BINDURA UNIVERSITY OF SCIENCE EDUCATION

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COMPUTER SCIENCE DEPARTMENT

PROTOTYPE MOBILE APPLICATION SYSTEM FOR TRAFFIC OFFENCES IN ZIMBABWE

By

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APPROVAL FORM

The undersigned certify that they have supervised the student Makwarimba Leonel’s dissertation entitled: **Demonstrate The Possibility of Having A Centralised Traffic Offence Database And Use of Mobile Application System In Recording And Tracking of Traffic Offences In Zimbabwe** submitted in Partial fulfilment of the requirements for the Bachelor of Computer Science Honours Degree of Bindura University of Science Education.

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DEDICATION

This research is dedicated all people with passion in technology and fellow buddies interested in programming.
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ABSTRACT

Zimbabwe is using a manual distributed traffic enforcement system. It is difficult to track whether motorists issued with tickets for road offences settle their payments. Some local and international drivers proceed with journeys before settling payment. Government is losing large sums of revenue that could be collected from traffic offenders. Wanted vehicles pass several check points undetected due to slow dissemination. A mobile application traffic enforcement system prototype was designed and used to demonstrate the possibility of having an integrated centralized traffic offence system traffic offences in Zimbabwe. The researcher concluded a cost effective real time or close to real time system is achievable using mobile technology.
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CHAPTER 1: PROBLEM IDENTIFICATION

1.1 INTRODUCTION

Zimbabwe has a road network linking the different parts of the country and providing access to neighbouring countries for imports and exports. It is the duty of Zimbabwe Republic Police Department of Traffic Management to enforce road rules and regulations. This includes issuing fine tickets to motorists who are found guilty. Traditional offline distributed traffic enforcement system (paper based system) is being used for traffic offence recording and tracking. The system does not produce real time information of traffic offences records to traffic enforcers. This resulting in motorists with road offences proceeds with their journeys before making any payments or caution receiving. The government is losing large sums of incomes that could be collected from local and international offenders.

1.2 BACKGROUND TO THE STUDY

Zimbabwe Police Traffic Enforcement and Management Department deploys several highway patrol cars, motorcycles and police officers on highways and in cities in trying to mitigate traffic offences and accidents. They use paper based systems (Occurrence Books, Admission of guilty Receipt Books and even small personal note books) to record and track offences. A Police radio is the backbone for communication to disseminate traffic crime information to all police stations across Zimbabwe. Traffic offences are tied to a vehicle and/or the driver. The details of vehicle owner are found at Ministry of Transport, Central Vehicle Registration department (CVR) where all vehicles in Zimbabwe are registered whereas details of a driver are found at the Ministry of Transport Vehicles Inspection Department (VID), which is responsible for issuing drivers licenses as well. The other database of vehicles is with the Zimbabwe National Roads Administration (ZINARA) which deals with quarterly vehicle licenses. According to Bindura Traffic officer in charge, police have no direct real time access to information of the driver, vehicle or its owner. Most of the road offences are very minor offences yet occurred frequently. Taking such offences to courts will lead in flooding of courts, hence motorist who commits such offence and admit they are guilty, are issued with an admission of guilty receipt. Traffic officers are mandated to receive payments from motorists commonly known as spot fine. However
motorists have an option to make their payments at police station within 7 days. The use of manual system in recording and tracking of fines a number of challenges such as:

- Fraud: Police officers are using their personal ticket books to collect spot fines.
- Motorist evading payments (international motorist getting out of country without making their payments).
- Difficult to track whether payments would be made and track defaulters, thereby forcing officers to insist on spot fine.

1.3 STATEMENT OF THE PROBLEM

The use of a traditional traffic enforcement system gives the police a great challenge on track motorists who would have received admission of guilt receipts and defaulted or fails to settle their fines within the specified time. It is very difficult to trace or verify that all motorists pay their fines since motorists are allowed to pay their fines at a police station in Zimbabwe without using a real time system.

Also it is very difficult for traffic enforcers to verify details of a driver or vehicle on the road without real time access to CVR and VID databases. This result in motorist faking their drivers’ licenses and black listed vehicles travelling and not detected at road checkpoints. Traffic crime and offence details are distributed and not sharable.

1.4 RESEARCH OBJECTIVES

As part of the aims of the overall project, the researcher has come up with the following research objectives:

a. To identify data elements from CVR and VID databases which can be integrated in traffic offence central database
b. To develop a Traffic Enforcement software system prototype which uses a mobile application for recording and tracking of traffic offences
c. To demonstrate the applicability of traffic offence recording and tracking using the developed prototype in the Zimbabwean environment.
d. To evaluate end-user acceptance of the proposed system
1.5 RESEARCH QUESTIONS
The research will be guided by and centered on a set of the following research questions:

a. How can different elements from different databases be integrated?
b. How to develop a cost effective real time application prototype for traffic enforcers using mobile technology?
c. How can offense recording and tracking be improved

1.6 JUSTIFICATION/ SIGNIFICANCE OF THE STUDY
The researcher assumes that Traffic Enforcement will improve effectiveness of enforcement system to encourage a positive behavioral change on drivers hence reduction of accidents.

According to Rothengatter (1991) automatic enforcement methods:

- Can provide support to systematically increase the probability of detection of a violation without requiring a substantial increase in police manpower.
- Can be of use in providing immediate feedback after a violation has been detected. May be perceived as more “objective” by road users, thus increasing the perceived fairness and acceptance of police enforcement.

