ASHESI UNIVERSITY COLLEGE

A ROAD TRAFFIC OFFENSE MANAGEMENT SYSTEM

INTEGRATED WITH PAYMENT SYSTEM

UNDERGRADUATE APPLIED PROJECT

B.Sc. Computer Science

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2016

ASHESI UNIVERSITY COLLEGE

A ROAD TRAFFIC OFFENSE MANAGEMENT SYSTEM INTEGRATED WITH PAYMENT SYSTEM

APPLIED PROJECT

Applied project submitted to the Department of Computer Science, Ashesi University College in partial fulfilment of the requirements for the award of Bachelor of Science degree in Computer Science

Rahab Wangari

April 2016

DECLARATION

I hereby declare that this applied project is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:

……

Candidate's Name:

……

Date:

……

I hereby declare that preparation and presentation of this applied project were supervised in accordance with the guidelines on supervision of applied project laid down by Ashesi University College.

Supervisor's Signature:

……

Supervisor's Name:

……

Date: ……

Acknowledgement

My outmost thanks goes to my family who supported me throughout my four years' journey here at Ashesi.

I would also like to thank my supervisor, Dr. Nathan Amanquah for his endless support and guidance he offered throughout the project.

I am also grateful to Dr. Julius Gatune who offered advice and gave new insights on the project as whole.

Finally, I thank the Computer science department and the Class of 2016, for the love and support through the four years.

Abstract

The project seeks to develop an easier way of reporting traffic offences which reduces time wastage and corruption. The project also provides an option for using mobile money and Visa/MasterCard to instantly pay for fine/bail. The project also digitalizes the mode of offence booking used by the police. Currently the traffic police books an offence by manually writing the details of the offence in a book. By use of the application, the traffic police will be able to use their mobile phones to report an offense which reduces the use the ineffective books. The project also seeks to make the police work easier by giving the general public an opportunity to report drivers who are misbehaving on the road. The general public can also give announcements on the traffic situations and recommendations to reduce traffic.

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Chapter 1: Introduction

1.1 Introduction & Background

Roads are one of the main means of transport worldwide**.** When using the roads there are certain rules and regulations to be observed. Failure to observe these regulations can land one in jail, life sentence, death or disabled for the rest of their life. Some people fail to observe the rules and they end up committing a traffic offense. Some of them manage to get their own way out without been charged for the mistake. To ensure that everyone follows traffic rules and regulations, governments have come up with laws e.g. *Kenya Traffic Act* in Kenya, and the *Road Traffic Act in* Ghana. The traffic Acts consists of all the traffic rules and regulations, and the sanctions involved for those who violate them.

The police department, is one among the few departments which are lagging behind in terms of technology. The information about traffic offenders is generally kept in flat files which makes it difficult to track back when one commits the crime again. It also becomes difficult to track older cases. In the current world, everything has gone digital; for example, people can bank and send money using their phones, chat with someone across the world instantly and send documents just by a click.

It has been empirically observed and confirmed anecdotally that most people end up getting late for work when they commit a traffic offence early morning, since they spend the bigger part of their day at the police station. The high penetration of smart phones and mobile money payment systems such as Tigo cash, MTN money and Airtel money supported by the

various mobile networks is no doubt an enabling platform which the police department can take advantage of.

1.2 Problem Statement

The main problem associated with the traffic offenses is the reporting procedure followed when one violates any of the offenses. The reporting of the offense is long, ineffective and involves wastage of time. These is because, one has to give out their licenses to the traffic police which is not returned until their offense has been recorded at the nearest police station where it is kept in flat files. This makes it hard for the offense to be referenced in future. After being caught, one has to drive to the police station and wait until their offense is booked. The police men are really slow and they take a lot of time before they finish up with one client. One ends up spending half a day if not the entire say at the station.

Another problem associated with traffic offense is bribery and corruption. Sometimes when you commit an offense one meets one of those "hungry" traffic police, the situation becomes "scratch my back I scratch yours". In Kenya they call it *kitu kidogo* meaning something small. In this scenario the traffic police collect some amount of money from the offender, which is less than what they could have paid if they went through the right procedure. This has become a habit to a point if the driver is aware they are in the wrong they just give the traffic police some money even before they request. This becomes a win win situation to the traffic police and the driver but it's against the government rules.

A third problem is the entire process followed to pay fines and bail bonds when one is found guilty. The process involves going to a specific bank to pay the money. The banks are not always close to the court and one often has to travel to for an hour or more to get them. This leads to waste of time.

The current means of reporting traffic offenses is ineffective, wastes a lot of time and encourages corruption. The government and the general public need a new way out. This project seeks to address these challenges.

1.3 Objective

"Offence reporter" comprises of a mobile app and a web application that aims at helping the traffic police report the traffic offenses easily. The application will also contain the Road traffic act which helps the drivers/ general public know their rights and the procedures they are supposed to follow, once caught with a traffic offense. Additionally, it seeks to reduce corruption through the introduction of an online payment system where the offenders will pay their fines or bail. To encourage use of the system, fines paid by cash will not be allowed since the electronic confirmation will be required to close one's case.

The application also gives the traffic police a chance to view the offenders past mistakes with the details of where they committed the offense and what they were charged since the application will be connected to a central database. The traffic police can also make any form of announcements using the application such as traffic announcement or accident announcement. This is necessary to help drivers and general public avoid a road segment if they have an alternative route minimizing the time they will spend on traffic. Driver and the traffic

police can report stolen cars through the application. This makes it easier to report the car instantly after it gets stolen.

The application also gives the general public a platform to report drivers and traffic police who are not behaving in the right manner while on the road by recording the offense and taking a photo to support the offense. Such behavior includes: a traffic police taking a bribe, a driver giving out a bribe, a driver overlapping etc. These reduces corruption and helps the police to get the law offenders even if they are not present at the site. Through the application the general public makes traffic announcements and recommendation. This helps the traffic police know the cause of traffic and what could be done to finish the traffic. It also creates awareness among drivers encouraging them to use other routes if possible.

The project also seeks to digitize and integrate the use of technology in the police department activities. The application will be in both web and mobile versions and will be connected to a central database, which connects all the police stations together to allow the traffic police to view all the data which has been submitted by the users.

1.4 Motivation and Potential benefits

The main motivation for taking this projects is the potential benefits it has both to the country and its main users: driver, court, general public and traffic police).

One of the advantages is that the application will save time wasted while booking an offense by the traffic police. By using the application, the traffic police will be able to record the application with less than 3 minutes and the offender receives a confirmation text message

immediately informing them of their offense and the sanction. Also the offender no longer needs to appear at the police station for the booking of the offense.

The application makes the storage of offenses digital and allows access by the traffic police from every part of the country. Since the application will be connected to a central database hosted in the cloud, it will be easier for the traffic police to access past history of an offender.

Use of the application will reduce bribery and corruption. Most people bribe to avoid going to court because of exaggerated sanctions explained by the police, the *ROAD TRAFFIC ACT* included in the application will provide the correct information about sanctions, and thus discouraging the offenders from bribing the police. Also the closer monitoring by general public on the police/driver taking bribes will discourage the police from taking any bribe given to them.

The application will also make the payment process easier. Offenders will be able to use to use mobile payment system and the online payment systems to instantly pay for their fines and bail. This reduces the time used going to the bank to pay the money.

1.5 Related work

In Africa, countries such as South Africa have an AART for reporting traffic offenses. The Administrative Adjudication of Road Traffic offences act(AART) system has helped the South African government make the roads safe by establishing procedures for effective reporting of offenses, effective monitoring of drivers who have committed lots of traffic

offenses which leads to suspension of license and alleviates the burden on the courts of trying offenders for infringements. (Corporation, 1998)

In July 2008, the European Union launched Advanced Safety and Driver Support for Essential Road Transport (ASSETT), the mobile system was developed by VTT technical research center, a company in Finland. By use of automated surveillance cameras, the application is able to detect when the driver is committing an offense such overlapping, speeding etc. (Coxworth, 2010). The system captures the offense details and the car details through the footage and send them to a central database which is under high maintenance by the police department. The police will then look for the person who committed the offence.

The problem with this mode of offense reporting is that it very costly, requires a lot of resources and technology to maintain the system. This means that if it has to be implemented in Ghana or Kenya, the government will have to import a lot of resources making it difficult to maintain when it breaks down.

A proposed automated system for reporting traffic offences, "Automated traffic violation monitoring and reporting system" has been developed to report offenses by use of images. The system relies on images by use of the cameras positioned on the highways. When the images are taken they are sent to the police officers where they will track the car which violated the traffic rules. (Robert Ciolli, 2003).

