AN ANDROID LOCATION-BASED CRIME REPORTING SYSTEM USING THE GOOGLE MAP API

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Keywords: Crime reporting system, android location-based crime, Google Map API crime report, crime prevention.

Abstract: *Fighting crime has posture incredible difficulties to the law enforcement agencies. Crime being an act against the law of a society is a danger to the prosperity of the people and thusly, requires productive and efficient monitoring. Portable processing gadgets can be used as a feasible vehicle for the utilization of the Geo-Locational Information System to recognize, capture, and indict guilty parties. This study, therefore, developed an android crime reporting system, which coordinates the Google Map/Places APIs in reporting a crime to a nearby police station. It gives options to report crime through an App-To-App call, audio recording, and sending images of the crime scene. The developed application has proven to be effective (when compared to the existing method of reporting a crime) in terms of timely intervention to a crime scene by law enforcement agencies and the confidentiality of the person reporting the crime.*

1. INTRODUCTION

Crime has been a compassionate test that impedes the general development of nations and communities, undermining the spiritual and material wellbeing of societies [1]. It has bargain human pride while advancing an atmosphere of dread and brutality among individuals from the general public [2]. For a considerable length of time, different strategies have been received to address crime issues. Many developed nations have driven their citizens to their present status by constantly controlling crime through all conceivable and material methodologies, including the utilization of Information and Communication Technology (ICT). ICT, particularly mobile computing has been a significant instrument in controlling and to a huge degree battling crime. In certain spots like the United States of America, the United Kingdom, Jamaica, Sweden, and Canada, the police offices have in front line portable applications for crime reporting [1].

A critical look at crime activities in Nigeria demonstrates that the absence of an effective crime reporting system between the law enforcement agencies and the general public has led to a breakdown of law and order and perpetuation of crime activities at will. Different crimes are left unreported, making incredible harm to lives and properties. This study tries to battle crime through a real-time reporting system using smartphones. The proposed framework; "an Android Location-Based Crime Reporting System" will incorporate the Google Map API. This will empower the station to get the area from which the crime scene is reported. It likewise gives choices to report crime to the closest police headquarters through the Google Places API or report crime through an App-To-App call medium.

2. LITERTURE REVIEW

Several crimes reporting systems have been created by different specialists and analysts, each of which is unique to the environment for

which it was developed. The authors in [3] built up a versatile crime reporting and management system using Global System for Mobile communications (GSM) and Geographical Information Systems (GIS) innovations to report crime scene to the police headquarters in Zambia. This was a contextual investigation of the Zambian Police Service attempted by undergraduate students of the University of Zambia in November 2015. The important thought process behind the usage of the framework was to moderate the difficulties faced by the greater part of the developing nations within the Africa landmass in battling misconduct like crime. Its execution has seen incredible improvement in Zambia, as the pace of reporting crime by its public using cell phones has enormously expanded and has viably helped the law requirement offices in controlling crime [3]. The mobile application enables registered individuals from the overall population to report crime in two different ways – normal mode of crime reporting and panic mode. In normal mode, a user signs into the application, select the kind of crime they need to report and include a description of the crime through writings/pictures. In the panic mode, the user uses the panic button to report crime by calling the emergency call service center. The police division can see revealed violations, and can likewise track the source/area of the message using Global Positioning System (GPS), assign specialists to the crime scene, investigate detailed crime patterns and call the witness to get better situational awareness of the event [3].

The architecture of the mobile crime reporting application proposed by [3] is based on the client-server relationship. The client-side is a versatile application running on the handheld gadget of the user (for example, the general public) with GPS capabilities which is liable for retrieving the user's location. The server side is back-end application which fills in as a firewall and information store that interconnects the police office to the general public using the normal mode of communicating crime information and also using the Short Message Service Centre (SMSC) gateway interface via the panic mode to call the emergency service center.

TapShield is a crime reporting application for IOS and Android gadgets which was launched on July 14, 2013, at the University of Florida Campus by UF graduate and the former Student Body President Jordan Johnson, presently CEO of TapShield [4]. It was chiefly intended to permit campus students in summoning emergency help from campus police and security by essentially tapping the alarm button and when tapped, the application sends the caller's identity alongside the student's GPS area to the campus security. TapShield became accessible to the overall population of the United State in 2014 [4]. In a less emergent situation, TapShield enables the general public to view real-time crime stats and submits GPS-tagged tips to the nearby police either namelessly or alongside the user's details at the top of the report button [4].

