Low Cost PM Sensors; are they Suitable for Measuring Subtle Particle Variations in Ambient or Indoor Air?

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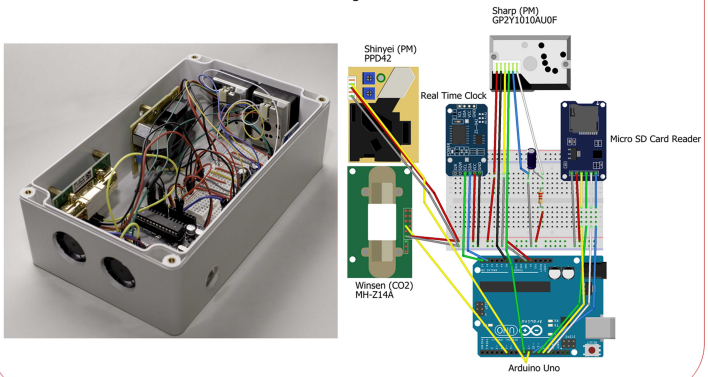
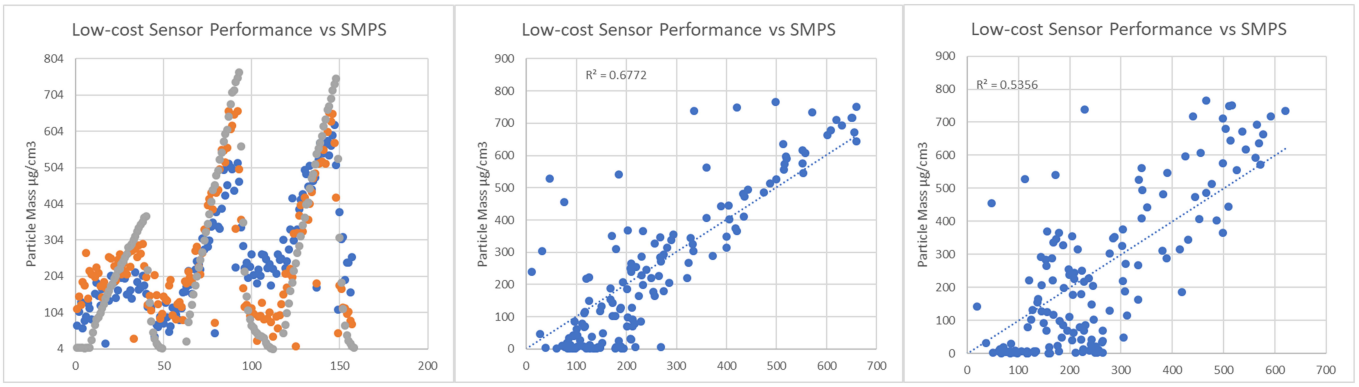
Background

Researchers are increasingly interested in the use of low-cost sensors to supplement the more scarce and static air pollution monitoring stations in order to achieve higher spatial distribution measurements of PM. Similarly, taking a single measurement within an indoor environment makes the assumption that the air is homogeneous, neglecting spatial variation. During the impending age of low-cost sensors, these are likely to play an increasingly important role in indoor PM measurement.

Development



Results



- Measured performance was much lower than previous laboratory tests ($R^2 = 0.99$) (Wang et al., 2015).
- The sensors displayed low sensitivity at lower PM concentrations.
- Sensors were able to effectively indicate when concentrations were increased above background, but were unable to indicate when concentrations dropped below background, i.e when operating an air purifier.

Advantages

- Low-cost (<£100)
- Unintrusive
- Spatially distributed PM measurements
- Portable, battery powered
- Commercial availability improves citizen involvement and interest

Limitations

- Insensitive at lower concentrations
- Short Lifetimes (6 months to years)
- High Calibration and data processing costs
- Relatively low reliability
- High development costs

Future Applications

- Real-time indoor air quality warming systems in residences, allowing residents to more easily mitigate pollution events. For example, simultaneously measuring indoor/outdoor PM concentrations and adjusting ventilation accordingly.
- Decreasing air exchange rates is a key method to improve the energy efficiency of buildings. However, this can have severe repercussions on indoor air quality. Low-cost sensors could help resolve this conflict.

Wang, Y. *et al.* (2015) 'Laboratory Evaluation and Calibration of Three Low-Cost Particle Sensors for Particulate Matter Measurement', *Aerosol Science and Technology*, 49(11), pp. 1063–1077. doi: 10.1080/02786826.2015.1100710.