

# CitiSafe – Interactive Crime Reporting

Chitra Bhole<sup>[1]</sup>

Professor, Department of Computer Engineering, K. J. Somaiya Institute of Engineering and Information Technology, Mumbai, India  
cbhole@somaiya.edu

Vinayak Sanjay Malviya<sup>[1]</sup>, Shweta Saravanan Nadar<sup>[1]</sup>, Janvi Vipul Patel<sup>[1]</sup>

Undergraduate Students, Department of Computer Engineering,  
K. J. Somaiya Institute of Engineering and Information Technology, Mumbai, India  
vinayak.malviya@somaiya.edu, shweta.nadar@somaiya.edu, janvi.vp@somaiya.edu

**Abstract**— Crimes and emergencies require urgent responses from emergency services like police, fire services and medical services. These response services have a reporting system that is tedious. Most times reported incidents are not seen through properly. The victim or witness who reported the crime has no means to know the status or progress of their report. Efficient, easy and direct reporting along with immediate or minimal inputs are very crucial as lives may be at risk in the said cases. The proposed system aims to achieve these goals and provide a complete end-to-end solution for real-time crime reporting along with location tracking. The application will consist of an interactive and user-friendly map application for the public to inform the authorities about the crimes and emergencies in real-time. The interactive map will showcase all the nearby emergency services such as police stations, hospitals, etc. The crime or emergency will be reported in real-time along with location marked on the map. The emergency or crime can be reported with images or voice recordings as well. The appropriate authorities will receive the reports which will be available to them on a dashboard. The status of the response to a report can be monitored in real-time. The details of the reporting, tracking and response times will be recorded in the system.

**Keywords**—Crime reporting, emergency reporting, interactive, maps, real-time

## I. INTRODUCTION

With the arrival of technology and its support for communications, people are also adopting the influence, fun and convenience that it offers. The industry has changed its communication from text messages to email and even to use social networking. This phenomenon triggers businesses to supply value added services and improved communication lines to its customers or partners. Even the government is moving towards services offered online or easier ways to access information to concerned citizens.

Smartphones have various functions to support different user interests. GPS in Smartphones offer geo-positioning services and this function can be helpful when someone is in an emergency.

Emergency situations and crime scenes go unreported to the authorities because of the fear of getting involved. Some people fail to report a criminal offense due to the costs and time incurred in travelling to police stations that are situated far away from their homes and workplaces. This shows that the distance is also a factor that influences greatly how crimes are being handled with many crimes going unreported as a result a lot of crime happens anywhere and going to the police department and municipality hall is a very time consuming because they are still using manual method and it takes a week or two to make an action on the said complaints.

Public confidence within the police can often depend on the way crimes are investigated and not simply the results of investigations. An effective crime reporting, recording, investigation, and monitoring process will change the design of policing to a victim-centered approach to crime management. This will not only enable the police to be simpler in fighting and managing crime but could also cause a far better image, reputation, and more public confidence in the police force.

The paper is structured as follows. Section II discusses similar existing systems as well as research work on real-time information systems. Section III explains the user groups and features in the proposed system. Section IV depicts the system architecture in detail. Section V provides the detailed explanation about the implementation of proposed system and the results are provided in Section VI. Section VII concludes the paper.

## II. EXISTING SYSTEMS

The Crime Mapping Solution built for Nigeria [1] focused on a system designed for the Law Enforcement Agents. The system empowers their officers to create and maintain crime and accident reports more effectively and more efficiently by improving the current paper-based measures.

The system uses a central repository to allow fast and easy access for relevant stakeholders, and demonstrates how this repository can be used together with GIS data to create powerful crime mapping tools. While in the early phases the researcher's reveal the feasibility of the proposed solution through implementation of prototypes and isolated studies of core modules in the architecture and a first iteration of the interface design based on interviews with stakeholders in the organization and analysis of the current workflows.

Another closely related work is a Smartphone Emergency Reporting Application in Urban Areas using GIS Location based and Google Web Services [2]. This is the client-server GIS and Smartphone application for the person at emergency situation. the person at emergency select the emergency service such as in client application medical, fire, police, then it detect the user current location along with information name of the person and contact number(person's identity) for providing service. This proposed work will record all emergency details of rescued person with location onto maps, GIS will provide detection of emergency person coordinates (latitude and longitude) tracked by GPS and also provide plotting coordinates onto maps within the web application.

