



**ADDIS ABABA UNIVERSITY**

**COLLEGE OF NATURAL SCIENCES**

**DEPARTMENT OF COMPUTER SCIENCE**

***Misbehaving Public Transport Drivers Reporting System Using  
Smart Phone***

***Shimels Bizuneh***

A Project Paper Submitted to Department of Computer Science in Partial  
Fulfillment of the Requirements for the Degree of Master of Science in Computer  
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**ADDIS ABABA UNIVERSITY**

**COLLEGE OF NATURAL SCIENCE**

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Smart Phone***

Advisor: Dida Midekso(PHD)

This is to certify that the project prepared by *Shimels Bizuneh*, titled: *Misbehaving public transport drivers reporting system using smart phone* and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Computer Science complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Name	Signature	Date
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Examiner _____	_____	_____
Examiner: _____	_____	_____

## Abstract

People use different transportation methods to move from one place to another for different reasons. Public transportation, taxi and bus, is widely used for moving many people from one place to another. Many people live in Addis Ababa use these public transportations for their day to day activities. As public transportation has many benefits, it has problems that affect the passenger and sometime the reason to injure, disable and kill many people.

Most of the problems are caused by drivers, some of them are, over speed, overload, drunk and other. People face these problems every day and they don't have easy way to report these problems to the right authority.

This project is done to reduce the problems and accidents mentioned above on public transport cars, taxis and bus, by providing an easy way to passengers and others to report on the drivers' bad behavior and actions during driving to the traffic polices using smart phone.

The system has been tested on sample data in some area of Addis Ababa. It found that the system is working as expected and help the passengers to report the problems that they face while they use public transport cars.

Keywords:

Public transport, Misbehave drivers, Bad behavior drivers, Traffic accidents, Passengers, Reporting system.

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## **Abbreviations**

<b>AATPR</b>	Addis Ababa Traffic Police Report
<b>GPS</b>	Global Positioning System
<b>GIS</b>	Geographical Information System
<b>MPTDRS</b>	Misbehave Public Transport drivers reporting system
<b>NPM</b>	Nodejs package manager
<b>PC</b>	Personal Computer
<b>ODK</b>	Open Data Kit
<b>OSM</b>	Open Street Map
<b>SMS</b>	Short Message Service
<b>WHO</b>	World Health Organization

# Chapter One: Introduction

## 1.1 Background

People use different transportation methods to move from one place to another for different reasons. Public transportation, taxi and bus, is widely used for moving many people from one place to another. As public transportation has many benefits, it is also the reason to injure, disable and kill many people.

In Ethiopia, the number of deaths due to traffic accidents is reported to be amongst the highest in the world. According to the WHO, in 2013 the road crash fatality rate in Ethiopia was 4984.3 deaths per 100,000 vehicles per year, compared to 574 across sub-Saharan African countries. In general, the scale and the severity of the problem are increasing from time to time and adversely affecting the economy of the country in general and the livelihood of individuals in particular [1].

It is a daily trend for us to hear lot of accident in media happen mainly because of over speeding of vehicle i.e. rash driving, not following sign board and fatigue states of driver like drowsy, drunken state [2].

Drivers are the major cause of most accidents according to traffic police report. Trucks and minibus taxis were involved in the majority of crashes, while automobiles (small vehicles) were less involved in crashes relative to other vehicle types [3].

It is important to decrease the rate of traffic accidents to reduce not only human casualties but also medical expenses, damages of vehicles and road facilities, congestion due to accidents, and other economic losses (such as losses of production) [4].

Controlling each driver is difficult because of the limited number traffic police in the country. Drivers follow the rule when there is traffic police around so this is what makes it difficult to reduce the accident.

Currently, Smart phones are widely used for different purpose. These smart phones have built-in GPS (Global positioning system) device which use to determine the current position and can download and use different applications [5]. This project will help passengers and other to submit dangerous drivers' information including their location to the nearest traffic police using smart phone.

The aim of this project is to reduce car accident that will occur on taxis and bus by making passengers and others to report on the drivers' illegal action during driving to the nearest traffic police using smart phone.

## **1.2 Motivation**

Car accidents became critical issue in Ethiopia which takes much human life and people are getting worry while they travel to other places using public transportation. Because of drivers fault many parents lost their children, children are forced to live without their parents, and many people became disabled and stay at home without work. If a technology that controls the drivers and penalize them implemented such accidents will be reduced. This motivates us to conduct this project.

## **1.3 Statement of the Problem**

According to Addis Ababa Traffic Police Report (AATPR), nearly 75% of the accident was attributable to the driver [6]. Some of the attributes are speed, drunk driving, using mobile device and alike. Generally, most public transportation drivers' problem is not willing to follow the traffic law [2].

Passengers usually argue with drivers about their illegal action while they travel to some place but most drivers do not accept what the passenger say.

In many countries different authorities have set up a call center where motorists and public transport users are able to report dangerous driving behavior and make a complaint. Traditional dangerous driving report system is usually carried out by telephone calls in order to report or make a complaint regarding bad driving behavior [17]. Reporting the drivers action by calling to call center (991) takes more time to reach the traffic polices so it cannot help to prevent accidents before happing and calling direct to traffic polices is also difficult because they are not staying permanently in one place and new comers don't get the telephone address of traffic officers. Therefore, it is difficult to report illegal drivers through telephone for accident prevention.

Currently, traffic police randomly use radar guns to control over speed vehicles in different places which are important to reduce accident cause by over speed but they only use it in specific area and time because of limited resource. This kind of mobile device cannot be used all over the country for 24 hours.

Alcohol testing device is also used to control drunk driver. This device is also useful to reduce accident caused by drunk drivers but as radar guns it is not used frequently in all places.

There are research works try to solve this problem by using different technology. According to research work by Chalernpol and Wasan [17], by collecting a stream of data through built-in GPS receiver in smart phone, a time series of speed profile can be obtained for a given journey.

The above research work is trying to report over speed using smart phone to passenger but in the case of Ethiopia, there are different reasons other than the above attribute. Some of them are over speed, on boarding over the vehicle capacity, using mobile phone and others.

Implementing the technology to control this kind of driver behaviors is also challenging. That is why we try to solve this problem by allowing passengers of public transportation and others who see the driver's behavior to report the situation to the right authority using their smart phone.

## 1.4 Objectives

### General Objective

The general objective of the project is to develop a system which makes people able to report misbehaving public transport driver to the nearest traffic police.

### Specific Objective

The specific objectives that will help us to meet the general objectives are listed below.

- Study the bad driving behavior of public transport drivers while they drive
- Analyze the bad driving behavior of the public transport drivers
- Design the architecture of the solution domain based on the problem
- Develop a prototype application that can solve the problem using smart phone
- User acceptance test
- Use manual preparation

## 1.5 Methodology

### 1.5.1 Literature Review

Extensive literature review will be made on different related works to obtain an in-depth understanding of the area and to identify the actual problem. Moreover, to find useful approaches that can efficiently solve the problem.

### **1.5.2 Data collection**

The relevant data for this study will be gathered by collecting data through physical observation of necessary documents and interview the appropriate person to capture raw facts and to come up with appropriate information.

### **1.5.3 Tools**

Different tools will be used for analysis, design and implementation of misbehaving public transport drivers reporting system. Among these: edraw max for design, MS-excel of form design, node.js is used for developing real time web application and NPM is used for package manager for node.js packages, and mongoDB is used for storing data in the database.

### **1.5.4 System Development**

Following the completion of requirements analysis, the system is modelled using UML tools which are use case diagram, class diagram and sequence diagram. Agile software methodology is used for the overall software development.

### **1.5.5 Evaluation of the project**

The prototype of misbehaving public transport drivers reporting system will be developed and deployed on a server before testing is done and the functionality of the system will be tested on sample data prepared for test.

## **1.6 Scope and Limitations**

The scope of this project is limited to public transport drivers as most of the passengers use public transportation and many public transport cars are available throughout Ethiopia but our scope is with in Addis Ababa city.

Internet connection might also be a limitation as continuous Internet connection is required so that reporting is possible anytime.

## **1.7 Application Results**

The result of this project benefits people who use public transportation and drivers by reporting public transport drivers' illegal action during driving. It will also support the effort of traffic officers.

## **1.8 Organization of the Document**

The rest of the document is organized as follows. Chapter two presents the literature review, Chapter three describes related works. Chapter four describes about the proposed system that includes functional, nonfunctional, and system models. Chapter five presents the general system architecture of the proposed system, decomposition of the system into subsystems, the relational model and access control policy defined for the system. Chapter six presents the implementation. Finally, Chapter seven presents conclusion and future works.

## **Chapter Two: Literature Review**

### **2.1 Public Transport**

Public transportation is a transportation service that is available to the general public and that carries passengers to destinations for a fee. The systems are broadly accepted in many cities as preferred transportation alternative for commuting to work, performing errands or travelling to social events. The mode is an essential component especially for low income groups [7]. Public transport is therefore vital for the vast majority without access to private transport. But it should not be viewed as only for the poor, as the importance of public transport to all income groups in many rich European cities demonstrates [8]. It also provides an alternative to those who have private transport [7].

One of the urban transportation systems is public transport. Urban transport in Addis Ababa is carried by a mixture of ownership structures, of which public and private operators are predominantly contenders for business. Around 2.2 million people in Addis Ababa are using public transport of which 3.6 million trips happen in the city on daily basis. Currently, the modalities of public transport mobility in Addis Ababa are limited to the road transport that mainly comprises 10, 000 white and blue Minibus taxis that can seat at most 12 people, about 460 Higer midi-buses that seat 22 to 27 people, 487 Anbessa city buses (which carry 30 people seated and 70 standing), and Alliance bus (have 40 seats and 60 hangers). Currently, public transport including Anbessa buses, Higer mid-buses, Alliance buses, minibus taxis, and Salon taxis all together cover about 48 percent while private mode only 9 percent [18].

### **2.2 Misbehaving Drivers**

Unacceptably high road traffic crashes statistics in Addis Ababa are attributed to complex interrelated risk factors ranging from driver and pedestrian behavior, traffic rules and regulations, and vehicle and road conditions. For instance, the Ministry of Infrastructure, Roads Authority in 2005 report showed that problems related to the road itself were only responsible for about 1 to 3% while the largest crashes were attributed to driver errors, which accounted for 81%. Similarly, Tesema et al. [9] in their study of road traffic crashes in Ethiopia reported that about 81% of the road traffic crashes countrywide are due to driver errors such as: drivers not

respecting pedestrian priority, speeding, unsafe utilization of freight vehicles for passenger transportation, poor driving skills and undisciplined driver behavior.

According to Addis Ababa traffic police commission report in 2017 said that, “an overwhelming number of crashes (99.2 percent) involve male drivers, with the highest proportion of fatal crashes involving public taxis (23 percent) and 26 percent of fatal crashes involving drivers with less than two years of driving experience” [10].

### **2.3 Reporting system**

There are different reporting mechanisms used for submitting the work to the right authority. The most used reporting method is submitting the report through paper and phone calls. When an event is reported using the paper based reporting system, it could take a number of days before the supervisor gets the report and take any necessary action. This delay is due to the fact that most often paper based error reports are mailed using internal mail or dropped off at specified drop boxes. The nature of the time delay inherent in these methods can delay the response time for the necessary action taken. With the electronic reporting system, the event can be noticed with minutes of reporting and facilitates faster response times. The electronic error reporting system became an effective concurrent risk management tool by providing timely communication about real time events as they occur [11].

### **2.4 Global Positioning System(GPS)**

GPS is a satellite navigation system used to determine the ground position of an object. GPS technology was first used by the United States military in the 1960s and expanded into civilian use over the next few decades. Today, GPS receivers are included in many commercial products, such as automobiles, smart phones, exercise watches, and GIS devices. It uses radio waves between satellites and a receiver inside the phone to provide location and time information to any software that needs to use it. You don't have to send any actual data back into space for GPS to work; you only need to be able to receive data from four or more of the 28 satellites in orbit that are dedicated for geolocation use[12].

In this project, we are using GPS for capturing the location of report sender to notice the traffic police around in that area. The location of the sender helps to get the traffic police assigned in that area.

All traffic police information including their location is captured in the system before sending the report data to them. The report data transfer to traffic police is based on the location of the user who sends the report.

## **2.5 Mobile Internet**

In today's age of connectivity, smart phones and tablets are becoming more of a necessity rather than a luxury. Whether it is not to miss important mails, being updated with the news or finding directions when lost – connecting to the Internet anytime and anywhere is becoming an integral part of our lives. It's now possible to get Internet access in any location as long as your phone gets a good signal from the cellular network. You can also use public Wi-Fi hotspots to connect to the Internet through a shared connection therefore there are usually two ways to connect to the internet through mobile phone – Via a cellular telephone service provider or by using standard Wi-Fi. A Wi-Fi enabled device lets you surf the Web at free Wi-Fi hotspots, which is helpful when the phone network connection isn't that strong. Through a cellular service provider, the phone connects to the Internet through data transfer the same way a PC does, but with a wireless link [13].

## **2.6 Short Message Service (SMS)**

SMS, or Short Message Service, is the technical term for text messaging, the most widely used data application in the world. SMS users can send messages between cell phones or from a computer to a cell phone. It was first conceptualized in the 1980s and in the last 10 years has become an important medium in both personal and business communication. SMS is made possible by the robust cell phone infrastructure made up of cell towers and satellites. These remote hubs create control channels. When you send a text message, it travels on one of these control channels to the corresponding tower, which routes it to the corresponding control channel of the receiver. SMS messages can fit up to 160 characters in a single message, but modern services can automatically split up longer messages in order to send the complete text [14].

Our system uses short SMS to notify the reported data comes from the user to the appropriate traffic police around that area. When the traffic police get this SMS, they immediately read the this data to capture the driver.

## 2.7 ODK Collect

ODK Collect is an open source Android app that allows data collection using mobile devices and data submission to an online server, even without an Internet connection or mobile carrier service at the time of data collection. It renders forms into a sequence of input prompts that apply form logic, entry constraints, and repeating sub-structures. Users work through the prompts and can save the submission at any point. Finalized submissions can be sent to (and new forms downloaded from) a server. Data collection supports location, audio, images, video, barcodes, signatures, multiple-choice, free text, and numeric answers. It can even accept answers from other apps on your device [15].

## 2.8 OpenStreetMap(OSM)

OpenStreetMap(OSM) is an online map, that can interactively be zoomed and panned. The map on the site is nothing more than a display of map tiles, static images rendered from OpenStreetMap data as an example of what you can do with it. The real power of OpenStreetMap is not this default rendering, but the possibility to actually access the data behind this map rendering. And this is where it differs from Google maps, Bing Maps and Yahoo! Maps and various others. OpenStreetMap is the only mapping service that allows you to do something more than just look at pretty map tiles [16].