1.7 ASSUMPTIONS
The research project is carried out on the following assumptions:

a. The System will also be integrated with ZINARA such that no vehicle owner will be allowed to purchase vehicle licenses or proceed with journey at tollgates before settling off debts of traffic crime committed.
b. Internet will be available 24/7

1.8 LIMITATIONS/CHALLENGES
a. Lack of knowledge and resources for other mobile devices Operating System, therefore the mobile app going to be developed will only work on android Operating System devices
b. It’s not easy to get enough information from the stakeholder especially the police.

1.9 DEFINITION OF TERMS

Traffic Offence: violation of traffic regulation such as breaking the speed limit.

Mobile applications: consist of software or a set of program that runs on a mobile device and perform certain tasks for the user, Simpson (2012).

1.10 CONCLUSION

This chapter discussed the identification of the problem and the next chapter is a detailed literature review of what is currently happening nationally, regionally and internationally and what has been done so far.
CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In all African countries motorised mobility has increased with economic growth and road safety has suffered dramatically (Mubaraka, 2013). Expansion of the police force in line with the enormous increase in vehicles in order to maintain adequate enforcement levels is no longer feasible which encourages African countries to also incorporate automated traffic enforcement into their road safety strategy. Moreover, African traffic police forces, as an essential, costly and limited resource should focus on tasks which cannot be automated (WIJERS, P J, 2014). In Zimbabwe according to (ZINARA, 2015) the population of registered vehicle is about 2.1 million. With those large numbers there is a great need for moving from manual to automatic system of traffic enforcement.

Several countries including Zimbabwe have decentralised government structures on a state, regional or local level. States within a federal system, regions within a country, or local communities may have their own budgets, police forces, legal administration, and statistics offices. Traffic policing data are not routinely aggregated for the whole country. Data may be out there somewhere, but they are dispersed among many agencies and jurisdictions (Mäkinen, et al, 2003).

MOHAMMED (2008) defined traffic enforcement as the area of activity aimed at controlling road user behaviour by preventative, persuasive and punitive measures in order to effect the safe and efficient movement of traffic. Also traffic enforcement can be defined as the whole of actions taken by the police or other responsible bodies to ensure compliance of traffic participants with existing traffic rules without a specific suspicion of an offence. Among other tasks (e.g. education, prosecution) enforcement is one of the most important tasks of the police in the area of traffic safety, which is preventive in nature (Hilse, 1995; Kößmann, 1996). Thus, an enforcement system can be defined as a set of measures that are routinely taken by the police to enforce a certain type of non-compliant behaviour. The most important target behaviours by motorists are speeding, alcohol-impaired driving, non-use of seatbelts and red-light running although numerous others could be reasonably added to this list (e.g. dangerous overtaking, close following, disobeying priority rules).
Among enforcement systems conventional and automated methods can be distinguished depending on the personal involvement of a police officer in the detection and apprehension of a certain violation. An automated enforcement system is defined here as a technical recording device that is triggered automatically by a traffic violation, so that information about the violating vehicle is recorded, making possible the subsequent identification of the vehicle for the purpose of sanctioning the owner or driver (Fridulv, Sagberg, 2000).

According to Vaa (1997) the behavior of drivers and other traffic participants depends largely on the police enforcement, and a higher enforcement might significantly reduce the number of drivers who make traffic violations. Using real time system in traffic recording in Zimbabwe will improve effectiveness enforcement and probably reduction in violation.

The concept of automated enforcement integrates the following three procedures (ESCAPE Deliverable 6; Heidstra et al. 2000):

- The detection of a certain violation,
- The identification of the vehicle involved,
- The identification of and contact with the owner (and/or driver) of the vehicle.

### 2.2 RELEVANT THEORY OF RELATED MATTER

#### 2.2.1 Technologies that are used in traffic offence recording and tracking globally

There is a wide range of technologies currently being used by police to support their road traffic enforcement activities. These technologies can be classed as those that are designed to prevent drivers from engaging in illegal driving behaviours in the first instance and those that support the enforcement of road rules and punishment of drivers once they have violated them. There are a number of devices and a range of technologies. According to (Sagberg 2000) the basic technologies that have been used for detecting and recording of violations are:

- Radar
- Laser
- inductive loops in pavement
- pneumatic tubes across road
- piezoelectric cables
- infrared detectors, and other optical sensors
- video image processing
- electronic detection based on in-car electronic tags

Some technologies are common to systems for detecting different violations, whereas others are particularly tailored to the detection of specific kinds of violations.

**Road Safety Cameras:** Road safety cameras are used to capture images of traffic offences. A central unit controls the camera that electronically stores encrypted images and incident information. For example, a red-light-camera (RLC) system automatically detects when a vehicle has entered an intersection during the red phase for an approach and takes a photograph of the red-light-running violation. Jurisdictional staff members review photographs to determine if a ticket should be sent to the driver (Forrest M., et al., 2005). This highlights that the basic steps in tracking traffic offences start with identification of the vehicle which the researcher must consider when developing the prototype.

**In-vehicle Data Recorders:** Event data recorders (EDRs), sometimes known as accident data recorders or crash data recorders. These are similar to flight data recorders or ‘black boxes’ used in aviation, however EDRs do not record voices. EDRs record data prior to, and during a crash to assist accident investigators in reconstructing the events that occurred. EDRs can record vehicle speed or direction of travel, steering or brake performance, including whether brakes were applied before an accident, airbag deployment status and driver seat belt usage (NHTSA, 2001). EDRs are now fitted to many new vehicles. While police and other law enforcement agencies have subpoenaed data from EDRs in the past, their application as a traffic law enforcement device is limited to those occasions where a vehicle has been involved in a collision of some kind because the system will only save data immediately prior to and during a crash.