Looking up to enhance campus safety at Virginia Commonwealth University in 2014, the University Police joined forces up with LiveSafe Technologies (an association that makes mobile application to improve communication between the campus law enforcement agencies and their communities) which was established by Kristina Anderson, a survivor of the celebrated Virginia Tech shooting in April 2007 to build up a Campus security application in Virginia called the "LiveSafe" [5]. Using the application, campus students and staff can secretly record crime scenes through audio, video, and pictures labeled with GPS (Global Positioning System) information about their coordinate to tip-off the law enforcement offices about crime events [6]. LiveSafe seemingly moves past simply conveying crisis warnings through instant message and email. The application is a two different ways correspondence framework between the campus police/securities and the students/staff using an emergency service mean (call mode) to communicate crime events to the campus police and securities [6]. The application isn't simply constrained to the campus students/staff only; it likewise extends its administrations to the overall population in Virginia. Also, people in general can report crime events regarding their directions and can secretly append crime scene audio, video, and pictures [6].

The Crime Stoppers, New Orleans proposed a free versatile crime battling application for Androids and iPhones called Tip Submit [7]. The application was made by Tip Soft and Crime Reports and is known to be the principal unknown tip accommodation versatile programming. By configuration, Tip Submit enables residents to submit wrongdoing tips to

crime plugs safely and secretly [7]. The framework recognizes tipsters by their tip number, which it allots to the tip. The Mobile App enables tipsters to transfer photographs or video, and can send the area of the video by a GPS locator [7]. Another key element of TipSubmit is that it has no restrictions on the measure of content when sending SMS instant messages. Likewise, it keeps up a two-way exchange and constant talk between the tipster and crime plugs [7]. Designers at the University of Virginia also developed an application that helps the police effectively access crime data online [8]. The framework, called Webcast permits build-up patterns on the information, indicating the sorts of violations that regularly happen, and the spots with which they are related [8]. By typing-in specific dates, kinds of violations, areas, and choosing names of weapons utilized, Web-Cat produces charts, reports, and maps of horror regions [8].

Another groundbreaking PC based crime-fighting device is Mobile Vic PD [9]. Portable Vic PD is a recent mobile application, released by the Victoria police in Canada for battling wrongdoing. The mobile application can be utilized to report minor violations, offer unknown tips to police, stay refreshed on wrongdoings in progress, get missing kid reports or keep an eye on stolen property. Mobile Vic can be utilized for the accompanying exercises; report violations where the suspect is obscure to you and the complete misfortune is under $5000, reconnect with your lost or stolen property through photograph index, see reports of wrongdoing in your geographic area, view, and request for the most recent pictures of Vic PD.

Another crime reporting application delivered by LexisNexis for the iPhone and iPad is Accurint [10]. This Mobile application connects government and law implementation organizations to over thirty billion open records and basic insightful instruments expected to check data in the field, and quickly follow-up on new leads as they emerge. Accurint is an incredible analytical open record device utilized by a huge number of government and law implementation offices to enforce laws and guidelines, battle crime and provide citizen-centric services [10]. Accurint's cutting edge search innovation empowers scientists and specialists to immediately look through billions of open records and play out their employments all the more productively and viably. A portion of the highlights of Accurint is; propelled person search, people at work search, phone search, death records search, business search, corporate filings search, and fictitious business name [10]. The most generally utilized strategic lead age instrument for law authorization in the United States is Cop Link mobile application, made by i2 [11]. The application runs on iPhone, iPad, and Android platforms. The application empowers officers to accomplish better situational mindfulness with mechanized geospatial searches of on-going events, as it permits the looking of state and neighborhood criminal records from numerous purviews' databases [11]. Another incredible element of the application is its capacity to arrange huge amounts of apparently disconnected information to help with making strategic, vital, and order level choices [11]. IPOL-mobile is another iPhone application used for fighting crime by police in Geneva, Switzerland [12]. The device empowers the police to have prompt access to different data, for example, the most recent theft or savagery episode just as the characters of offenders of such violations [12]. IPOL-Mobile tracks the statuses and stages of crime. Law enforcement officers can follow possession data of vehicles by essentially entering its number plate into the smartphone application and can likewise get significant constant data about their obligations (watch hours and area), police indexes, legal counselors and interpreters, and their accessibility hours utilizing the application. Hatari.co.ke is a web-based platform that empowers residents in Kenya to report different violations by sending an instant message containing the area and the type of crime to a number [13]. The message will be displayed on the platform including a position on the map where it was reported from [13].

