Open Source Based Sensor Platform for Mobile Environmental Monitoring and Data Acquisition

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The impact of global change, urbanization and complex interactions between humans and the environment show different effects on different scales. However, the desire to obtain a better understanding of ecosystems and process dynamics in nature accentuates the need for observing these processes in higher temporal and spatial resolutions. Especially with regard to the process dynamics and heterogeneity of urban areas, a comprehensive monitoring of these effects remains to be a challenging issue.

Open source based electronics and cost-effective sensors are offering a promising approach to explore new possibilities of mobile data acquisition and innovative strategies and thereby support a comprehensive ad-hoc monitoring and the capturing of environmental processes close to real time. Accordingly, our project aims the development of new strategies for mobile data acquisition and real-time processing of user-specific environmental data, based on a holistic and integrated process. To this end, the concept of our monitoring system covers the data collection, data processing and data integration as well as the data provision within one infrastructure. This ensures a consistent data stream and a rapid data processing. However, the overarching goal is the provision of an integrated service instead of lengthy and arduous data acquisition by hand. Therefore, the system also serves as a data acquisition assistant and gives guidance during the measurements.

In technical terms, our monitoring system consists of mobile sensor devices, which can be controlled and managed by a smart phone app (Android). At the moment, the system is able to acquire temperature and humidity in space (GPS) and time (real-time clock) as a built in function. In addition, larger system functionality can be accomplished by adding further sensors for the detection of e.g. fine dust, methane or dissolved organic compounds. From the IT point of view, the system includes a smart phone app and a web service for data processing, data provision and data visualization. The smart phone app allows the configuration of the mobile sensor devices and provides some built-in functions such as simple data visualization or data transmission via e-mail whereas the web service provides the visualization of the data and tools for data processing.

In an initial field experiment, a methane monitoring based on our sensor integration platform was performed in the city area of Leipzig (Germany) in late June 2015. The study has shown that an urban monitoring can be conducted based on open source components. Moreover, the system enabled the detection of hot spots and methane emission sources. In September 2015, a larger scaled city monitoring based on the mobile monitoring platform was performed by five independently driving cyclists through the city center of Leipzig (Germany). As a result we were able to instantly show a heat and humidity map of the inner city center as well as an exposure map for each cyclist. This emphasizes the feasibility and high potential of open source based monitoring approaches for future research in the field of urban area monitoring in general, citizen science or the validation of remote sensing data.