**Automatic Licence Plate Recognition Systems:** Automatic licence plate recognition (ALPR) systems are one form of automatic vehicle identification (AVI) systems, which automatically detect and read the registration/licence plates of vehicles that pass the system’s cameras. ALPR systems can either be fixed-position units or mobile units and include a digital or video camera...
or closed circuit television (CCTV), image processing software, a control computer and illumination equipment such as infra-red to light up the registration plate (Hoffman, 2003). ALPR systems have been used in a number of different applications, including enforcement to identify vehicles involved in red light and speed violations, obtain information on the average speed of a vehicle between two points and to track stolen vehicles (Garibotto et al., 2003; Hoffman, 2003). In some applications, such as electronic tolling and speed and red-light enforcement, ALPR systems capture an image of the registration plate number so the vehicle owner can be automatically identified and issued with the toll or fine, or their registration number can be displayed on a variable message sign further down the road. These systems replace the manual process of a human having to verify registration details and produce an infringement notice, thereby reducing administration costs and processing times (Hoffman, 2003). ALPR systems are also currently equipped to Police vehicles in the UK to automatically read vehicle registration plates and check them against details in a database to determine if the vehicle is stolen, unregistered or if the owner has outstanding infringements. If so, the Police are able to intercept the vehicle, without having to manually enter the vehicle’s details (PACTS, 2005). ALPR is the ones of the best technology in the vehicles identification but this technology is very costly to implement in Zimbabwe. Due to limited resources the researcher will used manual capturing of vehicle plates in prototype development.

**In-road sensors:** It’s used to detect the speed of a vehicle. Two in-road sensors, such as piezos or inductive loops, are placed a fixed distance apart. This fixed distance, and the time it takes for a vehicle to travel between the sensors, is used to calculate the speed of a vehicle. These sensors are also used for red-light offences and work to detect the movement of a vehicle as it enters an intersection. If a vehicle enters the intersection after the traffic light has turned red the sensor triggers the camera. In-road sensors are installed in individual lanes on roadways. This allows the system to differentiate between vehicles in different lanes. In-road sensor are more efficient but due Zimbabwe situation they are very expensive to acquire and keep maintain considering their cost and issue of electricity, But the proposed system will more or less achieve the same goal with less cost.

**Tasmania Police** (Tasmania an island state that is part of the Commonwealth of Australia), started a research of developing a mobile app in 2014, the Police Infringement Notice System
(PINS), which issues infringement notices electronically via tablet computers. PINS process the infringement electronically and it is sent to the recipient by post. PINS features include automatic retrieval of license, registration details and the photograph of the license holder for identity checks. Officers will have the ability to perform identification validation and capture geo-location data. Checks for information on prior convictions can also be made. A PIN automatically inputs the appropriate penalty for the infringement, and has the capacity to add notes and take photos. Infringement notices enable offences to be dealt with without a court appearance. There will be significant efficiencies from PINS. It’s anticipated that the savings in police time and paperwork will amount to 39 police hours a day, or $250,000 annually. The scope of this research will support the proposed Traffic Enforcement System.

2.2.2 Technologies that are used in traffic offence recording and tracking in Zimbabwe

Conventional traffic enforcement is being used in Zimbabwe. The system is based on the policeman personnel support by few patrol cars. According Section 356 of the Criminal Procedure and Evidence Act Chapter 9:07, police is allowed to receive fine and issue admission of guilty receipts to motorists who violated road rules and regulation. Traffic offences/crimes are categorized into two, court offence and fine offence. A Court offence requires a motorist to appear in the magistrate court within 7 days from crime date, for example exceeding speed limits with 50 km/hr. The fine offences, motorists must pay a fine penalty as spot fine or within 7 days from the crime date.

Police place checkpoints in the roads where they inspect vehicles. Man powered or vehicle mounted speed cameras are used to catch over speeding motorists. All processes of recording and tracking traffic offense are paper based. Small notebook called occurrence book (OB) are used to record vehicles pending issues or offences and then the information in the OB is used at checkpoints or for request the vehicle's owner details from Central Vehicles Registration for further investigations.

All motorists who defaulted or failed to pay their fine within specified period will be summoned to court of magistrate. But due to use of paper based system it’s very difficult to track all motorists who defaulted or failed to pay their fine. Hence motorists are ending up being forced to pay spot fine or their vehicles will be impounded. Also the current system doesn’t have ability to
provide up-to-date information like vehicle or driver offenses history, required by the traffic enforcers at check points.

