

# Development of an Android Application for COVID-19 using Firebase and Geo-fencing

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**Abstract:** The coronavirus has challenged the lives of many people all around the globe. The widespread use of COVID-19 left people starving with no money and bread. To combat this effect on people the only way is to maintain social distance and be cautious all the time. We put forward a mobile application-based strategy to combat the risk of COVID-19. The motive of the proposed model is to make people aware of COVID-19 cases updates and also notify them at various situations. We developed the mobile application using android studio and made use of Google firebase for the database. COVID-19 cases status along with information related to pandemic and emergency contacts are featured in the application. The outcomes of the application are good in response time as well as in the delivering of notifications.

**Index Terms:** Geo-Fencing, Mobile Application, COVID-19, Android Studio, Google Firebase

## I. INTRODUCTION

The dreadful COVID-19 virus affected several lives all around the globe. COVID-19 pandemic has been declared a global health emergency by the World Health Organization (WHO) [1]. WHO has suggested a ‘test-isolate-trace’ approach throughout the pandemic [2]. In parallel, there has been a worldwide cooperative effort to develop a vaccine and numerous serological tests for the presence of antibodies [3]. This alarming situation has a great deal of impact on the lives of citizens. Many people across the globe are infected and have died due to this virus [4]. Strong immunity surely saves people at risk from getting affected with COVID-19. Children below 10 years and adults above 60 years are vulnerable to this disease as per the recorded statistics. Keeping ourselves clean and eating a nutritious diet would help us prevent ourselves from the deadly infection of the disease.

The coronavirus has brought all the people together to strive hard in the field of science and technology so as to contribute to the society in this distressed period [5]. Since there is a rampant usage of mobile phones, every citizen has the knowledge of using mobile applications. There is no doubt in saying that mobile applications are pre-dominant than web-based applications. As the COVID-19 pandemic rages, engineers and researchers are coming up with applications, services, systems for contact tracing and many more creative ideas [6].

Mobile applications keep track of registered users so that they can know the vulnerable areas. Coronavirus Pandemic Epidemiology (COPE) has come up with a symptom tracker mobile application which collects the data and analyzes the effect of COVID-19 in different areas, thus residents in those localities can be alerted to take precautions. This application, launched in the UK, got a great reach of 2.8 million users in less than 2 months [7]. People get information regarding COVID-19 happenings around them through their mobiles. COVID-19 cases are gradually increasing irrespective of many lockdowns and strict guidelines given by the governments. The UK Government has a motive that better contact tracing application plays a vital role in beating COVID-19 and helps the present situation become new normal [8].

People can be alert all the time of what is happening around them through the updates. Mobile applications serve as a better aid to fulfill this requirement. The application developed notifies the user on entering and exiting the containment region. Many people are dubious that the virus spreads via waves. All these assumptions are absurd. Many countries, which do not have a 5G network, have a lot more COVID-19 cases than the countries which have better networks [9].

The organization of the paper is as follows. Section II of the paper deals with literature survey on applications in the market and their limitations. Section III gives better knowledge on proposed methodology. In section IV, results and performance of the application is discussed. Section V gives conclusion along with the future work of the proposed model.

## II. LITERATURE SURVEY

At present many applications exist all over the world, which give information related to COVID-19. In India, many states have developed an application to provide their state COVID-19 updates and information. Kerala, Tamil Nadu, Punjab, Maharashtra and Mizoram states have come up with the mobile applications for safeguarding the lives of their states’ people [10]. There are API’s which provide data regarding COVID-19 cases and updates [11]. These API’s make work easier as there is no need to update the database manually. Existing API’s provide data related to countries and states round the globe.

At present, many applications are released in the market which have information regarding cases, state-wise count of cases, symptoms and measures to be taken in the pandemic. Some of the applications have the restricted access, that is only they can be accessed by people who are affected by COVID-19 to monitor their status by the health department. Few of them include states like Kerala, Karnataka and Maharashtra. Mizoram state government developed an application to maintain authenticated records of COVID-19 updates and information so that people can be aware of daily happenings [12].