Most of the crime reporting applications/systems discussed above have a common drawback; tracing the identity of the person reporting crime is not a requirement and does not form part of the features in the existing applications. While this may not be an issue in most of the countries under study due to easy trace of citizens through their centralized database system, it constitutes a greater deficiency in a country like Nigeria. The identity of the person reporting crime is essential to avoid unnecessary/fake reports. The proposed system,

therefore, takes into cognizance the identity of whoever is reporting crime. While the identity of such a person is unknown to the general public and even field operation officers (Policemen), his/her identity is however kept in a log only accessible to top management of the security agencies. This feature is important to avoid reporting fake crime activities. The developed crime reporting application also takes into cognizance, the unique nature of the area under study, hence there are various alternatives for reporting crimes. This is crucial considering the issue of network, which is a bottleneck in the area under study.

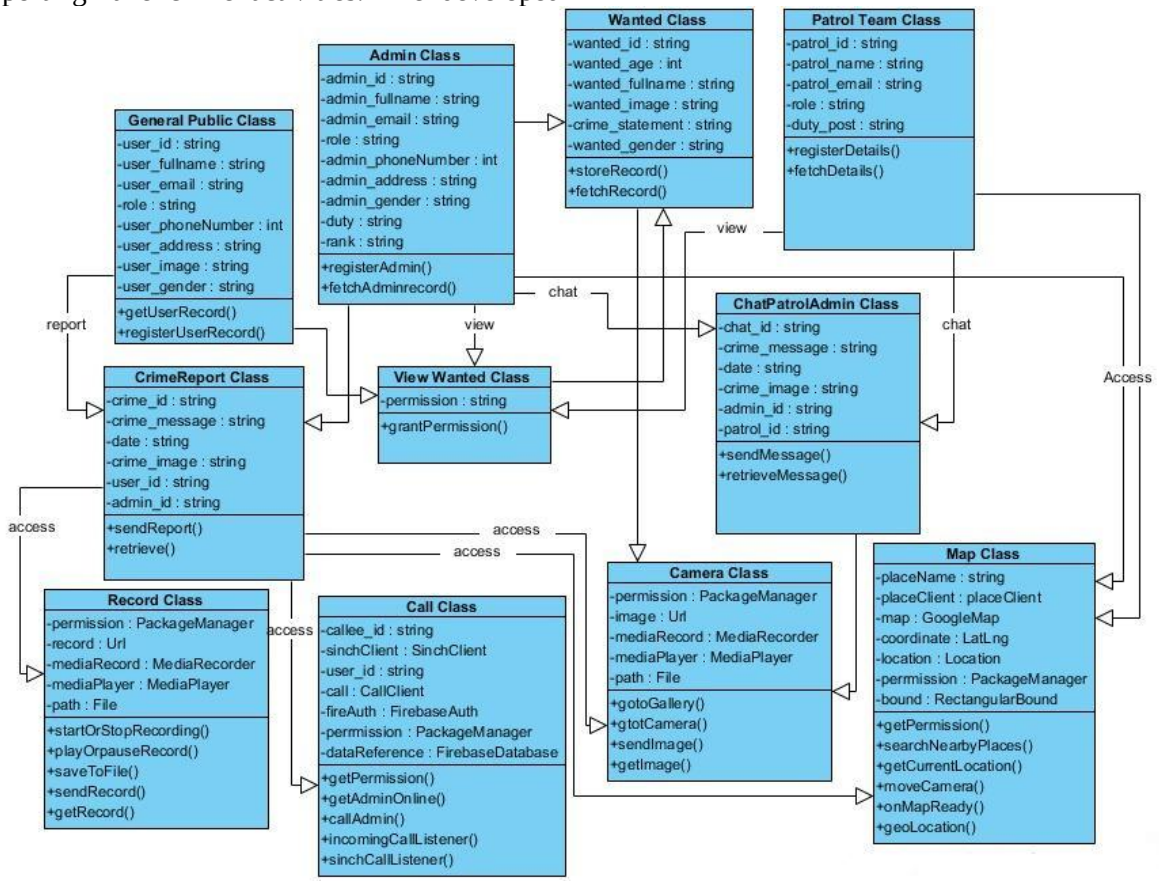


Fig. 1: Class diagram for the developed system

3. METHODOLOGY AND SYSTEM ANALYSIS

3.1 Methodology

The study embraces the object-oritneted philosophy for the development of this application. The development integrates Google Map/Places API in reporting a crime to a nearby police station. Features taken into consideration are map support, video support and sensor information. Android mobile operating system by Google was used for this application. This offers support natively on all Android phones and tablets. Java programming language using Android development API, which supports eclipse IDE plug-in was used.