The problem in the system is that it is hard to capture the number plate of the car when there is traffic, this makes the system less effective

In Ghana, a prototype of a mobile/web application," Mobile traffic offense monitoring system: A proposed model for the Ghana police service", was developed by an Ashesi Alumni (Boforo, 2010) the system aims at instant booking of the traffic offenses. The system enables the traffic police to book an offense using a mobile phone, allows the traffic police to suspend driver's license when they commit more than three offenses, report stolen cars and also validate the DVLA sticker.

The limitation of using the application is that one needs to be always connected to the internet to be able to book an offense, which is very inefficient to use in the rural areas.

This project is quite similar to that one because it is established in Ghana or Kenya and is targeting the police department. It combines payment system with the application, give traffic updates, allows the general public to report drivers/police who are misbehaving in the road, allow the general public to make traffic announcements and recommendation, allows reporting of stolen cars, allow the traffic police to view past offenses, allow general public to upload an image of a policeman taking a bribe which makes it different from this project.

1.6 Overview of Other Chapters

Chapter two describes the requirements of the project. All the system requirements and the user requirements. Chapter three describes the software design. These shows how the different components of the system will communicate within the application. Chapter four focuses on implementation and the technologies used to model the application. It shows the different user interfaces on the mobile and web application. Chapter five focuses on User

testing. This includes the UI testing and the code testing. Chapter six will have the conclusion, recommendation and future work.

Chapter 2: Software Requirements Analysis

2.1 Source of Requirements

The requirements of the project were obtained by continuous brainstorming with my supervisor who acted as my client. Other students and lecturers in the school contributed to the project with what they would like to see in the application. The traffic police at the Berekuso road post suggested the features they would like to have in such an application. Most requirements were obtained through the incremental model.

The requirements of the system are divided to User requirements, System requirements, functional requirements and nonfunctional requirements.

2.2 User Interactions

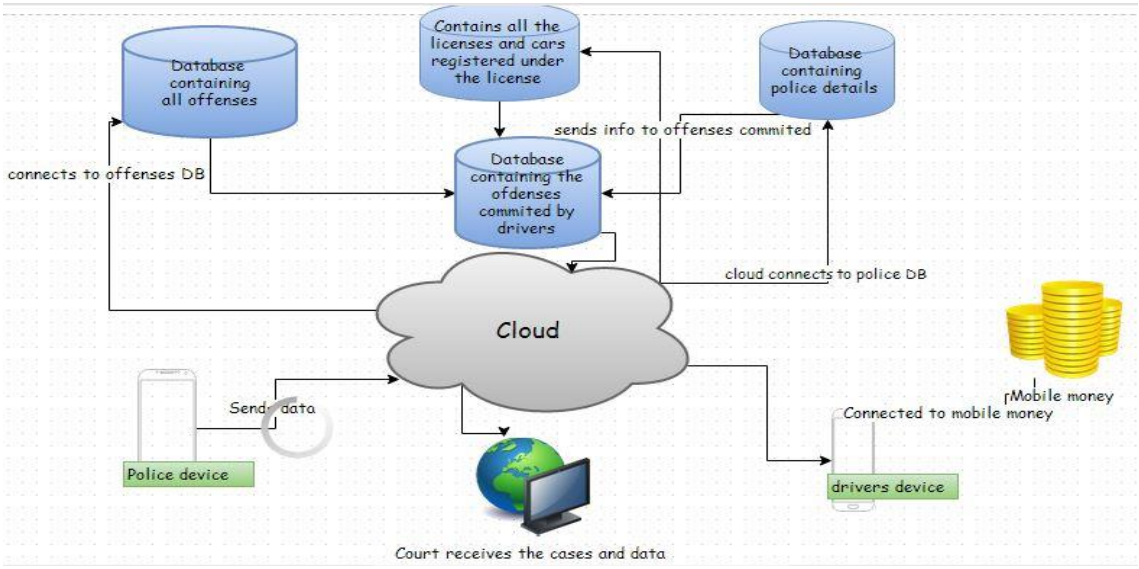

Figure 2. 1 Context Diagram for Court,Driver and Police

From figure 2.1, the police record an offence using a mobile phone and sends the data to a centralized database which all other traffic police have access to. The information is forwarded to the court where they can view all the offenses which have been committed. The traffic police also book's a court day for the offender, and the details are forwarded to court where they can view all the people who are supposed to appear in court. The application also sends a notification to the offender informing them of the day they will appear in court. If found guilty the offender can use mobile money to pay for the fine and the bail.

The general public, who do not require to register, have access to the application. They are able to make can make traffic related announcements and give recommendation, view what is posted by the police and also report any police/drivers who are misbehaving (driver overlapping, police taking bribe etc.) on the road.

The Mobile traffic offense management system will have four different types of users.

- Traffic police – this is the Police Officer monitoring and guiding traffic on the road registered in the police department '. He is responsible for reporting all the drivers who commit the traffic rules, post traffic announcements and report stolen cars on behalf of the drivers. He ensures that drivers follow traffic rules while on the road.
- Drivers – this refers to any person who owns a car or drives a car on the road. It might be a *tricky* driver, lorry driver, taxi driver and also the individuals who drives.
- Court – this includes the judges and the people in the court who are available to handle the case of the accused.
- General public this is everyone else who uses the road at any time, e.g. passengers.

2.3 System Requirements

These are description of features or functionalities that the system is expected to have. They must be implemented to suit the system user's needs. The mobile traffic offense management system is expected to support all the activities the police, driver and general public will do in the application. The requirements include:

- The system should be able to display the correct module when the user logs in.
- The system should alert the offender when they are successfully booked for an offense
- The system should allow the general public to report traffic police who are misbehaving on the road
- The system should allow the general public to report drivers who are misbehaving on the road
- The system should display the case progress for different individuals
- The system should display traffic updates based on people's location
- The system should display all announcements made by the users
- The system should save data locally when there is not internet connection
- The system should allow login of the users who are registered and deny those who are not registered
- The system should allow registration of new users.
- The system should allow the payment of fines through the mobile money.

- The system should notify the offenders once they are booked for court or reported for a traffic offense.

The system requirements are further divided into functional and the nonfunctional requirements.

2.3.1 Functional Requirements

These requirements define the services the system is supposed to provide, how to react to certain inputs as well as how the system is supposed to respond to particular situations. The services include the services provided to the users of the system.

Below are functional requirements for the system.

- The user shall be able to view all offenses and their relevant sanctions.
- The user shall be able to receive a message upon successful registration.
- The drivers shall be able to view their case progress.
- The drivers shall be able to log in upon registration
- The driver shall be able to view their license status
- The driver shall be able to report stolen cars
- The general public shall be able to make traffic related announcements and give the recommendation on what should be done to reduce the traffic.
- The police should be able to schedule court days to all the offenders scheduled to appear in court.
- The police should be able to view all the past offenses committed by the offender
- The police should be able to validate the DVLA status check whether its valid or fake.

- The police should be able to make an announcement. Announcements include: traffic announcements, accident announcements etc.
- The general public shall be able to report any misbehaving driver on the road i.e. overlapping, giving bribe.
- The general public shall be able to view all the announcements posted by the police
- The general public shall be able to report a misbehaving traffic police i.e. police taking a bribe.

2.3.2 Nonfunctional Requirements

This are the quality characteristics that the system must have to ensure that its performing as expected. They include:

- The system should be secured from any attacks
- The system should be reliable
- The system should be available throughout the time to enhance effective reporting

2.3.2.1 Security

To ensure security in the system, every user apart from the general public is expected to log in by username and password. Also the system is designed in a way that, a traffic police will only see the things that are related to traffic police only and a driver will only see the things related to the driver only.

To register as a Traffic police user, one needs to have registered with the Ghana Police department and has an employee number which will be validated upon registration. This prevents the general public/driver from registering as a police.

2.2.2.2 Reliability

The system will be hosted in the cloud instead of being hosted locally. This will ensure that the system is functioning at all times. Hosting the system locally reduces the reliability since the servers might be affected by power shortage and low internet bandwidth. Therefore, hosting on the cloud will ensure that the application is reliable.

2.3.2.3 Availability

The system should be up at all times to enhance effective reporting. To enhance availability, the system will save the data to local storage using HTML 5 when there is no internet connection. This ensures that the traffic police will be able to report an offense even when there is no internet connection. When the application connects to the internet again, it synchronizes with the central database and updates the database with the information which is in the local storage but not present in the database.

