INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
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R&D SHOWCASE 2021

Improving Spatio-Temporal Resolution of Particulate Matter using Low-Cost IoT Sensors

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Motivation

- Particulate matter (PM) is one of the most dangerous pollutants specifically in India
- Traditional - beta attenuation monitor (BAM) and tapered element oscillating microbalance (TEOM) are Expensive, bulky and large leading to Sparse Deployment and lack of easy access to data.
- Low-cost portable sensors along with internet of things (IoT) can overcome issues of traditional methods

Contributions

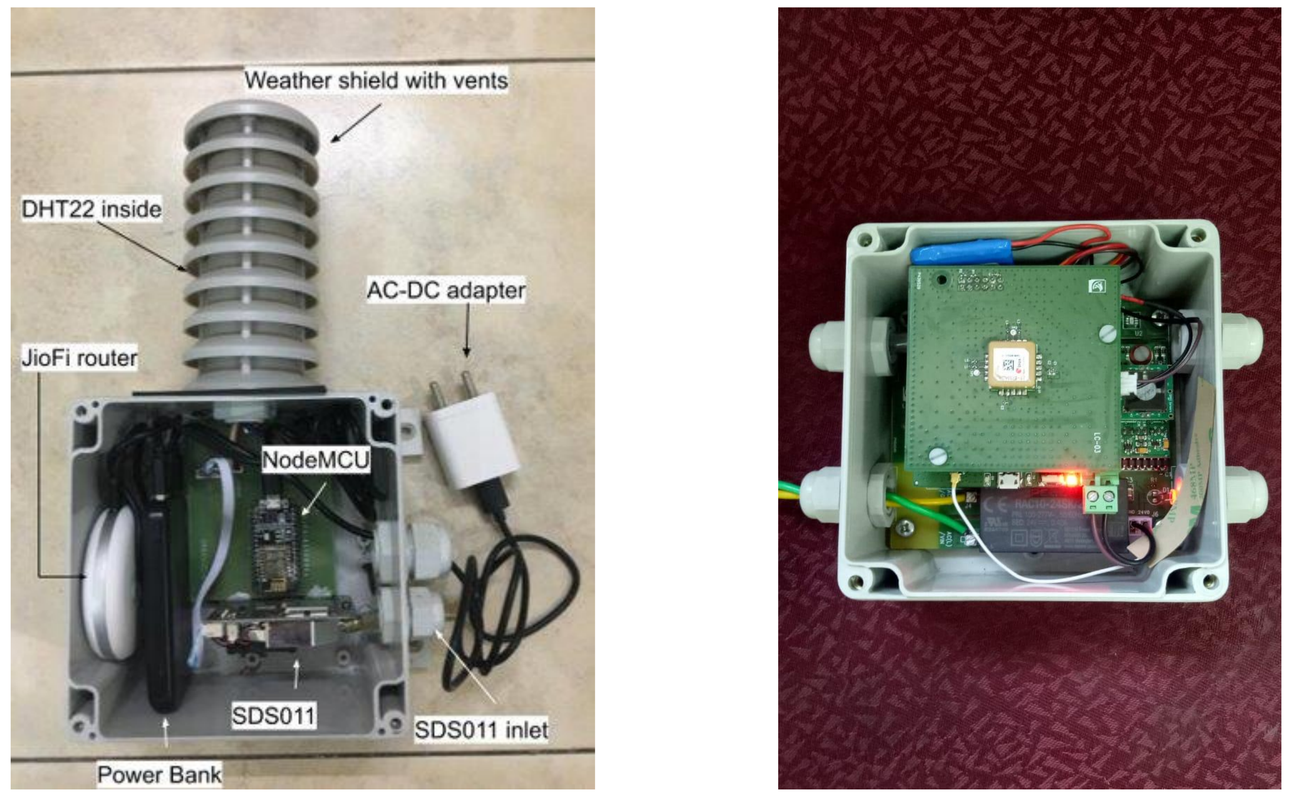
- Providing sufficient motivation for a dense deployment for PM monitoring using in-depth analysis of spatial and temporal variation of PM in small spatial area
- Development and deployment of IoT based sensor network for PM monitoring
- Web based dashboard for real time view of Air pollutants and easy access of data

