Corona Tracer®: Preventing expansion of workplace clusters

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1. Introduction

The SARS-CoV-2 coronavirus that causes COVID-19 is reported to be spread mainly through contact with infected air droplets, and the spread can be controlled effectively by severing the paths of such infection. Formation of clusters can be prevented by "contact tracing," which involves quickly identifying any close contacts and notifying them when an infected person is found.

Conventionally, contact tracing has been done mainly by telephone, asking questions, checking and giving instructions. This method takes time and effort to identify patients and becomes more difficult as the number of patients increases. With the recent spread of smartphones, efforts to accelerate contact tracing using mobile applications have begun.

In South Korea, a mobile application was developed using the location services smartphone feature (a standard feature that integrates data from GPS, base station locations, Wi-Fi, the compass, etc.), which linked with several systems that collect personal information to track the movement history of infected people. Currently published information includes age, sex, workplace, approximate home address, convenience stores used, and modes of transport used. Names are not published, but associates in the same cluster are, and there have been reports of individuals being identified through SNS and attacked. Such incidents have been used to show the difficulty of maintaining privacy while dealing with infection risk.

Another mobile application called "Trace Together" was developed in Singapore using a short-distance communication technology called Bluetooth Low Energy (BLE). The application enables rapid contact tracing and notifications by keeping a 21-day log of people who were in close proximity and also had the application installed on their smartphones. This application uses the phone number for notifications, so it is considered to use individual-identifying information.

Since late March, 2020, our group and several others in Japan (such as Code for Japan) have also developed contact tracing applications. At the time, "Trace Together" in Singapore had about a 10% usage rate, was initially only available for Android devices, and had to be run in the foreground. Apple severely limits background applications over concern for privacy and battery life, so dealing with these restrictions caused difficulty in Japan, where iPhones have a large market share.

Amid these efforts, on April 10, 2020, Apple and Google jointly announced their support for government and insurance agency efforts to prevent the spread of infection, including a contact tracing framework that uses Bluetooth Low Energy (BLE) and not location services features. This enabled iOS devices, not only Android devices, to also have applications that run continuously in the background.

2. Issues identified during development and resolutions

We initially analyzed conventional contact tracing methods using telephones and identified the following five necessary tasks: (1) Collection of contact information, (2) Storage of contact information, (3) Reporting from infected persons, (4) Identification of close contacts, and (5) Notification of closely contacted persons. We then studied how these could be implemented and determined the scope of manual work that could be systematized effectively.

We first conducted tests to verify collection of contact information using BLE, which indicated that there was much noise and attenuation due to pillars, walls, clothing, and people's bodies, so that it was not possible to estimate distances (such as "within 1.5 m") from the strength of signals. Thus, we determined that if the signal was relatively strong, those persons would be considered under close contact.

We then decided that contact information would be stored in the application. Mobile applications use a sandbox architecture, so that a third-party application cannot see data stored in another application. Only identification numbers, which cannot be associated with an individual, would be sent to the cloud. If all data were sent to the cloud immediately, real-time monitoring would be possible. Even if data from a given application is processed to not identify individuals, the data could be linked with information collected by other applications from the same developer on the same smart phone, enabling them to identify individuals. How to handle the risk of identifying individuals when linking to the cloud was a concern when developing a service.

Apple and Google published a mechanism for contact tracing with sample code and specified that it would support one application per country. This mechanism was then built into the OS itself, so that the logic for collecting and storing contact information could not be changed. The mechanism has an Exposure Notification function to indicate when the user has been exposed to risk of infection.

From the start, our group has intended to provide a contact tracing service for corporate administration (general affairs administrators in most cases) rather than for national or insurance agencies. Enterprises must take measures to prevent the spread of

Figure 1: Typical operations for administrators when an infected person contacts the company

infection as part of their labor health and safety efforts to begin with, and our solution is meaningful as part of such efforts, and checking contacts using our service can be a meaningful part of such efforts for companies required to do so. It could also be used to meet the needs of national and regional public organization as a measure against the spread of infection.