Chapter 3: Architecture and Design

3.1 Introduction

The document will discuss the design of the entire project. This includes several class diagrams and how they are connected. It will also discuss the class diagrams used to implement the different model in the database. Different user case diagrams will also be discussed and illustrated.

3.1.1 Purpose

The purpose of this design document is to help the user understand into detail how the system will be designed and how it will work. The System Requirement Design helps the software developer to have the knowledge of how the final system is supposed to be working as well as how different components will be connected.

3.1.2 Assumptions, Constraints and Dependencies

In designing this chapter different assumptions have been made. They are:

- Every traffic officer will have an android smart phone
- The different modules will communicate
- In order for the traffic police to register in the application, he must be maintained in the police systems first
- The driver's license should be registered in the system as a holder of license and a car before one registers in the application.
- The general public do not require registration in order to access the application

- Most of the drivers use mobile money

3.2 System Overview

The application is a mobile based traffic management system which will be used to report minor traffic offenses. The application will comprise the different modules showing the different people who will have access and the right to use the application to see different views. The users will include the traffic police, drivers and the judges in the court and the general public.

The police will be responsible for reporting the offenses committed by the drivers. The drivers will be able to view the case progress as well as the sanctions related to the different offenses. The general public will be anyone who downloads the application. They will act as source of information to the people using the application. They will be able to make traffic announcements and give recommendation. They will also report the misbehaving police men and drivers.

3.2.1 Context Diagram

Figure 3.1, shows how the different users interact with the application. The traffic police will have a mobile phone where the application will be deployed. From the application, the traffic police send the offences and announcements to a central database through a server hosted in the cloud. The drivers receive text message showing the offense they committed and the sanction. They view all their offenses from a central database through the server in the cloud. The general public post announcements and recommendation to the central database through the server. The driver uses mobile money to pay for the traffic fines/bail when found guilty.

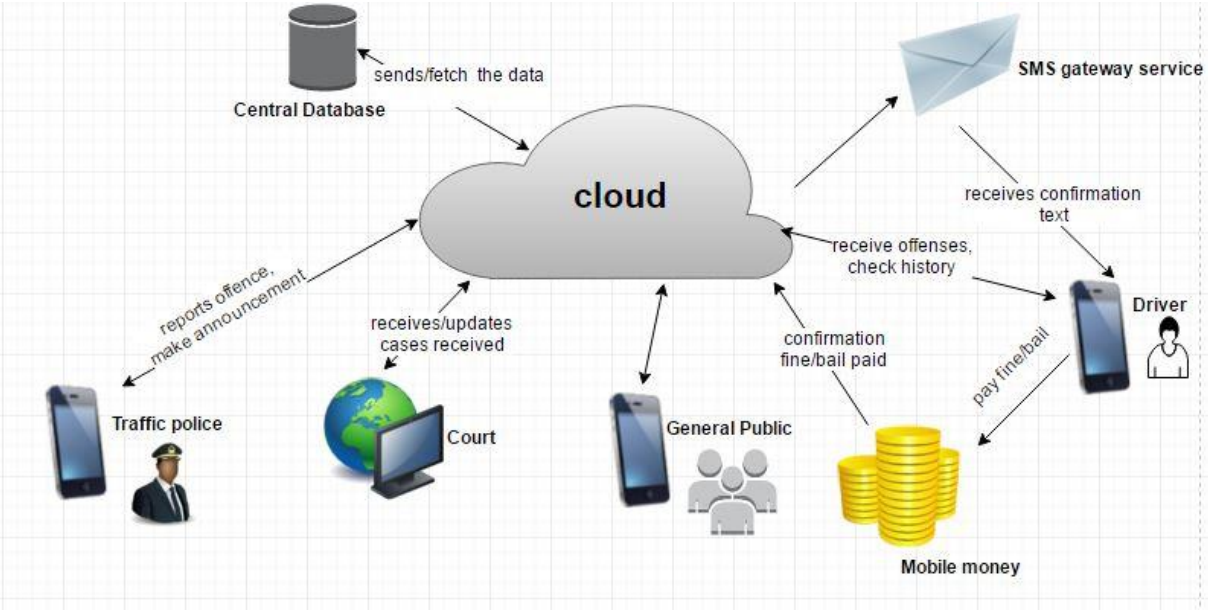

Figure 3. 1 High Level Architecture Diagram

3.2.2 Use Case Diagrams

Figure 3.2 and figure 3.3 describes the use cases of traffic police, driver, court and general public.

- The police and court use case shows the actions that the traffic police and the court can perform
- The driver and the general republic shows the actions the driver and general public can perform

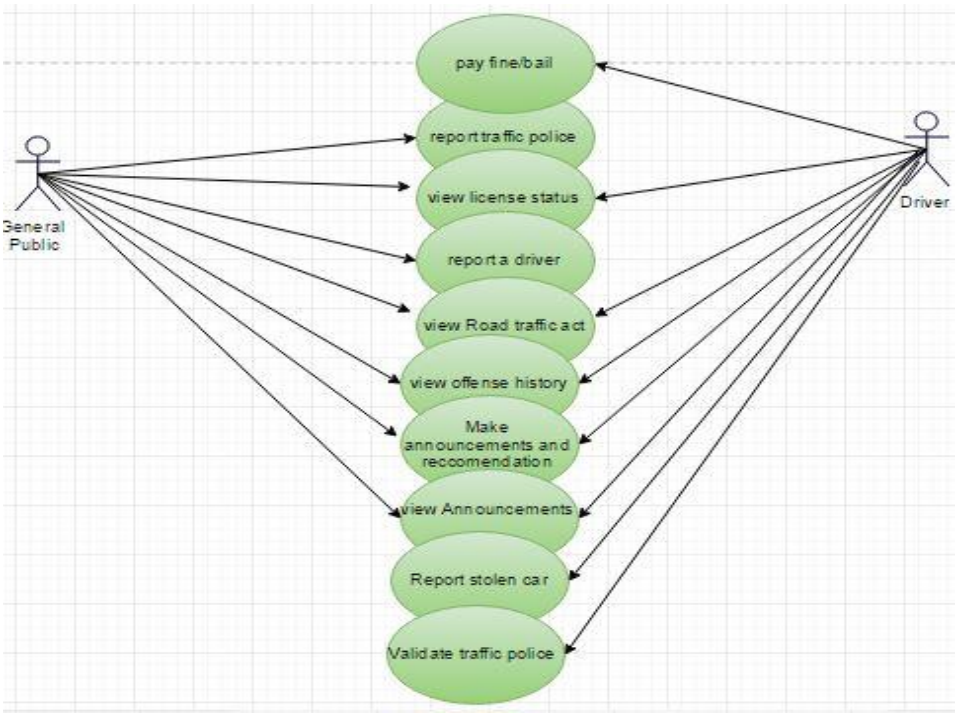

Figure 3. 2 General Public and Driver Use Case

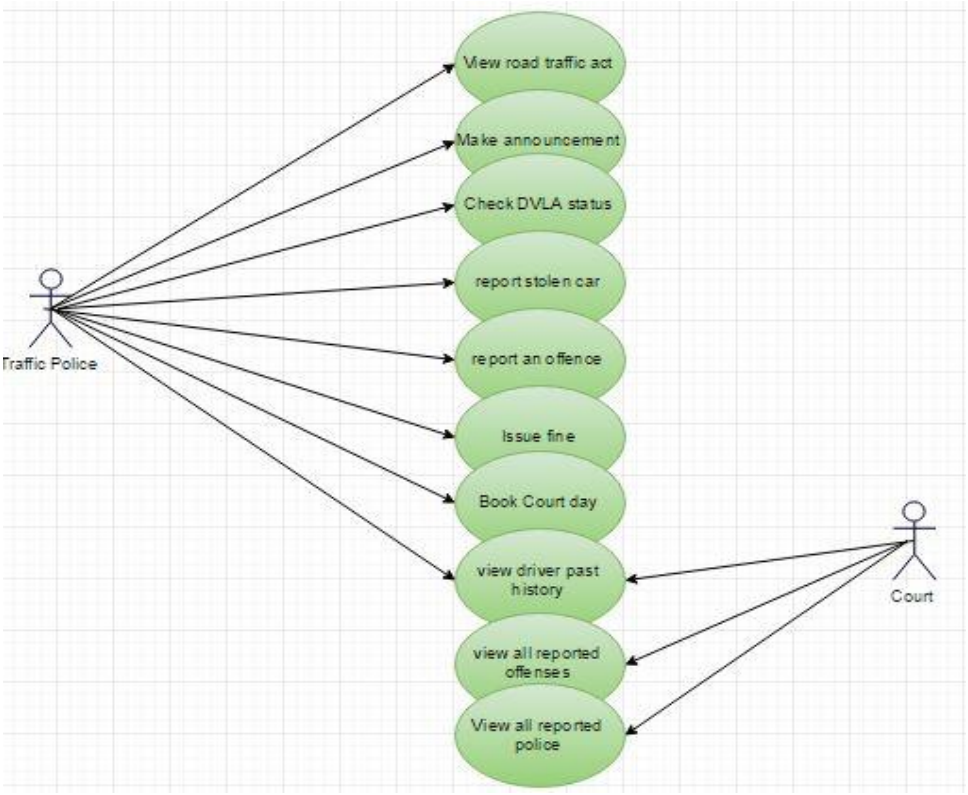

Figure 3. 3 Court and Traffic Police Use Case

3.3 System Architecture

3.3.1 Model View Architecture

The system is designed using the Model view architecture(MVC). The driver and the traffic police have separate views. When the police logs in, they get a view which is only for the police. The view displays what the police can do. The driver also logs in to a different view. The general public which includes everyone also have a different view. To use the application as general public you do not need to register. It is open and everyone should be able to access general view page

