Portable air quality sensor unit for participatory monitoring: an end-to-end VESNA-AQ based prototype

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The emergence of low-cost easy to use portable air quality sensors units is opening new possibilities for individuals to assess their exposure to air pollutants at specific place and time, and share this information through the Internet connection. Such portable sensors units are being used in an ongoing citizen science project called CITI-SENSE, which enables citizens to measure and share the data. The project aims through creating citizens observatories' to empower citizens to contribute to and participate in environmental governance, enabling them to support and influence community and societal priorities as well as associated decision making.

An air quality measurement system based on VESNA sensor platform was primarily designed within the project for the use as portable sensor unit in selected pilot cities (Belgrade, Ljubljana and Vienna) for monitoring outdoor exposure to pollutants. However, functionally the same unit with different set of sensors could be used for example as an indoor platform. The version designed for the pilot studies was equipped with the following sensors: NO_2, O_3, CO, temperature, relative humidity, pressure and accelerometer.

The personal sensor unit is battery powered and housed in a plastic box. The VESNA-based air quality (AQ) monitoring system comprises the VESNA-AQ portable sensor unit, a smartphone app and the remote server. Personal sensor unit supports wireless connection to an Android smartphone via built-in Wi-Fi. The smartphone in turn serves also as the communication gateway towards the remote server using any of available data connections. Besides the gateway functionality the role of smartphone is to enrich data coming from the personal sensor unit with the GPS location, timestamps and user defined context. This, together with an accelerometer, enables the user to better estimate ones exposure in relation to physical activities, time and location. The end user can monitor the measured parameters through a smartphone application. The smartphone app implements a custom developed LCSP (Lightweight Client Server Protocol) protocol which is used to send requests to the VESNA-AQ unit and to exchange information. When the data is obtained from the VESNA-AQ unit, the mobile application visualizes the data. It also has an option to forward the data to the remote server in a custom JSON structure over a HTTP POST request. The server stores the data in the database and in parallel translates the data to WFS and forwards it to the main CITI-SENSE platform over WFS-T in a common XML format over HTTP POST request. From there data can be accessed through the Internet and visualised in different forms and web applications developed by the CITI-SENSE project. In the course of the project, the collected data will be made publicly available enabling the citizens to participate in environmental governance.