

ABSTRACT

Long-Range Air Pollution Monitoring

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Air pollution in major cities worldwide today has become an important topic due to its adverse effects on human health and the environment. This research aims to monitor particulate matter (PM) at different sizes, i.e., less than 1 μm (PM_{1}), 2.5 μm ($\text{PM}_{2.5}$), 4 μm (PM_{4}), and 10 μm (PM_{10}), and that the concentration of particulate matter changes with location and time. Also, particulate matter is one of the primary pollutants in the air, which affects the environment and the risk of human mortality and morbidity of respiratory disease. This research presents the design and development of a low-cost network using LoRa (short for long-range), a spread spectrum modulation technique derived from Chirp Spread Spectrum (CSS) technology. Semtech's LoRa is a long-range, low power wireless platform that has become the de-facto wireless platform of the Internet of Things (IoT). For detecting particulate matter levels, a commercially available Sensirion sensor (SPS30) was purchased and used. The developed and the deployed network has these sensors connected to LoRa modules (senor nodes) with an ESP32 microcontroller programmed to collect and send data to a gateway using the 915 MHz frequency band. The gateway then sends the data to 'The Things Network (TTN)', where a developed cloud-based dashboard reads the data. Several sensor nodes collect the measured values in the air at different elevations at the monitoring location. The proposed network design has been implemented at a specified location in Auckland City Centre, New Zealand. The designed network system allows the users to access a developed online dashboard, which shows the different concentration levels of particulate matter in the air in real-time.