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Unlocking the mobile computing future

SMU Associate Professor Archan Misra is leading mobile analytics projects that will reshape urban living and provide improved understanding of our behaviour in the physical world

WALK around Singapore Management University (SMU) with your Wi-Fi enabled mobile phone, and you might become an oblivious, anonymous participant in studies on crowd movement. As your phone constantly sends signals searching for Wi-Fi access points, a computer program can measure those signals and pinpoint the location of your device.

This technology behind location awareness has enabled SMU's LiveLabs Urban Lifestyle Innovation Platform, a government-supported research centre, to create crowd density "heat-maps" at two additional test sites: Sentosa, as well as the Suntec Convention & Exhibition Centre.

"The data collected is anonymised, so we do not know who this person is. Suntec can use this information to, among other things, send cleaners to restrooms if they observe a sudden surge in visits to a particular facility," said Archan Misra, Associate Professor of Information Systems who directs the LiveLabs centre jointly with his colleague, Associate Professor Rajesh Balan.

"For Sentosa, we have enabled the push notification of special location-aware promotions to targeted groups of guests who have downloaded the MySentosa mobile app as a handy guide to the resort island. Our ongoing research on Sentosa also involves integrating Wi-Fi based location awareness with other available data sources to better analyse visitor profiles and understand guests' needs."

Prof Misra is also a principal investigator in SMU's Living Analytics Research Centre (LARC), where he is involved in a project on optimising issues around mobile crowdsourcing. Crowdsourcing refers to how location-specific tasks (e.g., verifying the wait times at queues or delivering packages in the neighbourhood) can be outsourced to the public.

Another notable project that excites him involves the development of a smartwatch app that unobtrusively captures a person's eating habits and collects pictures of the food consumed.

The end-goal of such research is to improve the everyday lives of consumers. Information collected can help tweak urban infrastructure services, and provide personalisation, Prof Misra said.

"This is really about building smart cities and businesses that adapt to you," he said.

Crowdsourcing: customising and bundling

One of the key findings of Prof Misra's research is that crowdsourcing programs work better when proactively offered to people that are best positioned to do them.

In other words, individuals might not go out of the way to perform certain tasks if they are simply given an overall list of tasks. But if an application can proactively suggest tasks that are closer to the individual's anticipated commuting route, he is more likely to complete it.

Prof Misra and his colleagues arrived at this conclusion via extensive studies conducted with over 1,000 student volunteers who signed up to use a mobile app called "Ta$ker" on the SMU campus. Students are paid S$0.25 to S$0.50 per task, such as reporting on the waiting time for a particular stall at the cafeteria, or whether a toilet is clean.

Using data from over 50,000 tasks that have already been completed over a period of six months, Prof Misra's team confirmed that their "push-based" approach, where students are offered individualised tasks based on their travel patterns, resulted in higher completion rates. They also established that bundling tasks together in nearby locations can improve efficiency: while students are paid relatively less per task, they receive more in total when they complete a series of tasks clustered at a location.

Prof Misra believes that these insights can help improve both individual businesses and smart nation services. He has been working with Courex, an SME focused on package delivery, since 2014. Courex already uses a mobile app to crowdsource people to deliver items for them. Prof Misra is helping Courex to see if this app can offer customised bundles, adapted to the individual travel patterns of delivery agents, to help improve their productivity.

> **"The end-goal of such research is to enable better capture of people's activities and preferences in the physical world. Such information can help personalise urban infrastructure services and businesses. This is really about building smart cities and businesses that adapt to you."**
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> **Associate Professor of Information Systems and co-director of SMU LiveLabs Archan Misra**

In the future, Prof Misra is interested to explore whether crowdsourcing can be an effective tool for obtaining participatory feedback from residents (e.g., of a specific housing estate) about the condition of various infrastructural components, such as if the garbage bin is filling up or whether the lights are working. He believes that, by smartly pushing bundles of such tasks to the right volunteer, one can develop effective ways to anticipate city-level infrastructure or service failures and intervene proactively.

Creating a food diary

One mobile sensing project Prof Misra is especially excited about uses a smartwatch to keep track of food eaten.

Reducing the costs involved in tracking one's diet has been a longstanding goal of the wearables community. Keeping this "food diary" can help stave off weight gain, and see if one has irregular eating habits that harms one's health. Parents can also see what their children ate to diagnose any possible allergic reactions after.

Smartwatches have sensors such as accelerometers and gyroscopes that detect the speed and rotation of a human arm's movement. Many models also have cameras. In the last one and a half years, Prof Misra and his colleagues have been working to use these sensors of commercially-available smartwatches to create food diaries.

"Throughout the day, it can figure out how many spoonfuls or mouthfuls you consume at each meal and intelligently decide when to take a picture (while eating) of the food being consumed. To enhance privacy, before it uploads the pictures, it can also eliminate the pictures that are not food-related," he said.

In the longer term, Prof Misra expects that such personalised monitoring, when coupled with increasing availability of public information on food content (e.g., from fast food restaurants) will transform businesses ranging from restaurants to personalised wellness management. For now, his team is focused on the information collection front.

"Our challenges are that our smartwatch app has to be energy efficient, privacy conscious, and accurate."

The personal mobile future

Prof Misra used to be a researcher involved with wireless and mobile networking, before moving to SMU five and a half years ago to pursue research on "physical analytics" – the ability to understand both the individual-level and collective activities and behaviour of people in the physical world, via their personal mobile devices.

"Compared to telco companies like AT&T and Vodafone, why are Facebook and Google valued so much higher? It's because of their ability to curate knowledge about 'you' – your preferences and lifestyle habits online. I think that the next big revolution is around how best we can capture and use personal data about what you do in the physical world," he said.

Looking ahead, Prof Misra believes that such physical analytics can be combined with social analytics, which is what people post on social media.

"For example, sensors can detect buses and cars moving slowly, and combine that with Twitter when people start talking about an oil spill on the roads. So not only can you detect there's congestion but also explain why the congestion happened," he said. "This will let urban agencies respond to anomalies faster."

People will always have privacy concerns, he conceded. The onus is on the collectors of the data to convince people that the resulting personalised services will improve their lives.

"You have Moore's law and computers are becoming more and more powerful. But the thing that doesn't grow at all is human attention. So the main focus of future research is to distil information for people, to give them the things that only they care about. And socio-physical analytics is a powerful tool to aid such distillation."

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