### **Summary**

The above literatures were reviewed to get more understanding about the problems happen in public transport drivers. Based on the literature, over 2.2 million people in the Addis Ababa use public transport every day. This people face different problems while they use this public transport and some time they may be injured or killed in case of accidents. They don't have easy way to report the misbehavior of the drivers.

## Chapter Three: Related Work

### 3.1 Detecting Aggressive Driving using smart phone

- **Smartphone Enabled Dangerous Driving report system** - This paper proposes a novel dangerous driving report system using a smart phone platform, by collecting a stream of data through built-in GPS receiver in smart phone, a time series of speed profile can be obtained for a given journey. An algorithm is proposed to detect anomaly in speed profile in order to detect whether a vehicle is speeding. As well as the ability to alert passengers in real-time in the case of speeding, the proposed system also records the journey data to be used as evidence when making a report. Furthermore, the work in this paper focuses mainly on the speed domain where public transport passengers are alerted automatically when the driver violates the specified speed limit in real-time as they travel in the vehicle through the mobile application [17].
- **Driving Style Recognition Using a Smartphone as a Sensor Platform** - They develop a system called MIROAD (Mobile-Sensor-Platform for Intelligent Recognition of Aggressive Driving). The system can provide audible feedback if a driver's style becomes aggressive, as well as the information leading up to an aggressive event including video, location, speed and recent driving maneuvers. The system is designed to help prevent incidents by warning a driver if his or her driving style becomes aggressive, and to provide information about incidents so that we have a better understanding of what causes them [19]. The paper proposes a method for determining both driving style and type of driving maneuver using sensor fusion and the Dynamic Time Warping algorithm; a complete driver monitoring system on a mobile phone that records and plays back video and sensor data in a synchronized manner; and finally a comparison of individual sensors vs. sensor-fused data for driving event recognition using DTW [19].
- **Detecting Driving Events Using Smartphone** - Human error is one of the three key contributing factors to road traffic accidents, the other two being vehicles capabilities and road infrastructures. The fundamental elements leading up to aggressive driving behaviors are from different driving events that occur during a journey such as harsh braking and acceleration, rapid turning and rapid lane change. Therefore, it is essential to be able to detect these fundamental driving events and classify whether or not they are

aggressive in order to recognize potential crashes [20].The research work proposes two algorithms which detect driving events using data collected from smart phone sensors such as GPS, accelerometer and magnetometer. More importantly, the proposed algorithms classify whether or not these driving events are aggressive. With all the data and sensors they are able to detect vehicle's movement when a smart phone is placed inside a vehicle of interest. As a result, typical driving events such as turning left and right, braking and accelerating can be detected. It is important to detect these typical driving events as they are fundamental to the evaluation of driver behavior [20].

- **Safe Driving Using Mobile Phones** - Using a smart phone, they have demonstrated applications that are integrated inside an automobile to evaluate a vehicle's condition, such as gear shifts and overall road conditions. Along with these findings, an analysis of a driver behavior for safe and sudden maneuvers, such as vehicle accelerations and lane changes, has been identified, which can advise drivers who are unaware of the risks they are potentially creating for themselves and neighboring vehicles. The direction of lane change, as well as safe acceleration, compared with sudden acceleration, was easily distinguishable [21].The device, which is a smart phone, contains GPS, microphones, and an accelerometer offering flexibility in methodology and user implementation. Encouraging results in identifying numerous road anomalies and sudden driving maneuvers allow for the system to evaluate an entire road's condition and help advice drivers on unsafe characteristics, respectively, both of which are distinguishable factors that can determine safety on the road [21].

## **Summary**

The limitations of the paper, smart phone enable dangerous driving report is continuous GPS reading and good connection is require, the accuracy is vary low using GPS and they only test in outside the city.

The limitations of the “Driving Style Recognition Using a Smartphone as a Sensor Platform” are specifically designed to monitor company drivers, requires latest smart phone which include all sensors for only this purpose and it always need good internet connection.

The third paper which is called Detecting Driving Events Using Smartphone, the limitations of this research are the raw data was collected using a single driver in one vehicle and some of the events not detected well in pattern matching.

The limitations of the paper Safe Driving Using Mobile Phones is, it uses for driver safety and only tells the driver about his driving behavior and only use one device to test.

The above research works tries to prevent the accidents cause by specific attributes by placing smart phone in each car. Among this: over speed, hard braking, rapid turning and lane change can be detected and recorded using smart phone and report the situation to the driver himself and the companies but our project provide an option for passengers and others to report in addition to the mention attribute to the traffic police before accident will happen using smart phone.

## **Chapter Four: System Analysis**

### **3.1 Overview**

System analysis involves a detailed study of the existing system to find out what feature the current system has and what additional features should be included. This will lead to specifications of a new system.

This chapter discusses the identified functional and non-functional requirements of the system and the models (use case diagram, class diagram and sequence diagram) used to present the structural and dynamic behavior of the system. Information about the existing system has been collected mainly through a questionnaire, interview, observation and document analysis method.

### **3.2 Functional Requirement**

The functional requirements of the system are requirements that are directly related to the functional aspect of the system. Main functional requirements of the system include:

- The system shall register new traffic police information
- The system shall have the ability to update the traffic police when their assigned place is changed.
- The system shall hold the list of the main misbehave action done by public transport drivers
- The system shall accept the reported data sent by a passenger or other.
- The system shall notify the reported data immediately by SMS to the traffic polices assigned in the sender area.
- The system shall display the report data on the web application on the map.
- The system shall generate report.

### **3.3 Non Functional Requirement**

Non-functional requirements describe user visible aspects of the system that are not directly related with the functional behavior of the system. The Non-Functional requirements of the system are described as follows:

**Performance**

The performance of the system should be reliable and the response time should be reasonable according to the available resource.

**Reliability**

The system should be reliable and the input data should be returning the exact result at all time.

**Usability**

The system should be easily understandable by its users. The interface should be easy to use and it should have a customary look and feel so that users can easily be acquainted with the system. It should be easy to learn, operate and it should provide alternatives to different tasks. It should be usable for accomplishing tasks to the client.

**Maintainability**

The system should be developed for easy future maintenance and enhancement if there are additional user requirements, system failure, new technological shift, etc.

### 3.4 System Model

System modeling is the process of developing abstract models of a system, with each model presenting a different view or perspective of that system.

System modeling helps the analyst to understand the functionality of the system and models are used to communicate with customers.

#### 3.4.1 Use Case Diagram

Use cases are used during requirements elicitation and analysis to represent the functionality of the proposed system. Use cases focus on the behavior of the system from an external point of view. A use case is used to describe a function provided by the system that yields a visible result for an actor. An actor describes any entity that interacts with the system, such as a user, another system. The actors are outside the boundary of the system, whereas the use cases are inside the boundary of the system. The following use cases and actors are identified for the proposed system.

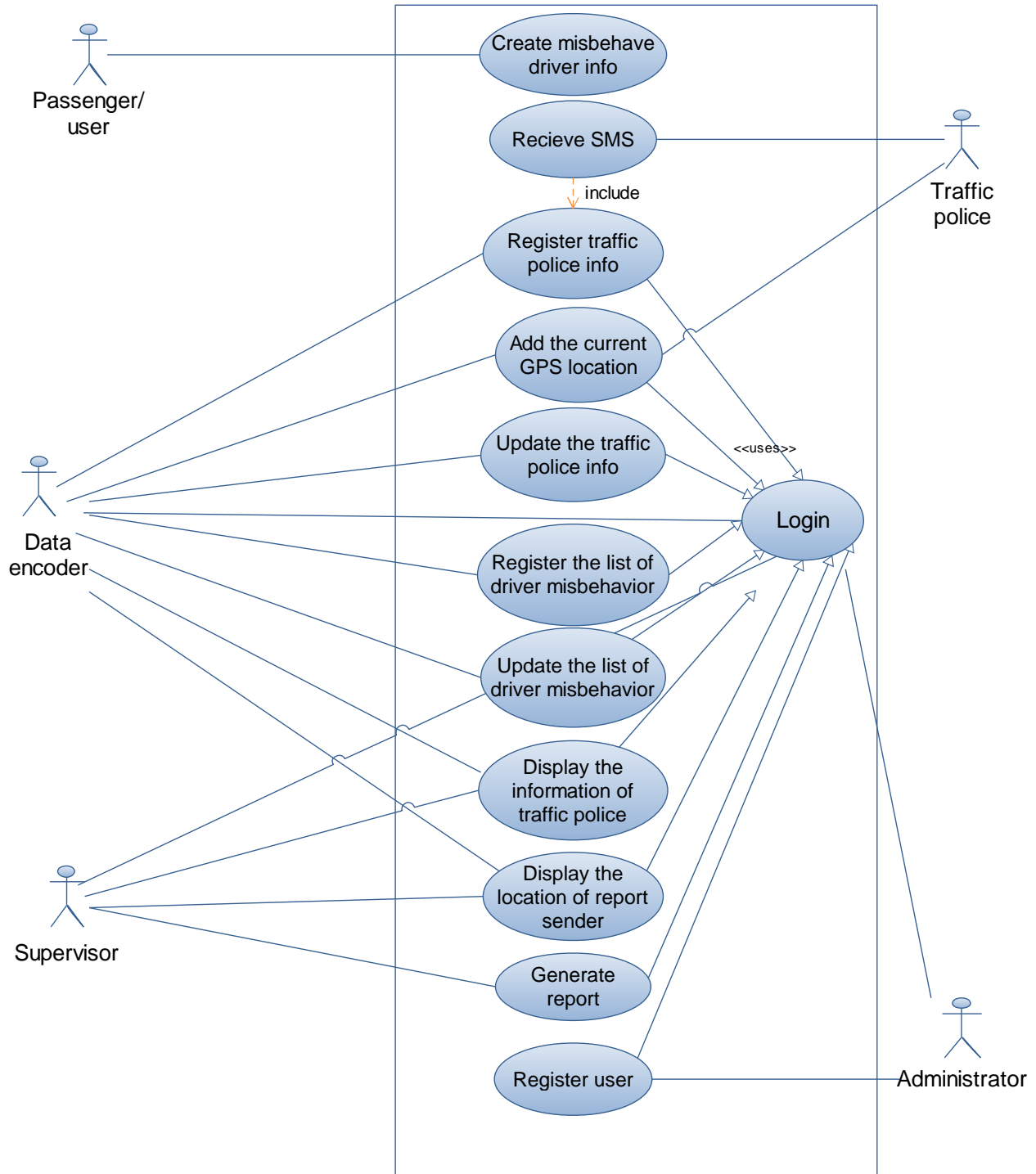


Figure 4 1. Use case diagram

## **Actor Description**

**Actor Name-** Administrator

**Description** – a person who is responsible for the creation of user, manage and assign their roles in the system.

**Actor Name** – Passenger/observer

**Description** – a person who is responsible to send report on driver's dangerous action while traveling from one place to another by public transport or anyone who sees the driver illegal action but not necessarily traveling by the public transport.

**Actor Name** – Traffic Police

**Description** – a person who get SMS from the system about dangerous drivers around his location. Based on the message he gets from his phone, he will take appropriate action on the driver before accident may happen.

**Actor Name** – Data Encoder

**Description** – a person who is responsible for entering and updating data in the system. He/she enters the new incoming data and updates the data which needs to be modified in the database.

**Actor Name** – Supervisor

**Description** – a person who is responsible for displaying the traffic polices location and generates report.

## Use Case Description

*Table 4 1 Login*

Use Case ID	UC-001
Use case Name:	Login
Actors:	Administrator, Data encoder, Supervisor
Purpose:	To login to the system by entering a combination of username and password.
Precondition:	User must exist in system database
Flow of events:	<ol style="list-style-type: none"> <li>1. The actors enter username and password on login page.</li> <li>2. The system checks the user is exist[ALT 2]</li> <li>3. The system displays home page.</li> </ol>
Alternative flow:	<p>[ALT 2]: User account not exists</p> <p>ALT 2.1: the system displays invalid username or password.</p> <p>ALT 2.2: Use case ends</p>
Post Conditions:	User login successfully

*Table 4 2 Register user*

Use Case ID	UC-002
Use case Name:	Register user
Actors:	Administrator
Purpose:	Allows to create the user for using the web based application.
Precondition:	The actor must have an account for login
Flow of events:	<ol style="list-style-type: none"> <li>1. The administrator logs in to the system</li> <li>2. The administrator opens user registration form</li> <li>3. The system displays user registration form</li> <li>4. The administrator fill and submit the form</li> <li>5. The system checks whether the user account exist[ALT 5]</li> </ol>
Alternative flow:	<p>[ALT 5]: User account already exists</p> <p>ALT 5.1: the system displays the account already exists</p> <p>ALT 5.2: Use case ends</p>
Post Conditions:	User is registered

*Table 4 3 Create misbehaving driver information*

Use Case ID	UC-003
Use case Name:	Create misbehaving driver information
Actors:	Passenger/user
Purpose:	Allows to record and report drivers' dangerous action including their location while they drive public transport cars.
Precondition:	The actor must install the mobile application on his smart phone. The GPS application must be on.
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor passenger/user launches the mobile application</li> <li>2. The actor passenger/user downloads the form</li> <li>3. The actor passenger/user opens the form</li> <li>4. The actor passenger/user fills and submit the form</li> <li>5. The report is saved</li> </ol>
Alternative flow:	
Post Conditions:	The system displays the confirmation message

*Table 4 4 Add the current traffic police location*

Use Case ID	UC-004
Use case Name:	Add the current GPS location
Actors:	Data encoder
Purpose:	Allows recording the GPS location of the traffic police.
Precondition:	The actor must install the mobile application on his smart phone. The GPS app should be on.
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor data encoder launch the mobile application</li> <li>2. The actor data encoder download the form[ALT 2]</li> <li>3. The actor data encoder open the form</li> <li>4. The actor capture the longitude and latitude of the current position</li> </ol>
Alternative flow:	
Post Conditions:	The longitude and latitude information should be displayed

*Table 4 5 Recieve SMS*

Use Case ID	UC-005
Use case Name:	Recieve SMS
Actor(s):	Traffic police
Purpose:	The traffic police receive driver misbehavior report when the passenger send driver misbehavior report.
Precondition:	The passenger send the driver misbehave report.
Flow of events:	<ol style="list-style-type: none"> <li>1. The SMS arrival notice is displayed in the phone.</li> <li>2. The Traffic police open the SMS</li> </ol>
Alternative flow:	
Post Conditions:	The SMS displays the drivers and the car information.

