Smarter use of mobile data

12 June 2017

Credit: Swiss National Science Foundation

The data constantly collected and reported by smartphones can find numerous applications. An SNSF-funded project devoted to crowdsensing has found ways to improve privacy and localisation accuracy as well as reduce the impact on hardware.

Connecting data from the world's smartphones could put a global supercomputer into all of our pockets. Tapping into that processing power would improve the real-time collection and analysis of data, but technical hurdles and privacy concerns linger. Scientists from SwissSenseSynergy, a project funded by the Swiss National Science Foundation (SNSF), have addressed issues and proposed new ways to collect and use such information.

The main focus of the project is crowdsensing, in which access to a smartphone's sensors makes it possible to collect information about a particular area. A typical example are map applications which can infer traffic congestion data from the smartphones' accelerometers. As our connected devices gather insights about many facets of our environment – motion, sound, people, air quality, etc. – crowdsensing has the potential to guide decisions on where we eat, what we wear or how we travel.

"All of this information is useful in applications ranging from marketing predictions to predicting crowd behaviours," explains Torsten Braun from the University of Bern and coordinator for the project. Nonetheless, crowdsensing applications face significant challenges. In particular, there is a trade-off between data collection, user impact and privacy. Transmitting data drains hardware resources, for example, while poor security measures pose risks for identity theft.

Four teams developed new approaches to improve crowdsensing technology and establish best practices for its application. Researchers are exploring four key areas: improving location accuracy, increasing security, industry uses, and making data collection more efficient.

Localisation beyond GPS

The team led by Torsten Braun at the University of Bern improved location accuracy indoors and underground to 1.1 metres in 90% of cases. That is comparable to GPS, but relies only on the device's sensor data and radio signals, reaching areas behind walls and concrete where GPS signals are blocked. The researchers collect sensor measurements from the smartphones, alongside the Wifi radio's signal strength. This information is then passed through several machine learning algorithms. "The next step is to determine where users are going," Braun said. "This could have an impact on shopping centres or train stations, for example."

Scientists from the universities of Bern and Geneva collaborated to design a mobile application combining indoor localisation, mobile crowdsensing and smart spaces. The resulting mobile app integrates sophisticated localisation algorithms and location-stamped sensor measurements, which are pushed to the cloud. From there, the information is fed to the Internet of Things, allowing personalised and location-based automation applications across a number of smart objects and products.

A team at the University of Applied Sciences and Arts of Southern Switzerland in Lugano (SUPSI) has developed models that use predictive location data to distribute information through social media. The experiments showed that they could create rapid outreach on social networks such as Facebook and Twitter, but also in ad hoc physical networks of mobile devices. These messages could respond to local behaviours, assess feedback in real time and circulate more quickly among targeted users. The research provides a deeper understanding of social influence in human behaviour, and discovered correlations between physical locations, shared preferences and event-based social communities.

A balancing act

"A major problem for researchers is balancing data and privacy," explains Braun. "Accurate data can cost privacy." If user information is being swept up while collecting data, it discourages participation. To ensure security, the Chalmers University of Technology team in Sweden has developed machine learning methods for data analysis and automatic decision making that achieve "differential privacy". This protects the data of individuals by injecting carefully calibrated "noise" (random data) into information collected from a device.

Researchers at the University of Geneva addressed another challenge: the desire to collect large amounts of data against the burden that crowdsensing can have on hardware. If users fear a strain on their phone, they might reject applications which make use of otherwise idle sensors. This project is investigating game theory models for distributing such burdens among phones and users. In a field experiment, volunteers in San Francisco downloaded apps to map noise levels in the city, collecting useful data for the local government while testing competing methods for distributing loads among devices.

With its interdisciplinary approach, the SwissSenseSynergy project has yielded new techniques with potential benefits for research and applications. The project is developing a novel experimentation architecture, called Vivo, to involve volunteers in the experimental phase to support application development.

More information: J. Buwaya, J. D. P. Rolim: Atomic Routing Mechanisms for Balance of Costs and Quality in Mobile Crowdsensing Systems. IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS) (2017). www.swiss-sense-synergy.ch/wp- … ya_Rolim_DCOSS17.pdf

J. Buwaya, J. D. P. Rolim: Mobile Crowdsensing from a Selfish Routing Perspective. IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPS Workshops) (2017). www.swiss-sense-synergy.ch/wp- … Rolim_IPDPS_WS17.pdf

Differential Privacy for Bayesian Inference through Posterior Sampling. jmlr.org/papers/volume18/15-257/15-257.pdf

Achieving Privacy in the Adversarial Multi-Armed Bandit. arxiv.org/abs/1701.04222

Next Place Prediction with Hybrid Features using Ensemble Learning. DOI: 10.7892/boris.98674

Provided by Swiss National Science Foundation

APA citation: Smarter use of mobile data (2017, June 12) retrieved 23 October 2019 from
https://phys.org/news/2017-06-smarter-mobile.html