A research paper with Location-Based Reporting and Mapping of Crimes Using Google Maps [3] described a system that used Google Maps to present crime information accessible through a browser. In this way, people may report crimes using a location pointed on the map before providing

detailed information. It enables an automatic method for displaying information on the map because the respondents themselves identify the location.

Several Android applications have been developed to tackle crime reporting via digital means. One such application aims to speed up the investigation process with the intervention of the common people [6]. The above application provides the citizens with access to criminal data available with the authorities. The intended use of this data is to help the investigation of the police. But this data in the wrong hands could be used to sway the investigations in the wrong direction. Data has to be secured and access to it should be restricted when building such a solution.

Various implementation of location-based tracking has been utilised in different places [7] – [9]. Mainly GPS based tracking solutions have been utilised for ease of usage and optimal results.

### III. PROPOSED SYSTEM

The proposed system aims to provide a complete end to end solution for real-time crime reporting along with location tracking. It includes three user groups; the role of the solution for each group is listed below:

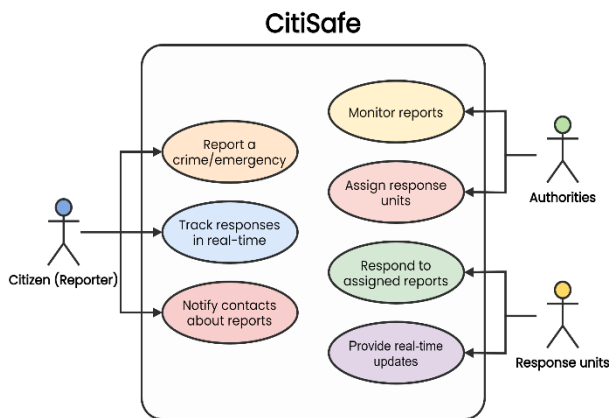


Fig. 1. Use case diagram

#### A. Citizen (Reporter)

Citizen will have an interactive and user-friendly map based application to inform the authorities about the crimes and emergencies in real-time. The application will consist of an interactive map which will showcase all the nearby emergency services such as police stations, hospitals, etc. and it can be used to report a crime or emergency in real-time along with location marked on the map. The emergency or crime can be reported with images or voice recordings as well. Emergency contacts using the application are notified of the incident. The status of the response to a report can be monitored in real-time. The main functionalities available to Citizens through the application are listed in Figure 1.

#### B. Authorities (Bureau of Police Research and Development, Emergency Response Center)

The appropriate authorities will receive the reports which will be available to them on a centralized dashboard. The details of the reports including user details, location and media attached will be visible on the dashboard. The authorities can then accordingly assign respond units like police units, fire brigades or ambulances to the reports. Authorities can perform the tasks listed in Figure 1 through the dashboard.

#### C. Response Units (Police vans, Amublances and Fire brigades)

The mobile application which the response unit uses the obtained geo-Location of the report and gets the shortest distance to reach the place of incident. Their movement is tracked and is updated in real-time for the reporter to view and estimated arrival time is also provided.

### IV. SYSTEM ARCHITECTURE

CitiSafe will act as a complete end to end system providing a centralised interface between authorities, the citizens and the response units. The system caters to the needs of each user group mentioned in Section III and provides an easy to use and interactive platform keeping in mind best practices and accessibility. Citizens are provided with a map based, interactive mobile application. The authorities perform their duties via a robust dashboard and the response units respond to the reports along with real-time updates via a minimal interaction mobile application on their end. The complete system is divided into 6 modules for better development and best practices, viz. Authentication, Locating, Reporting, Responding, Realtime tracking and Contacting. Figure 2 depicts the CitiSafe System Architecture. Each module specified is depicted in Figure 2 including the services used by each module.