Software tools used for this development are;

i. Java Development Kit (JDK)
ii. Android Software Development Kit (SDK)
iii. Sinch SDK for App-to-App call
iv. Development environment: Android studio
v. Database: Firebase
vi. Device: Virtual emulator

Class diagram as shown in Fig. 1 was used to conceptualize the objects used in the framework. The class diagram presents the distinct classes

for the administrators, patrol team and the general public as major stakeholders for reporting a crime. The diagram shows respective attributes and methods that warrants these stakeholders to report crime scene through the crime report class and patrol-admin class. The crime report class provides the general public some alternatives to report crime either by sending an audio record of the event through the record class, calling the sub-admin via the call class, sending crime coordinate via the Map class or sending crime images via the camera class.

Firebase was chosen as the database development tool for this project. The database design and structure is represented in the entity relationship diagram described in Fig. 2. The diagram depicts the relationship between the four system users. The crime report relation defines the association between the sub-admin and the general public relations. The two have one to many associations with the crime report relation. That is, a member of the general public can report one or more crime message(s) to the sub admin whereas the sub admin can respond to one or more reports from the general public.

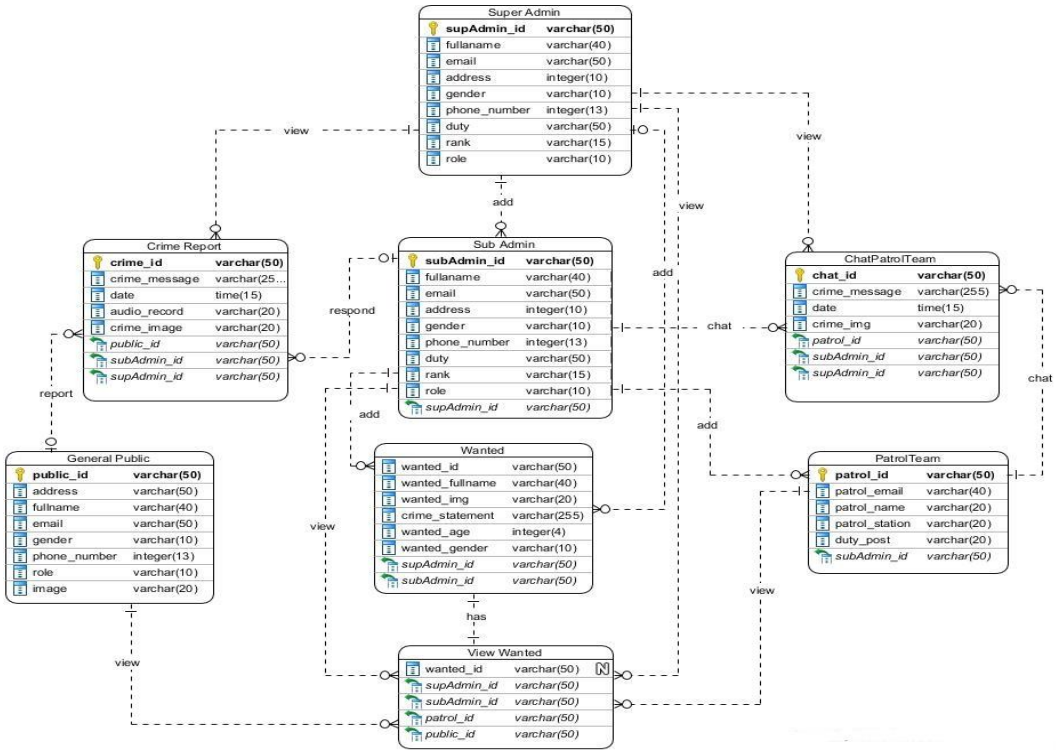


Fig. 2: Database design for the developed system

The chat patrol-admin class enable the sub-admin to send the crime coordinates tip-off by a reporter to the patrol team so as to dispatch crime scene and can alternatively send crime images via the camera class. The wanted class enable the administrators (either the super or sub-admin) to add attributes of the wanted person using the method specified in the wanted class whereas the view wanted class, which is a sub class of the wanted class enables the entire system users to view the list wanted persons. To project the coordinate of the crime scene for strategic planning, the map class enable the admin and the patrol team to view the coordinate tip-off.