Moreover it’s easy for blacklisted vehicle, driver with fake or cancelled license, to pass several check points undetected because current system doesn’t offer a method for verification to the police

2.2.3 Advanced Transport Management Systems used in other countries.

With the implementation of Intelligent Transportation System (ITS) for system management purposes there is now ability to extract archive data that that can be used to evaluate the implementation of new operational strategies (European Union, 2014). To enhance provision of feedback and traffic offence tracking in developed countries, advanced transport management system are being developed for the areas like of freeway management, incident management, arterial management and transit management (Škorput, Pero, Sadko Mandžuka, Niko Jelušić, 2010)

In South Africa a combined e-NaTIS system was developed to replace the system that was in place, thus the NaTIS system that has been in operation since 1991. The e-NaTIS system according to (Botha 2014) uses a Card Verification Device (CVD) which is used to scan and validate licenses. The scanned information on drivers and vehicles is also transmitted to NaTIS which automatically replies with verification and additional information, such as:

- Validity and authenticity of a driving license or Professional Driving Permit (PrDP);
- Outstanding traffic fines and warrants of arrest against the driver;
- Penalty points accumulated;
- Validity and authenticity of the registration and license of a motor vehicle;
- Correctness of the roadworthiness status of a motor vehicle; and
- Whether the vehicle is marked as a stolen.

The proposed system achieves most of the e-NaTIS system goals without requirement of complicated expensive resource.
Inmon (2003) notes that in United States of America, Model State Traffic Records System (MTRS) was developed to integrate information now stored in different forms and systems through the state, to integrate operations of various agencies and to reduce duplication of effort by different entities. MTRS also aids in comprehensive planning and evaluation. Highway safety problems are isolated by applying accident and UTC data supported by roadway environment, driver, and vehicle background information to: i) location analysis techniques to identify hazardous locations; ii) standard statistical analysis techniques to identify patterns that indicate possible problem areas and details of the MTRS data base are summarized.

In Jamaica there is system called Traffic Ticket Management System TTMS. In Jamaica there is a system called Traffic Ticket Management According to (egovja, 2015) Traffic police issues ticket using the manual ticket books, later then captured the information in the Traffic Ticket Issuing System (TTIS) a data-entry of traffic tickets. TTIS if transfers the tickets to Traffic Ticket Management System (TTMS) for processing and management.

The Traffic Ticket Management System (TTMS) is a web-based application which was developed on behalf of the Ministry of National Security (MNS). It’s integrated with several technologies. The system facilitates the management of traffic tickets issued by the Police. Major features of the system include:

- Matching of tickets with payments
- Reporting on outstanding tickets
- Calculation and management of demerit points accumulated against Offenders’ driver’s licences
- Recording of court proceedings related to traffic offences
- Collection of payments made at the Courts for traffic offences
- Recording and tracking of warrants issued to traffic offenders.

The demerits of this system is that the recording and issuing of tickets id an offline process and also it won't give at offence history to the traffic enforcers in the roads

Also and according to (roadtraffic-technology, 2015) Greece developed a traffic management
A traffic management system (TMS) that was first planned in 2002 and was completed on time for the summer 2004, costing an estimated €255m to design, construct and implement. The traffic management system (TMS) central software is Siemens SI-Traffic Concert. The system is operated from two control centres (to allow for the event of one control centre failing) fed with data from a variety of sources including close circuit television cameras, traffic signals, Auto scope video-detection cameras, ground loop detectors, speed radar devices and security personnel and traffic police on the ground. The system can analyse and process the information it receives and then display traffic conditions using a graphic user interface (GUI). The decision-making algorithms programmed into the TMS can then determine how best to handle the problems. The system can act automatically via variable message signs on the road side, by adjusting the phase and continuity of traffic signals (by rerouting traffic around obstructions or temporary bottlenecks) and by alerting traffic police on the scene. In this way Athens famous grid-lock traffic jams were avoided during the Olympics and are hopefully a thing of the dim and distant past. The TMS is a very usefully and efficient system but it’s very difficult and expensive to implement in developing countries like Zimbabwe.

2.2.4 Proposed mobile application framework overview

According to Simpson (2012) mobile applications are consist of software or a set of program that runs on a mobile device and perform certain tasks for the user.

Mobile phones and applications have profoundly transformed world’s economy in recent years. Today, almost everyone has at least one mobile phone and daily uses a range of mobile applications. The telecommunications industry has transformed the way people behave, how they buy products or interact with family and friends. The mobile phone service market in recent years has grown fast and has been the most fiercely competitive market within the telecommunications service industry (Chuang & Tsaih, 2013).

Today's mobile phones are equipped with functionalities that surpass communication needs and inspire the development of new value-added mobile applications (Dahlberg et al. 2008) and the researcher tries to utilises those functionalities and develop an mobile application for traffic offence recording and tracking.
2.2.4.1 Advantages of mobile application
According to Moohan (2012) mobile applications has got advantages which are as follows:

A richer, more compelling user experience: This means that mobile apps can leverage the capabilities of the mobile device, including onboard hardware (such as GPS, camera, and graphics) and software (such as email, calendar, contacts, picture/video gallery, file manager, and home screen widget areas).

Ability to run offline: Since the application remains installed on the device from the original download, no internet connection is required. Users get peak performance at all times, with all graphics, images, scripts and data. Data transfers can resume (and re-sync with back end apps) when the connection is restored.

Better “front of mind” penetration: Mobile apps place a logo in the application list screen, providing visibility on a daily basis. In addition, app stores remind users to upgrade apps, so apps that update frequently (with real improvements) are more frequently brought to the user’s attention.

- Mobile apps are “hot” right now. Users are continually combing app stores for the latest app they can’t live without, giving products there a higher likelihood of being discovered.
- Mobile apps are also easier to monetize. One can set a price, list the app on an app store, and when users buy it, one can make money immediately (minus the commission) as compared to a web app, where one would have to set up a payment or subscription gateway if monetizing the app is something one wants to do.