“Arogya Setu” is an application developed and released by the Central government. This application has the self-assessment test, which has the questions related to COVID-19 symptoms and travel history. After the test, it gives the status of the person. It has a special feature that works with the help of Bluetooth, which notifies whenever affected people who have taken the test come in your vicinity. This application displays status of cases within the range of 500m to 10km [13]. There are some loopholes in this application. Users may submit the wrong answers in self-assessment tests. No individual may tell that he/she is suffering from a particular symptom. This will tend to be misleading data. People are asked by the government to download the application and take self-assessment tests timely so as to curb the spread of the virus.

Many countries have put forward their ideas in order to fight the pandemic effectively. The major concern with this is the privacy of a user. Location is being tracked in most of the applications and stored in databases. It is said that no data will be leaked out or used by authorities but what if it gets hacked, is a bigger issue. Developers are trying to find a better solution to overcome this challenge [14]. The issues mainly come up with regard to geographical location tracking. [15]. Many applications in today’s market take the location of the user denying the user’s privacy. This has no point in safeguarding user’s privacy and users do not know what it is used for.

Web applications are an alternative to mobile applications to get the desired data. The access time for desired data varies to a greater extent. Mobile applications are much handier comparatively. Efficient contact tracing applications are being made by countries like China, South Korea and Singapore [16]. Mobile applications are much better than web applications. Hence, we put forth the idea of developing mobile applications and facilitating all the features required for a user in this pandemic. A team of software engineers put forth their efforts and came up with a web-based application which notifies potential risk, symptoms and it also has the feature of taking self-assessment test [17].

### III. PROPOSED MODEL

An efficient model is proposed to reach people’s needs and facilitate the services conveniently. The model does not store the geographical location of the user in the database, rather it shows his/her location in the application itself. Privacy is given great importance in the proposed model, which is lacking in many other existing applications. Static and dynamically triggered notifications by the application

help the user to be alert all the time. Containment zones are clearly marked on the maps to send the alerts on entering the regions. Many other features are included in this application and they are as follows

- COVID-19 information
- State-wise and overall COVID-19 cases statistics
- Press-meets, Media Bulletins and Orders issued by the government (GO’s)
- Addresses and contacts of various COVID-19 health centers
- Google maps with containment regions highlighted
- One click to reach out to emergency services

#### A. Approach towards the problem

Android studio is used to develop the entire application. Third party services like Google firebase database, firebase cloud messaging service and firebase in-app messaging service are used to facilitate various services. Google drive is used to store various kinds of information. When a user needs the data, they are redirected to a particular file in the drive.

The user login is made mandatory which is possible after the registration. User is authenticated by the authentication services of firebase. User gets static and dynamic notification once he/she registers in the application. Any information updated in the application is notified by static notifications. Most important information is displayed on the opening screen, which is done with the help of in-app messaging services provided by firebase. Various departments’ contact numbers are displayed in the application, which helps the user to call the required department in one click. Dynamic notifications which are enabled using android notification manager are triggered based on a criterion set, i.e., on entering and exiting the radius defined in a containment region.

#### B. Geo-Fencing

Geo-fencing feature enables it to detect when an object enters in and goes out of the area defined. This feature is used in the proposed model to notify the user on entering the containment areas. Whenever the user enters and exits the region, a notification is triggered by the application, provided the application runs in the background of the user’s mobile. Notification stating “You are in the containment region” is popped up with the notification sound. The regions on map are defined by providing latitude and longitude in the database. These are fetched by android and the circles are marked on the map with latitude and longitude as center and pre-defined radius as size.

Geo fencing is used in various fields depending on the requirement of the organization [18]. The present model is built completely from scratch by coding. Besides this, there are third party geo fencing API services which makes work simpler. One such is TOMTOM API, which interprets virtual boundaries in real geographical areas. Also we can have knowledge of whether an object is outside or inside the defined areas. TOMTOM API provides various roles for the development side while working with it [19].