For the chat patrol relation, both the sub admins and their respective patrol team have one to many associations. The sub administrator can communicate one or more crime messages to the patrol team through the chat patrol relationship while the patrol team can reply to one or more crime messages sent by the sub administrator through the chat patrol association. The sup-admin relation warrants the super admin to monitor one or more crime conversation between the sub-admin and the general public and also between each station sub-admin and their respective patrol teams. For the add wanted, sub-admin and sup-admin can add as many records

of wanted persons and can view one or more of these records through the view wanted relation. The patrol team and general public have one to many associations with the view wanted relation as they can view one or more record of wanted persons updated by the administrators. Furthermore, the sup-admin relation has one to many relations with the sub-admin relation. That is, one sup-admin can register one or more sub-admins with respect to their stations, whereas sub-admin can register one or more details of their respective station patrol teams.

3.2 Analysis of the developed system

To remedy the predominant issues of crime, the proposed framework was incorporated with Google Maps/Places APIs in reporting crime coordinates to a nearby police station.

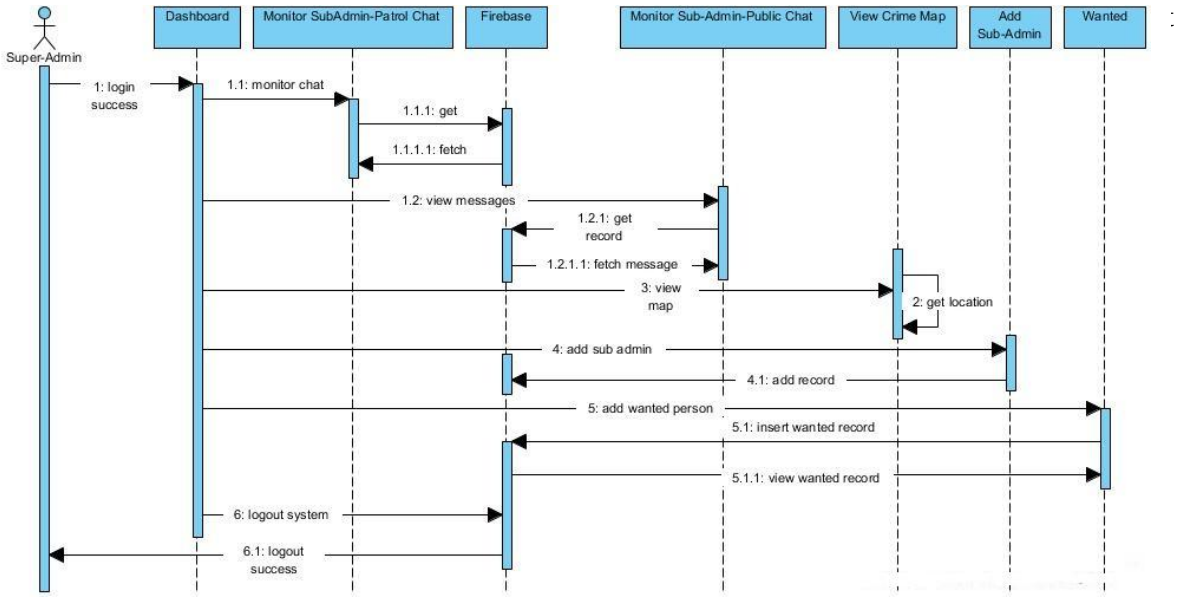


Fig. 3: Super-Admin module

The execution focuses on improving the brisk mediation of the law authorization organizations to the crime scene and to wipe out the pressure engaged with the conventional strategy of searching for and reporting crimes to a nearby station. With this, the rate at which wrongdoing happens can be controlled.

Google Map API was used in the implementation to automatically locate the point from which a report is to be filed, while Google Places API fetches lists of the nearby police stations, which pops-up on the user screen in the form of a drop-down list. The Places API is a service that returns information about places using the HTTP (Hyper-Text Transfer Protocol) request in a JSON (JavaScript Object Notation) and XML (Extensible Markup Language) response format. The Places API enables the application to search for prominent places of interest within a map bound. It also offers autocomplete features that give the application the type-ahead-search behavior of the Google Maps search field. The developed system also incorporates the Sinch App-To-App call client services as an option to report crimes. The Sinch App-to-App call client services use the unique identifier of the callee (the user receiving the call), which enables Sinch Server to connects the caller to the callee. Firebase database warrants Sinch server to access the unique identity of authenticated and registered users making it

The system consists of four interfaces; the Super-Admin, Sub-Admin, Patrol Team, and the General Public interface. These are described in the sequence diagrams in Figures 3 to 6. Fig. 3 defines the program module pre-specified for the super administrator. The module warrants the super admin (also called the main admin) to monitor crime conversation between the sub-admin and the general public likewise between the patrol team and the sub-admin in each station; add and view wanted persons through the add/view wanted sub-module; view crime scene

locations and can also add sub-admin to each respective station.