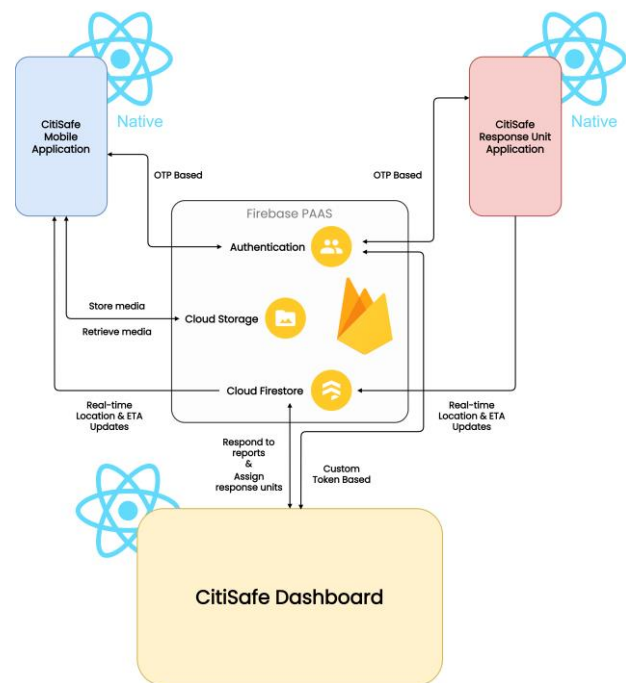


Fig. 2. CitiSafe System Architecture

#### A. Authentication

Authenticity of user credentials is of utmost importance. The validity of reports is a major concern, user details are verified by this module to minimize false reports and hold the users accountable in case of any misuses. This module onboards users securely and easily by using OTP authentication or their Google Account. Authentication uses Firebase Authentication service provided with a Firebase Backend as a Service (BAAS).

### B. Locating

This module will be responsible for locating the user geographically and identifying the nearby essential services for the user on the interactive map. It will also provide users with an option to search for services as well. Mapbox SDK is used to provide the interactive maps and additional services on the map.

### C. Reporting

The reporting module will capture the user's geographic location along with their uploaded media content and textual description and create a report which will be available on the dashboard. This module also records some essential nearby services for the user such as fire stations, hospitals, police stations, etc.

### D. Responding

Responding to the reports available on the dashboard will be handled by the responding module. The authorities will be able to respond to the reports via the dashboard. The dashboard also provides the reports on an interactive map-based interface for better visualization and accessibility. The response units are a major part of this module. They respond to the assigned reports using the CitiSafe Response unit mobile application. This application provides the real-time updates for location and Estimated Time of Arrival (ETA) along with a suggested route on the map to reach the citizen's (reporter) location while ensuring minimal disturbances to the response units.

### E. Real-time tracking

Reporting and responding will take place in real-time. The authorities will be able to view and respond to the reports in real-time via the dashboard. The dashboard is updated in real-time; no manual updates are required. Similarly, citizens are provided updates for their reports on the CitiSafe mobile application in real-time; no manual updates are required. The CitiSafe Response unit application provides the real-time updates for response unit location and Estimated Time of Arrival (ETA) to the system. This functionality will be enabled via the real-time tracking module.

### F. Contacting

Selected emergency contacts of the citizen will be informed with basic report details such as reporting location, time, date and type of report and assistance requested via the CitiSafe mobile application. The emergency contacts will be notified immediately with a simple message enclosing the above-mentioned details.

## V. IMPLEMENTATION

The implementation included the simultaneous development of applications for each user group. Each application is responsible for multiple modules described in Section IV. The applications have been built for optimizing ease of use with minimal interactions to ensure quick reporting and hassle-free response. Robust frontend frameworks, APIs and scalable architectures were implemented while ensuring best practices.

### A. Mobile Applications (CitiSafe and Response unit)

The mobile applications for citizens and response units are built using React Native. React Native is a JavaScript

cross platform app development framework, which allows developers to build native applications for both Android and iOS with the same codebase. React Native is used to ensure maximum compatibility with large number of devices without developing and maintaining separate codebases for each platform on which the application is to be used. CitiSafe - Interactive Crime Reporting solution comprises of 2 separate mobile applications

#### 1) CitiSafe

The citizens will use this application for reporting and tracking the response to crimes and emergencies, along with other features mentioned in Section IV. This application also uses Cloud Storage provided by Firebase BAAS which is an object storage service to store and retrieve user uploaded media such as images, audio recordings and videos.

#### 2) CitiSafe Response unit

This application will be used by the response units (ambulances, fire brigades, police units, etc.) to respond to the assigned report(s).