Sensor Node Implementation

- Each PM monitoring node developed at IIITH consists of ESP8266 based NodeMCU microcontroller,Nova PM SDS011 and DHT22
- The sensor node transmits data periodically via WiFi to ThingSpeak cloud.
- The sampling time is every 15 seconds with added network delay to the cloud
- The node has been upgraded to version 2 a much compact version which includes GPS feature also has shown in Fig. 1

IoT Network Deployment & Dashboard

- Measurement region is the IIIT-H campus which is of area 66 acres
- The website developed for displaying the real-time PM values is hosted at the address https:/spcrc.iiit.ac.in/air/.
- The network has now been expanded to outside the campus and the updated network is as shown in Fig.2



a) Version 1 b) Version 2

Fig. 1 Sensor Node Implementation

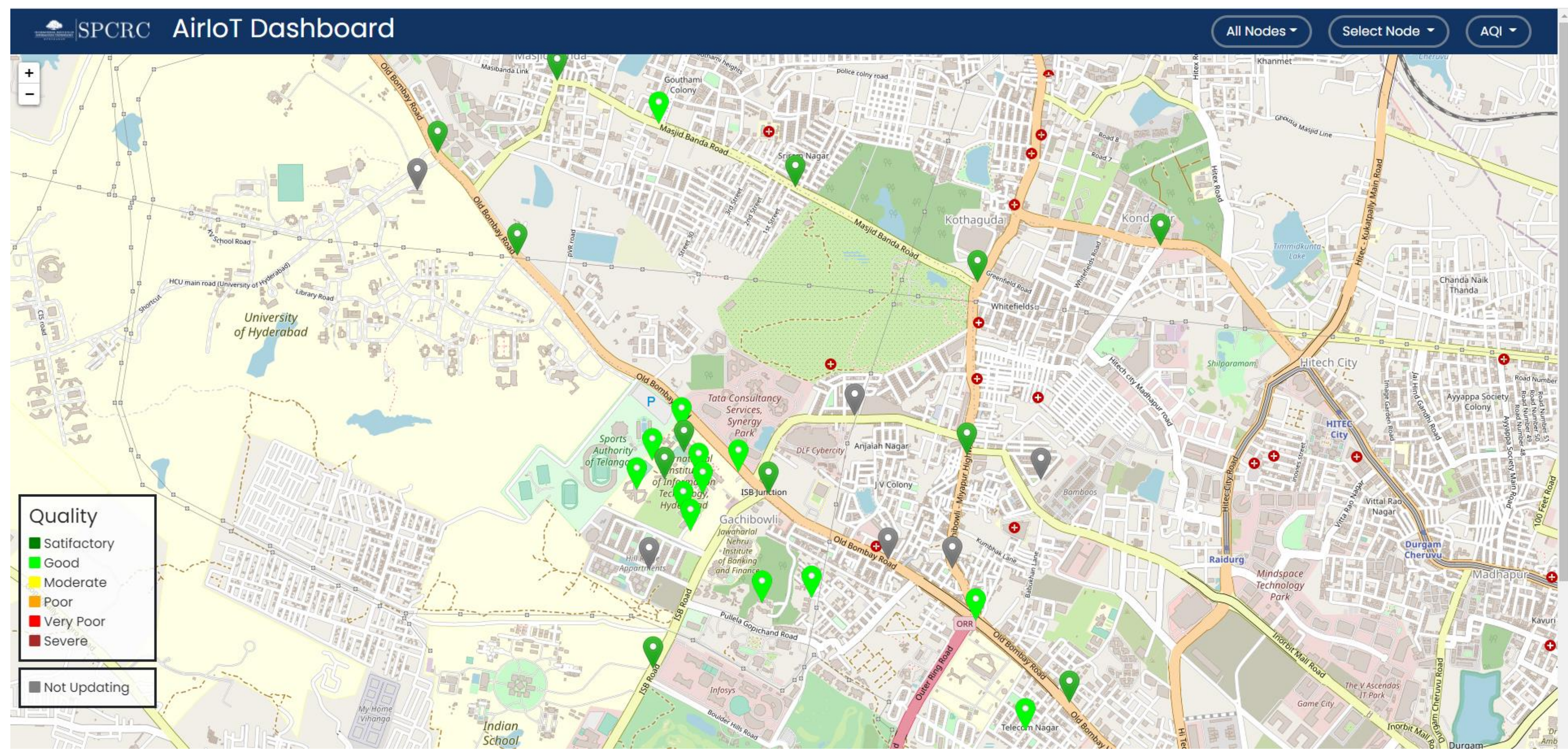
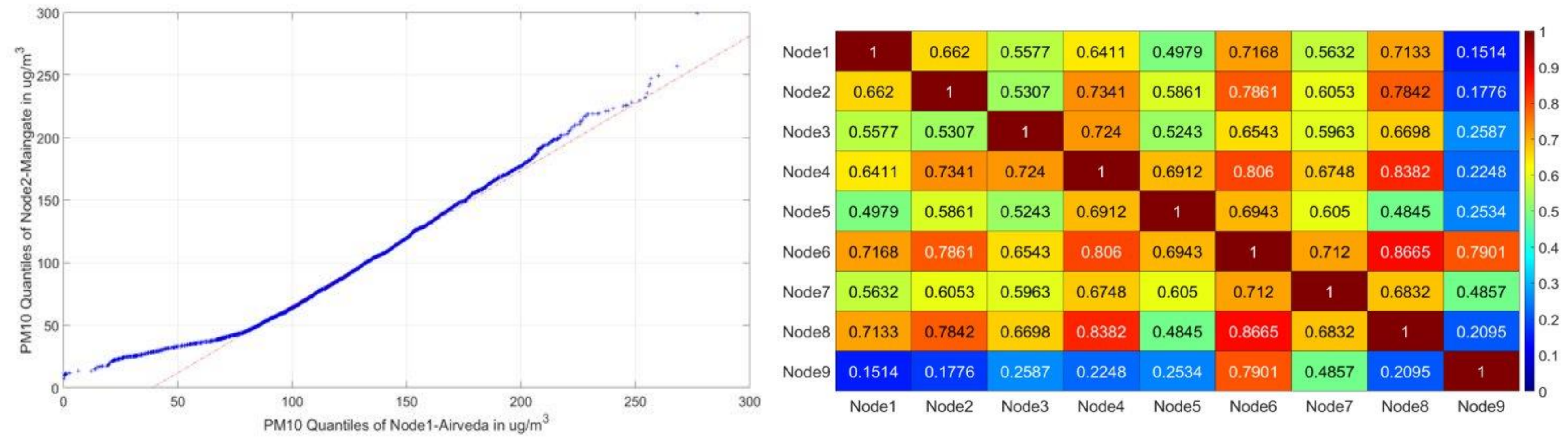


Fig. 2 Web Dashboard – (www.spcrc.iiit.ac.in/air/)