*Table 4 6 Register traffic police information*

Use Case ID	UC-006
Use case Name:	Register traffic police information
Actors:	Data encoder
Purpose:	Allows to register a traffic police
Precondition:	The traffic police must be employed in the commission.
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor data encoder logs in to the system</li> <li>2. The actor data encoder clicks the traffic police registration menu</li> <li>3. The system displays the registration form.</li> <li>4. The actor data encoder fills the information and submit.</li> <li>5. The system checks whether the traffic police is registered [ALT 5]</li> <li>6. Traffic police information is saved.</li> </ol>
Alternative flow:	<p>[ALT 5]: Data is already registered</p> <p>ALT 5.1: the system displays the data is already exist</p> <p>ALT 5.2: use case ends</p>
Post Conditions:	Data saved successfully message displayed

*Table 4 7 Update the location of traffic police*

Use Case ID	UC-007
Use case Name:	Update the traffic police information
Actors:	Data encoder
Purpose:	Allows to update the traffic police information including their location
Precondition:	The traffic police must be assigned on some place first.
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor data encoder logs in to the system</li> <li>2. The actor data encoder clicks the traffic police menu</li> <li>3. The system displays the traffic police update form.</li> <li>4. The actor data encoder search the traffic police that going to be change[4]</li> <li>5. Traffic police information saved.</li> </ol>
Alternative flow:	<p>[ALT 4]: traffic police is not registered</p> <p>ALT 4.1: The system displays empty</p> <p>ALT 4.2: use case ends</p>
Post Conditions:	Data saved successfully

*Table 4 8 Register the list of the driver misbehavior*

Use Case ID	UC-008
Use case Name:	Register the list of the driver misbehavior
Actors:	Data encoder
Purpose:	Allows to register the list of drivers' misbehavior
Precondition:	Gather and prioritize the list of drivers' misbehavior
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor data encoder logs in to the system</li> <li>2. The actor data encoder clicks the add the drivers' misbehavior</li> <li>3. The system displays the drivers' misbehavior form.</li> <li>4. The actor data encoder fills and submit the form</li> <li>5. The actor data encoder checks the drivers' misbehavior is registered [ALT 5]</li> <li>6. Driver misbehave information is saved.</li> </ol>
Alternative flow:	<p>[ALT 5]: Data is already registered</p> <p>ALT 5.1: the system displays the data is already exist</p> <p>ALT 5.2: use case ends</p>
Post Conditions:	Data saved successfully

*Table 4 9 Update the main cause of accident*

Use Case ID	UC-009
Use case Name:	update the driver's misbehavior
Actors:	Data encoder
Purpose:	Update the driver's misbehavior that mostly done in public transport drivers
Precondition:	The list of driver's misbehavior registered first
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor data encoder logs in to the system</li> <li>2. The actor data encoder clicks the driver's misbehavior menu</li> <li>3. The system displays the driver's misbehavior form.</li> <li>4. The actor data encoder check the driver's misbehavior is registered before[ALT 4]</li> <li>5. Data is saved</li> </ol>
Alternative flow:	<p>[ALT 4]: Data is not registered</p> <p>ALT 4.1: The system displays empty</p> <p>ALT 4.2: use case ends</p>
Post Conditions:	Data updated successfully confirmation is displayed

*Table 4 10 Display the information of traffic police*

Use Case ID	UC-010
Use case Name:	Display the information of traffic police
Actors:	Data encoder, Supervisor
Purpose:	Display the traffic police detail information who registered in the system
Precondition:	The traffic police information including the location is exist in the system
Flow of events:	<ol style="list-style-type: none"> <li>1. The actors log in to the system</li> <li>2. The actors open the form which displays the traffic police information</li> <li>3. The system checks the traffic police is exist [4]</li> <li>4. The system displays the form which shows the information of the traffic police</li> </ol>
Alternative flow:	<p>[ALT 4]: Data is not registered</p> <p>ALT 4.1: The system displays nothing</p>
Post Conditions:	The form which contain the traffic police information is displays

*Table 4 11 Display the location of report sender*

Use Case ID	UC-0011
Use case Name:	Display the location of report sender
Actors:	Data encoder, Supervisor
Purpose:	Display the location of the report sender on the map
Precondition:	The traffic police information including the location exist in the system
Flow of events:	<ol style="list-style-type: none"> <li>1. The actors logs in to the system</li> <li>2. The actors open the form which displays the location of the report sender</li> <li>3. The system displays the map which shows the location of the report sender</li> </ol>
Alternative flow:	
Post Conditions:	The map which contains the report sender location is displayed

*Table 4 2 Generate report*

Use Case ID	UC-0012
Use case Name:	Generate report
Actors:	Supervisor
Purpose:	Generate misbehave driver report send by the user
Precondition:	Reported data must exist
Flow of events:	<ol style="list-style-type: none"> <li>1. The actor supervisor logs in to the system</li> <li>2. The actor supervisor opens the report form</li> <li>3. The system requests the report type</li> <li>4. The actor supervisor fill the request and submit</li> </ol>
Alternative flow:	
Post Conditions:	The report data is displayed

### 3.4.2 Class Diagram

Class diagrams describe the structure of the system in terms of classes and objects. Classes are abstractions that specify the attributes and behavior of a set of objects whereas objects are entities that encapsulate state and behavior.

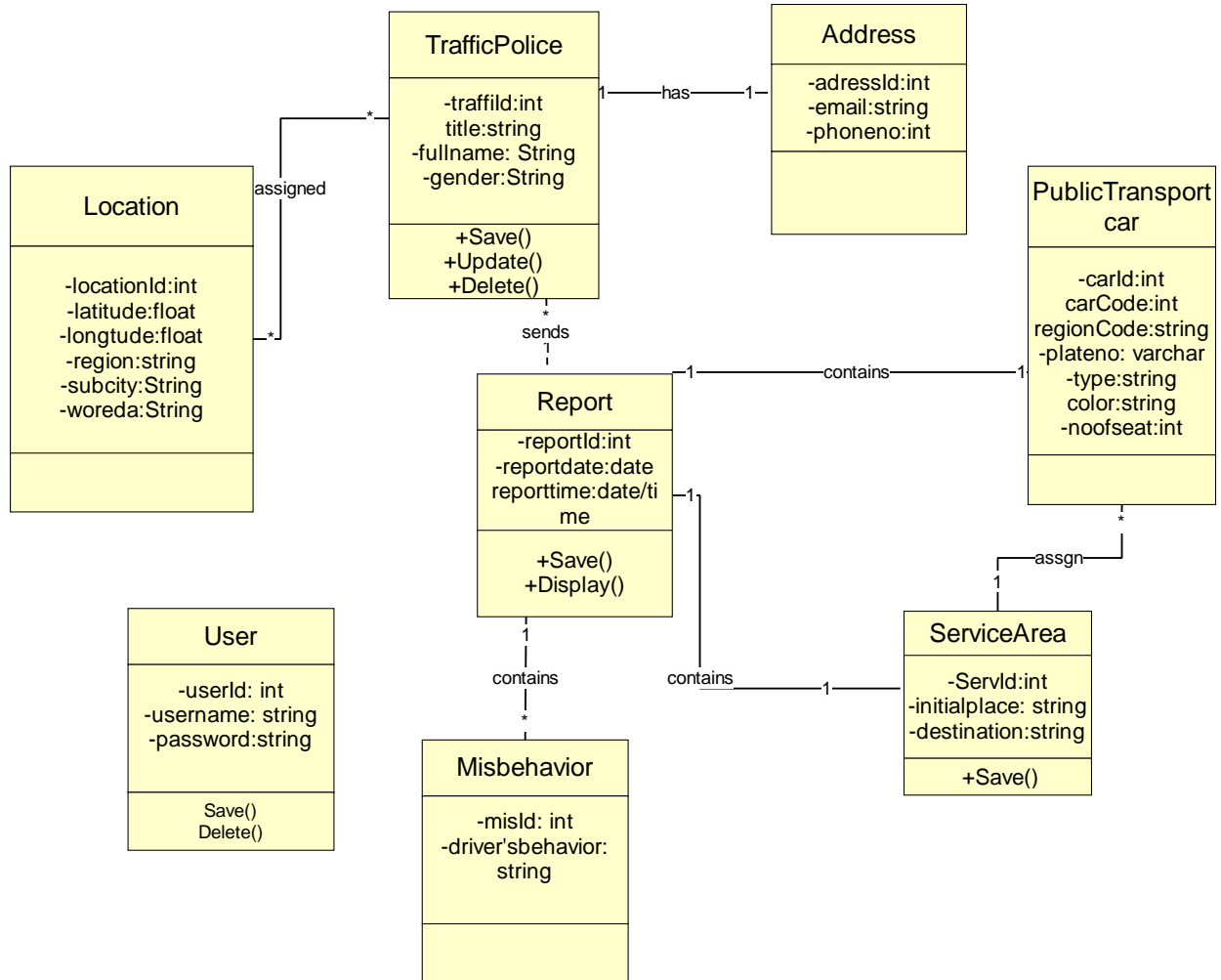


Figure 4 2 Class diagram

The report class will have the report date and time of a report send by the passenger. The report class has a relationship between the public transport car class which holds the car information, the service area class which holds the route of the public transport car and misbehaviour class which holds the driver misbehaviour while he/she drives. The traffic police class will have the profile of the traffic police and has relation with address class which holds the address of traffic police and location class which indicates the standing location of the traffic police. The user class will have the login information who can access the system.

### 3.4.3 Sequence Diagram

Sequence diagrams model the flow of logic within the system in a visual manner, enabling us both to document and validate our logic, and are commonly used for both analysis and design purposes. Sequence diagrams are the most popular UML artifact for dynamic modeling, which focuses on identifying the behavior within the system.