Both the mobile applications use redux, a predictable state container for JS apps and redux-saga, an ES6 generators-based library to make side effects i.e., asynchronous things such as data fetching, real-time listeners, location watchers, etc. efficient and performant. Both applications also use Firebase Authentication for OTP based secure user credentials authentication.

### B. Dashboard (Authorities)

The authorities monitor and respond to the reports generated by the citizens via the CitiSafe Dashboard. This dashboard is built using ReactJS, a component-based JavaScript library for building robust web applications. CitiSafe Dashboard is built as a web application using ReactJS as the requirements for a web application are minimal, hence ensuring maximum compatibility with the existing infrastructure with the authorities. The dashboard also uses redux and redux-saga as mentioned above. Firebase Authentication is also used in the CitiSafe Dashboard using custom tokens to authenticate authorities and disable unauthorized access.

### C. Map Services

Interactive maps, nearby features are enabled in CitiSafe using Mapbox SDK for Android, iOS and JS apps. Usage of Mapbox SDK in each application is described below:

#### 1) CitiSafe

CitiSafe uses Mapbox's Maps SDK for Android and iOS for providing interactive maps and features like search functionalities and nearby emergency services. The routing for response units is implemented using Mapbox's Directions API.

#### 2) Dashboard

CitiSafe dashboard uses Mapbox GL JS, a WebGL based JavaScript library for implementing interactive maps and displaying reports on the maps for the authorities.

#### 3) CitiSafe Response unit

CitiSafe Response unit uses Mapbox's Maps SDK for Android and iOS for providing interactive maps. The routing functionality is implemented using Mapbox's Directions API and ETA calculation is performed using Mapbox's Matrix API. The ETA calculation is adjusted

dynamically on the basis of distance to be covered and current location of the response unit.

#### D. Database

CitiSafe uses Cloud Firestore, a scalable NoSQL database provided with the Firebase BAAS. NoSQL database is used to ensure scalability and robust data management. Cloud Firestore consists of collections and documents. Each report has a corresponding document in the reports collection. Each user's details are stored securely in a corresponding document in users collection. Each type of response unit has a separate collection where each document corresponds to a specific response unit to ensure fewer loading times and flexibility for the number of response units to be handled.

#### E. Real-time updates

##### 1) Reports

Crime/emergency reports are generated and updated in real-time via WebSockets. Real-time listeners provided by Cloud Firestore utilize WebSockets to provide updates immediately as the reports collection is updated with newer reports or newer data. CitiSafe application initializes a real-time listener to fetch updates immediately and provide citizens with live updates automatically.

##### 2) ETA & Location

CitiSafe Response unit application provides real-time location updates via Geolocation services available in both Android and iOS devices. Location watchers are initialized at the start of response which provide updates about the current location and ETA to the database at dynamically calculated intervals, which are then propagated to the reporting citizens via real-time listeners in the CitiSafe application.

### VI. RESULTS

Each application of CitiSafe system i.e., CitiSafe mobile application, CitiSafe Dashboard and CitiSafe Response Unit mobile application is depicted with the following figures.

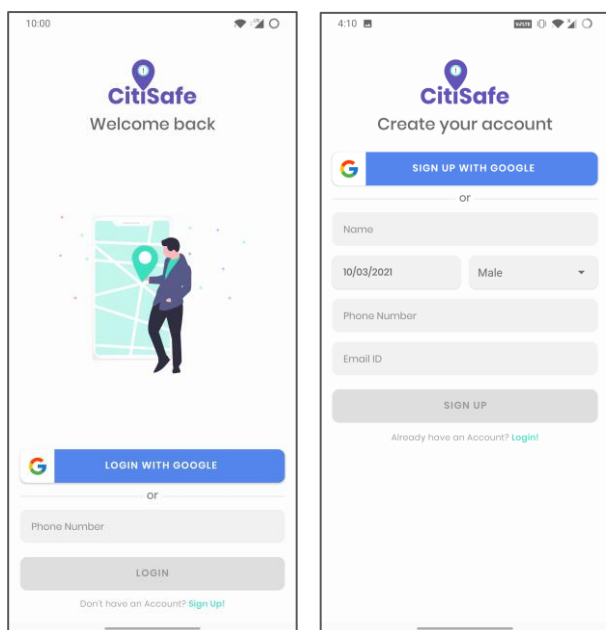


Fig. 3. CitiSafe Authentication

Figure 3 shows the Authentication module as described in Section IV. User Authentication in the CitiSafe mobile application is done using secure OTP based verification. Alternative approach for authentication is via Google Sign In.