Results & Analysis

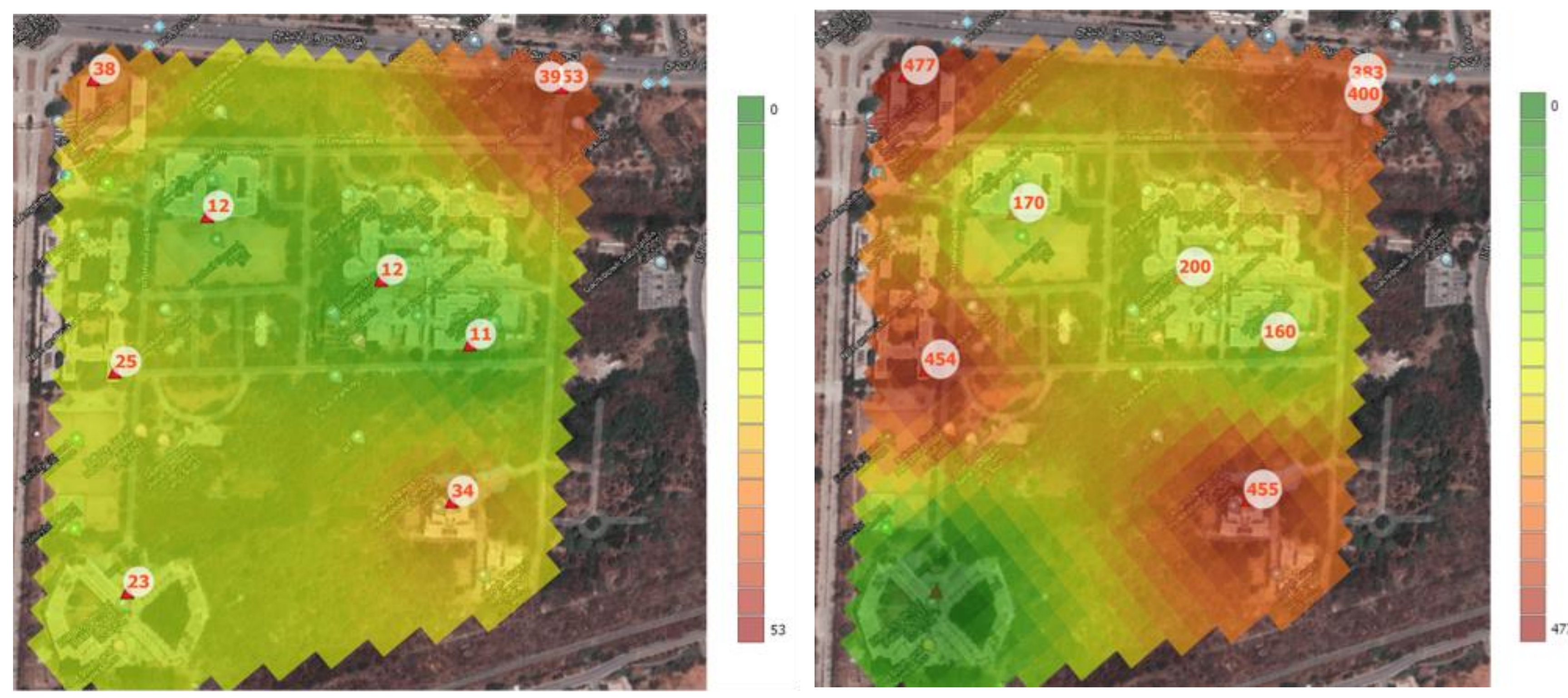
- The distribution similarity between the two collocated nodes is shown using the QQ plots
- The Kendall's coefficient has been calculated between the nodes and it varies from 0.1713 to 0.8529 for PM2.5 samples and 0.1514 to 0.8665 for PM10 samples which highlights the spatial variability between the PM values at different nodes
- Correlation coefficient between some nodes in the same campus have low values demonstrating that the PM values across a small region may be significantly different



a)QQ Plots b) Correlation Matrix

Fig. 3 Analysis

- The measurements done over the period of more than five months clearly show significant increase in PM values during Diwali as well as the noticeable reduction during national lockdown due COVID-19.
- Spatial variation in PM values in the campus ranging from 96 to 382 for locations just a few hundred meters apart for PM10.



At 19:00 on Diwali At 22:40 on Diwali

Fig. 3 Spatial Variation on Diwali

- The results show notable temporal variations with PM values rising to 25 times at the same spot in few hours, which gives sufficient motivation to use dense deployment of IoT nodes for improved spatiotemporal monitoring of PM values.

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