2.2.5 The need for database integration
Software Systems with databases that are not integrated are like islands of processing systems within an organization or across business boundaries. To meet the challenges presented by the competitive atmosphere there is need for an organization to solve the problem that cannot be solved on its own. There is need for a global, open and distributed computational capability, thus the demand is for a large scale, complex and integrated system. A way of looking at the currently faced challenges is to view the problems encountered from an engineering, management and technological aspect. Having more than one customer or clients to serve will automatically lead to multiple requirements and the presents of a heterogeneous environment will inevitably require engineering solutions to bridge the technology gap (Zaitun Abu Bakar 1999).
This clearly highlight that the current systems that are being used in the road sector have a lot of bottlenecks. There is need for technology to close that gap that allows loop holes to inefficiency and corruption. Since the manual system that are being used in the road sector are possess long life cycles, they also inevitably produce unstable requirements as well as unreliable results.

2.3 CONCLUSION

Although most developed Countries use advanced automatic recording and tracking of traffic crimes which has several advantages of efficiency and less labour, these technologies are still difficult to implement in most Developing countries including Zimbabwe due to the roads infrastructure, internet connectivity and electricity supply. Due electricity load shedding is evident to that Zimbabwe is not in a position to put sensors, CCTV cameras on our country for real-time monitoring and signal traffic and drivers on the road due to financial constrain and shortage of electricity and the roads themselves need to be maintained first before channelling funds to projects. Mobile application remains a solution for traffic offences recording and tracking. It can produce results which are more or less close to advanced automatic traffic systems whilst cheaper and gives better utility than the existing system.
CHAPTER 3: RESEARCH METHODOLOGY

3.1. INTRODUCTION
This chapter focuses on elaborating how the research was carried out (methodology), how data for the research project was collected, that is, describes the qualitative and quantitative techniques used (questionnaires and interviews). It also takes an in-depth review of the design process of the whole project giving step by step outline of the design procedures as they were implemented in coming up with the desired system.

3.2. RESEARCH DESIGN
A research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems (Kerlinger, 1986). The research has made use of number of methods of obtaining data. Data was collected methods used include quantitative reporting tools from the system and qualitative methods. The type of research carried out by the researcher is an experimental research and implementation was done at Bindura University of Science Education. Data collection methods used includes:

- Questionnaires
- Context Analysis
- Interviews

3.2.1 Questionnaires
A questionnaire is a research instrument consisting of a series of questions and other prompts usually printed for the purpose of gathering information from correspondents (SurveyMonkey, 2008). To gather standardised data in a more objective way, questionnaires were used for evaluating end-user acceptance and performance of the proposed Traffic Enforcement System. After demonstration of the Traffic Enforcement System to the targeted groups participated in the evaluation survey, the questionnaires were then distributed randomly to 12 policemen from Traffic Enforcement and Management Department, 20 drivers and 20 part 1 and part 2 computers science students. Computer Science students sample was chosen by the researcher to test the performance of Traffic Enforcement System because real users were not that technical and available.
3.2.2 Context Analysis
Context analysis is a data collection method or a research tool which involves the content and meaning of texts and information resources such as books, essay interviews, discussion, historical documents, speeches, conversation, website and images (Randolph, 2007).

Context analysis was employed in this research to analyse previous documents such as receipt books to identify data elements, completeness and trends of data.

3.2.3 Interviews
The researcher interviewed number of individual stockholders including the Officer in charge Bindura Traffic, several drivers and vehicle owners. Both open and closed interviews were used in this research in order to get details of about the topic under research to be able to capture current system and its interoperability requirements.

3.3. SYSTEM DESIGN

3.3.1. Functional Requirements
Statements of services the system should provide how the system should react to particular inputs and how the system should behave in particular situations, the system should be able to:

- Authenticate a police man.
- Allow a policeman to record an offence
- Allow a police to view offence history of a vehicle
- Allow a police man to process a fine payment.
- Allow a police man to view history of a driver
- Allow a system administrator to view reports

3.3.2. Non-Functional Requirements

- Performance requirements: the system must process transaction efficiently in term of speed and device resources
- Accessibility requirements: Authenticated police officer must be able to access the system.
• Availability requirements: the system services must be available to every authenticated user 24 hours a day.

3.3.3. Tools
Tools used to develop the proposed system

• Eclipse Juno with Android SDK
• PostgreSQL
• iReport 5.6 ,
• Apache Tomcat 7 ,
• Apache Wicket and Spring Framework
• Maven Building System
• JPA API and the Hibernate persistence framework
• Ubuntu 14.01,
• PHP Scripting language
• Netbeans IDE.

3.3.3.1 Eclipse Juno with Android SDK
Eclipse IDE was chosen as a primary platform for android application development because of its easy of use and easy integration with android SDK and xml plugins. Also eclipse is very economical on system resource such main memory and processor.

3.3.3.2 PostgreSQL
PostgreSQL is an object-relational database management system (ORDBMS) based on POSTGRES, developed at the University of California at Berkeley Computer Science Department. POSTGRES pioneered many concepts that only became available in some commercial database systems much later. PostgreSQL is an open-source descendant of this original Berkeley code (Postgres, 2014). It supports a large part of the SQL standard and offers many modern features:
• complex queries
• foreign keys
• triggers
• updatable views
• transactional integrity
• multisession concurrency control

The system database was hosted using PostgreSQL 9.3 and PostgreSQL was chosen because of compatibility with JPA architecture, hibernate architecture and its support to PHP scripts as web service.

