Digital Contact Tracing Using Power Over Ethernet (POE) devices in the Containment of Covid-19 Spread: A Solution for Non-Smartphone Users

Juzlinda Mohd Ghazali, Kamal Ismeth Abd Hamid, Nurul Ibtisam Yaacob
Faculty of Science and Information Technology
Kolej Universiti Islam Antarabangsa Selangor (KUIS)
juzlinda@kuis.edu.my, kamalismeth@gmail.com, nurulibtisam@kuis.edu.my

Abstract

Contract tracing has formed part of the response to the COVID-19 pandemic in many countries. In Malaysia, for instance, the implementation of MySejahtera application requires Malaysian citizens to own mobile smartphones. For those who do not own one, an alternative way is the manual contact tracing form which is handled by third-party. Unfortunately, this approach poses issues concerning exposure and misused of data, as well as possibility of questionable and lost of data. This study proposes using Power Over Ethernet (POE) devices, specifically, NFC-based contact tracing as a complimentary to the existing digital system. By implementing this extended system, a huge number of 2.3 million citizens will get benefit and will not be exempted from the centralized database. NFC is very resource-friendly in terms of electrical energy. NFC tag doesn't require any power and it is cheaper than other comparative devices. Since POE-based NFC does not require any power resources like smartphones, they will serve to be beneficial to the elders and children, or any other non-smartphone users. As such, a more comprehensive contract tracing system will be attained.

***Keywords*:** *Contact tracing, Covid-19 containment, Power Over Ethernet (POE), near-field communication (NFC), Non-Smartphone.*

1. Introduction

Covid-19 is the cause of an outbreak of respiratory illness that can be severe, and has caused millions of deaths around the world as well as lasting health problems in some who have survived the illness. Since it emerged in December 2019, the rapid spread of the disease has forced governments worldwide to take prompt measures including enforcements of lockdowns, to help curb transmission. Although it did reduce case numbers but in the long run, it had significant impact on economy, social and indirect health matters (Douglas et al., 2020). This lead for the need to devise alternative control measure strategies (Bedford et al., 2020).

Lin et al. (2020) and Lee et al. (2020) reported that in many countries, contact tracing has formed part of the management of infectious disease outbreaks, which intends to interrupt chains of infection transmission by quarantining identified contacts. With manual contact tracing, it requires a person recalling their recent close contacts and activities. Those who are believed to be at risk of infection are then contacted and advised to self-quarantine for a specified time period (European Centre for Disease Control, 2020).

There are various issues related to contact tracing which includes the limitations of incomplete or incorrect recall of contact events by cases; the time taken to notify contacts manually,

which can cause the delay in quarantine (Ferretti et al., 2020). Moreover, it is often resource intensive and time consuming. Some of these limitations can be dealt with by technology by automating the processing of test results or symptom reports and by use of smartphone capabilities to detect and alert contacts immediately who are at risk of infection (Keeling et al., 2020).

2. Background and Related Work

Taking into account the importance of comprehensiveness, reliability and promptness in attempting to curb Covid-19, digital contract tracing is most desirable. Nonetheless, limitation that arises will need to be addressed and accommodated. Currently, digital contact tracing will require the use of smartphones. Individual whereabouts and possible interactions may be determined by the records captured via an application, stored on the server database.

For those who do not own a smartphone, they may record their whereabouts by writing on a form or booklet at the entrance. This data will then be transferred later on in the day or the following day. This mechanism is prone to dummy data, lost of data or even data exposure and misuse. To take advantage of the digital system and to address the fact that not everyone owns a smartphone, our proposed approach is a way forward.

The challenge with digital contact tracing which requires owning smartphones is that it somewhat deprives certain social circles in that it increases their risk of covid-19 health impacts as they are less likely to own a smartphone (Chan et al., 2020; Klenk et al. 2020; Greer et a., 2019). These include older adults, homeless people, and poor people especially in low-income countries.