C. Implementation

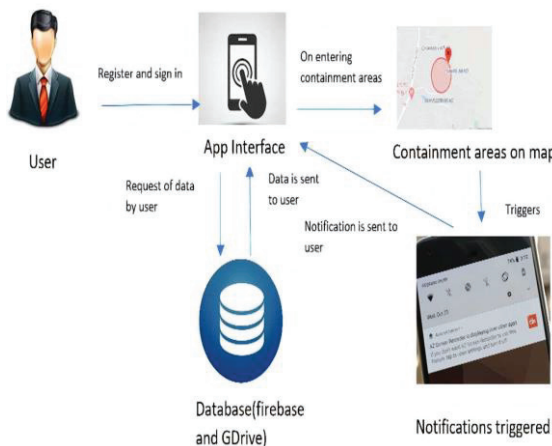


Figure 1. Block diagram of application functionality

Figure 1, explains about the application functionality. The user logs in after the authentication done by google firebase authentication. User fetches data from firebase database or is redirected to corresponding google drive folders. Notifications are triggered on entering into the containment region which is facilitated using notification manager in firebase. Static notifications are enabled with the help of firebase cloud messaging service, which also helps the admin to see various analytics. In-app messaging services are also added to focus on more important issues on opening the application. Admin needs to post the required information in the site beforehand, size, banner, text and image need to be added in the site while sending these notifications.[20].

IV. RESULTS AND ANALYSIS

A. Application design and their functionality

The design of the application is shown in figure 2. User login and registration pages are seen in 2.A screen and In screen 2.B, homepage consisting of information regarding COVID-19, its symptoms and preventive measures to be taken can be seen.

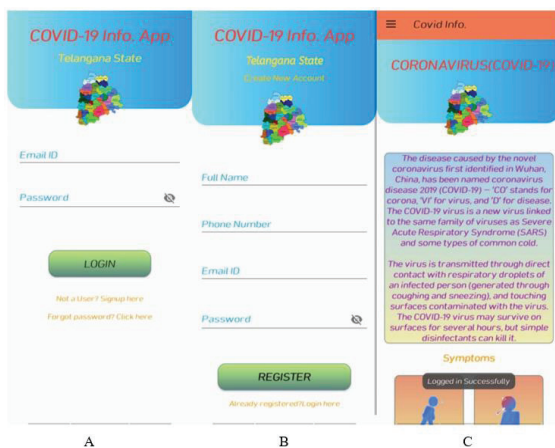


Figure 2. Screenshots of the application interface

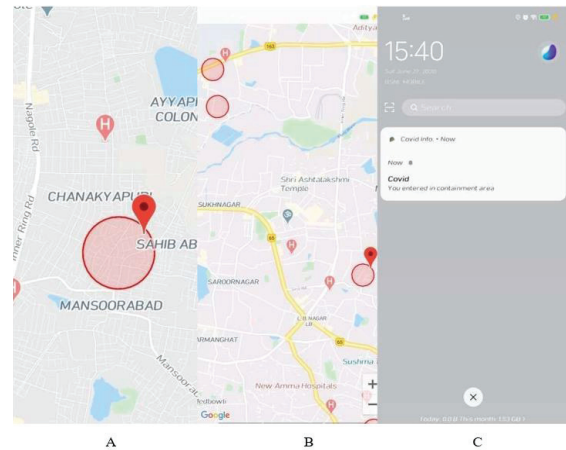


Figure 3. Screenshots of containment regions and dynamic notification

Figure 3, shows the major part of the complete application. Users on entering the containment region get the notification as shown in C. User can check where he is on the map. This is illustrated clearly in screen A. B screen clearly shows all the containment regions. This helps the user to plan before travelling to a place in the vicinity of contained regions, thus making him alert by giving the knowledge of vulnerable areas.

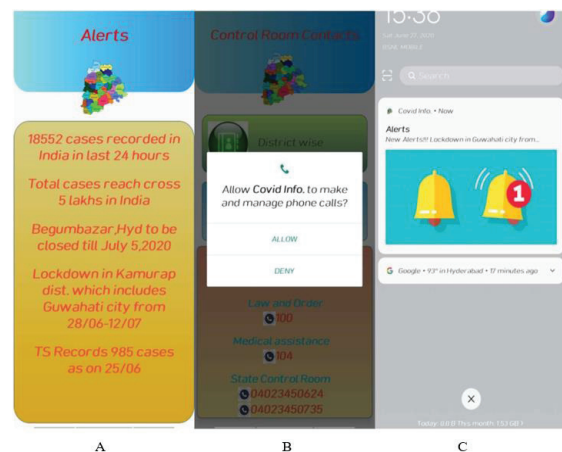


Figure 4. Screenshots of application with different features

In figure 4, screen A displays the auto scrolling updates which are updated by the admin in the database, screen B has the list of emergency contacts through which the user can ring up but tapping on the number and giving permission to the app to make calls. Cloud messaging service is used to trigger static alerts that can be visualized in screen C. Cloud messaging service enables to send any number of notifications at any time with desired content and image [21].



