Project Proposal

TITLE: COVID-19 Contact tracing tool focused on privacy protection.

Advisor: Dr. Banafsheh Rekabdar

Co-Advisor: Dr. Koushik Sinha

Contact tracing is the process of identification of persons who may have come into contact with an infected person and subsequent collection of further information about these contacts [1] It is one of the processes recommended by CDC, WHO to prevent the spread of novel emerged viral diseases like COVID-19 pandemic. The idea of this thesis is to build a tool in the form of a light weight mobile application with technologies like QR code scanning and NFC tagging using which every user would provide information about the places they've been to voluntarily.

For a particular organization to adopt this system, one must attach two QR codes and/or an NFC tags to every room of the organization. Every member of the institution is required to scan the first QR code or NFC tag before entering every room and scan the second code when they exit that room. This information is stored in the back end in a way such that the user's privacy is strictly maintained.

Unlike most of the contact tracing applications present in the market today, which use GPS and Bluetooth technologies to perform contact tracing where data is collected in the background without user's knowledge, a QR code or NFC scanning would put the user in control of his privacy. Every user would consciously share his information and has no reason to be concerned about compromising his privacy because the application would not share user's personal information with the server. Every user when installs the application, is given a unique code which is used to identify the user in the back end. The unique id has to be treated as a private key and cannot be shared with any other person except their trusted doctor.

The other role that is important for the tool to be useful is of the medical professionals who perform COVID-19 tests. If one of the users happened to have noticed some symptoms of the infection and has decided to undergo the diagnostic test, and is declared positive of the virus by a medical professional, then the medical professional is required to update this information to the server along with the unique id of the user. By giving access only to medical professionals, it can be assured that no false positive data gets added to the server also the privacy of the patient is not revealed to any third party because of the doctor-patient confidentiality.

Once the user id of the infected patient is shared with the backend, the tool uses this information to perform contact tracing by backtracking to all the places that the patient has been in the past to find out all users who has ever come in contact (being present in the same room) with the patient. The backend then quickly computes the risk level for each user who has come in contact with the patient in the past and sends a push notification to the user alerting him about the risk of an infection. The risk estimate is done using two main factors overlap index and overlap frequency, where the former provides the information about the time spent by the user in the vicinity of the patient and the latter provides information about how many times the encounter has happened.

Besides capturing information from the user and alerting them when there is a potential for past contact, the application also helps the users get information about last sanitized time of a room, information about the maximum safe capacity of a particular room according to the norms of social distancing and approximate number of people present in the room at the instant of scanning. This can only be possible with the help of building maintenance people(BMP). Every BMP is required to scan the room before and after being mopped/sanitized. On doing so, the organization can assure the users that they are following the guidelines given by CDC and neatly maintaining their facility [2].

The goal of this tool is to let the users know about the risk of being infected without compromising on their privacy. On being notified the user solely is responsible for whether or not to see a doctor. Besides, when information like last sanitized time of the room, or number of visitors to the room since last sanitization are shared with the user before he enters into the room, it would help the user be more conscious and aware of his actions. By knowing information like maximum recommended people in the room and the approximate number of people in the room, a user can get an idea of how crowded the room is and what precautions he must take during the time of his stay.

This tool provides its users with services like Privacy protection, Awareness, Maintenance, Authentication, Safety which collectively can be called as PAMAS services.

Another key goal of this tool is to facilitate with data related to room entry, exit, last sanitized time, user ids of infected patients to general public so that interested people can use this data to build machine learning models to understand the influence of different factors on the infection. When the data is open sourced, care would be taken to encrypt both user ids and room ids as another step to protect the users' privacy.

Implementation details:

Popular technologies like QR scanning and NFC tagging is used to capture information such as room id and status (entry/exit) of the user. This information along with user id and timestamp are sent to the server using micro-service calls. Complete mobile application is based on Flutter which is an efficient way of building apps for both Android and iPhone Users simultaneously. Mongo DB is used for database activities, queries responses. Data processing & contact tracing algorithms are developed using Python with FLASK. The application does not send any user related information to the server in order to protect users' privacy. The notifications services are to be built using Firebase notification services.

References

[1] Contact tracing - Wikipedia
[2] Cleaning and Disinfecting Your Facility - CDC guidelines

By:

Sai Shanmukha Narumanchi,

Masters Student

SIU856384425