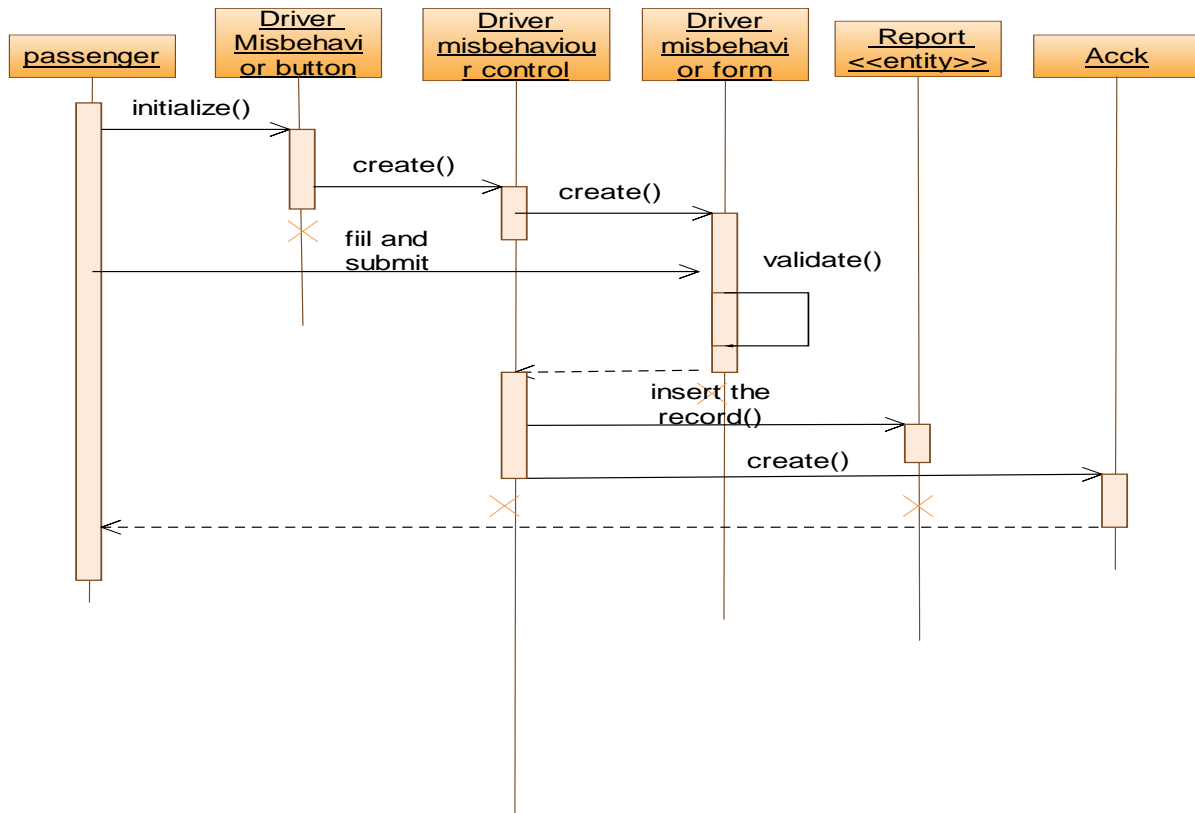


Figure 4.3 Add misbehaving driver information use case

N.B . The top line contains objects: boundary, control and entity

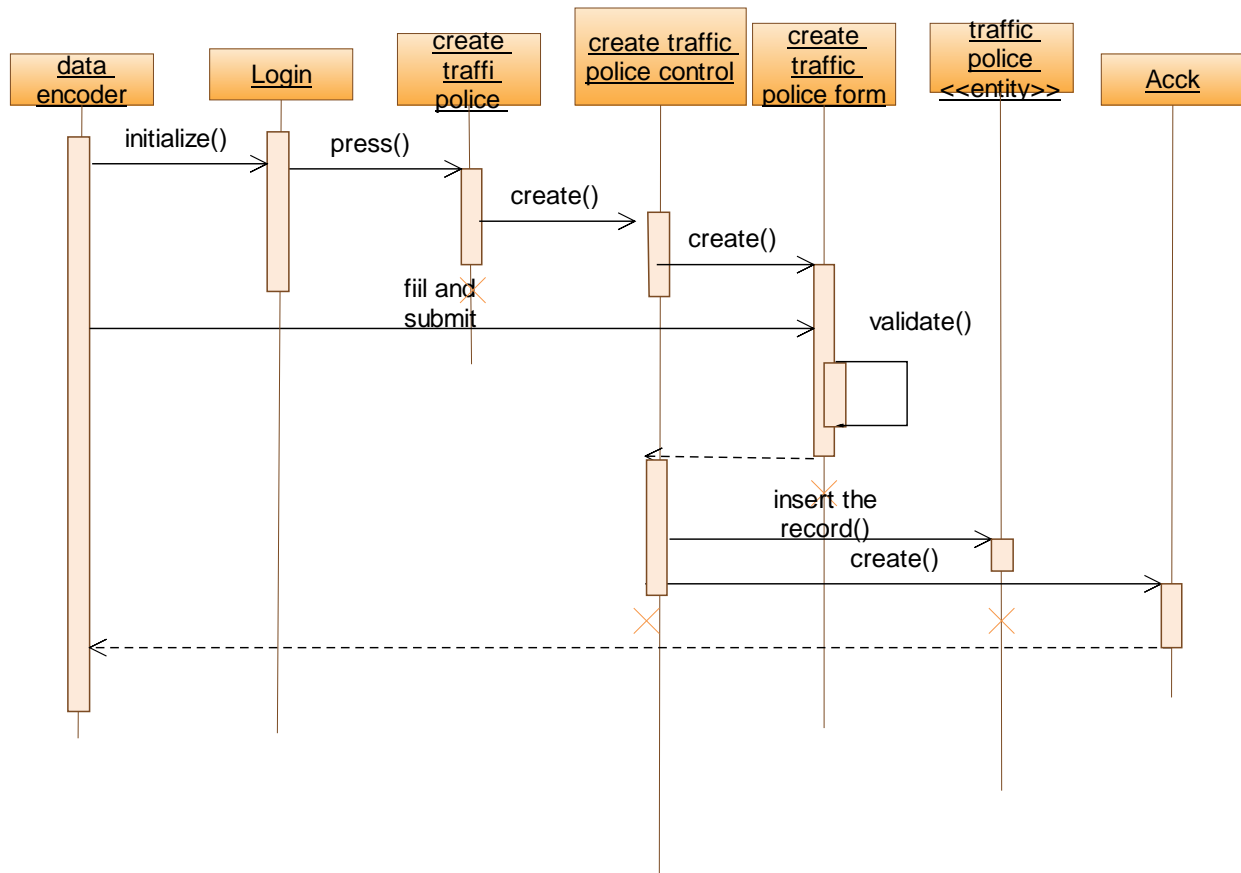


Figure 4 4. Registration of traffic police use case

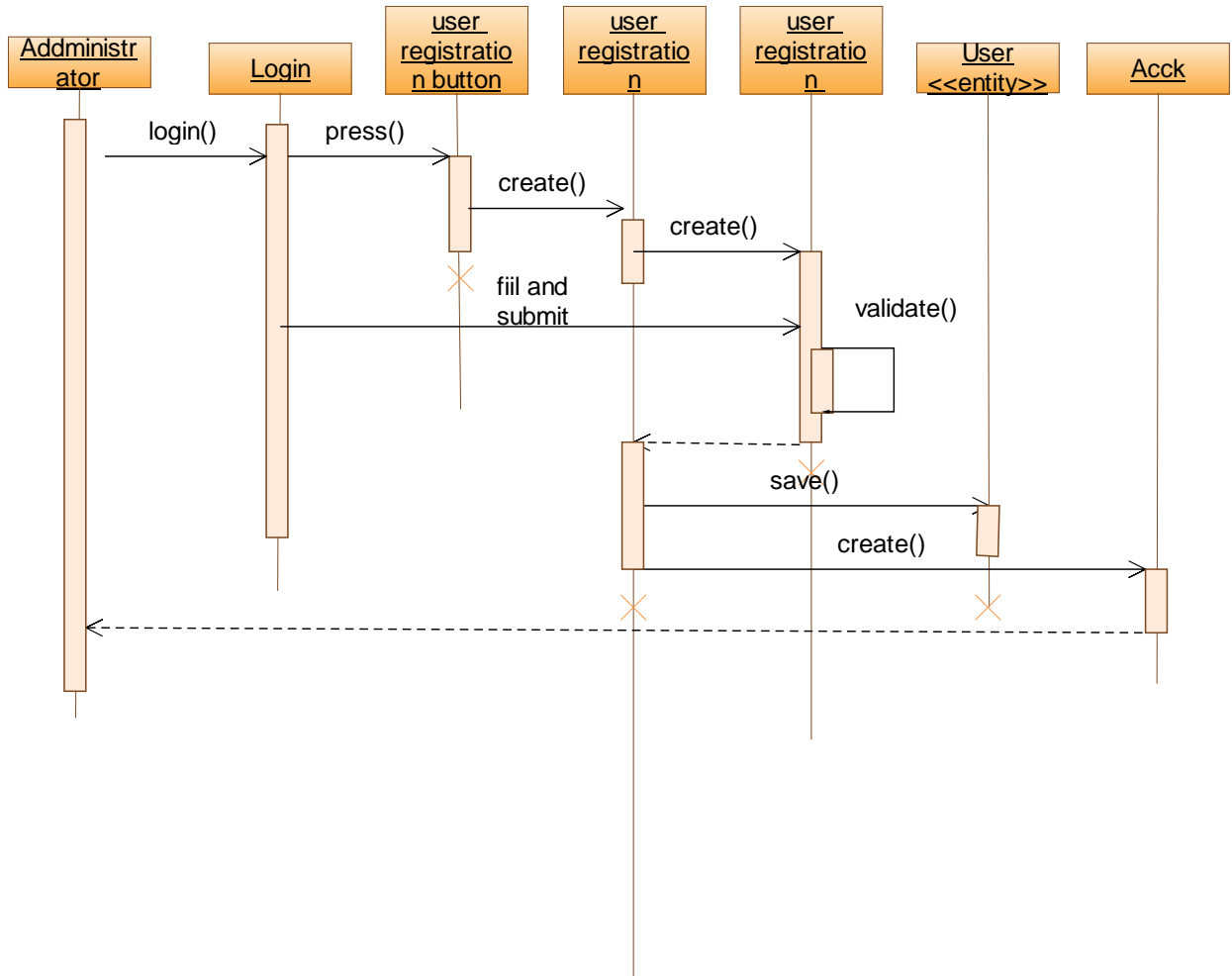


Figure 4.5. Register user use case

Other sequence diagrams for the use case are given in Annex A and Annex B.

## Chapter Five: System Design

The proposed system is designed based on the functional and non-functional requirements and analysis models defined in the previous Chapter. Consequently, the design goals, architecture, subsystem decomposition, deployment diagram, persistent data management of the new system have been identified, designed and presented in this section.

### 5.1 Design Goal

Design Goals describe the qualities of the system that developers should optimize. Such goals are normally derived from the non-functional requirements of the system that are written in the system analysis document. In this particular project, the following design goal have been identified to be realistic.

- **Response Time:** The system will provide as fast response as possible, at least before the public transport car reach to its destination. In order to minimize the time to response, good internet connection is required.
- **Throughput:** The system will support a number of users at a time using the available bandwidth of the system. Since the system is using mobile application, it has to demand minimal memory and reasonable processing power so that any user can access it simultaneously with available resources unless there are hardware and Internet connection constraints.
- **Reliability:** To make the system reliable, thorough testing will be done.
- **Availability:** The system will serve the user at any point in time without interruption as long as there are internet connection and active GPS.
- **Extensibility:** The system needs to be built considering possible mechanisms for expanding or enhancing the system to gain new capabilities without making major changes to the system structure.
- **Portability:** The system can be easily portable to different platforms.
- **User Interface:** In order to make the system user friendly and easy to use, easily navigate-able visual interface and interactive features will be implemented. So, the system should provide user friendly and self-explanatory graphical user interface that eases the interaction of the user with the system.

## 5.2 Architecture

The architecture of the misbehaving public transport drivers reporting system is designed to be client-server application that encloses three layers, namely Client Layer, Business Layer and Data Layer, as depicted in Figure 5.1.

Layered architectural style is appropriate for the general structure of this system because the business processes need to access different services from service providers through interfaces given by these providers.

**Client layer** - is the applications user interface that encloses administrative registration, deletion, views, modify the data on client side application that are running on the web browser of user machine. The system administrator and other users of the system directly interact with the system through graphical user interface. This layer interacts with the business layer to make requests to display the information that is retrieved from the data layer and service layer to get the current map.

**Service Layer** – is a service provider to prepare data service to the client layer. There are two services available in this layer; the first service is map service which is useful to get the current map of Addis Ababa. The second one is SMS(short message service) which is used for sending short message to traffic polices' phone.

**Middle Layer**- The middle layer contains web server, import system and the business logic. The web server handles all the HTTP and HTTPS requests coming from the client machines. It also manages the responses that are forwarded to the client machines. The import system is responsible to retrieve data from report data capturing system using restful service. The business logic component is responsible for handling all the core functionalities of the system such as input validation, performing calculations, report generation, access and retrieval of any data required by the client.

**Data layer** - The data tier is responsible to store the actual data in the database. It is implemented using MongoDB database. The database should be stored on a separate machine to facilitate the interaction with both the web server and the Import system.

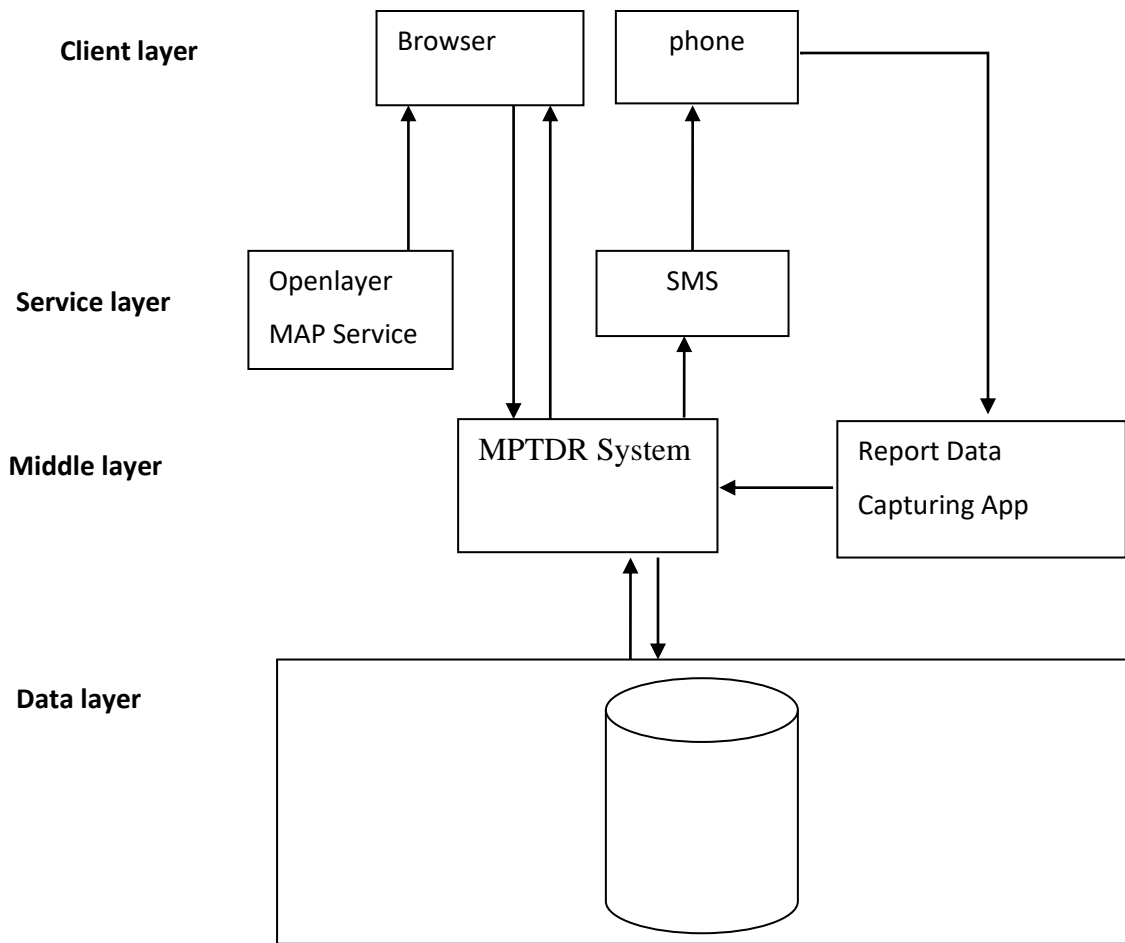


Figure 5.1 Architecture of MPTDRS

### 5.3 Subsystem Decomposition with Services

A system is decomposed into subsystems in order to decrease the complexity of a system so that it will be manageable for implementation. MPTDRS is decomposed into subsystems as shown in figure 5.2.

As a result:

- Highly related classes/objects or objects identified in one use case were assigned into the same subsystem
- Objects used for moving data among subsystems will be placed in a dedicated subsystem
- The system will have a minimal number of associations crossing subsystem boundaries
- All objects in the same subsystem should be functionally related

These criteria in general bring high cohesion and low coupling which enhances performance of the system. The sub systems are: Registration Subsystem, User Interface, Capture/calculate location Subsystem, Report data capturing Subsystem, Misbehave drivers' management Subsystem, Report Subsystem, User management Subsystem.

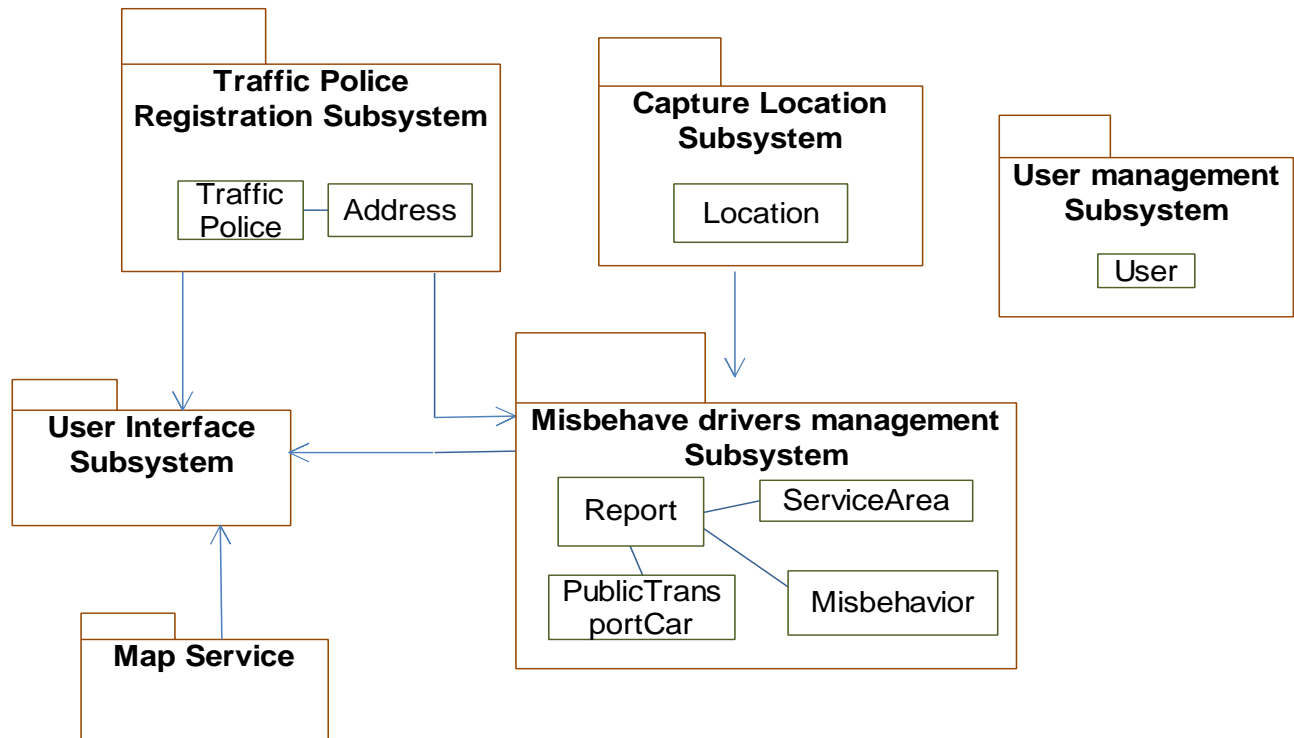


Figure 5 2 Subsystem decomposition

**Traffic Police Registration Subsystem** – The subsystem responsible to manage the information about the traffic polices and their address.