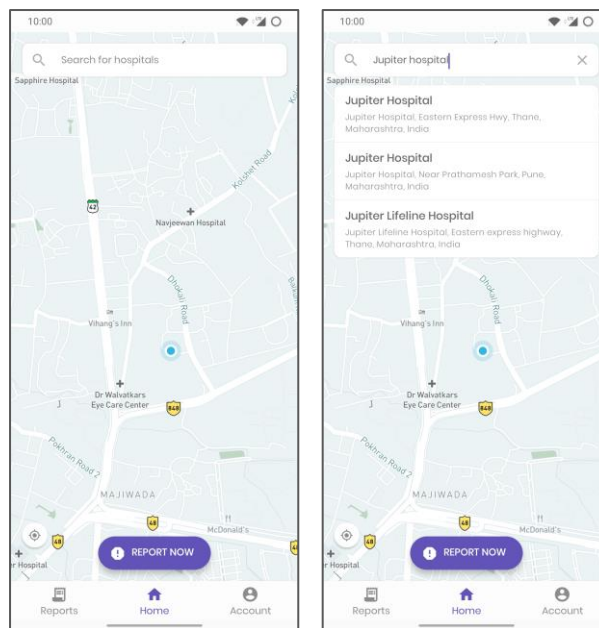


Fig. 4. CitiSafe Home Screen

Figure 4 depicts the Locating module as described in Section IV. Using the Home screen of the CitiSafe mobile application, citizens can search for the nearest emergency services such as police stations, hospitals, fire stations, etc.

Figure 5 shows the reporting screen which is used for reporting the crime or emergency. Reporting module is implemented via the screens shown in Figure 5. The report automatically fetches the location of the reporter (citizen), the reporter can attach media to the report and also provide an optional description.

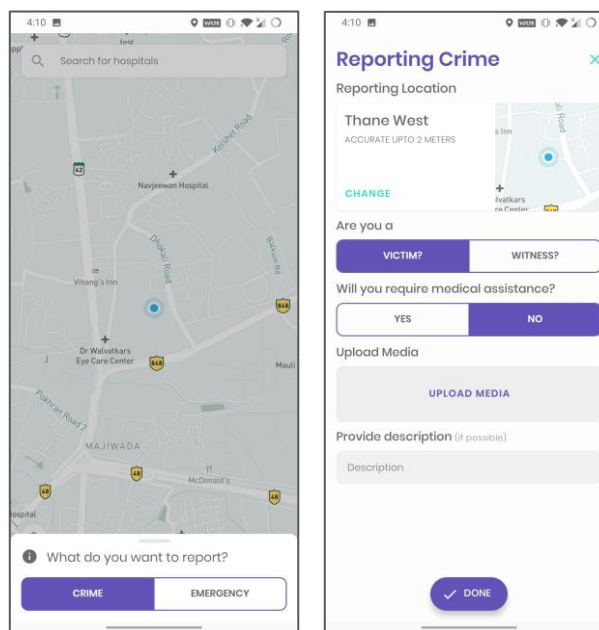


Fig. 5. CitiSafe Reporting Screen

Figure 6 represents the report details and real-time tracking module. Real-time information about the response such as Estimated Time of Arrival (ETA), Response unit location and Route taken by the Response unit. Relevant nearby essential services are also listed along with the above details.

Figure 7 shows all the emergency contacts selected by the user. The reporter's emergency contacts are informed of the report with necessary details. These details are displayed on this messages screen.

Figure 8 represents the CitiSafe dashboard authentication which is done via Custom Tokens and node email and password.