Figure 5. Screenshots of application with different features

Figure 5 depicts various screens of application, each having different features embedded in them. In Fig. 6, screen A shows the drawer navigator with various features available in the application. Screen B gives the gist of different centers which provide healthcare facilities. COVID-19 cases status of India and Telangana are clearly shown on the screen 5.C. The user can also navigate to see a list of cases in all states. Analytics related to various technical aspects are available from Firebase analytics. [22].

**B. Analytic Reports**

Google Firebase analytics are done based on authentication of user made while logging on to the application. Reports of application usage and data usage are drawn by firebase implicitly. This helps the admin to analyze and work on the necessary entities.

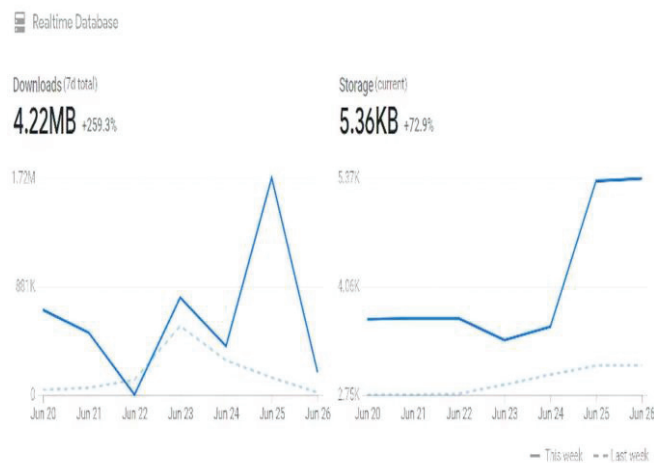


Figure 6. Reports consisting of the storage and download statistics of Firebase real-time database

Figure 6 report shows the download from the database done by the users. This tells about how much data is being fetched on user request on a daily basis. Storage deals with the admin activity which tells how much data is being stored in the database.

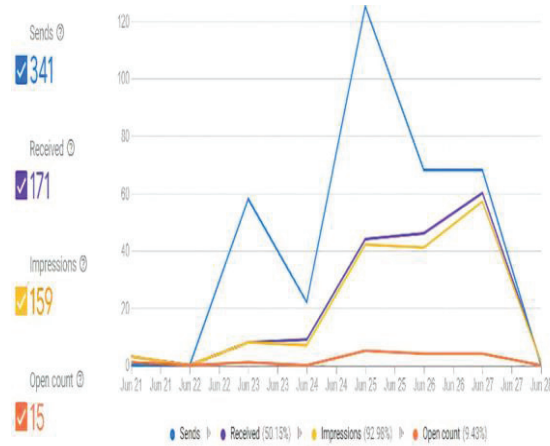


Figure 7. Different activities stats of google cloud in-app messaging service

In figure 7, the statistics of different activities are generated by google cloud messaging service, which helps administrators to send the updates in a more responsive way so as to get more impressions on the notifications sent. Thus, we can improve content to be sent to the user and keep them interactive with the application.

**V. CONCLUSIONS AND FUTURE WORK**

The proposed model allows the user to check the containment regions and plan his journey accordingly. It helps the user to have clear knowledge on the status of the pandemic. It keeps updating the user with static notifications. Users can reach out to emergency contacts in no time and get the services. This application stands out from other applications by dynamically triggering alerts to users on entering and exiting contained areas. The model has shown considerable results with authenticated users, fetching data and redirecting between the pages. The scalability is based on third party API, which makes applications accessible to more users at same time.

The work can be further extended by adding features of contact tracing and also alerting people when affected people come closer to the person. Other features like an alarm system to remind people to take medicine, and timely notifications to keep themselves sanitized can be added to make them more user-friendly and protect them from viruses. The same application can be replicated using flutter, which allows iOS users to use the application. Firebase and google maps API can be purchased to avail large database and API requests. Google maps provide a smaller number of requests i.e.,2500 requests per day, this can be increased by purchasing better plans. Thus, we can accommodate a large number of people’s requests with no interruptions. Geofencing API can also be used for better implementation of a few objectives.

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