**User Interface Subsystem**– the subsystem provides UI components for displaying and editing contents. It enables the user to see the traffic police location and the information sent by the passenger/user on the map using browser.

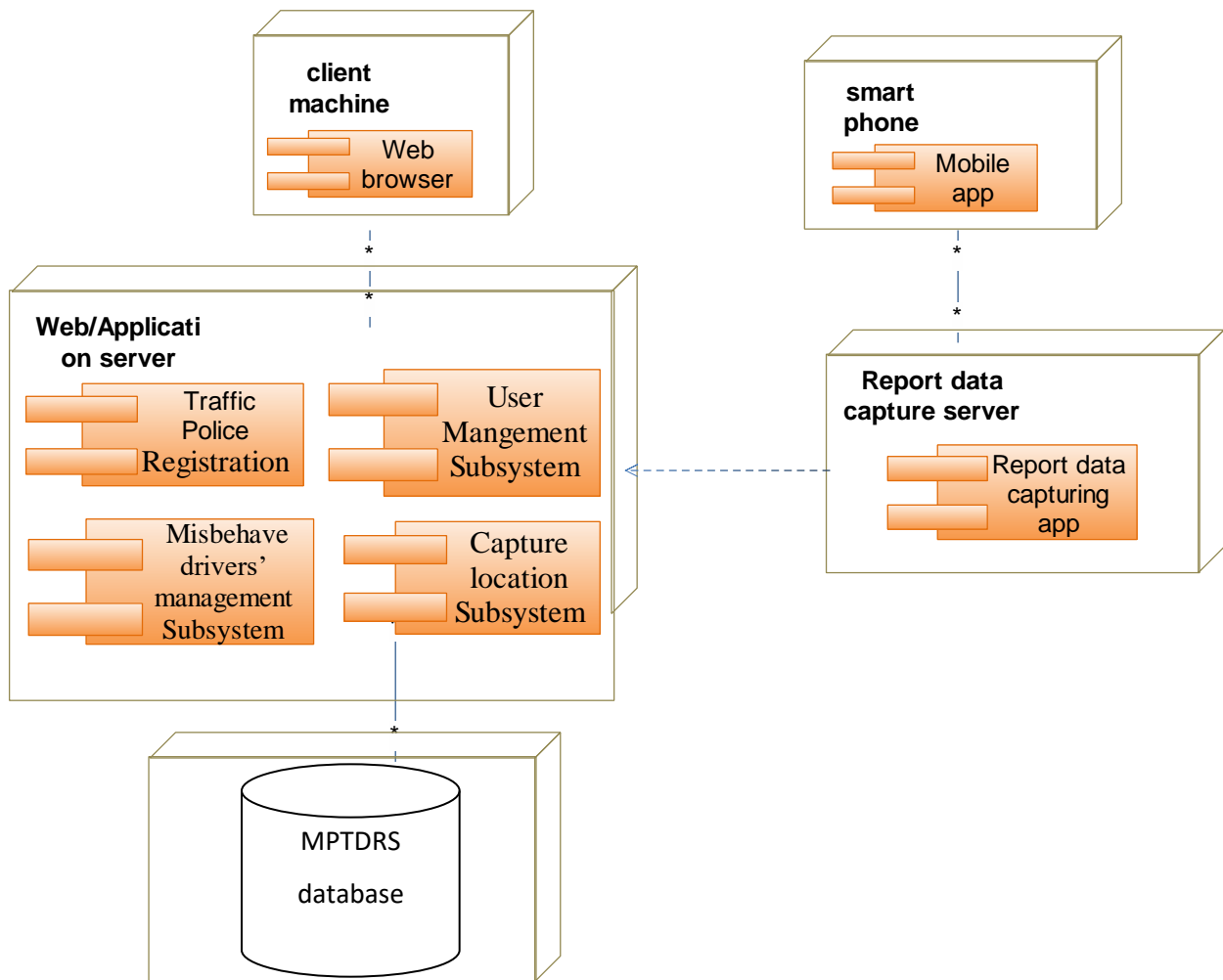
**Capture Location Subsystem** - The subsystem is responsible to get the location of the report sender and compare the sender location against the nearest traffic police location.

**Misbehave Drivers' Management Subsystem** – the subsystem is responsible to retrieve data from report data capturing subsystem and manage the information of misbehave public transport drivers and their dangerous action while they drive.

**User management Subsystem** - The sub system manages information about user registration and assign role to the user. It provides methods to add update and search information for the mentioned activities.

#### 5.4 Hardware/Software Mapping

This section shows the relationship among the nodes and the components in the system. The system contains three hardware components; the client machine, the application server machine and the database server machine. The client machine contains the web browser that enables system users to access the application server according to their privilege through HTTP/HTTPs. The application server or the web server contains the application logic and uses Nodejs to handle requests send from users through HTTP/s. And finally there is the database server that is used to perform tasks such as data analysis, storage, data manipulation, archiving, and other non-user specific tasks. The database server uses document database which is Mongodb. The data access from the database server using the application server is performed by using server side javascript. Figure 5.3 depicts the deployment diagram of MPTDRS.



*Figure 5 3 Deployment diagram*

The above figure shows the deployment of MPTDRS. The odk collect mobile application should be installed on the smart phone to send the misbehave drivers report. The report sent by the passenger can be captured by report data capturing application deployed on the report data capturing server. The MPTDRS web application will be installed on the web application server to fetch the report data, save into database and provide necessary data for client machine. The web browser should be installed on client machine to access the web application using the specified URL. The MPTDRS database should be installed on the server to store the data.

## 5.5 Persistent data management

Persistent data management deals with how the persistent data are stored and managed. Information related misbehave public transport drivers and other related information are persistent data and hence stored on a database management system. Moreover, storing data in a database enables the system to perform complex queries on large data sets. In order to store data persistently in a database those class objects identified in the class diagram of MPTDRS are mapped into tables and the attributes into fields to the respective tables. The tables of the system with their respective fields and the relationships that exist between the tables are illustrated in Figure 5.4.

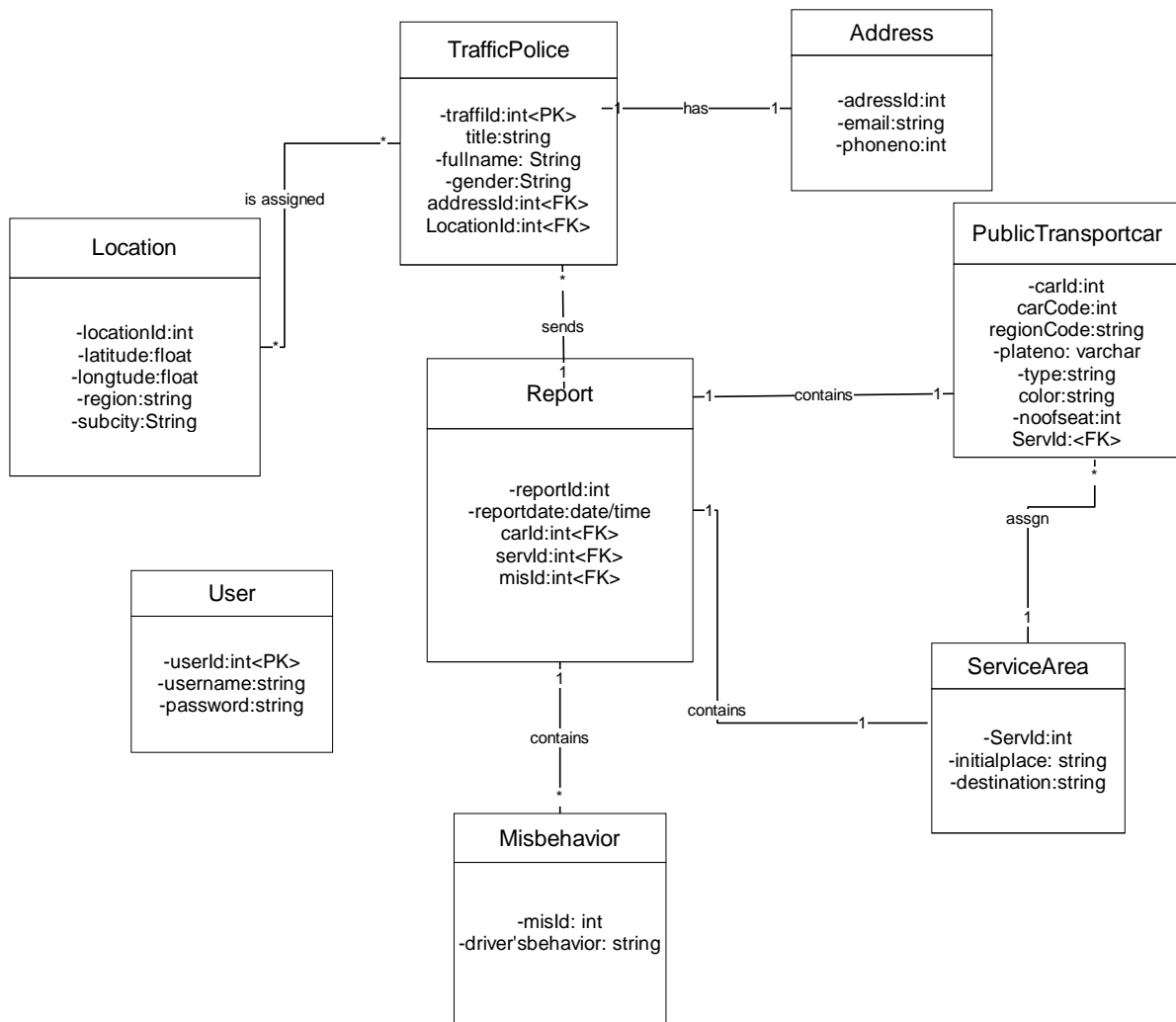


Figure 5 4 Table Relationship

There are eight table in MPTDRS. The report table stores data about the report date, time, the related foreign key of public transport car table which stores the car information, service area table which store the initial and destination of the car, and misbehave table which stores the misbehavior of the drivers. The traffic police table stores the profile of traffic police and the foreign key of address table which store the phone number and email address of the traffic police, and location table which store the gps location and area name of the traffic police standing location. The user table store the username and password of the user who can access the system.

### 5.6 Access Control and Security

Access control is a security technique that can be used to regulate who or what can view or use resources in a MPTDRS.

Table 5 1 Access Control Matrix for MPTDRS

Subsystem	Class	Operation	Actors		
			Data Encoder	Manager	System Admin
Registration	TrafficPolice	RegisterTrafficPolice ()	√		
		Search TrafficPolice ()	√		
		Update TrafficPolice ()	√		
		Delete TrafficPolice ()	√		
	Address	SaveAddress ()	√		
		EditAddress ()	√		
		SearchAddress()	√		
		DeleteAddress():		√	
Misbehave Drivers Management	Misbehavior	SaveMisbehavior ()	√		
		SearchMisbehavior ()		√	
		UpdateMisbehavior ()	√		
User Management	User	RegisterUser ()			√
		SerachUser ()			√
		UpdateUser()			√
		DeleteUser()			√

## Chapter six: Implementation

This chapter discusses the System Development Environment and Tools, System Presentation and Testing and Evaluation of the system.

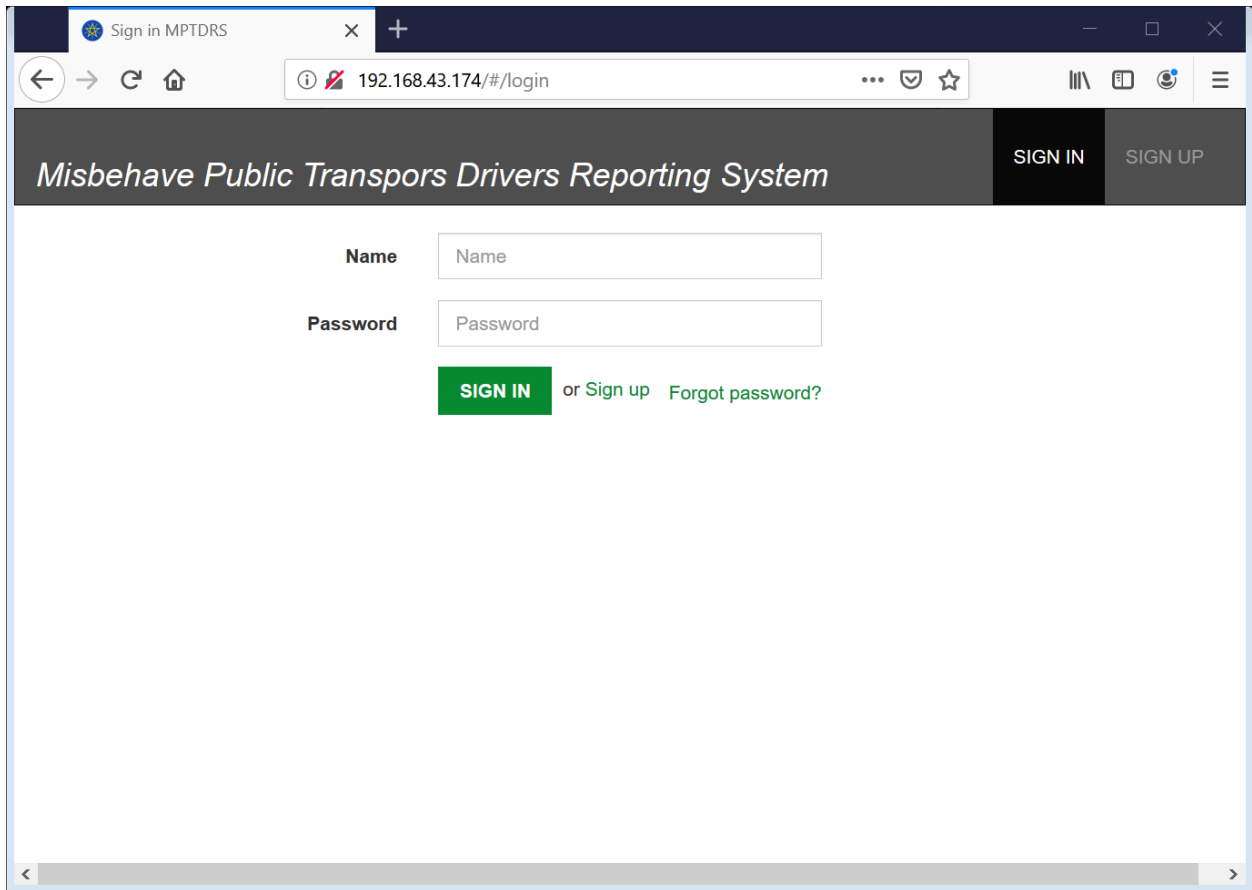
### 6.1 Development Environment and Tools

To develop the prototype which can meet the design goals of MPTDRS, different tools and platforms have been used.