All the views are connected to a controller and to a model which connects to a centralized database. The MVC helped to organize the code into different folders for easier interaction. Figure 3.4 shows the MVC model.

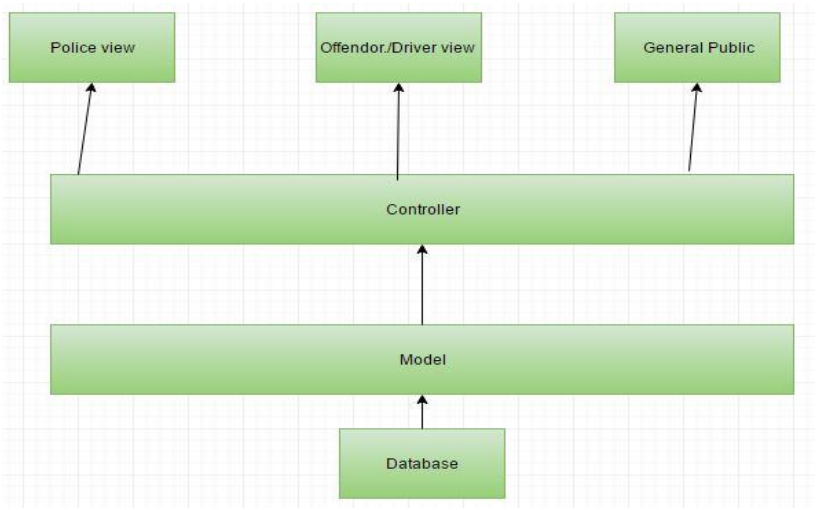

Figure 3. 4 MVC Model

3.3.2 Layered Architecture

The architecture of the application is layered in that you cannot connect to the third layer without the second layer. The controller depends on the database and the view depends on the controller they all depend on each other.

Layered model was chosen because it was easy to integrate with the model and ensure that the data passed passes through out all the layers. Figure 3.5 shows the layered architecture.

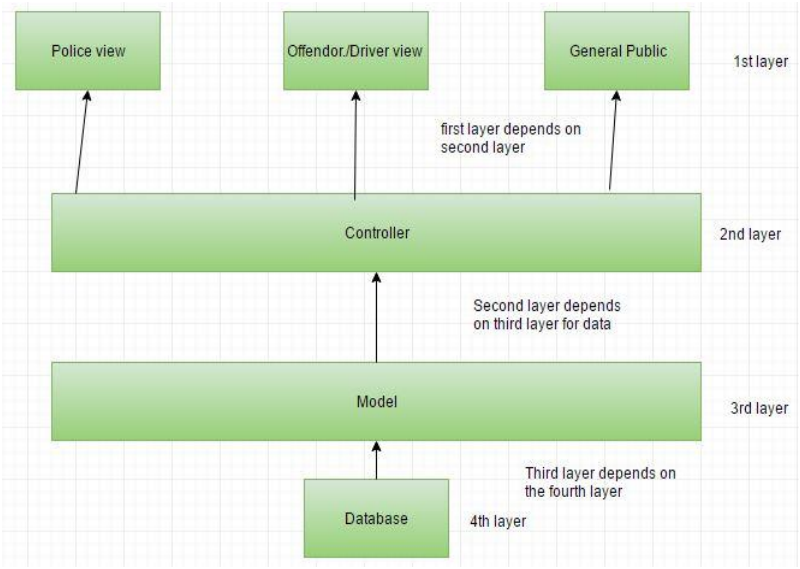

Figure 3. 5 Layered Architecture

3.4 Data Design

The database will contain the main key entities, such as the police, offender and the general public and the activities they can access. The database will also show the multiplicity between the different engagements.

3.4.1 Database Architecture

Figure 3.6 describes how the architecture of the database and the relationship between the different tables. The database stores all the data collected by the application.

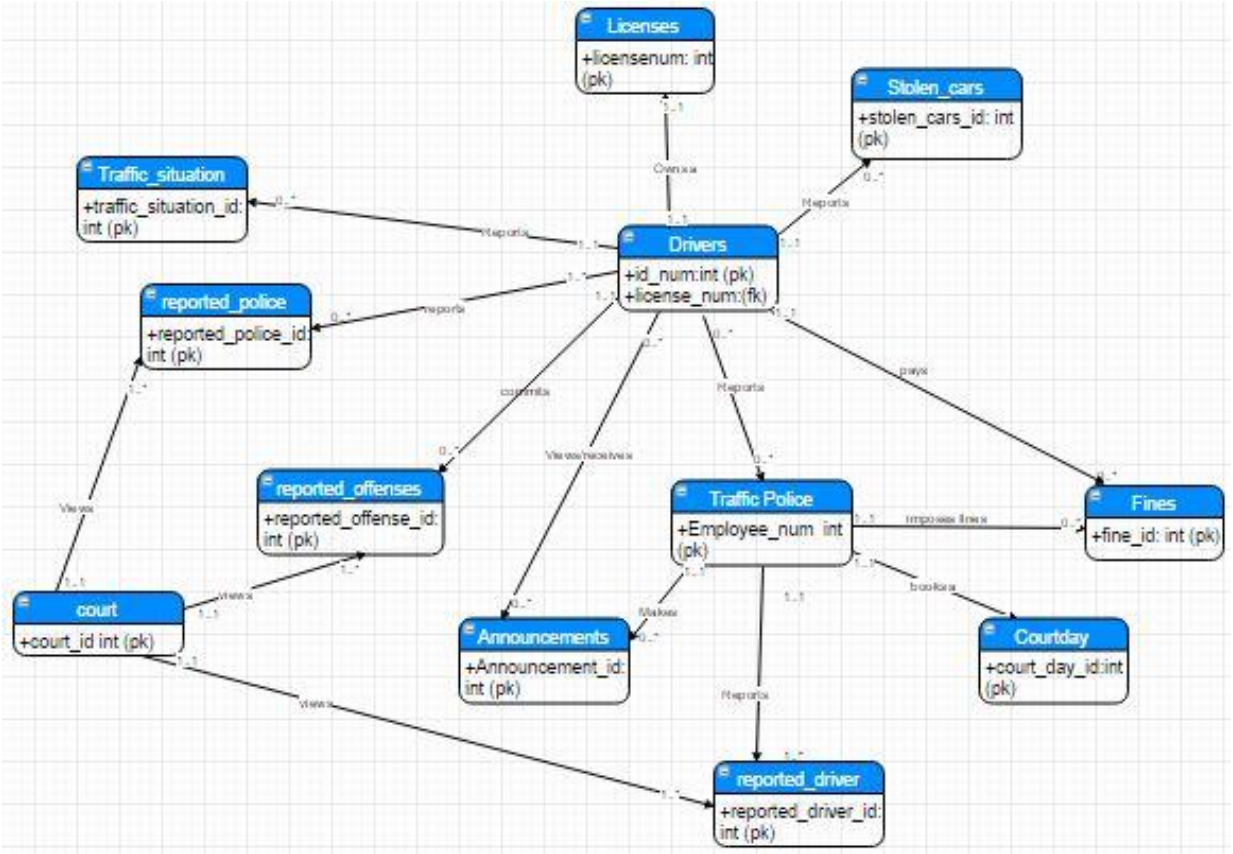

Figure 3. 6 Tables in the Database

3.4.2 Data Dictionary

Table 3.1 is a data dictionary that describes all the table fields present in the database. It shows the table name, field name, data type, whether to accept null or not and the field description.

