COVID-19 intelligent tracking platform

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Abstract.

From the ending of year 2019 till now, the COVID-19 pandemic has spread with expanded fatalities all throughout the planet and has become a worldwide general wellbeing emergency. General wellbeing experts in numerous nations have acquainted contact tracing applications to track and follow carrier people. Our proposed covid19 tracking platform aim to build a tracking system for the prospect COVID infected persons within specific domain defined by the WHO. The system is developed with the flutter and DART programming language to support as wide range of mobile phones as possible; the app uses Bluetooth address to tackle the known privacy issues and be able to track users without storing their real identities and uses their location data in real time to show hospitals. This considered one of the main uniqueness of our proposed system to adhere with the national and international privacy regulations in many countries. The results shed on that the app is able to successfully track users and create a statistic of all users registered with their real-time status and show hospitals for users.

Keywords: COVID-19, Mobile, Tracking, Intelligent

1. Introduction

As corona virus continues to kill humans and change the world as we know it, governments are trying to find new ways and solutions to face such crisis. New advances in technology lead us to a solution based on tracking the location of individuals and generating data to help watch and monitor the pandemic.

At the end of 2019 at Wuhan city in December, China announced to the globe the outbreak of SARS-CoV-2 or as known later by COVID-19 by the Chinese authorities and recognizing more than 2 cases and seeing how rapidly it's spreading, they traced it back to Wuhan food market.

After samples from the market resulting positive for COVID-19. Many of the earlier patients were either workers at the market or just a visitor. (WHO, 2020).

Wuhan was later identified as the initial city responsible for the outbreak or have played a role in the expansion of the coronavirus, where it was known to be where it evolved and moved from bats to humans, which is a dish known at the chines market.

Since, that time and the COVID-19 started to spread uncontrollably, causing more than 66 million people to get infected and over 1.5 million deaths across the globe. Governments have been trying to tackle this by forcing people on lockdown, but such thing wasn't enough as they can't keep track of each person.

So, from this requirement we start our proposed system and our aim from it is find new approach to manage and monitor the pandemic and the spread of COVID-19 in a more efficient and user-friendly way through identify, isolate the patients, and track their movements.

Our main objectives from this system are:

- Identify the infected persons via shared database linked with the global/national health institutes.

- Track the people and send an exposure notification as a warning if there is a contact with any infected or prospect person or not. via Bluetooth technology where the address of each user will be exchanged with all surrounding users, to be check if their address is recorded as COVID-19 positive case (infected) in the generated database and notify the possible infected people with preserve of the infected person identity.

Rest of the paper is organized as follows, Section 2 contains the related work of the systems implemented for tracking the COVID-19 infected people, Section 3 contains the architecture of our proposed system, explains the methodology with flow chart and describes results and discussion and Section 4 concludes research work with future directions.

2. Related Work

In our days, the whole world suffers from a dangerous phenomenon which is the easily spread of the COVID-19 virus. This dangerous spreading attacks many citizens in all countries. Many countries decided to work on tackling this extremely easily spreading of the virus by seeking innovative new techniques which mobile applications takes a place [1]. The most used systems are:

A. Trace Together App

This system was designed and implemented by the government intelligence department with the help of the world health organization. The app works by the Bluetooth Relative Signal Strength Indicator (RSSI) readings between the devices which uses this app if there are two users near to each other. This technology occurs by record the information: duration and proximity and this information stored for only 25 days and then automatically deleted to preserve storage [2].

Each user register with his/her own phone number and national ID (NRIC) which secured stored and enable Bluetooth and allow location access. If a user was suspected to be infected by the COVID-19 and show symptoms of the COVID-19 the app records out the activities done through the past 14 days [3], and the places that had been visited, then the app starts to send alert messages to all whom with in contact with the infected person without identity revealed for the infected person to maintain privacy. Also, the app offers the nearest hospital to go for check. There are many disadvantages for this system like not all the population can use this application, as not all of them has smartphones.

B. Apple & Google's contact tracing

After a collaboration with both Google and Apple they released the first application to help tracking COVID19 Patients it didn't need any kind of marketing as the application used their IDs captured from their phones [4]. The system works by using the already implemented basic "exposure notification" framework. in a decentralized monitoring system made available by google and apples. The system uses WI-FI, location services to record information of users have been close to, and

later if one of these users is recognized as contagious users been in close range for the last 14 days receives a notification indicating that they have been exposed [5]. There are many disadvantages for this system is keeping their users' data privacy.

C. Alhosn App

Alhosn is a newly launched application by the UAE government to help track potential people caught COVID-19 or infected people and be able to provide the needed healthcare, when possible, the application uses Secure Tracing Identifier (STI), location service (GPS) and Bluetooth to effectively function. The application also provides other useful futures like accessing tests results with no need to go to the hospital, or laboratory again [6]. There are many disadvantages for this system like users' data gets collected by UAE government, and stored in centralized data storage and no privacy [7] as shown in figure 1.