- ✓ Node.js - is server side java script programming used for accessing data from data collection application and the development of MPTDRS. It is mostly used for this kind of real time application.
- ✓ MongoDB - is used as a database management system to store data of MPTDRS. MongoDB is no-sql database or document oriented database.
- ✓ Formhub –is open source and used widely to collected data from anywhere. We used this data collection application to collect submitted data from passenger.
- ✓ ODK Collect- is a mobile application used to download, fill and submit the report to the formhub.
- ✓ MS-Excell – is used for designing the questions to be uploaded in to formhub. The passengers will later download from formhub to fill and submit the drivers bad behaviors.

### 6.2 Screenshots of the Web application

**Login Page:** is the first page when we access the MPTDRS using the domain name or the IP address. Figure 6.1 shows the Login page of the system.



*Figure 6 1 Login page*

**Home Page:** When a user logs in to the system he/she will see the home page as shown in Figure 6.2.

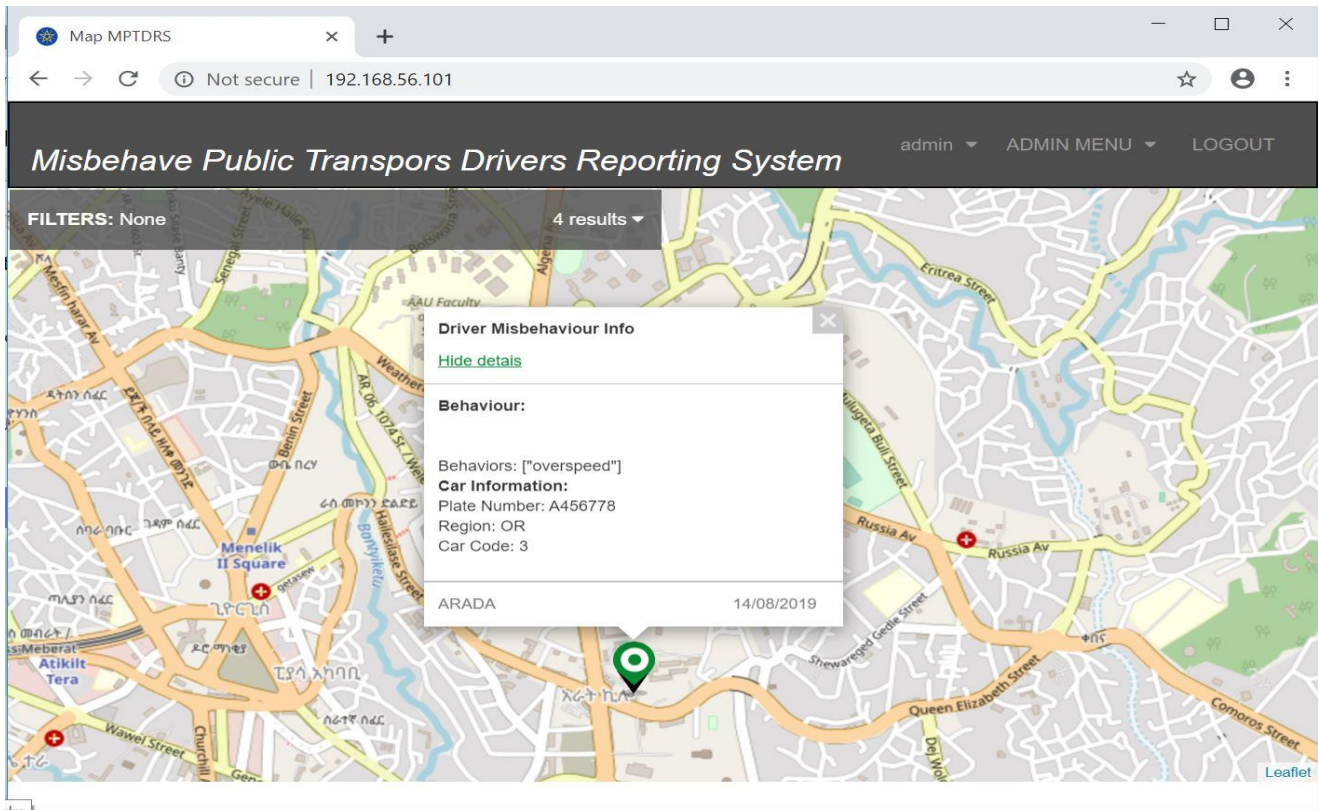


Figure 6 2 Home page

### Behavior Page:

The behavior page Figure 6.3 displays the list of bad behaviors that is occurred in the public transport drivers and also allow to add new bad behavior.

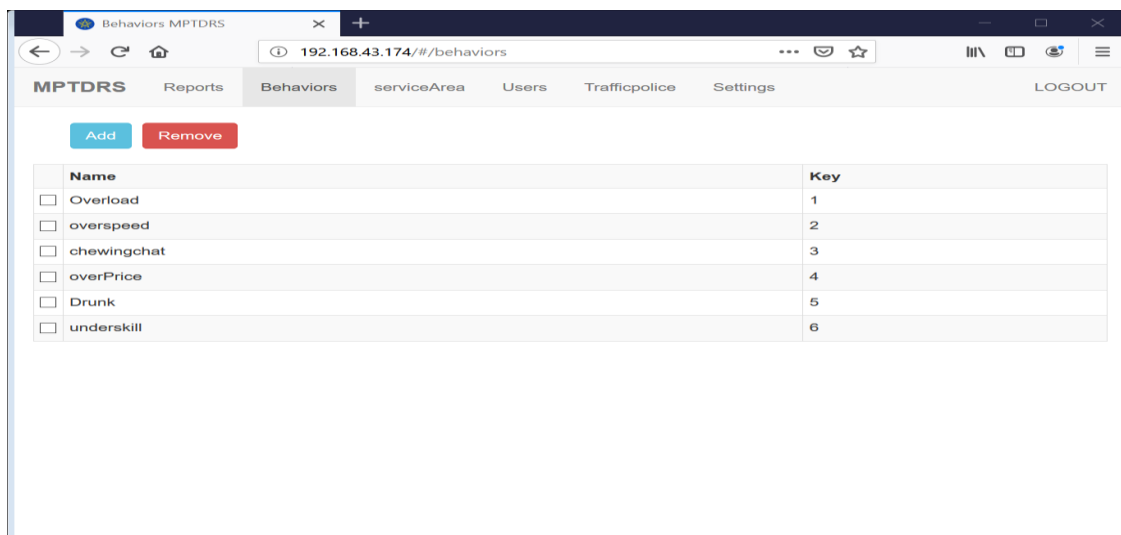


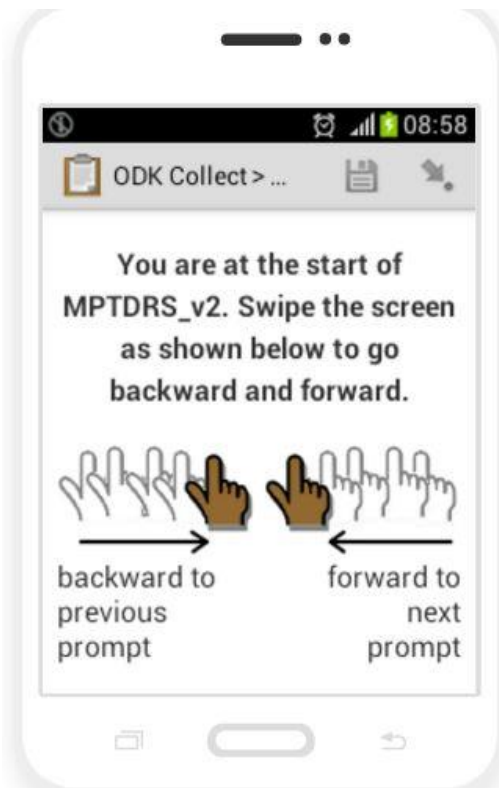
Figure 6 3 Behavior page

**Traffic Police Page:** When the user clicks on the traffic police menu, the list of traffic police o will be displayed.

**Report page:** The following report page displays when the user select the report menu, the report page holds the detail submitted data.

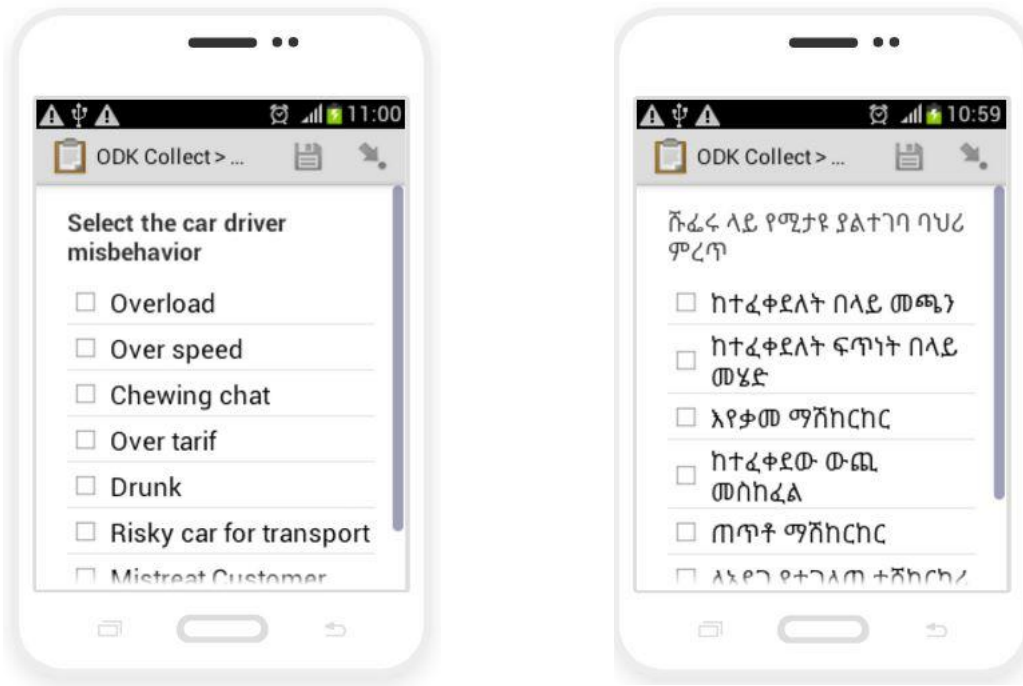
### 6.3 Screenshots of the Mobile Phone Application

ODK collect mobile application home page



*Figure 6 4 ODK collect app home page*

After the passenger install ODK collect in the mobile phone and, when the form open, the following question will be displayed. The report sender can choose English or Amharic language.



*Figure 6 5 Information displayed in the mobile phone*

**The SMS message:** The SMS message is sent to traffic polices phone that found with in 3 miles from the sender when the passenger submits the report.

## 6.4 Testing and Evaluation

To test whether the system fulfills the objective and realize the system for use, testing and evaluation activities are performed as follows.

### 6.4.1. Platform Testing

The system is tested whether it works efficiently or not on different Android platform mobile devices. This system has been tested on different android version in samsung and techno phone. So the result shows that it works effectively on android versions 4.1 and above on the mentioned mobile phones.

### 6.4.2. Usability Testing

We conducted usability tests to evaluate the mobile application interface and its functionalities. This study explores and maps experiences regarding the interaction of end users with the system.

Usability testing is performed by selecting users, phone apparatus, and representative tasks which are related to MPTDRS. Totally 15 volunteer respondents are chosen to evaluate the system using their phone. The questionnaire contains 10 questions as describe in the Table 6.1.

In the prototype evaluation, Addis Ababa police commission employees were involved. The participants were chosen considering their knowledge of the basics of computer. We have used 4 expert participants. Before conducting the evaluation process, detailed description about the prototype has been given to the participants as it helps them in having an insight to the system. After the demonstration of the prototype, participants were provided with respective questionnaires as described in the Table 6.3. A five level scale (strongly agree (5), agree (4), less agree (3), disagree (2) and strictly disagree (1)) is used for the responses of the questions because it is easy to interpret.

After getting response from users through the questionnaire, we calculated each scale of questionnaire. Table 6.1 summarizes the respondents’ result of the system questionnaire of each question.

*Table 6 1 Questionnaire For Mobile Application user*

<b>No</b>	<b>Questions</b>
1	The questions in the mobile application clear and easy to understand.
2	The mobile application easy to use.
3	The user interface of the mobile application is pleasant.
4	I can easily identify my current geo location on mobile application using GPS.
5	The response time of the mobile application is reasonable.
6	I fill and send report quickly using the mobile application.
7	A confirmation message is displayed on saved and send the report.
8	The mobile application validates the data entered.
9	The software is helpful to solve public transport problems.
10	I can easily send a report using mobile application with minimum Internet cost.

*Table 6 2 mobile app usability scale score*

Question No	User1	User2	User3	User4	User5	User6	User7	User8	User9	User10	User11	User12	User13	User14	User15	Average
Q1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	<b>5</b>
Q2	5	4	5	4	4	4	5	5	4	5	5	5	5	5	5	<b>4.67</b>
Q3	5	5	4	5	5	5	5	4	5	4	4	5	5	5	4	<b>4.67</b>
Q4	4	3	3	4	4	4	4	4	3	3	4	3	3	4	4	<b>3.6</b>
Q5	5	4	5	4	4	5	5	5	4	4	5	5	4	5	5	<b>4.6</b>
Q6	4	3	5	4	4	4	4	4	4	5	4	4	4	3	4	<b>4</b>
Q7	4	5	5	5	5	4	4	4	4	5	5	5	5	5	5	<b>4.67</b>
Q8	5	5	5	4	5	5	5	5	4	5	5	5	5	5	5	<b>4.87</b>
Q9	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	<b>5</b>
Q10	4	5	5	5	5	4	5	5	5	4	4	4	5	5	4	<b>4.6</b>

We can see from the above two tables (Table 6.1 and 6.2) that the most important functions of the mobile application are tested. And the mobile application usability score table also shows that the average score of usability test is satisfactory which means all question except 1 get above 4 points.

*Table 6 3 Questionnaire For Web Application user*

No	Questions
1	The web application can work on different browsers like (Chrome, firefox, internet explorer).
2	I find the graphical user interface of the web application pleasant.
3	I find the web application response time fast.
4	A confirmation message is displayed on insert, update and delete operation.
5	The system gives error messages that clearly tell me what I did wrong.
6	The web application validates the data entered.
7	The system provides all its functionalities.
8	The menu items are well organized.
9	The system generates the required report.
10	The map shows the locations properly.
11	I find the system functioning smoothly and is well integrated.