3.3.3.3 iReport (Jasper Report Generator)

iReport was used for design detailed, visual and summary reports. iReport designer was used because of easy configuration and compatibility with the primary IDE Netbeans and its ease of use with java.

3.3.3.4 Apache Tomcat

Tomcat was, developed by (Apache 2015), is a standard reference for java servlets and JSP. Tomcat was used plugged in apache web server for both development and implementation. The research chose tomcat because it’s an open source application and had adequate experience on how to configure and host applications on Apache tomcat.

3.3.3.5 Spring and Wicket framework

These are both set of tool that was used to in simplifying web development. Wicket framework was used to develop the web application portal that can be used to process court offense and to view the system reports.

Spring manages the life cycle of components used in the system by using its container (the Inversion of Control Container). This helped in controlling when components used by the application were created and destroyed.

3.3.3.6 Maven Building System
Apache Maven is a software project management. It’s based on the concept of project object model (POM), Maven can manage project’s build, dependences on other project, reporting and documentation and manage or glue together a project’s individual components. Maven was used to manage building and running of the server-side components of the system.

3.3.3.7 JPA API and the Hibernate persistence framework

JPA is a Java programming language API which describes the how relational data is managed in JAVA applications. It also includes a language called Java Persistence Query Language (JPQL) which was used to create abstract entity-based queries on the relational databases instead of traditional implementation-specific languages such as SQL. Hibernate is a tool based on JPQL and was used in object relational mapping. It converted JAVA objects into relational objects (tables) and vice versa.
3.3.4. System Overview

The system consists of two applications working together. One application is a client which runs on android mobile phones and on the client PCs, and the other one is the server application. Client application is the one which interacts with the policeman performing various transactions (eg recording offences, process payments etc.) by sending the users requests to the application server. The application server handles user requests by interacting with the database retrieved or save the require information and gives the feedback to the user.

The diagram below represents an overview or the setup of the all whole system.

![System Overview Diagram](image)

*Figure 1: System overview*
3.3.5. **System Design Architecture**

A three tier architecture design was used on implementing the system. And this architecture was chosen because:

- It improves data independence by avoid tying up a database to an application. It allows different system to be integrated or access the same database.
- It helps to improves processing speed of the android application by leaving the entire data processing task to the web server. Android applications just send a request to the server with some parameters and server performs all the data processing and return results to the application.

![System architecture](image)

*Figure 2: System architecture*
3.3.6. Use Case Diagrams

Use case diagrams show the relationship between user and the operation he/she can perform on the system.

### Android Traffic Offence Application

- **Register**
- **View blacklisted vehicles**
- **Record Offence**
- **Process payment**
- **View Car offence history**
- **View Drives License details**

**Policeman on the field**

**Figure 3: Android application use case**

On the Figure 3 above a policeman using the android app will be able to register in the system, view blacklisted or wanted cars, record an offence, process spot fine, view vehicle offence history and as well as viewing the driver’s license details.
Figure 4: web based application use case

User accessing the system using the web based application is able to view and generated reports, view vehicle offences, process fine payments and process court offences.
3.3.7. System Flow Charts
The flow chart specifies the flow of an operation in the system.

3.3.7.1 Registering user

![Registering User Flow Chart](image)

**Figure 5: registering user flow chart**

On figure 5 above user enters her/his credentials and send the server where it will be validated and verified and the system will give back the success or failure response.
3.3.7.2 Recording Offense

Figure 6: Recording a crime flow chart

On figure 6, above user is prompted to enter the vehicle registration number and the system will automatically extracts the vehicle crime history and he then prompted to select the offences and to enter the drivers license number if any and the system will validate and verified the information enter and give back the success or failure response.
3.3.7.3 Processing Payment

Figure 7: Process offence payment flow chart
3.3.8. System Entity Relationship Diagram

Entity relationship diagram show the entities that are modeled to the system database and the association between the entities

*Figure 8 : E R diagram*
3.4. IMPLEMENATION DESIGN

3.4.1 Screen Dumps
These are various screen shots showing the main user interface component of the system captured during implementation of the developed system. They illustrate various stages of the system during processing.

3.4.1.1 Android Application Screen shots

3.4.1.1.1 Login and Register

Figure 9: Android App Login and User Registration Page
To use the android app the user should register first using the screen of Figure 9 above using his or her employee number as username and his national id number for verification purposes. And then use the credentials to login after the registration is successful.

3.4.1.1.2 Wanted Cars list and Recording a crime

![Android App Wanted Cars and Recording Offence screen shot](image)

*Figure 10: Android App Wanted Cars and Recording Offence screen shot*
Wanted cars list window shown on Figure 10 above is the first window viewed by user after successful login. User can tap/select once from the list to view more details about that offence. To record an offence the user enters the vehicle registration number, the system will automatically retrieve the vehicle offence history (outstanding offences and all offence committed the very same day). Also the user just selects the offence name from the list all offences provided and the system will automatically generates the fine.