The following are prominent contact tracing applications worldwide in curbing Covid-19 spread:

i) China.

The contact tracing is primarily provided by Alipay and WeChat mobile applications. These applications use self-reported data by the user, their travel history, health status and government records for assigning green, yellow and red colors. The color signifies whether the user is healthy (green) or suspected of infection (yellow) or is a confirmed patient of COVID-19 (red) (European Centre for Disease Control, 2020). From privacy perspective it is very intrusive as these applications require user's identity, address and travel history.

ii) Singapore.

The official contact tracing application, called TraceTogether, utilizes Bluetooth data for determining the others in proximity of the user. Location permission is used only for finding the relative distance between the users (Data Evaluation and Learning for Viral Epidemics (DELVE) Initiative, 2020). It requires the user to register with her phone number for fast communication. Each device periodically generates a random unique identifier for communication with nearby devices. TraceTogether is relatively user privacy friendly as no identifiable information is shared between the devices and the government only knows about the phone number of the registered users (Kraemer et al., 2020).

iii) USA.

There are multiple contact tracing applications. In a decentralized setup, Covid Watch and CoEpi applications use Bluetooth for proximity-based contact tracing. Both these applications measure the signal strength for estimating the contact distance with other users. If the user remains in contact for a predetermined amount of time, then all the devices in proximity will generate a unique 'contact event number' for sharing, which is time limited and stored on the local device. Other devices then use this public list to find out whether they came in close contact of an infected person or not. These applications also allow users to locally store the location information for their own reference. This is good from an individual's privacy perspective. On the other hand, MIT's SafePaths is technology

agnostic and utilizes multiple methods for contact tracing, for example, it uses Bluetooth, WiFi SSID and GPS data for absolute and relative location tracking of users. In case a user is found infected then her location trail is redacted by a health officer for any personally identifiable information. The redacted trail is then used for alerting other users who came in contact with the infected person (Kraemer et al., 2020). Dependency of SafePaths on a human to redact sensitive data could create problem if the human-in-the-loop is incompetent or has malicious intent.

3. Proposed Approach

The proposed approach of our study is depicted by the graphical block diagram in Figure 1. The purpose of the approach is to address groups of people that are deprived from owning a smartphone like elders and poor people. It is only apparent that the device is convenient or attachable to the user and not expensive. This is so with the NFC-embedded bracelet.

The intended POE device uses near-field communication (NFC) chip embedded in a non-removable bracelet for security measures. This NFC-embedded bracelet will store all essential information of the user that can be scanned later in the NFC reader terminal which will record permitted data to be collected as tracing information. The recorded data will be sent by the terminal admin to the government database to be later analysed and processed. This rapid touch-and-go recording process imitates the current payment method used by Malaysia toll expressway. This method is proven to give high impact in the reduction of the queuing process on highway toll booths.

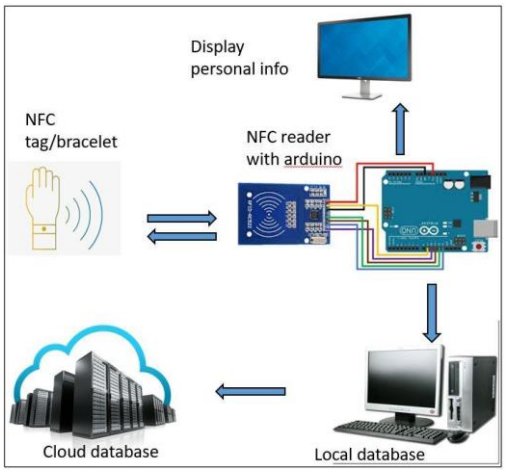

Figure 1: Graphical Block Diagram of the proposed approach.

4. Conclusion and Future Work

Everyone has a right to health equity. Health equity is when all members of society enjoy a fair and just opportunity to be as healthy as possible. This includes approaches adopted in the containment of Covid-19 spread which should be comprehensive enough to include and benefit all members of society.