*Table 6 4 Web application usability scale score*

Question No	User1	User2	User3	User4	Average
Q1	5	5	5	5	<b>5</b>
Q2	5	4	5	5	<b>4.75</b>
Q3	5	5	4	4	<b>4.5</b>
Q4	5	4	4	5	<b>4.5</b>
Q5	4	4	4	4	<b>4</b>
Q6	4	4	4	4	<b>4</b>
Q7	5	5	4	5	<b>4.75</b>
Q8	5	5	5	5	<b>5</b>
Q9	5	5	5	5	<b>5</b>
Q10	5	5	5	5	<b>5</b>
Q11	5	5	5	5	<b>5</b>

We can see from the above two tables (Table 6.3 and 6.4) that the most important functions of the web application are tested. And the web application usability score table also shows that the average score of usability test is more than satisfactory.

## **Chapter Seven: Conclusion and Future Work**

### **7.1 Conclusion**

The people who use the smart phone are grow up in Ethiopia because the latest smart phone functions are almost similar to computes. These smart phones make peoples life easier on their day to day activity. Some of the feature of this smart phone are, built-in GPS (Global positioning system) device which use to determine the current position, sensors, internet access and have the ability to download and use different free applications.

In Addis Ababa city, passenger mentions different problems of public transport drivers' bad behavior while they are travel from one place to another. In addition to inappropriate behavior of the drivers, the passenger may face to accidents because of the drivers' fault.

In this project, the problem is identified, performed requirement analysis and we have developed a system. The developed system reduces the problem and accident of public transport users by providing the platform on the smart phone to help them to report bad behaviors of the public transport drivers to traffic police while they travel from one place to another.

The prototype of this project has been tested on different android apparatus with different users and the web application also tested by Addis Ababa police Commission IT experts. The result shows that the project can reduce the problem of passengers as well as traffic accidents if the user submit the data on actual problems.

According to Addis Ababa Police Commission expert opinion the system should include roads and transport bureau because they have officers who controls public transport drivers like traffic police. They also mention some of the drivers misbehaving actions are difficult to control, like Over speed, the drivers can only be questioned when the speed can be captured on that moment, or the evidence may be needed.

Except the mentioned behaviors, the project can solve the problem of the people who uses public transport according to the expert's opinions.

Users of public transport said that, they face different problems every day on public transport drivers specially on minibus taxi. If such kind of system implemented, it can reduce our daily problems as well as accidents.

## 7.2. Future Work

The proposed misbehave public transport drivers reporting system can be enhanced by including the following feature for better benefits and efficiency.

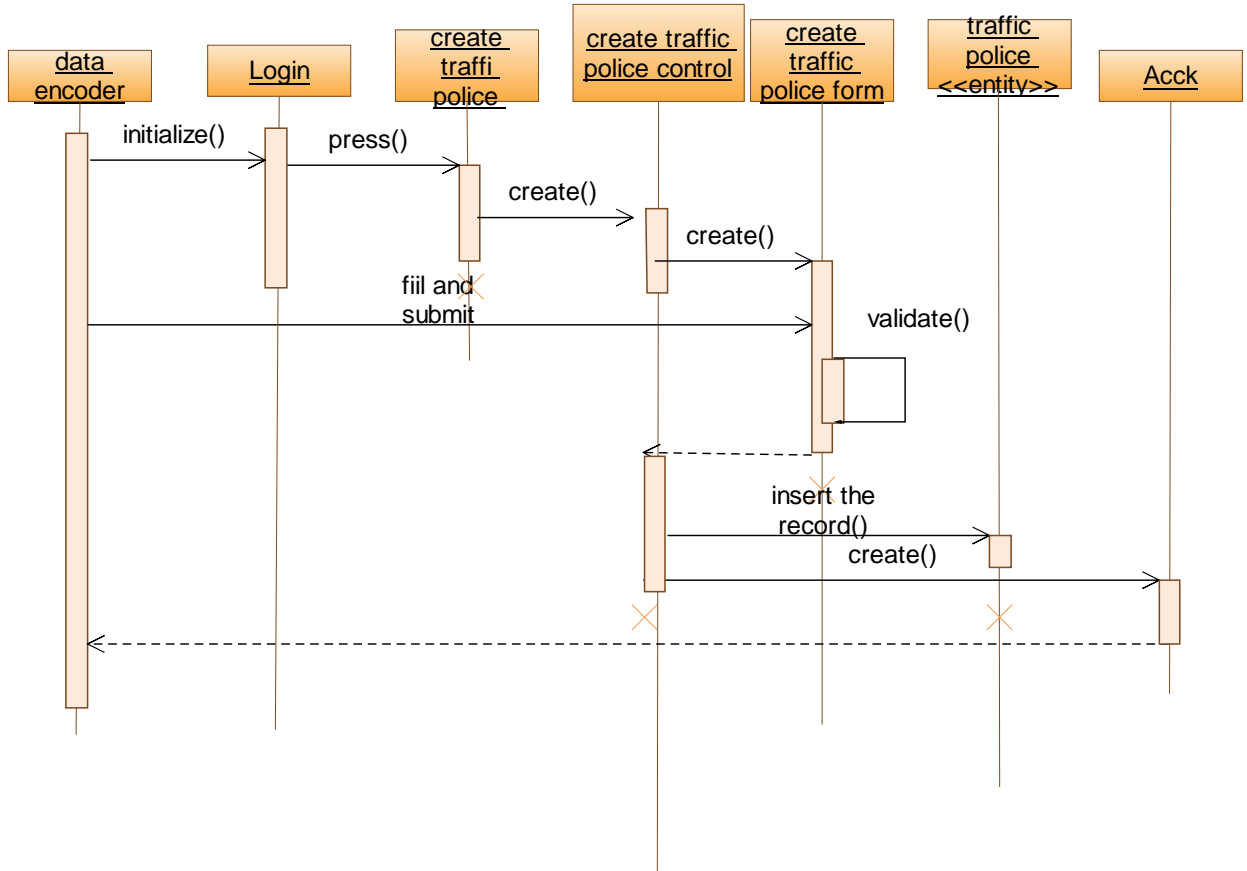
- ✓ Integrate with penalty system
- ✓ Including cars other than public transport
- ✓ Extended in all regions

## References

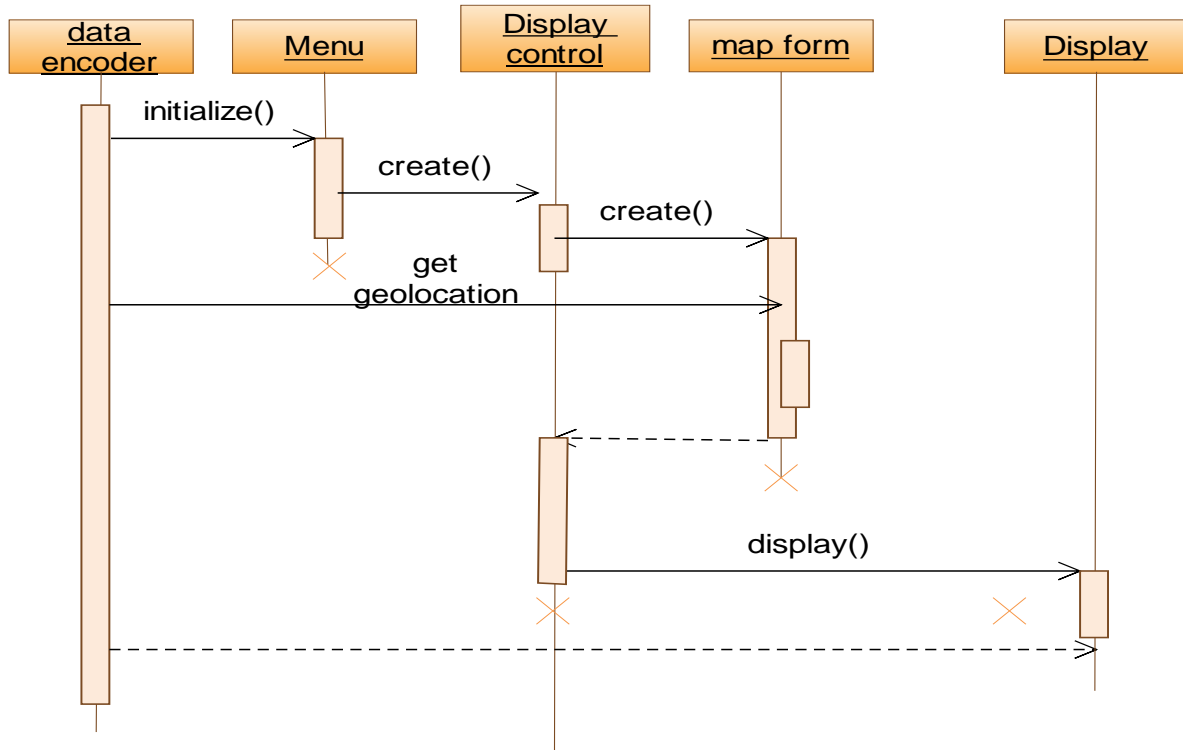
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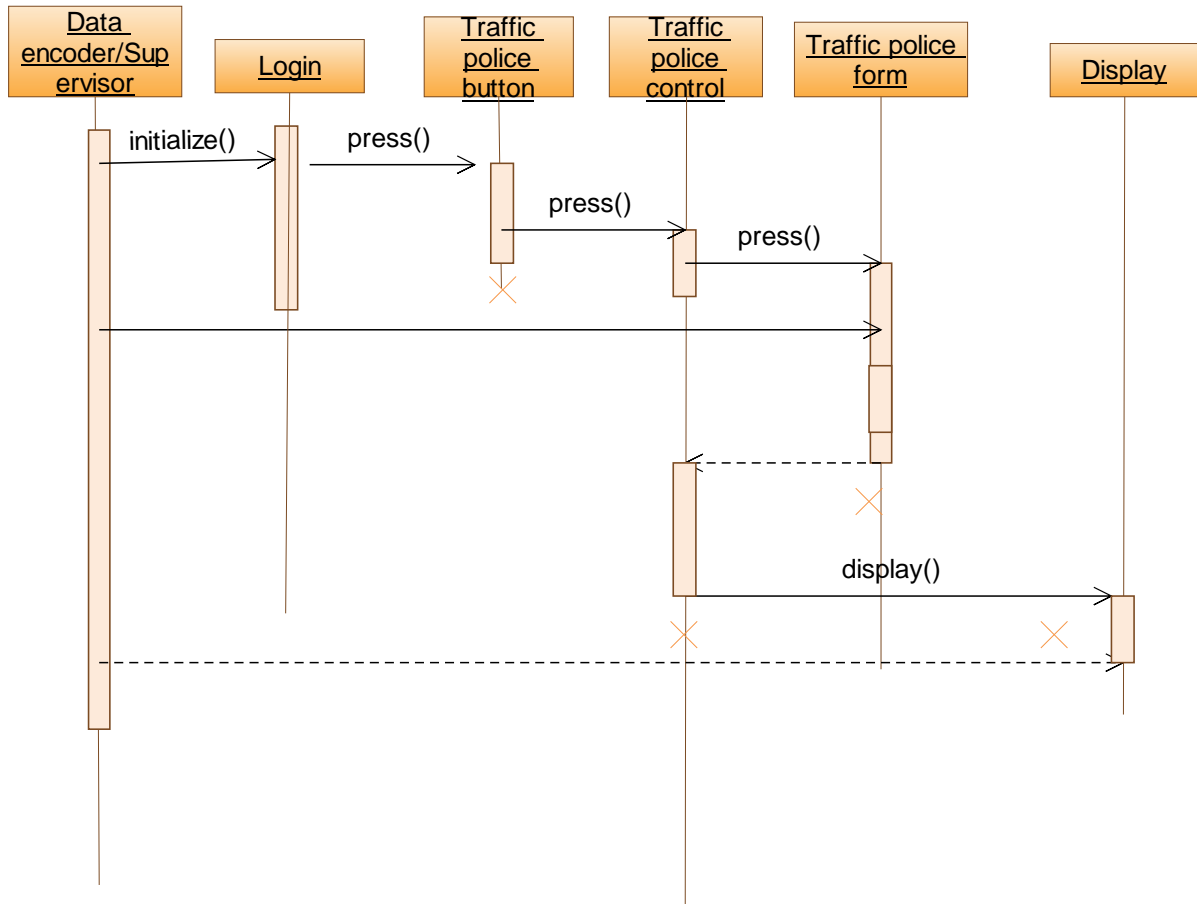
## Annex A: sequence diagram for Add misbehave driver info



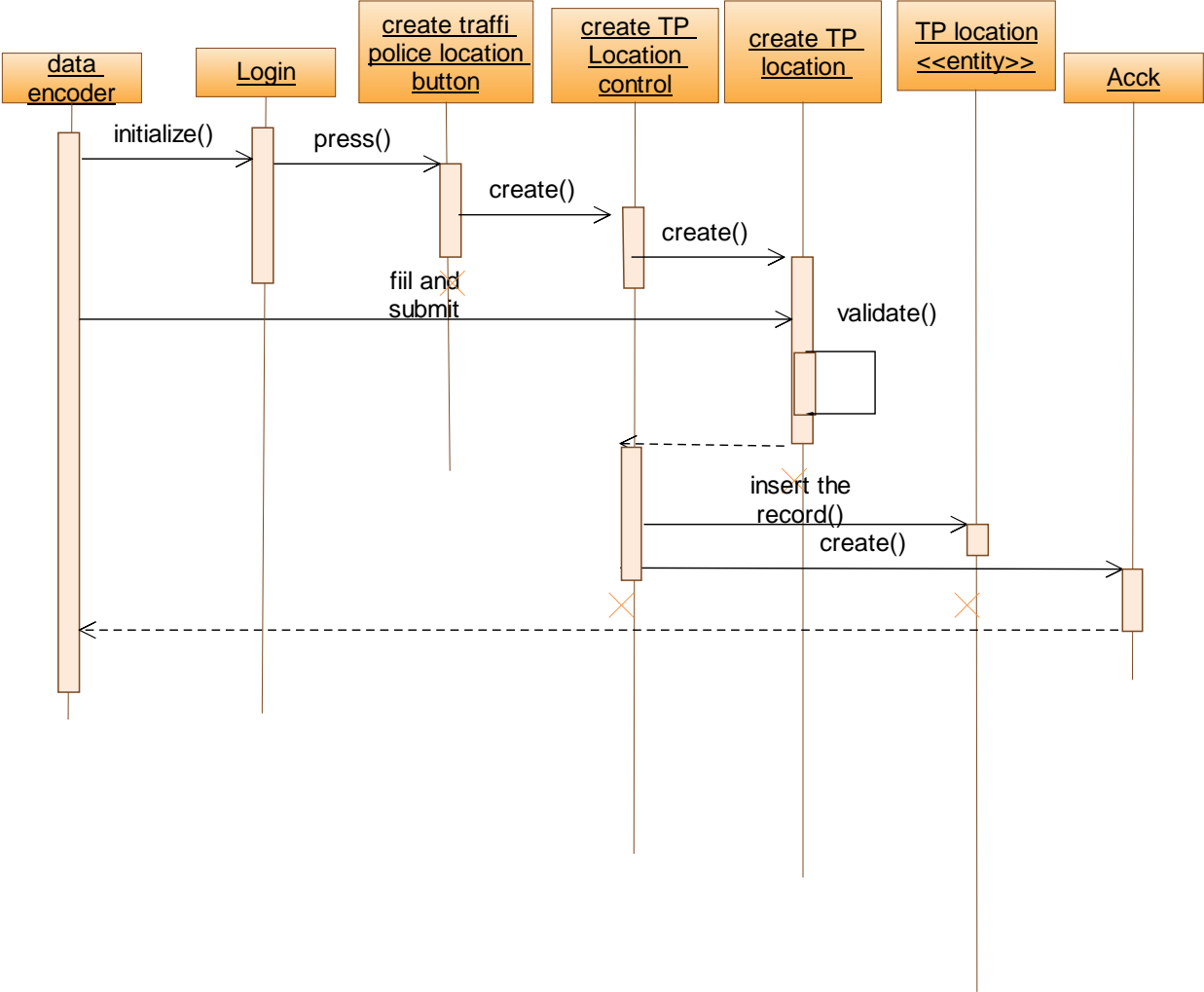
## ANNEX B: Sequence diagram for display the location of report sender