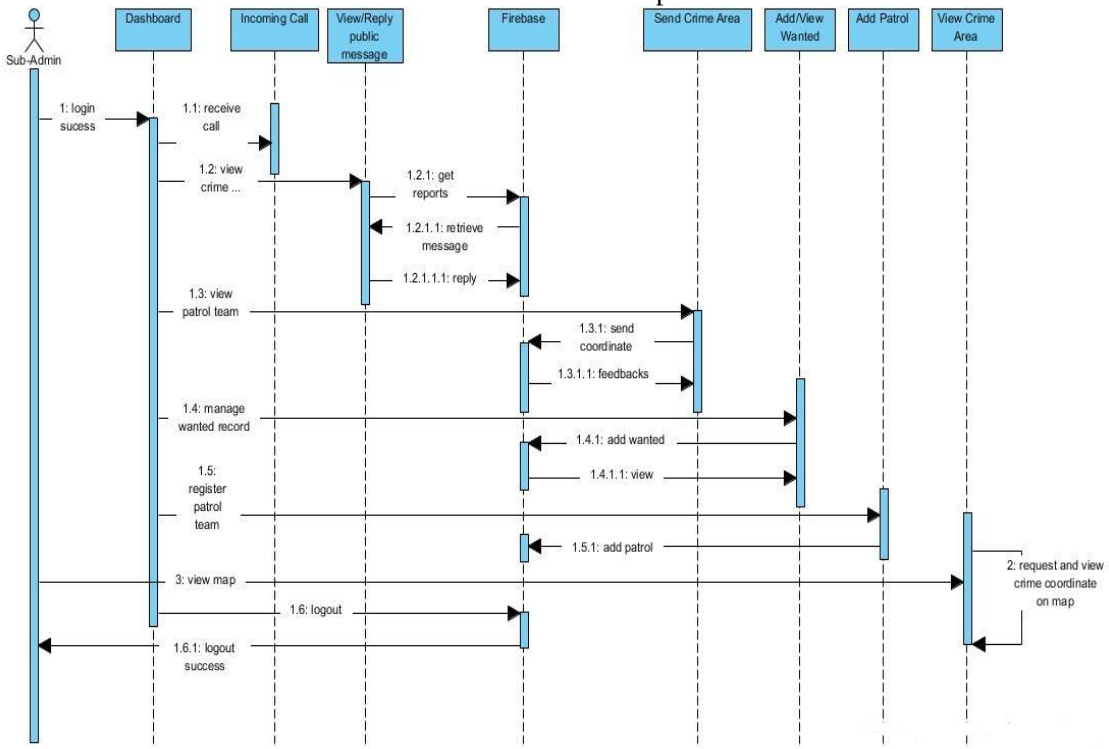


Fig. 4: Sequence diagram describing sub-Admin module

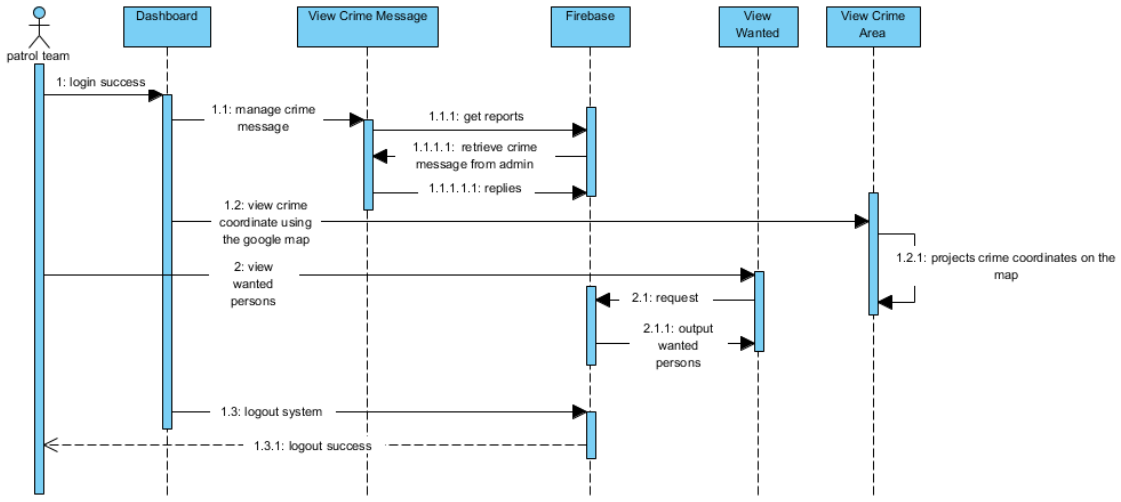


Fig. 5: Sequence diagram describing the Patrol-team module

Fig. 4 specifies the program module designed for the sub-admin. It encompasses the view/reply crime report, which enables the administrators of the app to view and respond to crime messages tipped-off by the general public. The "send crime area" is an interactive sub-module for conveying a crime scene coordinate tipped-off by a reporter to the patrol teams on duty and also for communicating strategies for combating an ongoing crime. The add/view wanted sub-module warrants the Sub-Admins to add and view wanted persons.

The application also allows sub-admin to answer calls from the general public, add and view records of registered patrol teams, send crime scene tipped-off by the general public to the patrol team, and project the location of the

crime tipped off by a reporter using the Google Map interface.

