Citizen observatories for effective Earth observations: the WeSenseIt Approach

Suvodeep Mazumdar, Vita Lanfranchi, Neil Ireson, Stuart Wrigley, Clara Bagnasco, Uta Wehn, Rosalind McDonagh, Michele Ferri, Simon McCarthy, Hendrik Huwald and Fabio Ciravegna describe how “citizen observatories” have been created with the help of new technology to allow the public to collaborate with authorities and organisations in day to day and emergency water management issues.

The WeSenseIt project defines citizen observatories as “A method, an environment and an infrastructure supporting an information ecosystem for communities and citizens, as well as emergency operators and policymakers, for discussion, monitoring and intervention on situations, places and events”. A collaborative approach has been taken to develop solutions that involve an exchange of information and expertise from all participants and where the focus is on arriving at practical solutions with a clear vision and direction. This has created a shared ownership scheme, and shifts power to the process itself rather than remaining within authorities, developers or decision-makers. The project’s emphasis is on delivering highly innovative technologies to support citizens, communities and authorities in developing a real-time situation awareness while ensuring all stakeholders play their part. Implementation has been through a combination of crowdsourcing, custom applications and dedicated web portals designed to foster collaboration, and which has created a shared knowledge base that facilitates decision-making processes and engages with communities. Data is captured via innovative sensors that are used directly by citizens and crowdsourcing from social networks (or by collective intelligence). We illustrate the different players and stakeholders in Figure 1.

The concentric circles in Figure 1 indicate the different types of information that are collected and shared. Among each concentric circle, a variety of stakeholders are indicated - emergency services, people involved in an emergency, explicit sensors (people actively contributing information via mobile and online systems through participatory crowdsourcing), and implicit sensors (people sharing information via social media, opportunistically crowdsourced to identify critical relevant information). A variety of applications and systems have been developed in the project to address each type of information need and stakeholder. 

CITIZENS AS SENSORS

Real-time high quality sensors provide “live” ground information on the current environmental conditions of a locality, and hence are critical to the understanding of areas of interest. Data from sensors are processed in a variety of ways and made available to decision makers as visualisations, predictive analyses or real-time alerts and triggers. All of these approaches together help inform decision makers of the existing and predicted conditions at specific locations. High precision sensors are highly expensive, need constant maintenance and are static, but can provide high volumes of data regarding areas that have been previously determined to be of interest. However, with the rapidly evolving environmental conditions and landscapes, critical areas of interest can be dynamic and different areas in cities can be of interest at different times. This challenge has been addressed by the development and deployment of low-cost sensor technology, as well as maintaining communication between citizens and the authorities.

A variety of information can be provided by citizens and to their participatory role is the large scale installation of low cost analogue devices across wide geographical areas. Examples of such devices are water depth gauge boards and snow depth gauge boards, which need to be manually “read” by counting clear numerical markings on the boards. They are relatively cheap to manufacture, require very little maintenance and can be installed at a large number of locations such as, rivers, canals, locks, waterways and so on. Citizens can quickly visually read the gauge boards and provide the information to the authorities via a smartphone or desktop application (app). In addition to the visual observation of analogue sensors, the WeSenseIt project has also developed several low cost electronic sensors using Raspberry Pi and Arduino platforms. These have been developed as small mobile devices which can provide data on local air temperature, barometric pressure, light levels as well as estimating water course flow rate (Figure 2). The devices are lightweight, portable, easy to adapt and flexible, and the data collected is periodically transmitted to the WeSenseIt data hub. A variety of user communities can use such sensors and citizen scientists, hobbyists and enthusiasts can build their own sensors using technical details provided by the project. A large number of sensors have also been distributed to volunteer flood wardens.

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To improve the support to emergency services, WeSenseIt developed an app that creates a direct video channel to the data hub. At the same time, owing to the democratisation of public policies, decisions can be made with true conviction when citizen data is included in the decision making processes. This requires citizens to have access to the data decision-makers use, so they can be more informed about situations in their regions of interest. A variety of data sources are hence provided to citizens such as weather and tide data, citizen generated reports, high precision weather station and sensor data, low cost sensors and social media. The data is presented in multiple ways - an initial home screen (Figure 5, Section 1-3) provides detailed information on subjects most relevant to typical user communities. For example, weather forecasts, flood warnings, official news reports, and citizen generated flood risk data, are pieces of information that users need to be immediately concerned with; any impending concerns can be identified from such information. Additionally, a “community wall” provides access to historical images previously uploaded by members of the community. This section provides ways for communities to remember past events which were significant in the lives of their communities for example, historical flooding events, or community charity events.

Citizens can choose to delve into more detail if they desire by accessing the raw data provided from the sensors (explicit or implicit). A map displays all the sensors at their current locations and clicking on each one provides historical sensor data. Users can also subscribe to each sensor (Figure 5, Section 3a), and set conditions to trigger alerts to notify them of any urgent readings (for example, if the river level is greater than five metres). Using a large amount of information can help citizens take better decisions regarding their personal activities as well as their community life. For example, immediately understanding the presence and locations of flood risks helps them plan their daily routes for walking, help citizens and communities be prepared for impending emergencies, as well as organise and coordinate rescue efforts by authorities and disaster response teams.

LESSONS LEARNT
The role of citizens in citizen observatories is key - not just as mere data providers or consumers, but as participants in a broader initiative and collective effort.
performed complex troubleshooting, and as a result, the availability and physical presence of support staff is essential. Volunteer communities also have a wide range of technological requirements that may evolve over the scope of the project, since engagements of communities are dynamic (with respect to volunteer members’ time, as well as technical needs and preferences). Furthermore, physical sensors require a reliable source of power in order to ensure a consistent stream of data is generated. Depending on the type of sensor and the amount of power required, this can be often challenging – batteries require constant monitoring and replacement while electricity and power lines are not always readily available and accessible. Solar panels, on the other hand are affected by weather conditions and obstruction by foliage and overgrowth (as seen in Figure 6). This is an important consideration that needs to be addressed, in order to ensure a continued and engaged participation from citizen communities.

During the lifetime of the project, all stakeholders and participants expressed concern regarding the longer term sustainability of Citizen Observatories. In addition to making available tools and technologies developed within the project as freely available open source code, several avenues are also being explored, such as identifying exploitation opportunities, providing post-project technical support, as well as code and data sharing initiatives with other citizen science and crowdsourcing projects.

The WeSenseIt project is in its final stages now, and the technologies developed are currently undergoing evaluation. The results are expected to provide a rich set of findings and a lot of interesting results, particularly in the way citizens and communities can work together to build a greater understanding of their local environment, their communities, as well as collaboratively developing solutions and taking decisions to improve water management and governance.

Acknowledgements

The WeSenseIt project is funded by the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 308429.

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