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AIRQino, a low-cost air quality mobile platform

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Recent air quality regulations (Directive 2008/50/EC) enforce the transition from point-based monitoring networks to new tools that must be capable of mapping and forecasting air quality on the totality of land area, and therefore the totality of citizens. This implies new technologies such as models and additional indicative measurements, are needed in addition to accurate fixed air quality monitoring stations, that until now have been taken as reference by local administrators for the enforcement of various mitigation strategies. However, due to their sporadic spatial distribution, they cannot describe the highly resolved spatial pollutant variations within cities. Integrating additional indicative measurements may provide adequate information on the spatial distribution of the ambient air quality, also allowing for a reduction of the required minimum number of fixed sampling points, whose high cost and complex maintenance still remain a crucial concern for local administrators. New low-cost and small size sensors are becoming available, that could be employed in air quality monitoring including mobile applications. However, accurate assessment of their accuracy and performance both in controlled and real monitoring conditions is crucially needed. Quantifying sensor response is a significant challenge due to the sensitivity to ambient temperature and humidity and the cross-sensitivity to others pollutant species. This study reports the development of an Arduino compatible electronic board (AIRQino) which integrates a series of low-cost metal oxide and NDIR sensors for air quality monitoring, with sensors to measure air temperature, relative humidity, noise, solar radiation and vertical acceleration. A comparative assessment was made for CO_2, CO, NO_2, CH4, O_3, VOCs concentrations, temperature and relative humidity. A controlled climatic chamber study (-80°C / +80°C) was performed to verify temperature and humidity interference using reference gas cylinders and high quality reference sensors. The AIRQino was installed on mobile vectors such as bikes, buses and trams in the cities of Firenze and Siracusa (Italy), that send data real-time to a Web portal. By integrating a microprocessor unit it is capable of directly updating calibration coefficients to provide corrected sensor output as digital string through RS232 serial port. Results from the lab tests and the ‘real world’ mobile applications are presented and discussed, to assess to what extent this sensor technology might be useful for the development of portable, compact, wireless and cost-effective system for air quality monitoring in urban areas at high spatio-temporal resolution.