Fig. 5 defines the program modules designed and restricted to the patrol team. The patrol team can receive crime messages tipped-off by the general public from the administrator through the chat admin module; view wanted persons updated by the admin through the view wanted module and can also view crime scene coordinates on the map interface predefined in the view crime area module.

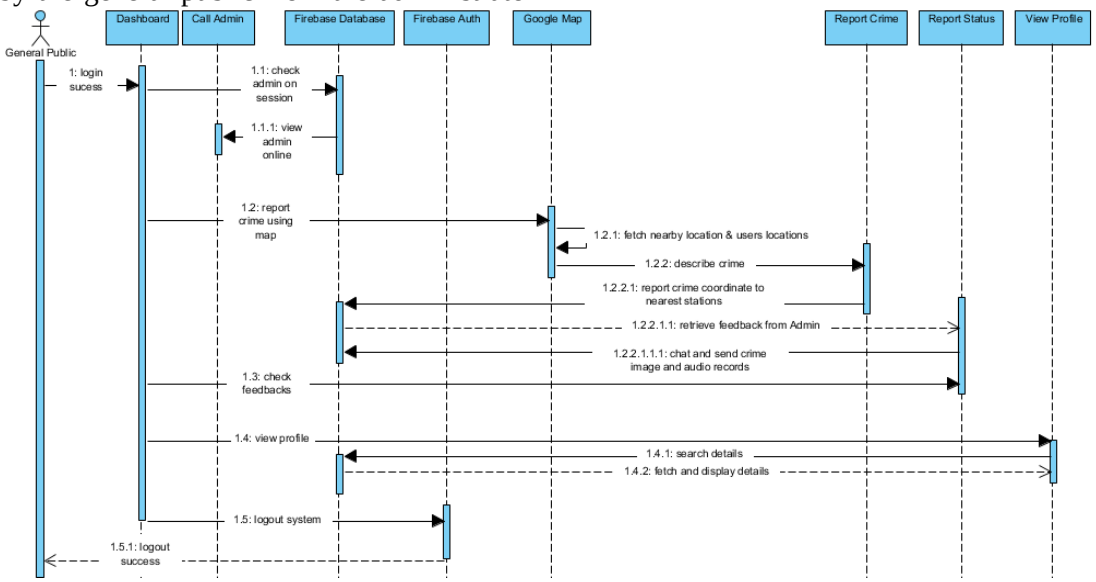
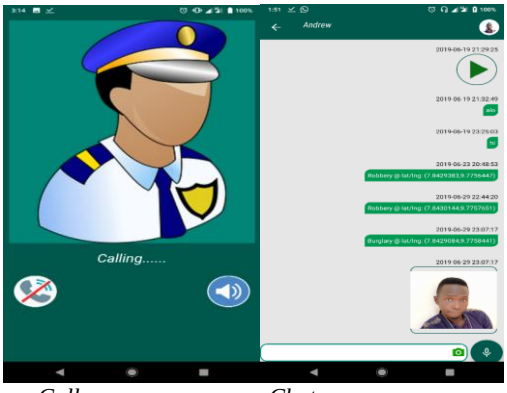


Fig. 6: Sequence diagram describing the General Public module

From Fig. 6, the general public module encompasses the "view-wanted sub-module", which enables the public to view wanted persons updated by the Administrators. It also has the "call-admin sub-module", which enables the general public to report crime happenings through App-To-App call. The "report crime sub-module" allows the general public to report a crime to a drop-down list of selected street names that represents the name of the nearby police station and can also get feedbacks on crime reported through the report status sub-module.