3. Proposed system

In this section we started we presents the proposed system architecture, design stages, implementation, and testing results to show how we overcome many of the previous existing systems drawbacks.

3.1. Initial Design

The idea of our proposed system and main challenges which we seek to tackle are to find a way to solve the identity and prospect infection's location issue, by assigning the Bluetooth address of each user that is automatically generated by their mobile phone and changed from mobile to another. The Bluetooth address is to be then shared between people phones when the Bluetooth device detects a contact between them. The addresses are kept encrypted and with no way for. a user to have access to view such addresses [8].

The proposed system takes into consideration as well helping the infected user to identify his/her own condition, by providing some questions about any symptoms S/he feels with, in the case of the user could not go for checkup in any hospital and no identification about user's health condition in the generated database records [17]. Our proposed system supports its users to let them know what they should do and the right method for treatment in case of being infected. We provide this application with some sort of treatment protocols that is proved from the World Health Organization (WHO), to make it more easily reaching the exact and efficient treatment.

The proposed system also has a feature to detect user's home isolation without using both his/her WI-FI and location data. The idea works by keeping track of how much time the user spends being in close range to each address, regarding the pandemic where everyone is almost at home the whole day. An average person supposed to spend at least 8 hours at home daily, which we used as a guide to detect the list of other persons in contact with our infected or prospect person. When our proposed application detects any new addresses for a specified period, this would mean the patient has broken his/her isolation [9] as shown in figure 2.
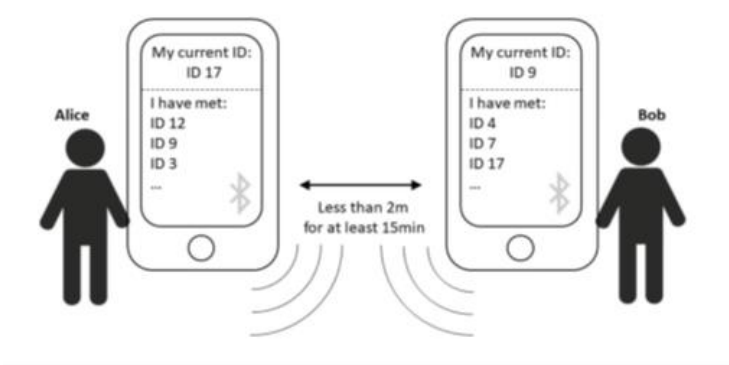
Fig.1. Initial Design Illustration Abeler, Bäcker, Buermeyer, & Zillessen, 2020, April 20).
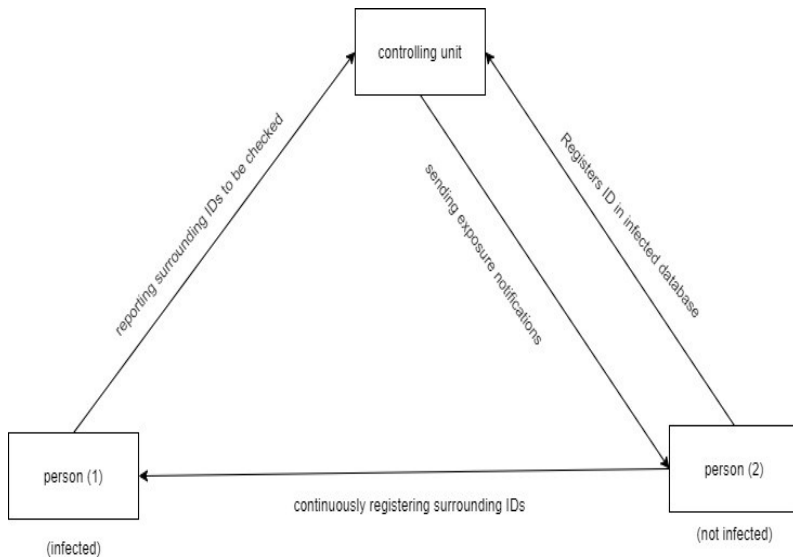
Fig.2. Block diagram of proposed system

3.2. Detailed Design

The dynamic keys caused issues from battery consumption to connection throttling, and consuming computational power from both the server and mobile phones, we had to figure out a new solution and this is where Bluetooth address to mitigate this challenge. It has proved to be much faster, and less power consuming compared to key generation. Bluetooth address is unique to each device like Media Access Control (MAC) addresses. As any device uses Bluetooth and shares his Bluetooth addresses by default to all surrounding users which even helped in detecting unregistered devices [10].

Our solution is solving identity and location issue, by using each device's Bluetooth address as a key. Then this key is exchanged between people phones when Bluetooth device detects contact between them with keep them private without identify any one of them as shown in the flow chart in figure 3 [16].

Keys are uploaded to a middle server upon signup and linked to their info, which are created by users on first time registration, after keys are linked to each user the app gives an alert to all users proven to be in contact with other keys as detailed in figure 5. At this point, no location data is stored anywhere on any user side nor the server-side [11]. This idea might be in close with the Singapore application, but the Singapore application does save keys to users' identity which can be hacked using fake Bluetooth devices in public places by the government or other snoopers.

