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Low-cost sensors development and deployment - a case study

Air pollution is a growing environmental challenge in urban areas globally. Among the affected areas are in Sub Saharan Africa, where outdoor air pollution is responsible for approximately 49,000 deaths annually (World Bank, 2012). In response to this, researchers, civic groups and local governments have embarked on air quality monitoring programmes. Reference grade monitors, which tend to be very costly, pose a challenge for interested parties due to limited resources available within the region. This has led most parties to opt for low cost air-quality monitors in the affected areas. The low cost monitors offer an opportunity to get real time data that can help in the campaign to reduce air pollution.

The operations of these monitors, however, face various challenges including haphazard power supply and unreliable wifi connectivity. This calls for alternative approaches to be adopted in developing monitors. As a result of this, it is necessary to explore alternative sources of power and network service providers to guarantee consistent and constant data collection. This is especially important when doing air quality monitoring in low income areas and public spaces.

As such, the installation of traditional low-cost sensors will require the use of alternative sources of power and network solutions. Among the alternative technologies that have been explored include use of solar panels and batteries as power sources. Researchers and technologists select the wattage of the solar panels depending on the number of sensors incorporated and overall power consumption of the interfaced system. The current draw for a typical low-cost particulate matter sensor ranges from 50mA to 200mA. When a GSM module is incorporated for transmission of real-time data, an extra battery and higher-wattage solar panel may be necessary due to frequent transmission power bursts reaching 2A. All solar panels require a battery with an acceptable capacity up from 10000mAH, which can cater for the energy demands for at least a day; this however is subjective to the use-case.. Applications that do not need real-time data have lower energy requirements, and a memory card can be used to log data that is sent at certain intervals, such as hourly or half daily. Case studies of these can be seen in the sensors.AFRICA outdoor air quality monitor and indoor air quality monitor respectively.

Additionally, NB-IoT, LTE-M, LoRa and Sigfox offer reasonable alternatives for network provision. They fall under the category of Low-Power Wide Area Networks (LPWAN). NB-IoT is a subset of LTE that uses a narrow band of 200kHz designed for low-power network applications. This standard uses less bandwidth than the designated/stipulated bandwidth for that channel. Therefore, it is suitable for real-time data transmission due to its relatively low latency. LoRa, on the other hand, is a low-power wide area network standard that offers a longer range than NB-IoT. On top of that, it guarantees a longer battery life, which adds to the solutions surrounding power issues. Sigfox is also a worthy alternative to LoRa as it offers extended range and leverages on an existing network.

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