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DERIVING USEFUL INFORMATION FROM INCREASED INTERACTION WITH SMART DEVICES

How the Internet of Things can affect our lives

COMMENTARY BY
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This commentary is part of a series in TODAY's *Science section, created in collaboration with the National University of Singapore's School of Computing, that explores the computer science research projects conducted here.*

Smart devices are everywhere these days. Many of them, from tablets and smartphones to wearables, are capable of performing communication and sensing functions, leading to the concept of the Internet of Things (IoT).

The IoT is promising because of its wide applicability, from very simple to highly complex systems. In Singapore, it promises to play an important role in the Smart Nation initiative launched by the Government, which targets applications related to our ageing society, mobility and cybersecurity.

Given the range of sensing and computation capabilities now available on powerful mobile devices — smartphones, for instance, now often come equipped with a plethora of sensors such as for temperature, humidity and movement — researchers have been looking at various ways to better exploit these resources.

In the future, one can perhaps expect a truly smart personal assistant running on the smartphone that can infer the user's intentions and needs, provide reminders, and suggest things the user should do.
PHOTO: BLOOMBERG

The work by my research group at the National University of Singapore School of Computing shows some of the interesting potential applications that can be employed by smartphones.

AUTOMATICALLY DETECTING CONVERSATION

We have designed a smartphone-based application that performs conversation clustering and builds conversation networks automatically. In essence, the application listens to conversations and is able to figure out who is speaking. The detection and identification are based on the timing and relative voice intensity recorded by different phones in the vicinity.

The uniqueness of our system is that it can detect conversations and identify the speakers without having to record the actual conversations. Hence, issues of user privacy are avoided.

Face-to-face communication remains an important and irreplaceable part of human social interaction. Understanding how people communicate with one another is important in many disciplines including social psychology, economics, marketing, and management science. For example, if one would like to understand how the staff of an organisation interact and work as a team, lots of insights can be derived if one has information on the various forms of social interaction, such as the duration and frequency of discussions between specific colleagues.

The existing approaches for detecting face-to-face social interactions are either based on the use of user surveys or specialised hardware. In a user survey, people are asked to recall information regarding their interaction with others. When special devices are used, they have to be worn by participants and audio recordings are often required in order to identify the individual speaker, which raises issues of user privacy.

In addition, our system is able to detect multiple concurrent conversation groups, such as in a social gathering where different groups of people are having conservations in close proximity. To save energy, the system also incorporates a dynamic scheme in which the amount of processing is adjusted accordingly to the environment, striking a balance between accuracy and energy consumption.

Our system, of which a prototype is now available, illustrates the possibility of building applications in which individual devices can collect information about the environment passively. This information can be combined later to build a more complete picture of our interaction with other users.

AUTOMATICALLY DETECTING THE MODE OF TRANSPORTATION

We have also designed smartphone apps for other uses. One of our apps can automatically detect whether the user is idle, waiting for a vehicle or travelling in one.

While the accelerometer is the primary sensor used, it is highly sensitive to phone orientation and user movements. We therefore also use the barometer sensor, a very low-power sensor that detects changes in terrain based on changes in air pressure. The barometer sensor is not sensitive to phone orientation and movements.

Besides, by combining data from different users, we can derive additional information such as bus routes, travelling time between bus stops, and expected journey duration. This is helpful for agencies such as the Land Transport Authority, which may seek more information on a commuter's journey.

We have a prototype available, and work is being done to make the system more useful. With the emergence of the IoT, one can expect increasingly smarter devices. My research group is actively examining how one can design systems and applications that can help us interact with these devices and automatically derive useful information about our environment.

In the future, one can perhaps expect a truly smart personal assistant running on the smartphone that can infer the user's intentions and needs, provide reminders and suggest things the user should do. For example, the system will know the user is about to visit a doctor; or that the user has forgotten to take his/her medication and needs a reminder; it can also detect one's health condition and suggest that the user needs more exercise. All these will be done automatically, with minimum input from the user.

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