The proposed system is developed using flutter technology to be a cross platform application working on both Android and IOS systems, to make it easier when the app communicates with other mobile in range to exchange code [15].

Data collected by the application is later reported to the server as soon as any person is infected or prospect infected person. Server used for Data storage and retrieval to send a push notification order to the app when a user needed to be alerted [5] as detailed in the detailed block diagram in figure 4 and use case scenarios in figure 6.
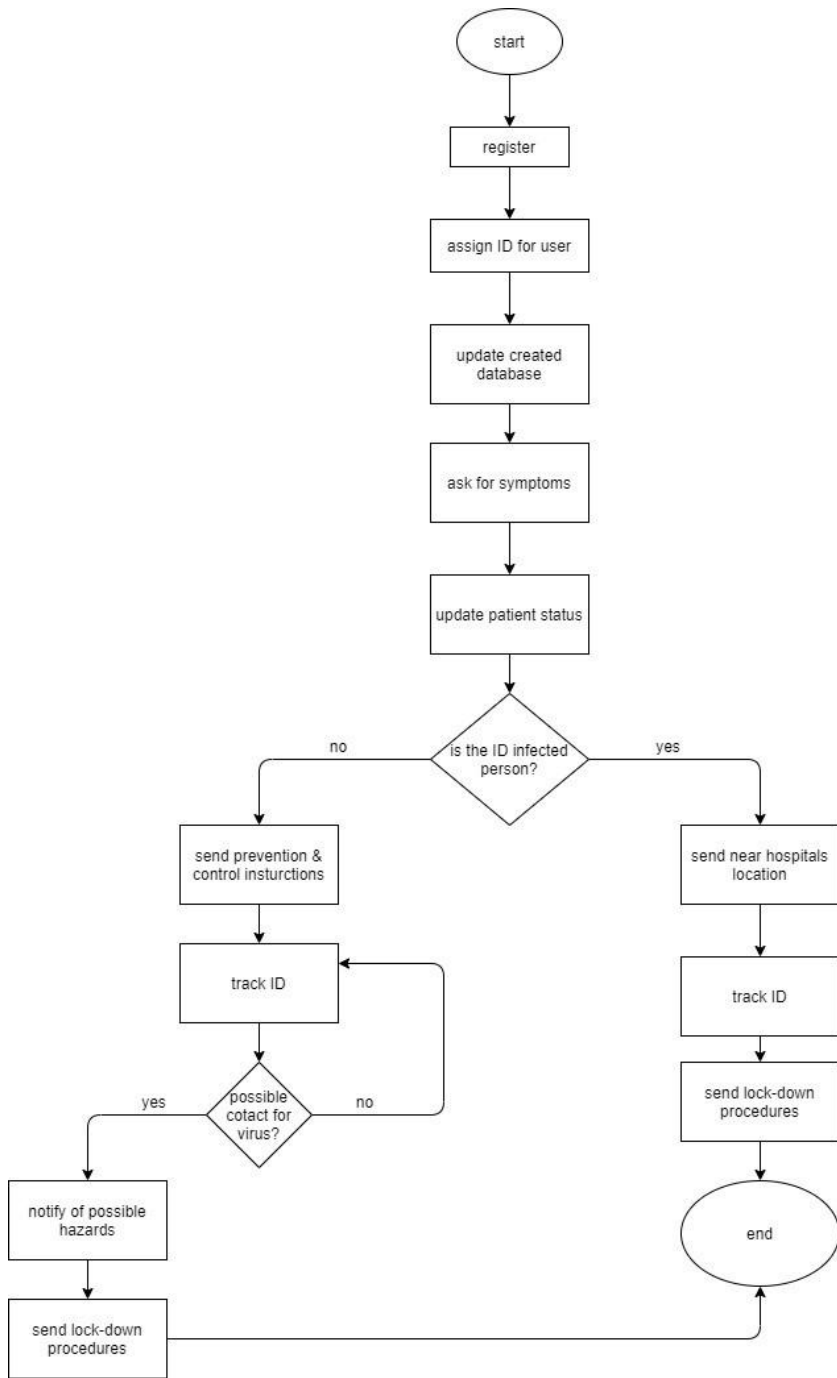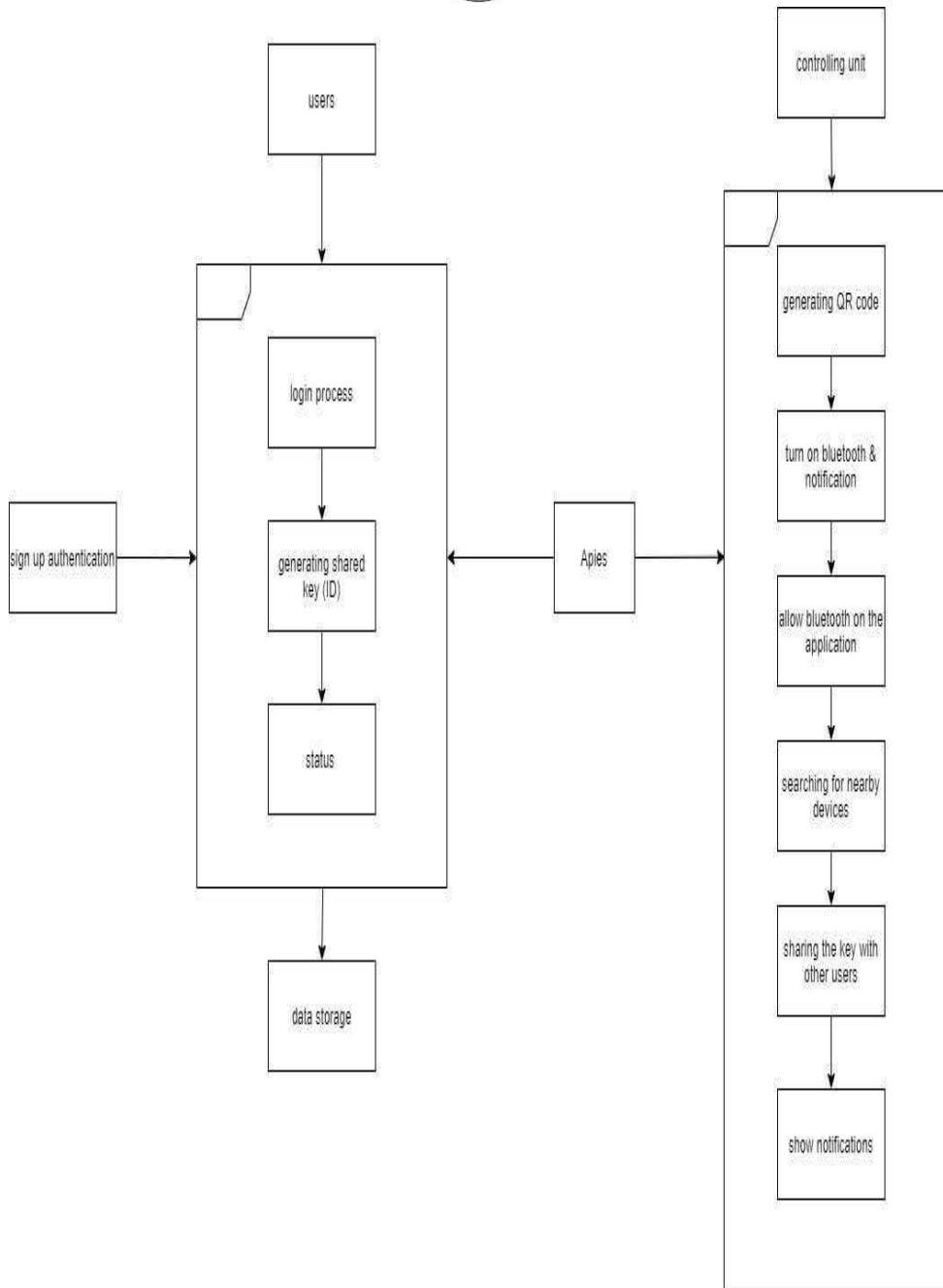
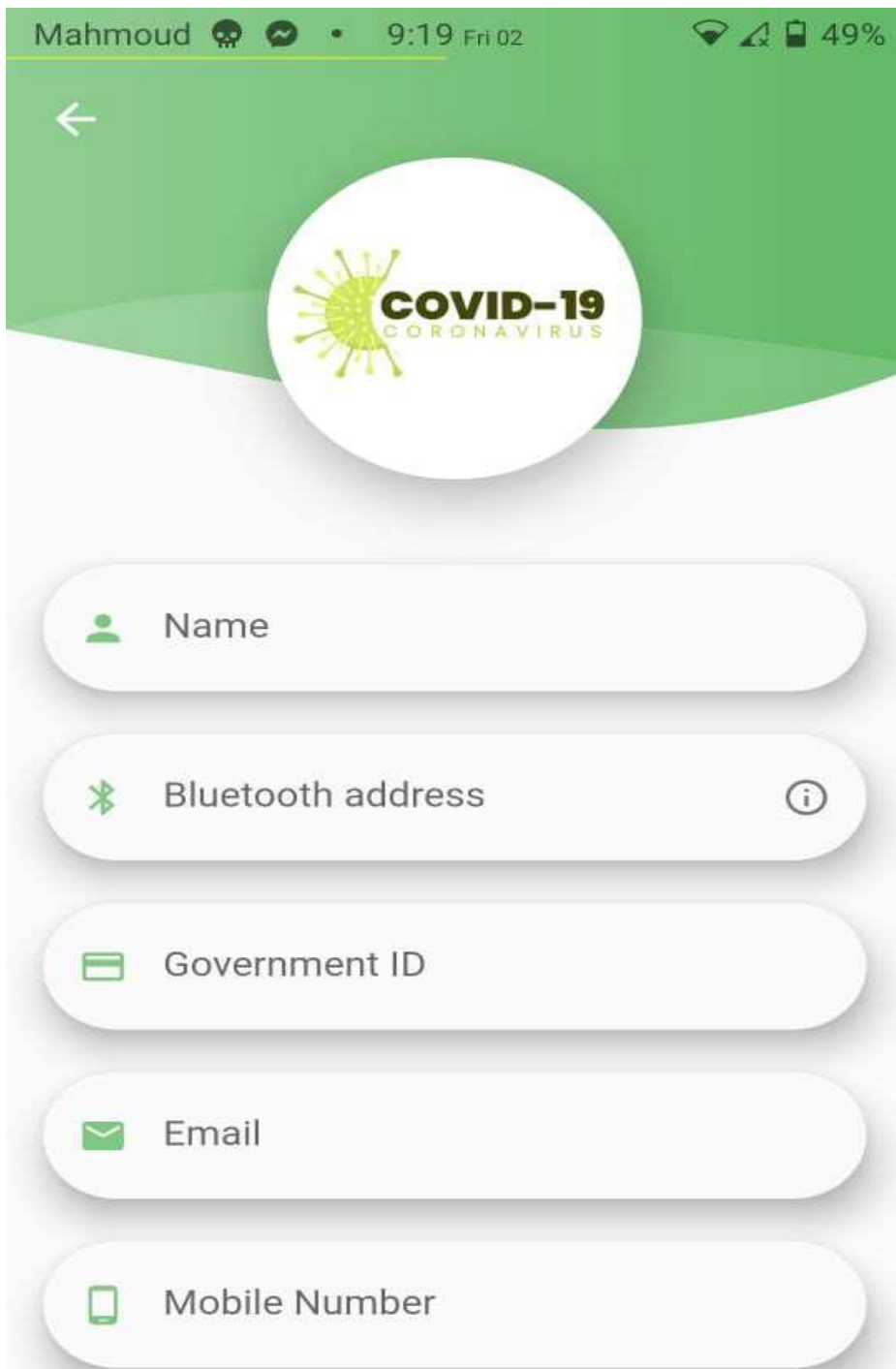Fig.3. Flowchart of Proposed system