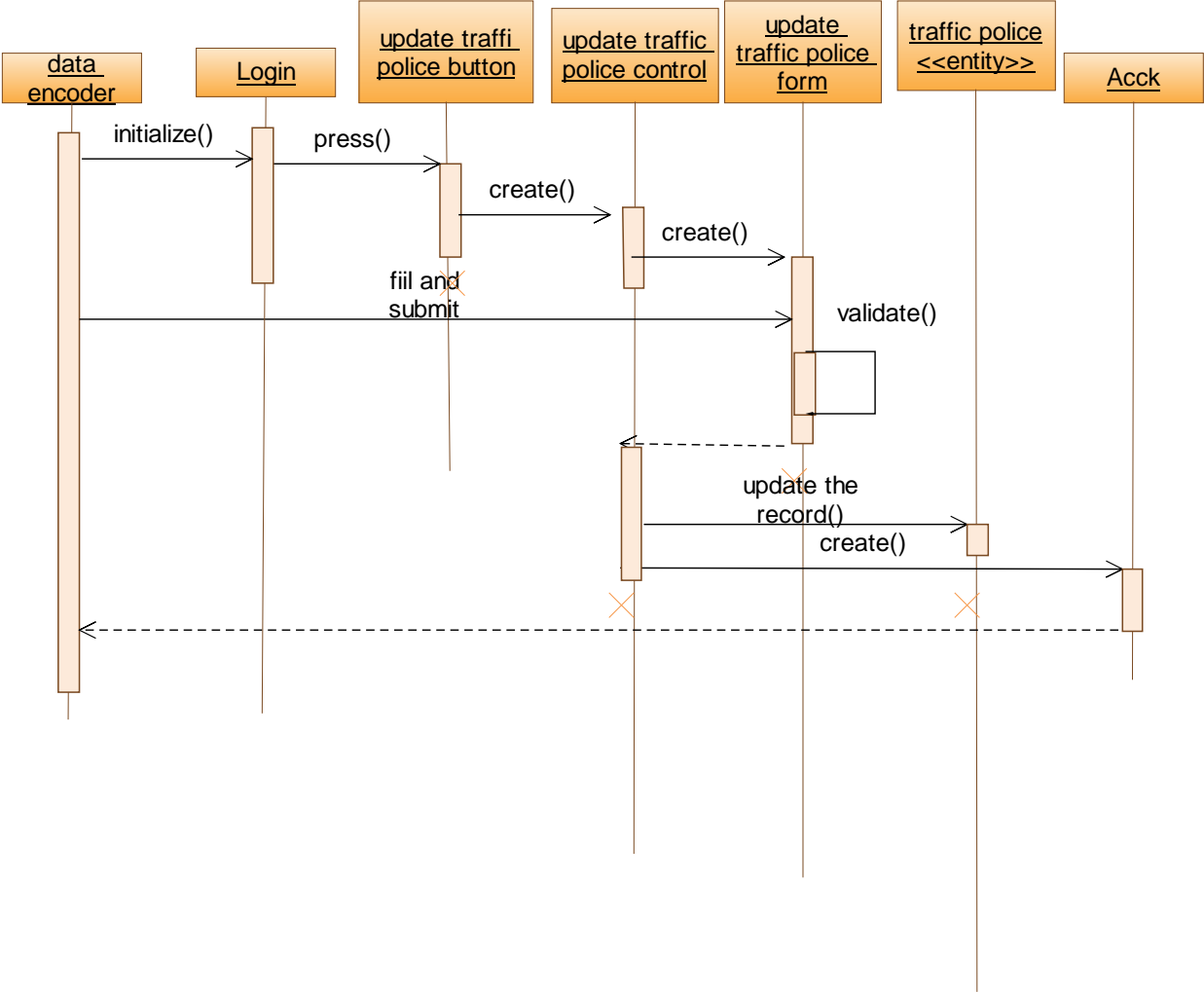
# ANNEX C: Sequence diagram for display traffic police information



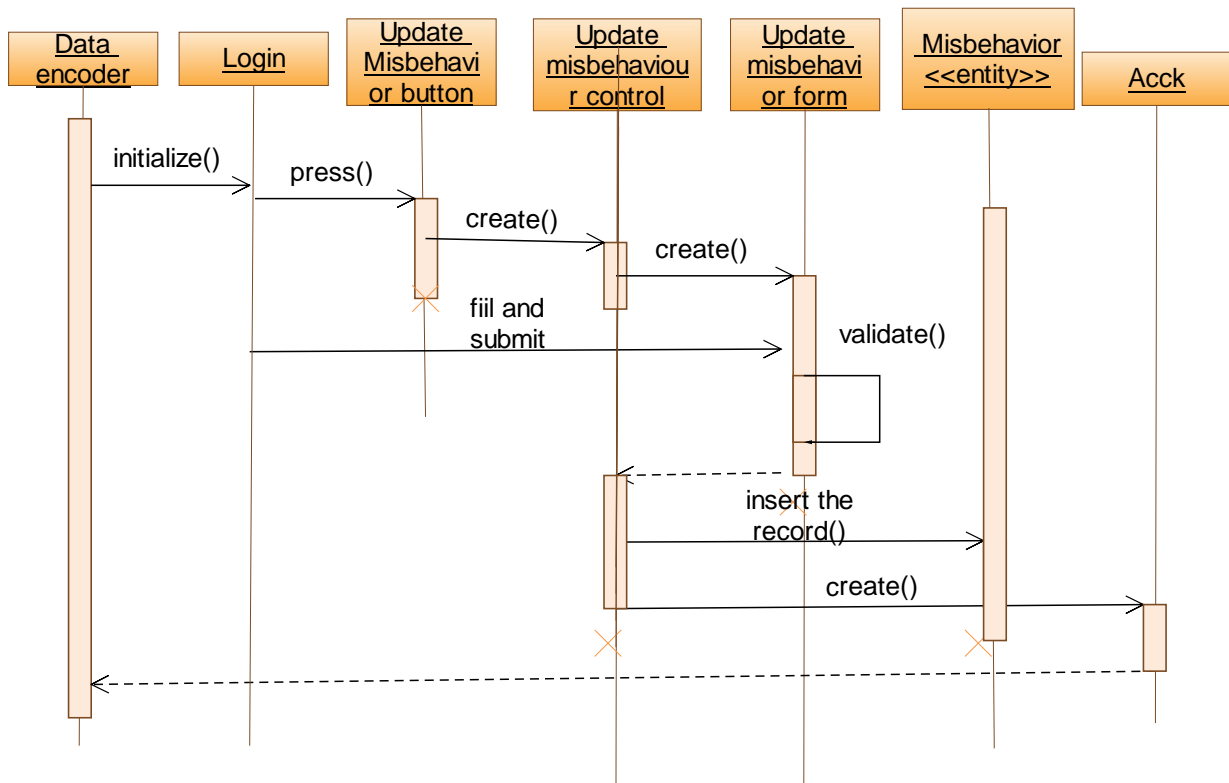
# ANNEX D: Sequence diagram for add the current GPS location



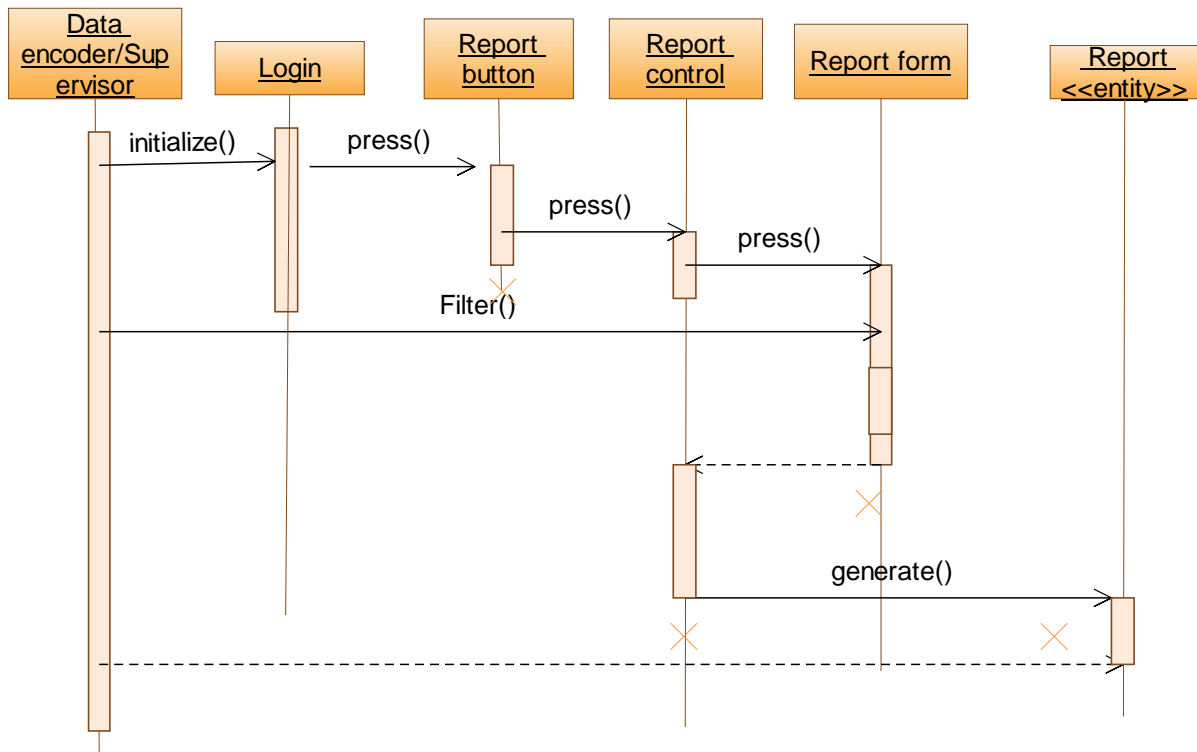
# ANNEX E: Sequence diagram for update traffic police information



## ANNEX F: Sequence diagram for update Misbehavior



## ANNEX G: Sequence diagram for generate report



## ANNEX H: Sample Source code

```
/**
 * Create new report from formhub response
 */
function *reportFunc(data) {
  var doc = {};
  if (!_isEmpty(data)) {
    doc = data;
  } else {
    doc = yield parse(this);
  }

  var report = yield reportsHelper.createReport(doc);
  var document = new Report(report);
  yield document.save();
  this.status = 'ok';
}
/**
 * Create beautiful report model from formhub response
 */
exports.createReport = function *createReport(doc) {
  var report = {
    result: doc,
    passengerOrNot: doc.passenger_or_notPassenger,
    date: doc.date_of_observation ? doc.date_of_observation : doc._submission_time,
    submissionDate: doc._submission_time,
    data: [],
    image: {
      src: doc._attachments.length ? doc._attachments[doc._attachments.length - 1] : "",
      name: ""
    },
    phone: {
      imei: doc.deviceid,
      phonenumber: doc.phonenumber || ""
    }
  };
};
```

```

report._id = doc._id ? doc._id : mongoose.Types.ObjectId();

var loc = [];
var data = {
  behaviors: [],
  serviceArea: []
};

data.plateNo = doc.plateNo;
data.plateRegionCode = doc.plateRegionCode;
data.carCode = doc.carCode;
data.carType = doc.carType;
data.noOfSeat = doc.noOfSeat;
data.color = doc.color;
data.initialPlace = doc.initialPlace;
data.destination = doc.destination;

for (var key in doc) {
  if (doc.hasOwnProperty(key)) {
    var splitedKeyArr = key.split('/');

    if (splitedKeyArr[2] && splitedKeyArr[2].indexOf('other') !== -1) {
      data.behaviors.push({other:doc[key]});
    }

    if (doc[key] === 'yes') {

      if (splitedKeyArr[1].indexOf('behavior') !== -1) {
        var currentBehavior = splitedKeyArr[2].split('_');
        data.behaviors.push(currentBehavior[currentBehavior.length - 1]);
      }
      /* if (splitedKeyArr[1].indexOf('symptoms') !== -1) {           // TODO rename mistype symptoNs
        data.symptoms.push(splitedKeyArr[2]);
      }*/
    }
  }
}
//}

/* if (report.image.src && report.image.name) {
  saveImage(' https://formhub.org/attachment/large?media_file=' + report.image.src, report.image.name);
}

```

```

}*/

report.data = data;

report.location = {
  latitude: parseFloat(loc[0] || 0),
  longitude:parseFloat(loc[1] || 0),
  altitude: parseFloat(loc[2] || 0),
  accuracy: parseFloat(loc[3] || 0)
};

var point = yield Boundary.findOne({
  boundaryType: 'woreda',
  geometry:{
    $geoIntersects:{
      $geometry:{
        type:'Point',
        coordinates: [report.location.longitude, report.location.latitude]
      }
    }
  }
}).exec();

if (point) {
  report.woreda = point.properties.WOREDANAME;
  report.region = point.properties.REGIONNAME;
  report.zone = point.properties.ZONENAME;
} else {
  report.woreda = report.region = report.zone = config.constants.notInBoundaries;
}

return report;
};

```

## **ANNEX I: Interview Questions**

1. What are the most dangerous driving behavior or action done by public transport drivers?
2. Can you prioritize the cause of traffic accidents done by public transport drivers?
3. Where are the traffic police common standing location?
4. The frequency of shifting the standing location of the traffic polices.
5. What are the steps if a passenger want to report misbehave public transport driver.
6. Which type of car code and region code can give public transport service in Addis Ababa.
7. How to control if the driver is hidden or goes in different ways.