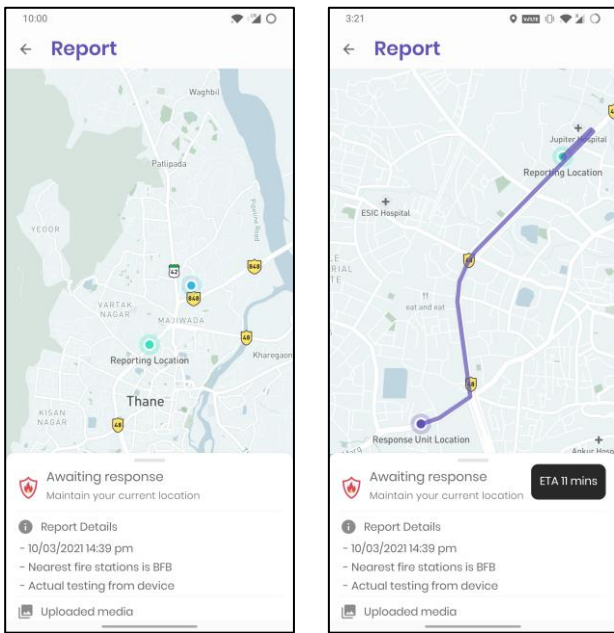


Fig. 6. CitiSafe Response tracking

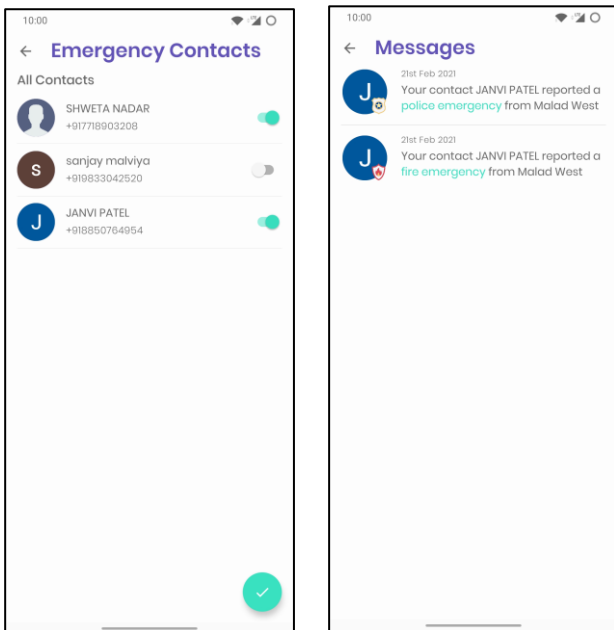


Fig. 7. CitiSafe contacting Emergency contacts

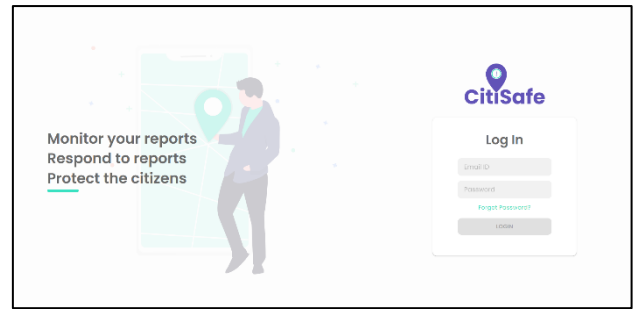


Fig. 8. CitiSafe Dashboard Authentication

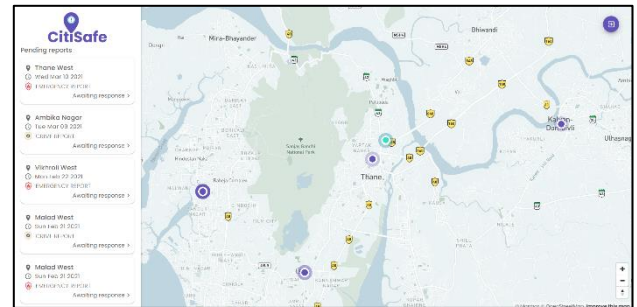


Fig. 9. CitiSafe Dashboard View Reports

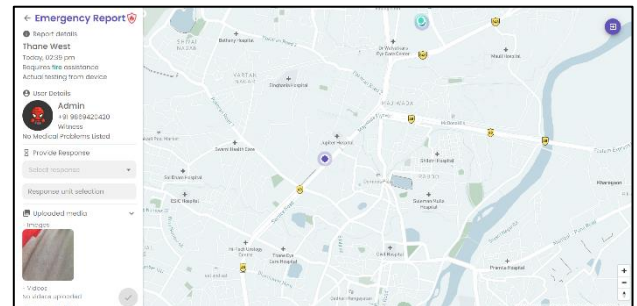


Fig. 10. CitiSafe Dashboard Responding

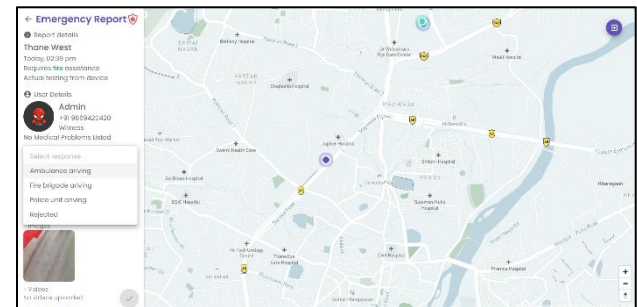


Fig. 11. CitiSafe Dashboard Response unit assignment

Figure 9 shows the view reports screen of the dashboard where all the reports that are not provided with the response can be viewed by the response unit.

Figure 10 shows the screen for the report which is selected by the response unit to provide with the response.

Figure 11 shows the screen where the response unit is providing with the assistance to the user by selecting the appropriate response vehicle.

Figure 12 shows the authentication which can be done by providing the phone number and selecting the appropriate response type unit.