Enterprise managers (general affairs administrators in most cases) manage employee names and contacts as part of their work and use them as needed. We separated the system for collecting and storing contact information from the system for identifying close contacts and coupled them loosely to prevent real-time monitoring and to forbid access to contact information unless an infection occurs.

We also do not enter information related to infection into the system, but rather, an (infected) person's name and (incubation) period is specified, and a list of employees who might have had close contact is displayed.

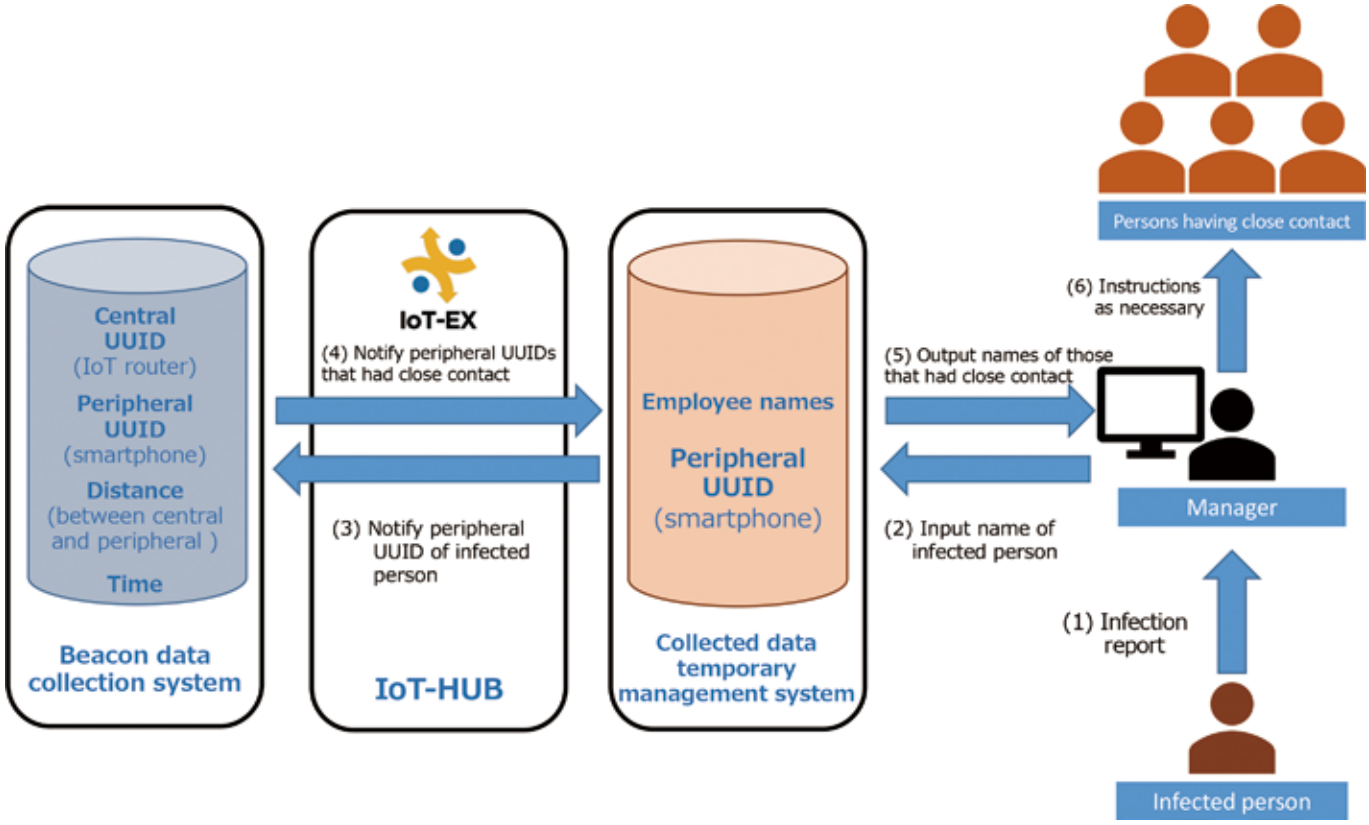
We have also prohibited linking of data stored in the system with any other system. This was made possible technically by using IoT-HUB, which we developed in collaboration with the University of Tokyo, Institute of Industrial Science, IoT Special Research Committee. Since IoT-EX Co. Ltd. is a registered telecommunications operator, which is regulated by the government, we are also prohibited from monitoring data on the cloud and must protect data privacy and security.