Table 3 1 Data Dictionary

Table Name	Field Name	Data Type	Allow null?	Field Description
Announcements	Announcement_id	Int (10)	NO	Id of the announcement
	About	Varchar (200)	NO	Describes the announcement
	Details	Varchar (200)	NO	More details of Announcement
	the_date	Date	NO	Date of announcement
	time	Time	YES	Time the announcement happened
	location	Varchar (50)	NO	Where it happened
	image	Long blob	NO	Picture to support the announcement
	image_name	Varchar(50)	YES	Picture name
Court_day	Court_day_id	Int (10)	NO	Id to show court day
	court_location	Varchar (30)	NO	Where the court is located
	case_number	Int	NO	Number of the case
	license_num	Varchar (15)	NO	License number of driver
	offendors_id	Varchar (15)	NO	Identification number
	court_date	Date	NO	Date to appear in court
	court_time	time	NO	The time of the day
Drivers	first_name	Varchar (30)	NO	Drivers first name
	last_name	Varchar (30)	NO	Drivers surname
	phone_num	Varchar (15)	NO	Drivers phone number
	license_num	Varchar (15)	NO	Driver's license number
	identification_num	Varchar (15)	NO	Drivers ID Number
	car_num	Varchar (15)	YES	Car number

	username	Varchar (30)	NO	Email of the driver
	password	Varchar(20)	NO	User password
Fines	fine_id	Int	NO	Fine id
	fname	Varchar (30)	NO	First Name of person paying the fine
	lname	Varchar (30)	NO	Last name of the person paying the fine
	fine	double (10)	NO	Amount of money charged as fine
	license_num	varchar (15)	NO	License number
	id_num	varchar (15)	NO	Identification number of person paying the fine
	car_num	varchar (10)	NO	Car number of the individual paying fine
Licenses	license_num	Varchar (15)	NO	License number
	fname	Varchar (30)	NO	First name of the license owner
	sname	Varchar (30)	NO	Surname of the license owner
	identification_num	Varchar (15)	NO	Identification number of the license owner
	acquired_date	Date	NO	Date when the license was acquired
	expirydate	date	NO	Date when the license will expire
Reporteddriver	reported_driver_id	Int	NO	Reported drive ID number
	car_num	Varchar (15)	NO	Car number of the reported driver
	offense	Varchar (200)	NO	Offense the driver committed
	location	Varchar (50)	NO	Where the offense was committed
	the_date	Date	NO	Date when the driver committed the offense

	image	Long blob	NO	Image showing the driver committing the offense
	image name	Varchar(30)	YES	Name of the image
Reported_offenses	reported_offense_id	Int	NO	Id to track reported offenses
	offense	Varchar (200)	NO	Offense committed
	sanction	Varchar (200)	NO	Punishment for the offense
	date_committed	Date	NO	Date when the offense was committed
	driver_license_num	Varchar (15)	NO	License number of the driver who committed the offense
	driver_id_num	Varchar (15)	NO	Identification number of the offender
	car_num	Varchar (15)	NO	Offender car number
	location	Varchar (30)	NO	Where the offense was committed
	station	Varchar (30)	YES	The nearest police station close to where the offense was committed
Reported police	reported_police_id	Int	NO	To track the reported police
	offense	Varchar (30)	NO	Offense committed by the police
	location	Varchar (30)	NO	Where the police committed the offense
	the_date	Date	NO	Date when offense was committed
	image	Long blob	NO	Image showing the police committing the offense
	image_name	Varchar(50)	YES	Name of the image
Stolen cars	stolen_cars_id	Int	NO	Tracks the reported stolen cars
	last_seen	Date	NO	

	car_type	Varchar (30)	YES	Last date the car was seen
	car_num	Varchar (15)	NO	Model of the car
	license_num	Varchar (15)	NO	Stolen cars number
	identification_num	Varchar (15)	NO	Owners license number
	first_name	Varchar (30)	NO	Owner identification number
	last_name	Varchar (30)	NO	Owners first name
	contact	Varchar (15)	YES	Owners surname
	date_reported	date	NO	Owner phone number
				Date the car is reported stolen
Traffic_police	First_name	Varchar (30)	NO	Traffic police first name
	last_name	Varchar (30)	NO	Traffic police last name
	employee_num	Varchar (20)	NO	Police employment number
	police_station	Varchar (50)	NO	Police station where the police belongs
	identification_num	Varchar (15)	NO	ID number of the police
	phone_number	Varchar (15)	NO	Phone number of the traffic police
	username	Varchar (15)	NO	Email address
	password	Varchar (30)	NO	Password for login
Traffic_situation	traffic_situation_id	Int	NO	Id refereeing to traffic situation reported
	situation	Varchar (30)	NO	Describes the traffic
	location	Varchar (30)	NO	Exactly Where the traffic is
	the_date	Date	NO	Date to show when the traffic was recorded
	traffic_cause	Varchar (200)	YES	Shows what caused traffic
	reccomendation	Varchar(200)	YES	What should be done to end traffic
court	courtside	Int	NO	Id of the court

	fname	Varchar (30)	NO	First name of the person handling case
	lname	Varchar (30)	NO	Surname the person handling the case
	employee_num	Varchar (15)	NO	Employee number
	Phone_num	Varchar(15)	NO	Contact number

Chapter 4: Technologies and Implementation

The “offense reporter” system is a web and mobile application. The web application will operate well in chrome, Mozilla and Maxton, to enhance maximum user experience, users should avoid use of Internet explorer while using the web application since some materialize icons are not compatible with the browser. The Mobile application, is expected to run on every smartphone that runs android as the operating System and it can be accessible from any web accessing machine.

4.1 Technologies Used

Different technologies have been employed to make the application work successfully. They include

- Materialize CSS
- SMS Gateway
- Vodafone API
- Phone gap
- MYSQL
- Google API
- Cordova
- Ajax
- HTML local Storage

4.1.1 Materialize CSS

Materialize CSS is a modern responsive framework based on google material design. It is designed and created by google. It provides both CSS and SCSS files along with JavaScript,

material design icons and *Roboto* font. Materialize was chosen because the project aim was to develop a cross platform application which is mobile friendly.

Materialize CSS has mobile icons such as receive call, dial, phonebook, calendar which make the user interface appealing and friendly. The framework is also highly responsive which makes usable with different devices.

4.1.2 SMS Gateway

SMS Gateway is a short messaging service gateway that enables messages(single/bulk) to be sent to or from a network. The SMS gateway is used to send messages to drivers and traffic police once they have successfully registered. The registered personnel receive a message on their phone informing them of their login details.

SMS gateway is used because it is an easy way to communicate to everyone using the application in spite of the type of mobile phone. It was easy to deploy both on the mobile phone and integrating the messaging API with the application. The SMS is supported by all phones which makes it easier to reach out to different people within a short period of time. The messaging service also sends login details to the user. This messaging service also acts as a backup for login credentials. If the user forgets the username and password, they can recheck the message they received and be able to retrieve their details.

4.1.3 Vodafone Mobile Money API

The application is integrated with mobile money payment system. This means that the offenders can pay for their fines/bails directly from their phone. The users' needs to have registered with Vodafone mobile money prior to using it.

The Vodafone API is a platform that offers integration with Vodafone mobile money. This means that customers who use Vodafone network can easily use their phone and clear their bills immediately.

Vodafone API was used because it was the only API readily available to use. The project intended to use a complete mobile money API with all the networks (Airtel money, MTN money Tigo Cash and Vodafone Money but the provider, Celulant suggested that the application had to be registered with the Bank of Ghana before making use of it. This was to prevent individuals who take advantage of such systems and engage in money laundering to use the API.

Integrating with the mobile money API has the potential of reducing the time spent queueing at the bank to deposit money and checks to pay for the fines. Another advantage of using the mobile API is that offenders will be able to instantly pay for their fines by using their phones, which makes it easier for the police department to track the payment records, since the transaction will be instant and will not require as much time like the normal method used of depositing banker's checks.

4.1.4 Phone Gap

This is a technology which wraps up plain html to cross platform project providing the executable files for android, windows and IOS. To wrap up the application with phone gap the applications view is separated from the back end and it should contain a file index.html which is the homepage connecting to other pages.

The reason for using Phone gap was simply because it supports cross platform application which means one does not need to have a native android code for mobile application and html code for web application. Using the same code saves time to research on other project requirements.