Future research on digital contact tracing system should look into privacy issues; whether concerns around public acceptability and privacy have been adequately addressed, with appropriate public consultation; how an automated system will be integrated with other forms of contact tracing and disease control strategies, in consultation with public health experts; and, whether it is likely

to be effective, cost-effective, and equitable in that context. There have yet studies rigorously evaluating the effectiveness, technical and equity dimensions, and qualitative studies to improve the understanding of key social and behavioural dimensions of application use and acceptability (Hellewel et al., 2020; Fraser et al., 2020).

References

Bedford, J., D Enria, J Giesecke, *et al.* (2020). COVID-19: towards controlling of a pandemic. Lancet, 395 (2020), pp. 1015-1018.

Chan, J., S Gollakota, E Horvitz, *et al.* (2020). PACT: privacy sensitive protocols and mechanisms for mobile contact tracing. ArXiv (2020) published online May 7.
https://arxiv.org/abs/2004.03544

Data Evaluation and Learning for Viral Epidemics (DELVE) Initiative (2020). Test, trace, isolate. Royal Society, London (2020)
https://rs-delve.github.io/reports/2020/05/27/test-trace-isolate.html, Accessed 30th September 2021.

Douglas, M., SV Katikireddi, M Taulbut, M McKee, G McCartney (2020). Mitigating the wider health effects of covid-19 pandemic response. BMJ, 369 (2020), Article m1557.

European Centre for Disease Control (2020). Contact tracing: public health management of persons, including healthcare workers, having had contact with COVID-19 cases in the European Union—second update. European Centre for Disease Control, Stockholm (2020)
https://www.ecdc.europa.eu/en/covid-19-contact-tracing-public-health-management, Accessed 30th September 2021

Ferretti, L., C Wymant, M Kendall, *et al.* (2020). Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. Science, 368 (2020), Article eabb6936.

Fraser, C., L Abeler-Dörner, L Ferretti, M Parker, M Kendall, D Bonsall (2020). Digital contact tracing: comparing the capabilities of centralised and decentralised data architectures to effectively suppress the COVID-19 epidemic whilst maximising freedom of movement and maintaining privacy. University of Oxford, Oxford (2020).
https://github.com/BDI-pathogens/covid-19_instant_tracing/blob/master/Centralised%20and%20decentralised%20systems%20for%20contact%20tracing.pdf, Accessed 30th September 2021.

Greer, B., D Robotham, S Simblett, H Curtis, H Griffiths, T Wykes. (2019). Digital exclusion among mental health service users: qualitative investigation. J Med Internet Res, 21 (2019), Article e11696.

Hellewell, J., S Abbott, A Gimma, *et al.* (2020). Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. Lancet Glob Health, 8 (2020), pp. e488-e496.

Keeling, MJ., TD Hollingsworth, JM Read (2020). Efficacy of contact tracing for the containment of the 2019 novel coronavirus (COVID-19). J Epidemiol Community Health (2020) published online June 23.
https://doi.org/10.1136/jech-2020-214051

Klenk, M., H Duijf, C Engels. (2020). Ethics of digital contact tracing and COVID-19: who is (not) free to go? SSRN (2020) published online May 8. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3595394

Kraemer, MUG, C-H Yang, B Gutierrez, *et al.* (2020). The effect of human mobility and control measures on the COVID-19 epidemic in China. Science, 368 (2020), pp. 493-497.

Lee, VJ., CJ Chiew, WX Khong (2020). Interrupting transmission of COVID-19: lessons from containment efforts in Singapore. J Travel Med, 27 (2020), Article taaa039.

Lin, C., WE Braund, J Auerbach, *et al.* (2020). Policy decisions and use of information technology to fight COVID-19, Taiwan. Emerg Infect Dis, 26 (2020), pp. 1506-1512.