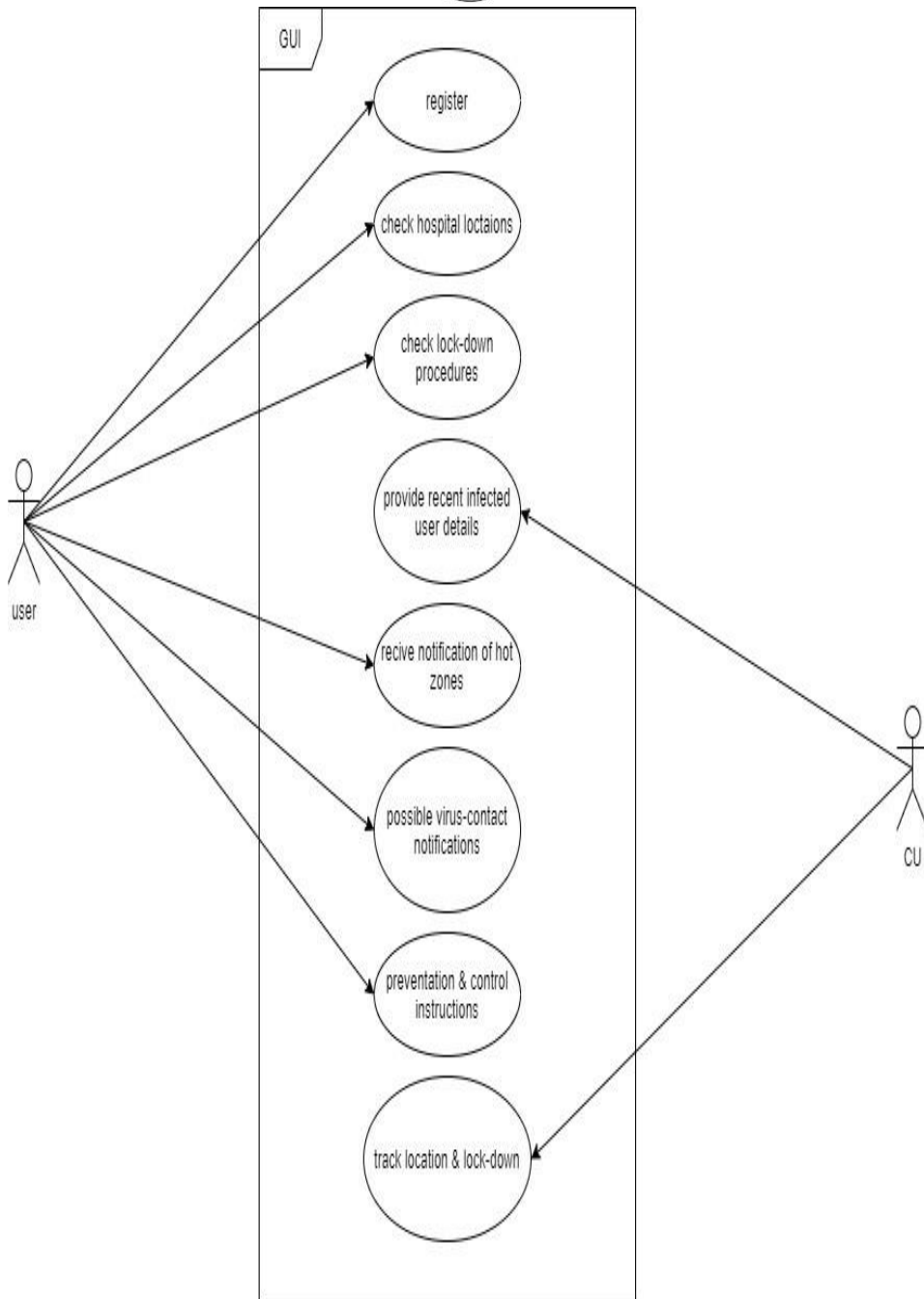Fig.4. Application Detailed Block

Fig. 5. Register New User

Fig. 6. Use case of User-Controlling Unit Relation

3.3. Software Development Tools Selection:

The development tools and platforms we used to develop the proposed systems are:

- Mobile application developments tools (Flutter coding language).
- Java-script coding technique for mobile app development (Python technique).
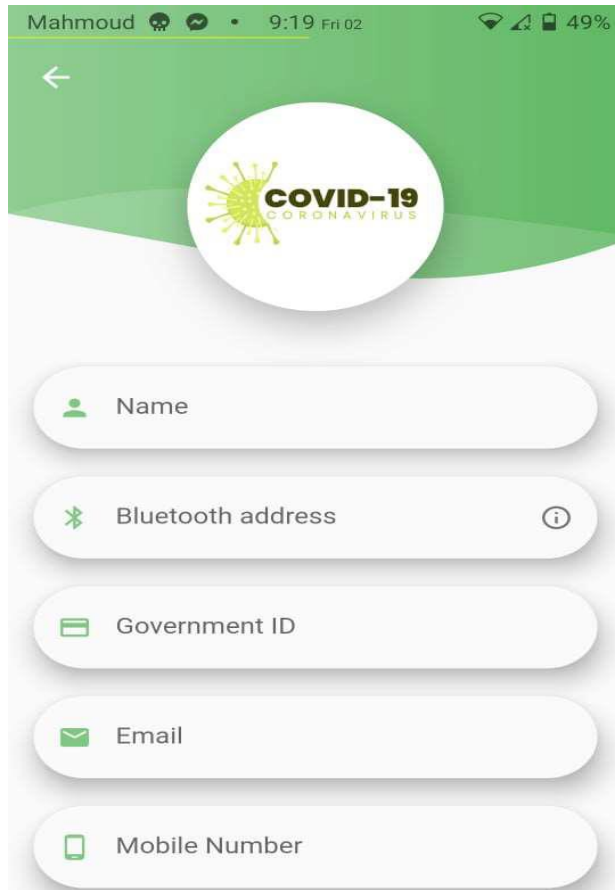

Fig.7. Register New User

Database software solution (MySQL).

- Storage Unit (Cloud Database storage).
- Android studio for mobile application development.
- Microsoft visual studio compliers (Visual Studio).

3.4. Implementation