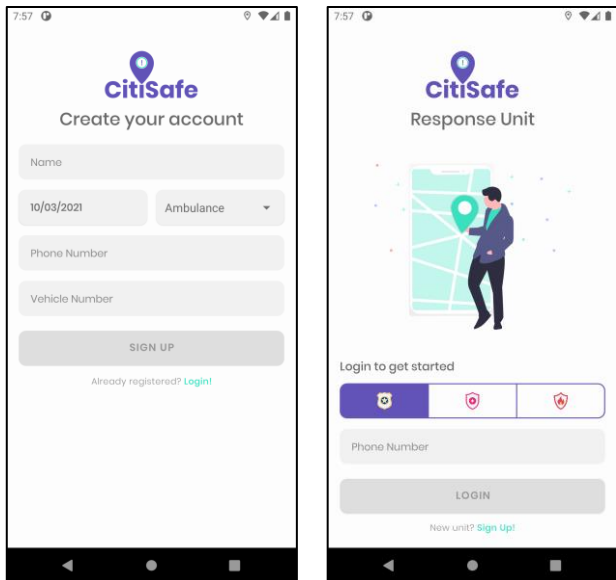


Fig. 12. CitiSafe Response unit authentication

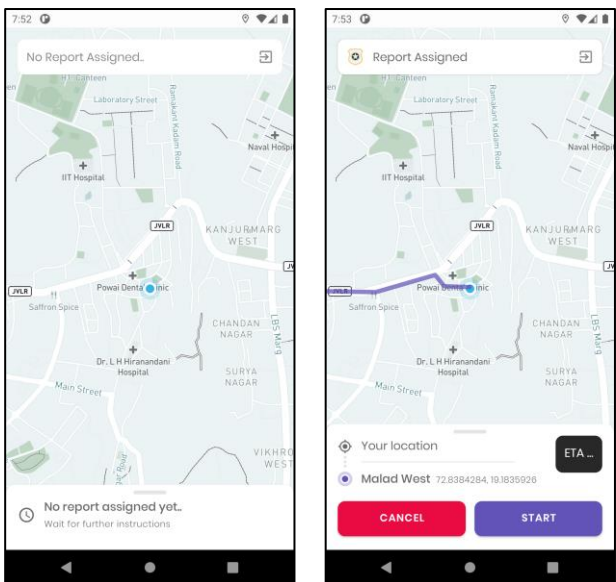


Fig. 13. CitiSafe Response unit responding to assigned report

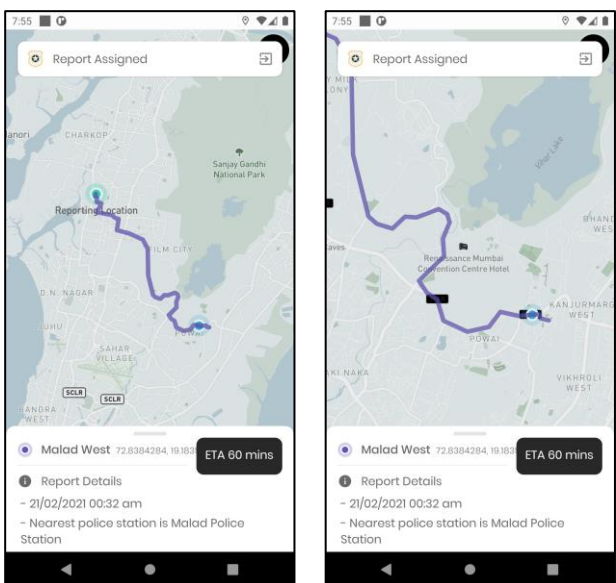


Fig. 14. CitiSafe Response unit real-time updates

Figure 13 shows the screen which is used for starting the response or rejecting the response.

Figure 14 shows the update on the map in real-time as the response unit moves towards the reporter. The path marked on the map changes and the ETA is also updated on the screen.

## VII. CONCLUSION

CitiSafe enables users to report a crime or emergency easily and directly. The report which includes real-time location of the user, type of assistance required, the media attached and other user details is sent to the dashboard immediately. The response to the report is tracked in real-time allowing the reporter to be informed of the status of the report. The essence of the system is to enhance the quick intervention of the law enforcement agencies, thereby saving the lives and properties at risk. The reporter can search for a nearby police station and notify them of a crime occurrence. This system takes advantage of these features and makes reporting crime or emergency easy and effective for victim or witness. Emergency contacts of the user are also notified. The authorities can view the details of the report directly and clearly on the dashboard. They use the dashboard to assign response units which are tracked to monitor the response. This makes the system transparent and helps the authorities to work with more accountability and effectiveness. Response units are supported in responding to reports effectively by providing them with updated information and hassle-free interaction with the CitiSafe Response Unit application.

## VIII. FUTURE SCOPE

In the future, the CitiSafe system can be expanded by providing analytics to the authorities from the collected data on reports. Analytics on crime rates, location-based crimes/emergencies, response times, etc. Contacting the nearby hospitals and essential services directly for assistance is also a possible addition to the CitiSafe system.