Scanning the DVLA requires a barcode scanner, phone gap has barcode plugin to decode the QR codes in the DVLA sticker. This made it more reliable and useful in my project

4.1.5 MYSQL Database

MySQL database is used to store all the collected data from police, general public and the driver. The other databases available to use for the project included mongo db. and MySQL lite. MSQL was chosen because it supports relational database unlike mongo database which is non-relational. MSQL have also been used for most of my projects which made it easy and comfortable to perform database operations. MySQL is very fast, light weight and capable of handling a high level of load. MySQL also has a very good support for concurrent access from a large number of users and this makes it very ideal for developing web applications.

4.1.6 Ajax & JavaScript

This is Asynchronous JavaScript and XML. It refreshes the application data instantly such that one does not need to reload a page to get new entries. The application requires internet connection, reloading pages now and then requires data traffic which translates to cost, therefore by use of AJAX the amount of data used while using the application is reduced. This makes the application user friendly.

JavaScript was used to validate data from the HTML forms. JavaScript was chosen because it was easy to use and it is compatible with other programming languages.

4.1.7 Google Maps API

Google API is a service offered by google that provides integration with an application to show the location and the maps of the place.

Although the streets in Ghana are not properly named especially most places outside Accra, the google API helped to locate the exact places where he offenses were committed mostly in Accra area. The google API was preferred to physically recording the location details because it was easy to use and to integrate with other technologies used in the project.

4.1.8 Pre Hypertext Processor (PHP)

PHP was mainly used as server side scripting language. The language was used because its compatibility with technologies such as Ajax and JavaScript which were also used in the application.

4.2 Activity Diagram

Figure 4.1 shows an activity diagram for booking an offense. It shows the process followed from the time the traffic police identify an offender to a point where they are released by court.

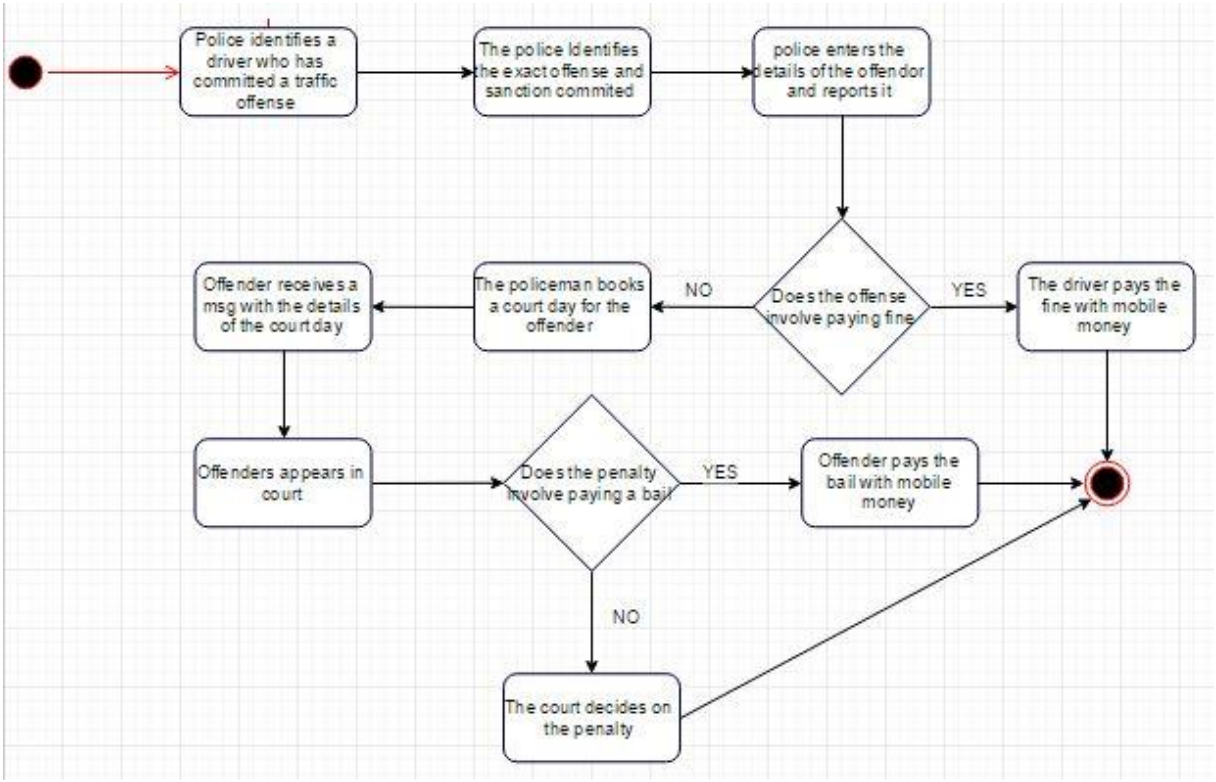

Figure 4. 1 Activity Diagram for reporting an offense

Figure 4.2 shows an activity diagram for reporting a stolen car. The driver or the policeman can report the stolen car.

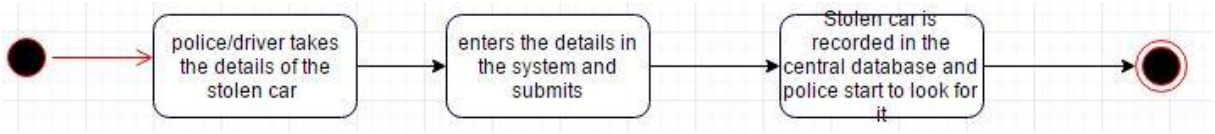

Figure 4. 2 Reporting a Stolen Car

Figure 4.3 shows an activity diagram for making announcement by the general public. Once the traffic announcement is made all the drivers in that location receive a text message informing them of the traffic. This is possible by use of the SMS gateway API which is integrated with the application

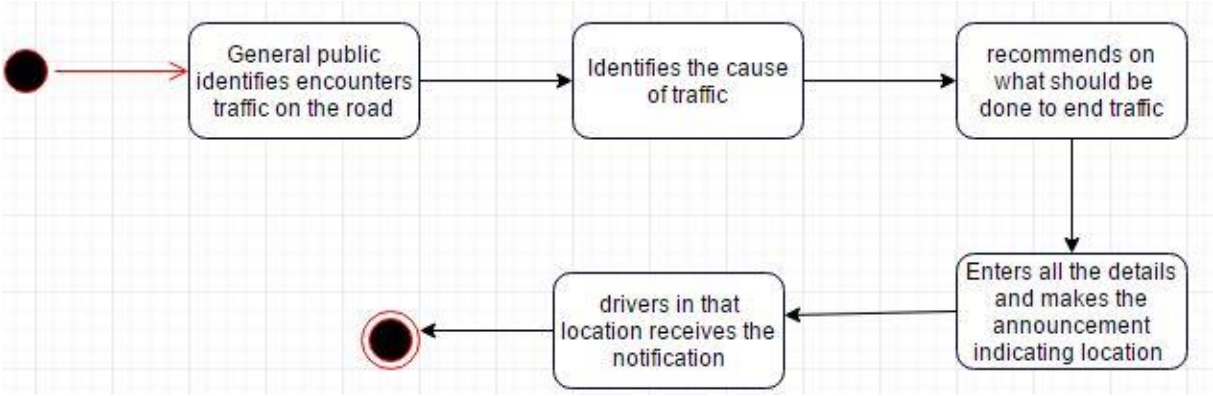

Figure 4. 3 Traffic Announcement

4.3 Main Components of the Application

The main user Interfaces will be shown both web application version and the mobile version. They include:

- Reporting offenses
- Reporting stolen cars
- View traffic act
- Number of times the offender has committed the offenses (offense history)
- Validation of traffic police officer

4.3.1 Reporting Offenses

Figure 4.4 shows the page for reporting offenses by the Ghana Traffic police. The police enter information the Offense committed, Sanction, date, Car number, license number.ID/passport number, location and the police station where the traffic police belong. The page also displays whether it was able to save the offense or not.

