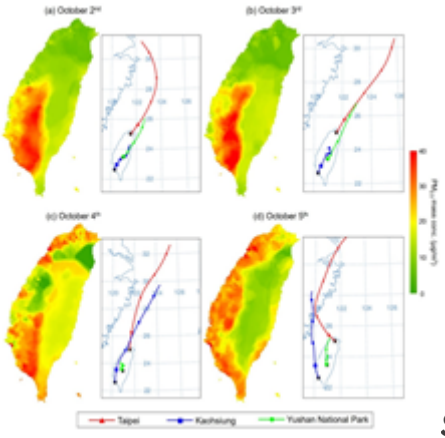
## Technology Description

Prof. Pratim Biswas and colleagues have developed an artificial intelligence platform to provide accurate, low-cost analysis of air and water quality by integrating data gathered from particulate matter (PM) sensors and other sources. This technology could be used to make the air we breathe and the water we drink cleaner through environmental management in smart cities or for personal monitoring.

Maintaining clean air and water quality is crucial for public health. Networks of low-cost, portable PM sensors could aid this effort by monitoring air pollution and water contaminants. However, no existing solutions can analyze the large data sets from these sensor networks and reliably interpret the environmental impact. Furthermore, current software for managing water supply cannon predict water quality (e.g., chlorine or contaminant concentration) at the end of the water supply pipes. This new advanced artificial intelligence technology could address those issues with software that processes, calibrates and enhances the accuracy of data gathered from PM sensors and integrates it with additional auxiliary information. This system includes models for both air quality (e.g., to predict carbon monoxide, lead and ozone) and water quality (e.g., to predict lead levels) to generate maps that identify the source of pollution and predict future air/water quality. The technology could optimize environmental systems for air and water quality control with end-user applications such as personal monitoring to estimate exposure, designing municipal water distribution systems, or managing air quality in smart cities.



***Sample air quality analysis**. Real-time air pollution map of Taiwan with wind speed information. This map was generated using three types of PM data input followed by data reliability analysis.*

## Stage of Research

The inventors have developed a calibration algorithm using data from a prototype remote mobile sensor. They are continuing to develop software that can integrate different data input formats from a range of PM sensors.

**Applications**

- **Real-time air and water quality monitoring**:
  - analysis of particulate matter such as pollution in air or lead and chlorine levels in water
  - end-user application such as personal exposure devices or smart cities

**Key Advantages**

- **Low-cost, accurate analysis:**
  - data input from low cost sensor and publically available sources
  - automated analysis could eliminate need for costly manual testing
  - artificial intelligence software (supervised and unsupervised machine learning models) integrates and analyzes large scale data sets from multiple sources to calibrate output and adjust for outliers
  - auxiliary approaches improve accuracy of sensor data by incorporating information from satellites and fixed sites

**Publications -** Cashikar, A., Li, J., & Biswas, P. (2019). Particulate Matter Sensors Mounted on a Robot for Environmental Aerosol Measurements. *Journal of Environmental Engineering*, 145(10), 04019057.

**Patents -** Designs of accurate pm sensors and systems for laboratory & real time calibration / data inversion (U.S. Patent Application, Publication No. US20190317019A1)

**Website -** Aerosol and Air Quality Research Laboratory