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Atmospheric Measurement Techniques
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Interactive comment on "The next generation of low-cost personal air quality sensors for quantitative exposure monitoring" *by* R. Piedrahita et al.

Anonymous Referee #3

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The authors present an interesting application based on low cost gas sensors. They developed a system that integrates 4 MOX gas sensors and one optical gas sensor, and temperature, humidity and light sensors. All the components of the system were off the shelf. The system is intended to quantify low levels of CO2, O3, NO2, and CO to monitor air quality.

Although the explored application is interesting, the authors give very few details on the developed system and overlooked several issues that are relevant to come up with a robust and reliable system. Hence, the authors need to discuss the actual limitations of their system and present their system in the state of the art of gas sensing. In

particular, the authors need to address the following points:

a) Monitoring air quality on-field has already been investigated. De Vito (2009) is only one example of a system aimed to detect CO, NO2 and NOx for air quality monitoring. The authors have to present the advances/differences of their system respect to previous systems.

b) The authors did not consider humidity in their models claiming that 'absolute humidity has a lesser effect on signal response'. The authors do not provide any evidence for that claim. Actually, it is well accepted that humidity causes dramatic decrease of sensors' resistance due to the dissociation of the water molecule and the creation of lattice vacancies (Romain 1997). Sohn (2008) shows that the sensor resistance can change a factor of 2 when changing the humidity levels. A lot of effort has been done to reduce the effect of cross-sensitivity to humidity. Humidity correction is considered to be a must, especially for uncontrolled sampling systems (Marco 2014). Different authors have explored algorithms to correct humidity (Di Natale, 2008; Romain 2010)

The authors need to discuss the effects of humidity or provide evidence that the sensors are not sensitive to humidity.

c) Similarly, the authors need to discuss the limitations of the system due to temperature variations. A change of the gas flow or of the surrounding atmosphere temperature can disturb the temperature of the semiconductor surface and hence the conductance values.

d) The authors made a big effort to compare different calibrations procedures, but more details need to be provided to compare the calibrations. For example, gas flow, number of calibration points, range of calibration points, etc are not detailed. In particular, it is important that the authors provide the calibration ranges. From the results it seems that the calibration ranges are different for different calibrations. Hence, the direct comparison between calibration errors is not possible.

e) The system needs to be detailed too. Dimensions, weight and volume of the gas chamber need to be specified. How are the sensors exposed to the gas samples? Is there any gas chamber?

f) The authors made an effort to increase the robustness of the system. They reduced the effects of temporal drift by adding a simple linear term in the calibration function. However, correlation between sensors can be used to address drift and sensor failures in more efficient ways. The authors should include reference to other works to show that the robustness of the system can be improved by means of data processing techniques (Ziyatdinov 2010, Fonollosa 2013, Vergara 2012)

g) A figure showing the sensors' signals from a calibration measurement would be very informative. Also, an example of the signals acquired while a user was carrying the sensor would show the complexity of the task. The authors should discuss the difficulty of gas discrimination in open sampling systems due to turbulences and environment variations (Vergara 2013).

In short, the developed system showed some promising results, but the authors need to provide better the limitations for integrating gas sensing in wearable devices.

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