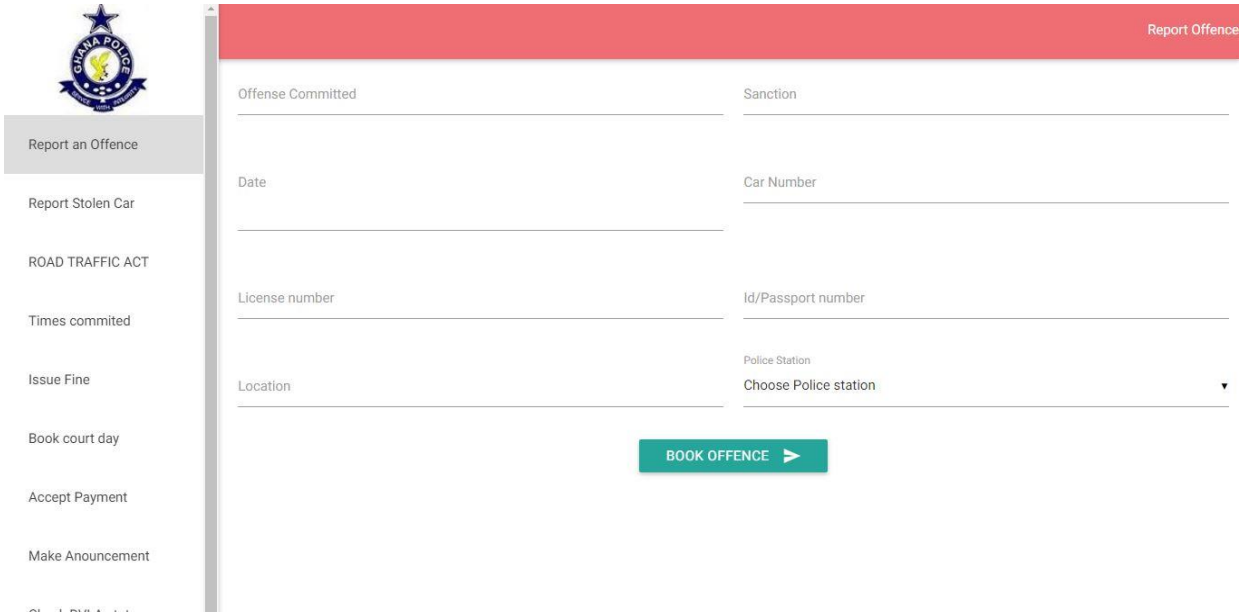

Figure 4. 4 Reporting an Offense User Interface

4.3.2 Reporting Stolen Cars

Figure 4.5 is a web page for reporting the stolen cars. It can be done by the drivers or the traffic police. The fields in the page includes: last seen, car type, car number, license number, date reported, id/passport number of the owner, first name, surname and the contact of the owner. The page also indicates whether the submission was successful or not by use of pop up.

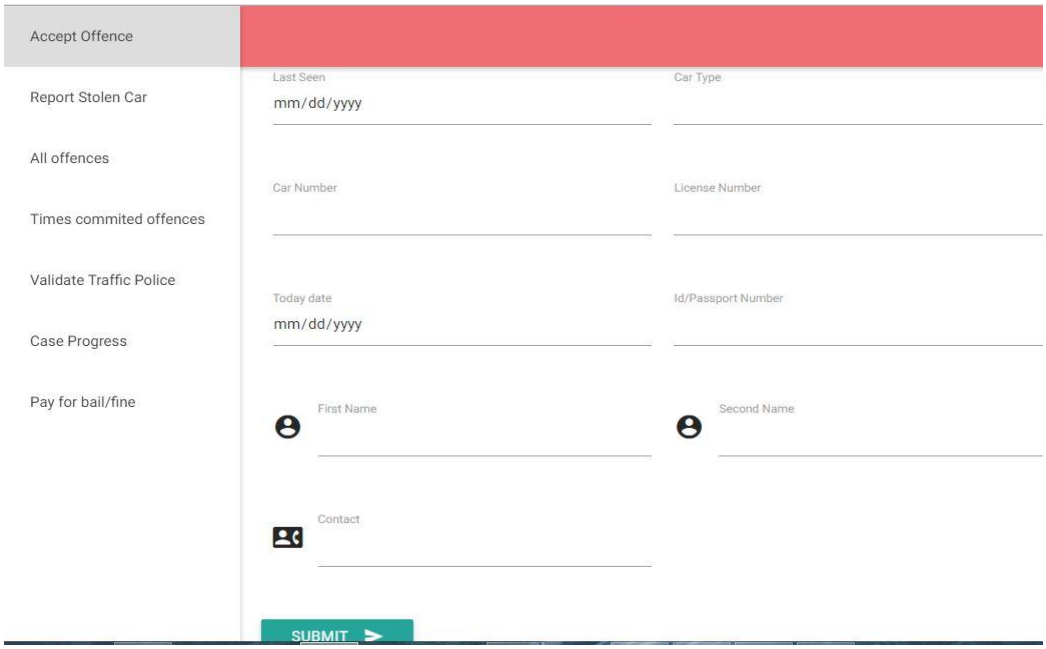

Figure 4. 5 Reporting a Stolen Car User Interface

4.3.3 Traffic Act

This includes all the offenses and upon clicking it displays the sanctions. It is available to the general public, traffic police and the drivers. Figure 4.6 and figure 4.7 are the mobile version before clicking a section and after clicking to view respectively

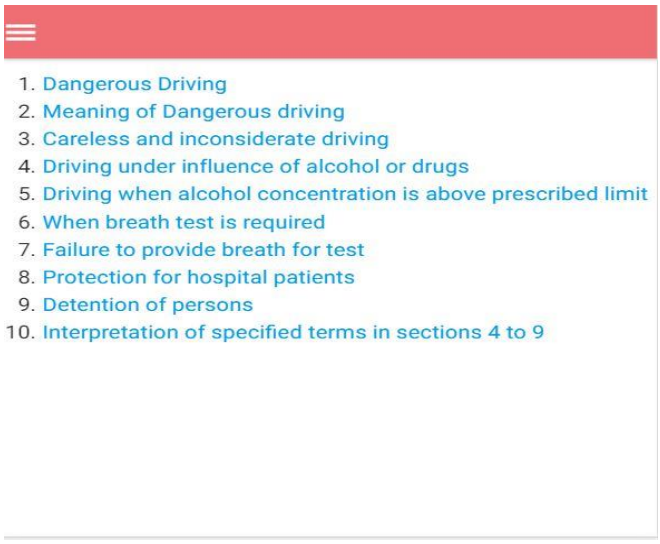

Figure 4. 6 Road Traffic Act

After clicking first section, Dangerous driving

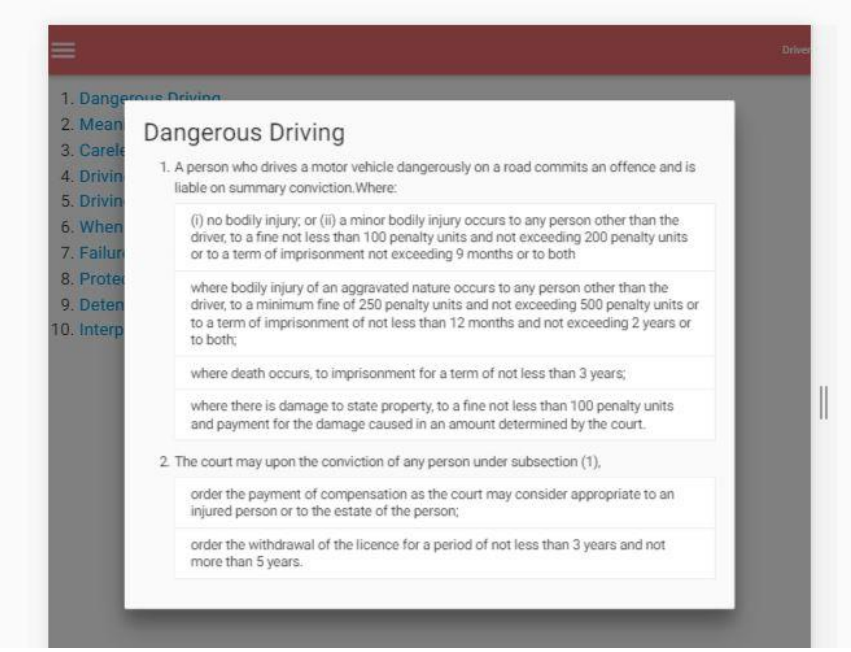

Figure 4. 7 Road Traffic Act Explanation

4.3.4 Offense History

Figure 4.8 shows the offenses committed by a driver by entering the license number. This is the web version and mobile version of the same on Figure 4.9. The page displays driver details such as id number, offense, sanction, date committed, car number, location and police station.