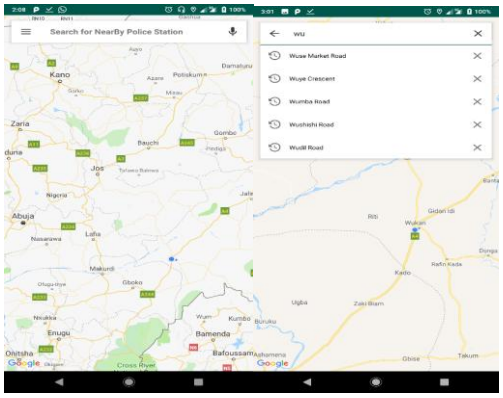
4. RESULTS AND DISCUSSION

The developed system provides distinct alternatives to report crime (see Fig. 7) depending on the crime situation. The "call module" enables the general public to make an app-to-app call to the Sub-Admin, while the chat module facilitates the communication of crime events through chat messages. The Google Places and Map module enables the general public to report a crime to a nearby police station by searching for a nearby police station using the Google Places APIs. All these distinct alternatives hasten the intervention of the police department to the crime scene and as such, lives at risk will be saved and the culprit apprehended. This helps to mitigate the rate of crime.



Calls *Chat messages*

Fig. 7a: Interfaces showing alternative means of reporting crime



Map Interface *Places view*

Fig. 7b: Interfaces showing alternative means of reporting crime

The wanted list/view option of this system as shown in Fig. 8 displays information about every wanted person from Firebase database to the user's screen. While the view profile module projects detailed information of the wanted person rendering his/her profile image, home base address, full name, and gender to the output screen.

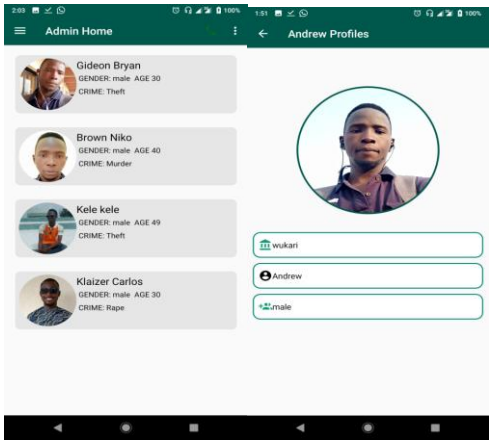
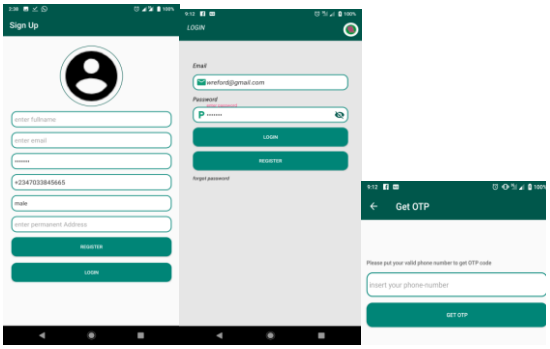


Fig. 8: Wanted person

To avoid reporting a fake crime to the police, each user of this system must be registered on the platform. The input value types for registration are email, password, users full name, registrar base address, and phone number as shown in Fig. 9.

It is important to note that, registration of any person in this platform is carried out by the Administrators of the system. This requires appearing physically at the police station. This requirement is very important so that, information about who reports crime at each moment is kept in a log file. It also creates a consciousness in the minds of registered members not to take advantage of the system by reporting fake news knowing they will be easily trapped if they so do.



Registration *Login* *One-time password*

Figure 9: Registration process in the developed system

5. CONCLUSIONS

After reviewing several works of literature on crime reporting systems by different developers, this study defined crime as a geographical event that takes place in a particular coordinate on the earth and as such requires the use of geographical information systems to effectively counter injurious act at the spot of crime occurrence. As such, the study identifies the Google Map/Places APIs as an effective measure to monitor and control its occurrence. The system identifies three key users to efficiently and effectively monitor and control crime. They are the general public, police administrator, and the patrol team. The essence of the study is to enhance the quick intervention of the law enforcement agencies, thereby saving the lives and properties at risk. The Google Map APIs provides the developed system the ability to spot the location of the scene by fetching the reporter's coordinates, while the Google Places APIs enables a reporter to search for a nearby police station and notify them of crime occurrence.

The study also takes cognizance of reporting crime through other majors depending on what the situation warrants. These alternative means include reporting a crime via App-To-App call to the administrators, sending crime scene images, or using the device microphone to record the event and hence, forward it to the station. The developed system has proved to be effective

when compared to the manual means of reporting crime.

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