In this section we will discuss the implementation details for the proposed system and the functionalities of each portal in frontend. Firstly, there is a welcome message appears and then there are the login/sing in parameters (if already registered user) which consists of: email address and the password or a sign up for the new users who are not registered yet at the application consists of several parameters: user's name, Bluetooth address, email address, government ID, mobile phone number and password as shown in Figure 7.

When the user finish signing in correctly, the application sends alert to turn on the Bluetooth and to allow device's location, this is for sending nearby hospitals location (as shown in Figure 8).
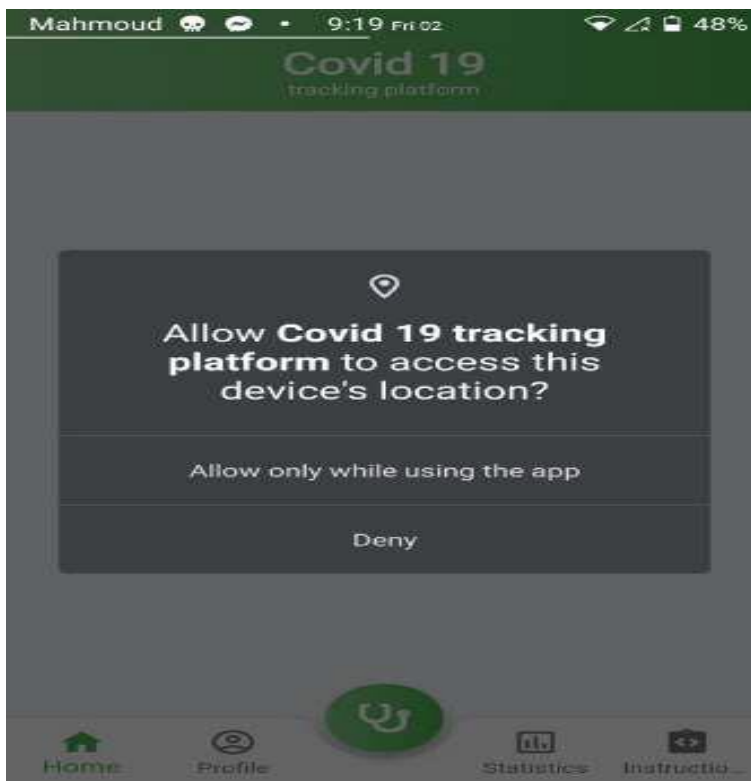