Figure 4. 8 Past Offenses Web Version

Mobile version:

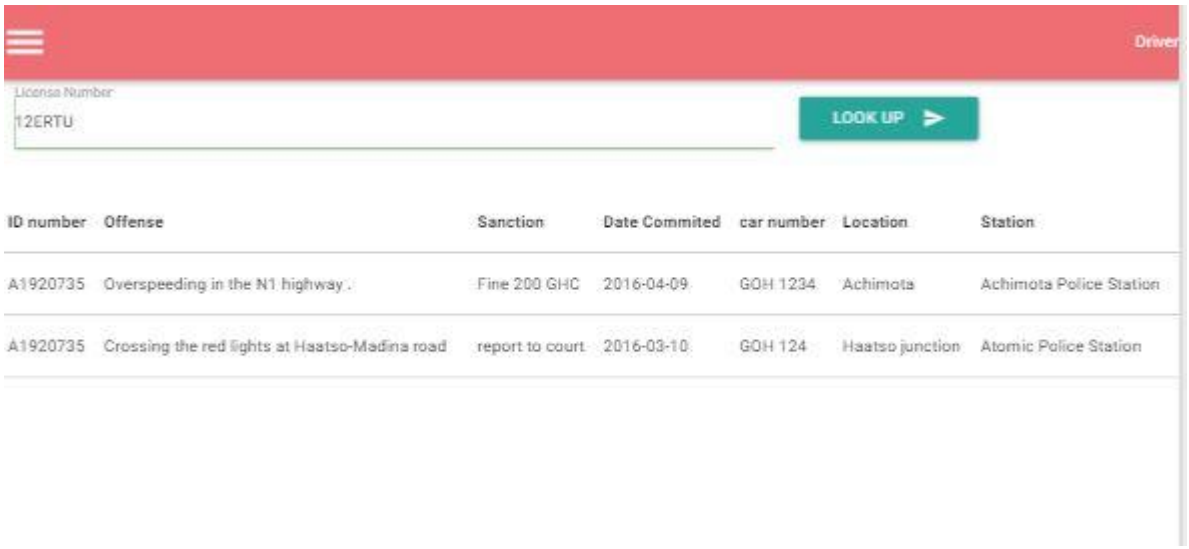

Figure 4. 9 Past Offenses Mobile Version

4.3.5 Validate Traffic Police

Figure 4.10, is a mobile version to validate traffic police using their employee number. The request displays the first name, last name, employee number, identification number, police station and the phone number of the traffic police.

Figure 4. 10 Validating Traffic Police

Chapter 5: Testing and Results

5.1 User Testing

Testing was critical part of the application. I focused on unit testing. Testing was done incremental throughout the application. It was done by using PHP unit testing which tested the important parts of the system. The major components of the application which were tested included:

- Reporting offenses
- Stolen cars
- Validate traffic police
- Court

The above components were chosen because they form the major part of the application which is mostly used by the driver and the offender. For the police module, reporting offenses functionality was tested. This is the major component of the police module. The project was also tested on the different users without training them and the time taken was recorded. The testing was done by 5 people per module. These were users without prior knowledge of the app and will be compared to the real users of the system.

The main reason for not training users was to observe how the drivers, general public, and the traffic police will interact with the application once they download it with no prior training. This gave an insight into what to expect once the application is deployed.

For the police module, the time taken to sign up and login was recorded. This is because signing up and login was essential part of the application since traffic police needs to be registered with the system before they can report an offense. Also the time taken by a policeman to report an offence was recorded, this was to see how fast the application was in case the traffic

police wanted to report multiple offense quickly in a short period of time. The time taken is in minutes. For the driver module, the time taken to signup, login, and to view past history offenses and report stolen car was recorded. In the general public module, time taken to make announcement, report a police and report a driver was recorded.

5.2 Results

5.2.1 Police Interface

Table 5.1 shows the table with data showing the time in minutes that the different people took to perform for the first time to use the police User Interface.

Table 5. 1 Results Police User Interface first Time

User	Signup	login	Report offense
1	1.5	0.5	2.5
2	1.28	0.7	2.2
3	1.04	0.6	1.8
4	2.0	1.0	2.48
5	1.0	0.7	2.0

The results were mainly affected by the unfamiliarity with the application. Also most of the people were not aware of what to put as the sanction this made me realize that I needed to put a drop down because every police do not know all the sanction for the different offenses.

Table 5. 2 Results Police User Interface second Time

User	Signup	Login	Report Offense

1	1.1	0.5	2.0
2	1.0	0.5	1.7
3	1.0	0.6	1.6
4	1.3	0.7	2.1
5	0.9	0.6	1.7

Table 5.2 shows that after the users were familiar with the user interface, they took less time that they had taken in their first round. Most users also had a chance to clarify some of the fields they were note sure of before their second round.

5.2.2 Driver Interface

Table 5.3 shows the time taken by the users who had no training to sign up, login, view past offenses and report stolen cars in the driver's module in minutes.

Table 5. 3 Results Driver Interface first Time

User	Signup	Login	Past offenses	Report stolen car
1	1.8	1.0	0.7	1.5
2	1.6	1.2	0.5	2.0
3	2.0	0.5	0.45	2.4
4	1.9	0.75	0.9	2.2
5	2.5	0.9	0.6	1.8

Table 5.4 shows the time taken by the same users again after training and explanation on the fields they were not sure.

Table 5. 4 Results Driver Interface second Time

User	Sign up	Login	Past offenses	Stolen cars
1	1.2	0.8	0.5	1.3
2	1.0	0.9	0.4	1.6
3	1.5	0.4	0.4	1.8
4	1.4	0.5	0.6	1.9
5	1.7	0.6	0.6	1.6

Comparing table 5.3 and table 5.4, users took longer time using the driver module in table 5.3. This is because they were not aware of what was expected of them in some fields. Also since it was a new application they took their time to read each part of the user interface carefully.

In table 5.4 the users took lesser time than in table 5.3 since they had prior teaching and familiarity with the application. This showed that if drivers are given prior information and training before using the application, they will take an average of 1.4 minutes to sign up, 0.75 minutes to log in, 0.5 minutes to view past offense history and 1.5 minutes to report a stolen car

5.2.3 General Public Interface

Testing was done on reporting a police and making an announcement. Table 5.5, shows the time taken in minutes when the users tried It for the first time and table 5.6 shows the time taken the second round.

Table 5. 5 Result General Public Interface first Time

User	Report a police	Report a driver
1	1.5	1.4
2	1.2	1.0
3	1.0	1.2
4	1.3	0.9
5	1.4	1.3

In table 5.5 on average it takes 1.28 to report a police and average of 1.16 minutes to report a driver.

Table 5. 6 Results General Public Interface second Time

User	Report a police	Report a driver
1	0.9	1.0
2	1.0	0.7
3	0.75	0.8
4	0.8	0.7
5	0.85	0.9

In table 5.6, on average it takes 0.86 minutes to report a police and an average of 0.82 to report a driver.

Comparing table 5.5 and 5.6 results, the users were able to do better in table 5.6. Also comparing to other interface the users performed better in 5.6 because they were already used to the project and they knew how the user interface worked as well how the different elements responded.

After the testing, some parts of the interfaces were redesigned to match what the users expected.

Chapter 6: Conclusion and Recommendation

6.1 Challenges Faced

Using materialize user interface was difficult since there were no solutions for the bugs I got while developing. There is no community e.g. Linux community available to solve the issues with the project. Once you get a problem you have to find way out by your own which becomes difficult if you are not familiar with the UI itself. The UI still has a lot of Bugs to be addressed.

6.2 Recommendation

While using the application and giving the users to use the application its necessary to give the user the highlight of the project as well as what one is trying to solve. This reduces the time they take while trying to understand the project.

Also the project should be hosted in the cloud to provide reliability of the system. When hosted locally, the application will be highly affected by power shortages, low internet and unreliable servers which leads to unreliability of the system.

6.3 Future work

Since the focus was to develop for small scale, the issue of security was not really a major key in the project, in the future the project should be secured from XSS, SQL injection and other forms of attack.

The DVLA validation should be implemented. This will help the police officers to distinguish between the fake and real DVLA. This will reduce theft since every car will have to be registered under the road authorities and the owner will be known.

The project will implement the full mobile Money API so that all offenders on the other networks than Vodafone will also be able to pay for their offenses.

6.4 Conclusion

The project has four modules, the police, driver, general public and the court module. All the modules were tested using PHP unit test and the system itself was tested against real people who entered the expected data. The system was also tested for errors in the different fields that required inputs from the user.

From the observation, the users will be able to use the application without training, and with training the will use less time since they will be familiar with what the application does.

Results indicate that it would be therefore useful for the government of Kenya and Ghana to focus on the model and use it to reduce time wastage while reporting offenses, corruption and bribery, and digitize the mode of reporting, such that it will be easier to monitor the reported offenses.

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