Enterprises are also using feature phones instead of smartphones in some cases. There is also the issue of handling visitors in addition to employees. To deal with such situations, we also added support for beacon tags and QR codes. With these additions, we also separated BLE operation for central and peripheral devices. Using beacon tag technology, it is also possible to handle children and the elderly, and with QR codes, we can also support schemes that have been used with feature phones, in which contacts are registered by reading a QR code and sending an empty email message. This technology also enables us to support situations such as event spaces.

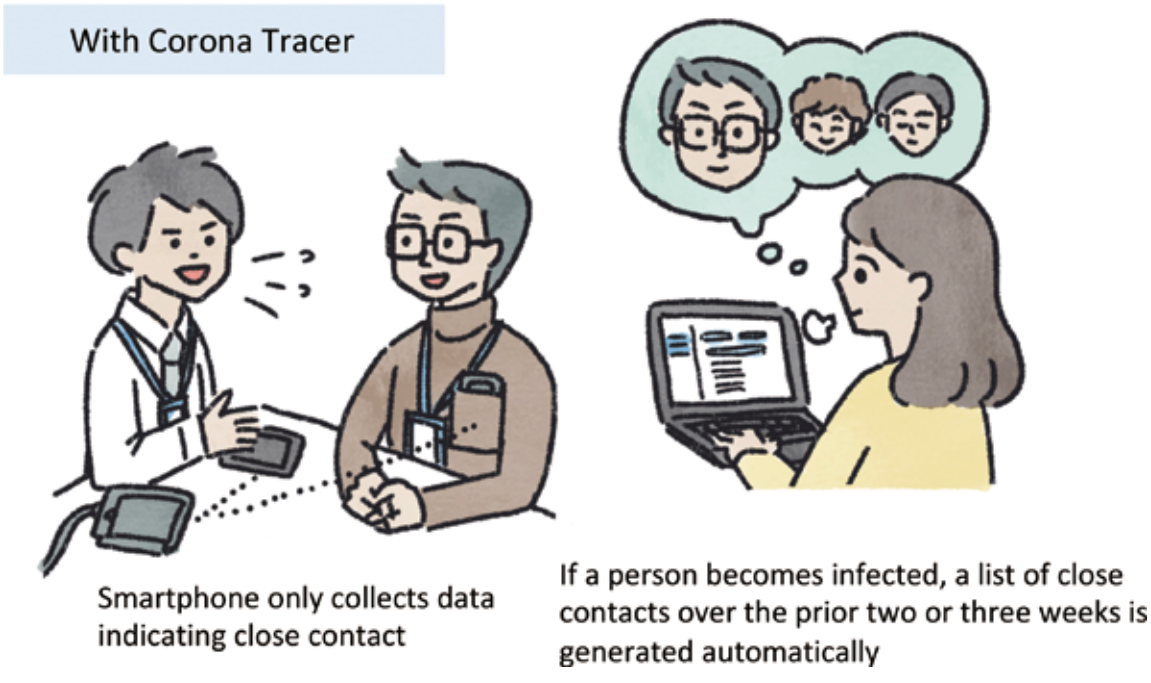
In the process of testing various beacon tags, we found that specifications for beacon tags are not uniform, and there are interoperation issues between different near-contact tracking systems (collecting and storing contact information). This can also be handled using IoT-HUB and applicable drivers. Specifically, by using a driver and a particular parsing feature of the IoT-HUB, no change to the application is required, and the devices can be supported right away, by just creating a format definition file for parsing (taking approximately 10 min.).