Fig.8. Allow Access Location Permission

Then the application takes the user to the home page where the Bluetooth checks for active users in the area and is shown as total encountered (as shown in Figure 9).
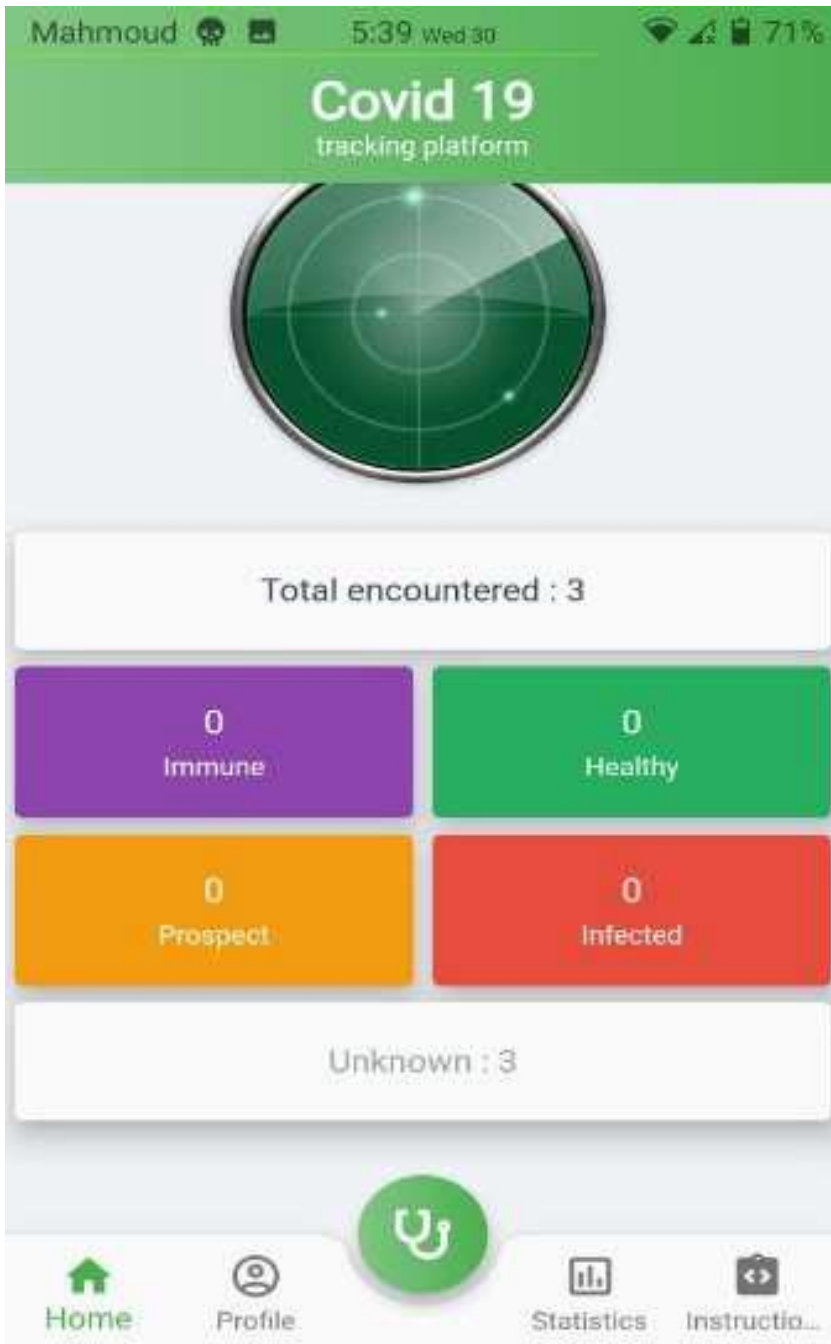
Fig. 9. Detect 3 Nearby Person

The application provides a feature through a simple questionnaire that was published and authorized from the World Health Organization, to check if there are any symptoms with COVID-19, as shown in Figure 10. The reason from these questions, is to know the status of any user who can't make a checkup in any hospitals and we don't have his status's history, even he/she in safe or patient case, if the answers was 'yes' to 4 or more symptoms his/her status will marked as infected, while less than 4 questions answered by 'yes' the status will marked as prospect, if the answers were 'no' to the questions, the status will marked as healthy

Fig.10. Statistics about the Daily Changes Updated from the World Health Organization

Moreover, the application provides bunch of statistics and analytics about the daily changes as; the new positive cases, the critical cases, death cases and the recovered cases, all these results are the daily changes around the world updated from the World Health Organization (as shown in Figure 11.