## REFERENCES

- [1] Akpan Abasiama G; Mmeh Shedrack; Baah Barida, "Toward an Effective Crime Mapping Solution for Nigeria: Leveraging Emerging Mobile Platforms." in IJCAT - International Journal of Computing and Technology, Volume 5, Issue 9, September 2018
- [2] Swapnil R. Rajput, Mohd Soheli Deshmukh, Karbhari V. Kale, PhD, Cross-platform Smartphone Emergency Reporting Application in Urban Areas using GIS Location based and Google Web Services International Journal of Computer Applications (0975 – 8887) Volume 130 – No.12, November 2015
- [3] Jan B. Elnas, Eldrin C. Duran, James Leo E. Mayol, and Rabby Q. Lavilles, Location-Based Reporting and Mapping of Crimes Using Google Maps February 2015 Lecture Notes on Software Engineering
- [4] Jay Sarraf, Ishaani Priyadarshini, Prasant Kumar Pattnaik, "REAL TIME BUS MONITORING SYSTEM" Springer AISC, Third International Conference INDIA.
- [5] Syed Mujtaba Raza, "A Proposed Solution for Crime Reporting and Crime Updates on Maps in Android Mobile Application" August 2015 International Journal of Computer Applications 124(1)
- [6] S.P. Godlin Jesil, Rajat Basant, Pratisvhir, "CRIME REPORTING SYSTEM USING ANDROID APPLICATION" International Journal of Pure and Applied Mathematics Volume 119 No. 7 2018, 533-538
- [7] Noppadol Chadil Apirak Russameesawang Phongsak Keeratiwintakorn, "Real-time tracking management system using GPS, GPRS and Google earth" Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, 2008. ECTI-CON 2008. 5th International Conference on Volume: 1

- [8] Kentaro Toyama, Ron Logan, Asta Roseway, "Geographic location tags on digital images," Proceedings of the Eleventh ACM International Conference on Multimedia, Berkeley, CA, USA, November 2-8, 2003
- [9] Jethro B. de Guzman, Ritz Carlo C. de Guzman, and Engr. Remedios G. Ado, Mobile Emergency Response Application Using Geolocation for Command Centers, International Journal of Computer and Communication Engineering, Vol. 3, No. 4, July 2014