3.4.1.2. Traffic Enforcement System Web app screen shots

3.4.1.3.1 Login page

![Login page](image)

*Figure 11: Web application login page*
3.4.1.3.2 Home page

![Traffic Enforcement Web application home page](image)

**Figure 12**: Traffic Enforcement Web application home page
3.4.1.3.3 Crimes exceeding 7 days without paid

Figure 13: Traffic Enforcement Web application Overdue Offences page
CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.1. INTRODUCTION

In this part of literate, the researcher will focus on presentation, analysis and interpretation of data obtained. This analysis will aid researcher including on whether the proposed system is feasible in Zimbabwe

4.2. FINDINGS FROM INTERVIEWS

From the interview conducted with the Office in Charge of Bindura Traffic police it was noted that the institution is still relying on paper work then be captured for analysis in Excel files on single offline desktop machine. This makes it complicated for propagation of information. They mainly use radio communication for faster information sharing though they admit the information may be distorted in such means of communication due to poor transmission. It was found that data elements required from Central Vehicle Registration (CVR) database are:

- Vehicle registration Number
- Chassis or Van Number
- Engine Number
- Owner: name, surname, nation id number, address, phone number and next of kin.

And the data elements require from Vehicle Inspection Department (VID) are:

- Licence Number
- Date issued
- Owner: name, surname, date of birth, nation id number, address and phone number
- Licences status( active or suspended )

4.3. FINDINGS FROM THE QUESTIONNAIRES

All policemen and students respond to all questionnaires. And 13 of out questionnaires were respondent by drivers. The following is what came out of the findings.

4.3.1. System accessibility and the request speed assessment

The 15 students respondents were asked about the system to rate accessibility and request response speed of both platforms independently and the finding are visualised in the pie chart,
bar graph and as well as tabulated the responses are given visually in a pie chart and as tabulated below.

### Accessibility and Response time on android app

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Very Unsatisfied</td>
<td>2</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
<td>15.0</td>
<td>15.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Satisfied</td>
<td>8</td>
<td>40.0</td>
<td>40.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>7</td>
<td>35.0</td>
<td>35.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Unsatisfied</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1: Respondents perception on accessibility and response time on android app*

![Accessibility and response time of android app](image)

*Figure 14: Respondents perception on accessibility and response time on android app*

From the *Figure 14: Respondents perception on accessibility and response time on android app* above, 40% which is the 8 out of 20 respondents agree that the system was accessible, 35% were very satisfied, 3 (15%) respondents remain neutral and 2 (10%) mentioned that they fail to join the network used during implementation. Also respondents perception on accessibility and response time of web-based app on *Figure 15 and Table 2* below, 7 (35%) respondents said
connectivity and response time was very fast, 12 (60%) respondents said the connection response time was fast fair and 1 (5) respondents said the request response was at average.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Satisfied</td>
<td>12</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>7</td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Unsatisfied</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Unsatisfied</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 2: Respondents perception on accessibility and response time on web app

![accessibility and response time of web app](image)

**Figure 15: Respondents perception on accessibility and response time on web app**

### 4.3.2. End user acceptance evaluation

As mentioned on the previous chapter, the system was first demonstrated to the police and drivers then they were asked to rate their acceptance or views of the system and the findings where illustrated on bar graph and as well as tabulated.
Policemen perception

Figure 16 and Table 3 below, of the 12 respondents 6 were unsatisfied, 2 were very unsatisfied, 3 were neutral and 1 was satisfied.

<table>
<thead>
<tr>
<th>Police perception on Current System</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Very Unsatisfied</td>
<td>2</td>
<td>16.7</td>
<td>16.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Valid Unsatisfied</td>
<td>6</td>
<td>50.0</td>
<td>50.0</td>
<td>66.7</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
<td>25.0</td>
<td>25.0</td>
<td>91.7</td>
</tr>
<tr>
<td>Satisfied</td>
<td>1</td>
<td>8.3</td>
<td>8.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: police perception on current system

![Police Perception on Current system](image)

Figure 16: police perception on current system pie chat
Figure 17 and Table 4 below, of the 12 respondents 4 (33.3%) agreed that they liked, 7 (58.3%) strongly agreed, 1 (8.3%) respondents didn’t saw any the difference.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>7</td>
<td>58.3</td>
<td>58.3</td>
<td>58.3</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
<td>33.3</td>
<td>33.3</td>
<td>91.7</td>
</tr>
<tr>
<td>Indifferent</td>
<td>1</td>
<td>8.3</td>
<td>8.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Police System Acceptance analysis table

Figure 17: Police system acceptance analysis graph
Driver’s perception

Figure 18 and Table 5 below, of the 16 respondents 10 (62.5%) agreed that they liked, 4 (25%) strongly disagreed and 2 (12.5%) respondents were indifferent.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>10</td>
<td>62.5</td>
<td>62.5</td>
<td>62.5</td>
</tr>
<tr>
<td>Indifferent</td>
<td>2</td>
<td>12.5</td>
<td>12.5</td>
<td>75.0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>4</td>
<td>25.0</td>
<td>25.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: driver perception on the system

Figure 18: driver perception on the system bar graph
4.3.3. Experience distribution of policemen

Police respondents were also asked to highlight their years of experience in the Traffic Enforcement Department which will help support their perception on system acceptance, and the finding were illustrated in Table 6 and Figure 19 below. Seven policemen respondents were between 1 to 3 years of experience in the Traffic Department, 2 correspondents had less than a year experience and the remaining three had more than 3 years working at traffic department.