Fig. 11. User's Checkup with Authorized Questions from World Health Organization

For Admin, there is a dashboard for all users using the application, it is same as a generated database for the users, to collect their information, the admin can control user's status, as we mentioned before that it is hard to get a database from national ministry of health, so we decided to create this dashboard to monitor and control such information and changing status of the users as shown in Figure 12.
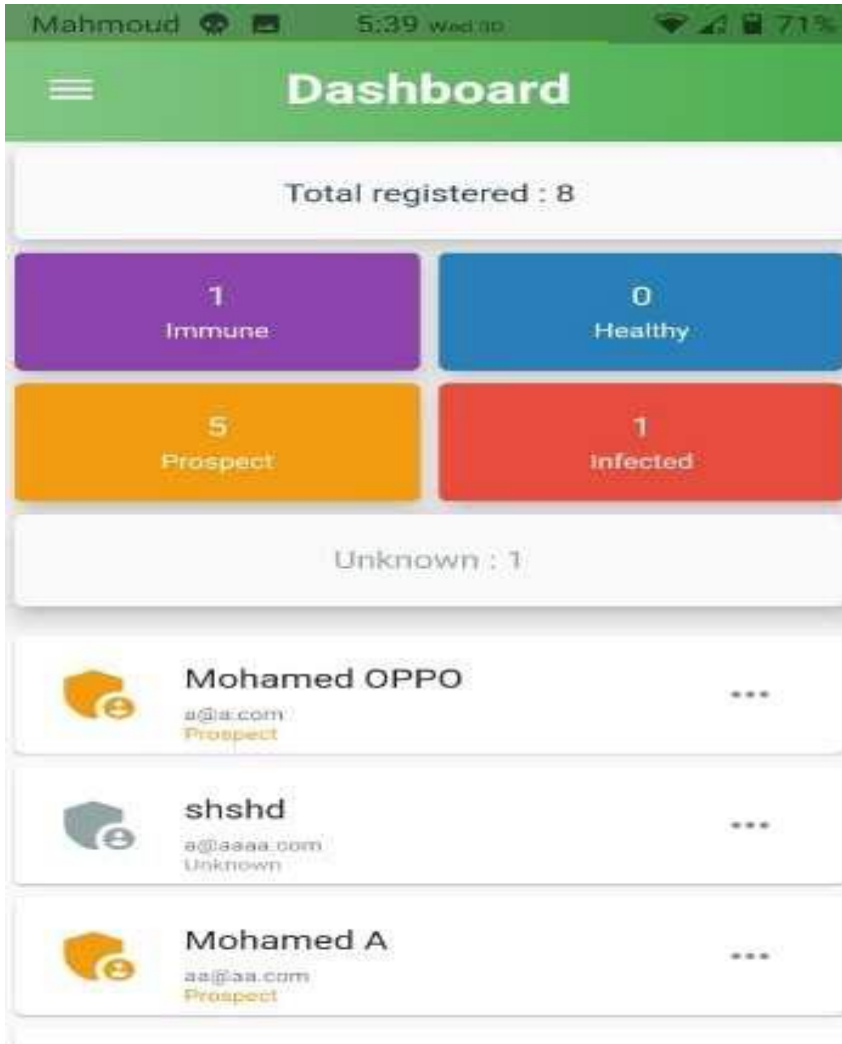
Fig. 12. Dashboard for All Users using the Application by Admin

3.5. Testing challenges

Through this section, we will demonstrate the testing details, challenges and results for our proposed system as follows:

- Firstly, there was a serious problem that we faced, which is the inability to obtain patient confidential information from the national ministry of health.

This was very hard to collect a data from the hospitals and the labs in our country, so we had to deal with this problem and find an efficient solution. Generating and creating dummy-like datasets for our purposes that collect user's information as: personal information and status. This status was changeable from user to another by the controlling of the admin [12].

- One other challenge which is related to the problem for generating those keys, as it consumes very high-power rates from mobile phone's battery due to high computational power from both the server and mobile phones, so the solution was to access the Bluetooth address of each mobile phone as a key that plays the dynamic key's role [14].

4. Conclusion

The whole world suffers from the COVID-19 pandemic and high demand for a solution to control this pandemic, by controlling the exceeding of the counts of the infected people. The most common solution is to develop an application that detect the infected persons and their nearby persons with the possibility of being infected. In our proposed system we aim to tackle this challenge using Bluetooth technology and building a mobile application, track the infected user without attack his/her privacy. On top of that the proposed system provides many other features to support users to be safe and support their home isolation. The testing results show promising results compared to other existing systems.

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