QR codes have also been adopted throughout Japan in recent years, but the mechanisms used are not consistent in each region, and we found out that there is no interoperability among them.

■ **Figure 2: Overview of the Corona Tracer system**



■ **Figure 3: Operation with Corona Tracer**



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We also had requests to be able to check work attendance rates from companies using Corona Tracer, so we added the ability to do so from the contact information collection and storage system. The system provides attendance rates by department and for the whole company, and by adding a sensor data (PM2.5 and CO_2 levels) collection and storage system, we are able to determine whether the "Three C's" (avoidance of closed space, crowded places and close contact) are being handled or not.

Recently, facilities are being required to operate safety measures for visitors in spaces where many people gather and interact. We tested whether Corona Tracer would be effective in such cases, and found that with multiple central devices, a rough estimate of locations of people could be determined from the BLE base stations. This showed that we would be able to trace possible transmission by air droplets (person-to-person), as well as through contact with objects that other people had touched (person-to-object-to-person). We are continuing to test this measurement.

3. Conclusion

The "COCOA" contact checking application for Japan, which notifies people if they may have had close contact with someone infected with the COVID-19, was reported to have been downloaded 18.9 million times as of the morning of October 26, 2020, which is approximately 15% of the population. We are being required to put a new type of lifestyle into practice in our daily lives, to protect ourselves, our families, the people around us, our workplaces, and our region from the spread of infection.

Our group has focused particularly on the workplace, supporting new work styles, and we aim to provide a service that will be useful for enterprise administrators. There have been a variety of services offered for business continuity planning (BCP) for situations such as major earthquakes or a pandemic. We are offering "Corona Tracer®" to contribute to stopping the expansion of workplace clusters in enterprises. Most of the features introduced in this article are patented or patent pending.

References

- Privacy-Preserving Contact Tracing
  https://covid19.apple.com/contacttracing
- Exposure Notifications Frequently Asked Questions
  https://covid19-static.cdn-apple.com/applications/covid19/current/static/contact-tracing/pdf/ExposureNotification-FAQv1.2.pdf
- Ministry of Health, Labour and Welfare, "Novel Coronavirus Q&A (For Enterprise)"
  https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/dengue_fever_qa_00007.html#Q6-1
- Examples showing the need for a contact checking application in society.
  https://www.nikkei.com/article/DGXMZO60262830R10C20A6MM8000/
- Accelerate identification of cases and close contacts with Corona Tracer
  https://smartiot-forum.jp/iot-val-team/iot-case/case-iot-ex
- Planning, Development and Launch of Contact Tracing Service in Six Weeks—IoT-EX Implementation
  https://smartiot-forum.jp/iot-val-team/iot-case/mailmagazine/mailmaga-039-20200514?mailmaga=
- Contact Tracing Scheme to prevent the spread of COVID-19
  https://webtan.impress.co.jp/u/2020/08/25/37244
- How Apple and Google Are Enabling Covid-19 Contact-Tracing
  https://www.wired.com/story/apple-google-bluetooth-contact-tracing-covid-19/
- Apple and Google partner on COVID-19 contact tracing technology
  https://www.apple.com/ca/newsroom/2020/04/apple-and-google-partner-on-covid-19-contact-tracing-technology/
- Why Singapore's COVID-19 contact tracing application cannot be used in Japan as-is"
  https://xtech.nikkei.com/atcl/nxt/column/18/01279/041700002/

Cover Art

Masaki Inari Shrine and Sumida River Ferry from the series Famous Places in the Eastern Capital (Tôto meisho)

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