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ICT

# SeRGIo

**Mobile Sensing Services for Developing Geospatial IoT Applications**

**Current data collection solutions in smart city contexts are great for measuring quantitative data. Examples are the temperature, air pollution or traffic density at a certain location. However, to improve the wellbeing of citizens or the level of public services, more qualitative data are needed. We need to know how people perceive the safety in their neighborhood, the cleanliness, the network connectivity, the public transport, and other subjective experiences. Such qualitative metrics are the missing piece in the data puzzle.**

**SeRGIo set out to investigate the complexity and costs of developing mobile sensing applications to harvest qualitative data using 'humans as a sensor'. At the heart is the idea of pushing appropriate questions and tasks to a selected target public equipped with mobile sensing and communication devices, and harvesting their answers. One enticing idea that SeRGIo investigated is how to leverage the mobile workforce of large companies, adding data sourcing to their service offering.**

Typically, data harvesting initiatives using humans face three main challenges. One: sourcing from a crowd often doesn't result in good geographical coverage. Second, unless you include repeated visits by many people, there is little guarantee as to the quality of the responses. And third: the engagement of volunteers easily wanes over time.

SeRGIo set out to overcome these challenges. One main idea is to use a mobile workforce from a larger company, where data sourcing is added to the job definition and the people are trained. This ensures good coverage, sustained engagement and appropriate quality. When using a crowd from the general population, the idea is to intelligently select a target group that is in the right zone, available to answer questions, and motivated by, for example, a rewarding model.

SeRGIo examined three business cases, one for each industrial partner in the project:

- Bpost has a workforce of 15.000, daily visiting every street in Belgium. The idea was to investigate if bpost could add data sourcing as a service model to its offering. Example cases are reporting on the status of buildings to update the database of the National Geographical Institute, or checking in on elderly people for public welfare organizations.
- Nokia was especially interested in harvesting subjectiv experiences about the availability and quality of service of the communication network. As an additional project, it also looked if it could use the available Wi-Fi infrastructure to locate people and opportunistically push tasks.
- Joyn wants to enhance data crowdsourcing by offering rewards for good quality data (such as a shopping bonus), thereby assuring sustained crowd engagement and geographical coverage.

## THE OUTCOMES

### 1. An innovative platform to push relevant tasks and harvest qualitative data

This platform includes a module to identify the right people to send questions to, based on their location, time and – if available – work agenda and trajectory. It also has functionality to detect the exact right moment to push a task. To do so, it intelligently deduces people's activity based on sensor input so that tasks are only pushed when people are able to answer, e.g. when they are not driving or carrying packages.

### 2. Orchestration models, sensing modalities, user experience

To maximize the sourcing of qualitative data, SeRGIo determined optimal ways of pushing tasks depending on peoples' location, activity, trajectory and workload. The orchestration is organized

using three key stages: coasting (locating people), sensing (determining a person's activity), and tasking (sending the right task at the right moment). Various sensing modalities (location, speed, sound...) and devices were studied to derive the best opportunity to push tasks. Last, it was also studied which tasks and questions were most appropriate for the target audience (in this case bpost workers).

In addition, IDLab developed a more generic sensing task scheduler to configure and test various task distribution strategies based on the type of application and on the type of participant. It also linked an agent-based simulation framework to the middleware, allowing the modeling and simulation of participant behavior to be used for easy validation of sensing strategies before they are deployed.

### 3. A security add-on to guarantee the data quality

SeRGIo partner DistriNet implemented a module to extend the secure processing and communication of data for both the smart devices of the data sourcing crowd and the sensors connected to those devices. This includes adding time and location stamps to make sure the data have been collected at the right time and location and have not been tampered with.

### 4. A proof of concept and field trial

As a proof of concept of the SeRGIo platform, the project partners conducted a field trial with two groups of bpost workers: a control group that received a number of preloaded questions and a test group that received 'right time and place' tasks. The results were positive, with the test group answering more questions than the control group, and also showing a growing engagement during the trial.

# NEXT STEPS

In the SeRGIo project, the project partners managed to solve the challenge of 'how' to harvest qualitative data. In a next step, also a next imec.icon project, they will now look at ways these data can be made useful and economical. As an additional next step, the project partners will also study how they can leverage additional, new sensing modalities.

SeRGIo project partners:

bpost joyn NOKIA Bell Labs

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AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

# FACTS

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| NAME | SeRGIo (Mobile Sensing Services for Developing Geospatial IoT Applications) |
| OBJECTIVE | SeRGIo investigated how to develop mobile sensing applications to crowd-source data using 'humans as a sensors'. The goal? To gather qualitative, high-resolution, highly accurate data to be used to enable better, more interactive services, safer cities and happier citizens |
| TECHNOLOGIES USED | Torch for Android, DeepX by Nokia, Android Wear, OP-TEE, ARM Trustzone, Flash FPGA, Raspberry Pi 3, YAML, mqtt, REST, Akka, Pykka, Acsim, Flexible ePaper displays |
| TYPE | imec.icon project |
| DURATION | 01/10/2016 - 30/09/2018 |
| PROJECT LEAD | Fahim Kawsar (Nokia Bell Labs) |
| RESEARCH LEAD | Danny Hughes (DistriNet, an imec research group at KU Leuven) |
| BUDGET | 2,211,528 euro |
| PROJECT PARTNERS | Nokia Bell Labs – bpost – Joyn |
| RESEARCH GROUPS | DistriNet, an imec research group at KU Leuven – IDLab, an imec research group at Antwerp University – EDM, a research group at Hasselt University. |

WHAT IS AN

## IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

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