<table>
<thead>
<tr>
<th>Years in Traffic Department</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid less than 1 year</td>
<td>2</td>
<td>16.7</td>
<td>16.7</td>
<td>16.7</td>
</tr>
<tr>
<td>between 1 and 3 years</td>
<td>7</td>
<td>58.3</td>
<td>58.3</td>
<td>75.0</td>
</tr>
<tr>
<td>more than 3 years</td>
<td>3</td>
<td>25.0</td>
<td>25.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6 policeman working experience in Traffic department

![Figure 19: policeman working experience in Traffic department](image-url)
4.4. DEMONSTRATING THE APPLICABILITY OF MOBILE APPLICATION IN RECORDING TRAFFIC OFFENCES IN ZIMBABWE

The current recording of an offence requires vehicle registration number, offence name, date, fine, Driver’s licence Number, drivers surname and officer name. On proposed Traffic Enforcement System requires user to login and the id of the logged user is automatically attached to every offence recording transactions taken place. It has inputs fields for entering the vehicle registration and license number as shown in Figure 20 below.

Figure 20: vehicle registration number and license input fields
For crime name and location it gives a list all crimes and locations for user to select as shown on Figure 21 below.

**Figure 21:** list of all offences provided to the user to choose
Also it automatically calculates fines of all crimes selected and gives user feedback when the recording is successful as shown Figure 22 below.

Confirmation and feedback diagram

![Image of recording offense feedback]

*Figure 22: Recording offence feedback*
Vehicle history search

![Vehicle record search and result list](image)

*Figure 23: Vehicle record search and result list*

The prototype allows user to enter the vehicle registration number and retrieve offence records of that car as shown above on **figure 23**.

### 4.5. DISCUSSION OF RESULTS

From **Figure 14 and table 1** above, 40% which is the 8 out of 20 respondents were satisfied with the android app connectivity and response time, 35% were very satisfied, 3 (15%) respondents remain neutral and 2 (10%) mentioned that they fail to join the network used during implementation. On web application 95% of the respondent agreed that the system was accessible and the response time was good. And maybe those 7 respondents who had very fast network in **figure 15 and table 2** probably they had a wired connection compared to those who were accessing the system using wireless connection. Connectivity is very important aspect because the proposed Traffic Enforcement is a real time system.
Policemen are the direct users of the Traffic Enforcement System, in **Figure 17 and table 4** the findings show that they really liked the system and their acceptance of the system also supported with their working experience in Traffic Enforcement department. **Figure 19 and table 6** show that’s 10 of all the 12 correspondents had more than one experience in Traffic Enforcement, which shows that they all do understand the subject much. Also 62.5% of the drivers liked the system, which show that all the parties welcomed the proposed systems to a greater extend.

**4.6. SUMMARY AND ANALYSIS OF RESULTS**

The findings of the research show that most of the respondents agreed the proposed system was accessible and has a good response time. Also most of the end-user respondents accepted the proposed system. It is possible to integrate the various data elements from databases used by different stack holders to come up with a real time system for recording and tracking of traffic offences in Zimbabwe as demonstrated by the prototype. Mobile technology can be utilized to come up with a cost effective real time or close to real time traffic offence recording and tracking system in Zimbabwe.
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1. INTRODUCTION

This chapter will outline the conclusions drawn from the project as well as the recommendations to the implementation and smooth running of the system. The conclusion will append the work of this project by just comparing the outcome of this project that is the system and compare with the aim and objectives of this project to check whether they were met. These will give an insight to all stakeholders on what could be expected out of this system and also areas that may need further attention to make the system more efficient and for future development which were beyond the scope of this project.

5.2. AIM AND OBJECTIVE REALISATION

The aim of the project was to develop a Traffic Enforcement software system prototype with central database which uses mobile application for recording and tracking of traffic offences. The researcher developed the mobile application by utilizing open source mobile development environment (Android SDK) and the Web-based part was developed in java. The prototype was deployed at Bindura University and was tested by students from Computer Science department for accessibility and performance. The system was assessed against the objectives and it satisfactorily meets the objectives to a greater extent.

5.3. CHALLENGES

During the requirements gathering the researcher faced reverses in getting access to some of the documents because they contains confidential details which does permits the researcher to view them. Also during implementation internet connectivity became a major challenge. And the system performance was very affected during testing since there were not enough resources for hosting the system hence the system was hosted on a personal machine with limited processing power instead of a server.
5.4. RECOMMENDATIONS

Research recommends the implementation of the prototype.

5.5. FUTURE WORK

Although much of work as set forth in this research has been done by the research and the objectives of the research were met the researcher found it necessary to include certain areas that the research could be expanded.

Utilising other mobile platforms by develop app versions with runs on other platform besides android.
Appendix 1

QUESTIONNAIRES

STUDENTS QUESTIONNAIRE

Hello

You are invited to participate in our Traffic Enforcement System assessment. In this survey, approximately [20] people will be asked to complete a survey that asks question about the System performance and functionality after you have accessed the system or the system demonstrated to you. Your participation in this study is completely voluntary. Also if you feel uncomfortable in answering any question, you can withdraw from any point. Your survey response will be strictly confidential. Thank you very much for your time and support.

Accessibility of the System

1. Your Gender

☐ Male ☐ Female

2. Your Age

☐ 18 and below ☐ 19 to 29 ☐ 30 to 39 ☐ 40 to 49

3. Was the system accessible

☐ Yes ☐ NO

4. Which system platform were you to access
5. How were you satisfied by the accessibility and response time of the system

<table>
<thead>
<tr>
<th>Very Unsatisfactory</th>
<th>Unsatisfactory</th>
<th>Neutral</th>
<th>Satisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. How do you rate the internet connectivity you were using

<table>
<thead>
<tr>
<th>Very Unsatisfactory</th>
<th>Unsatisfactory</th>
<th>Neutral</th>
<th>Satisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. What are your comments of suggestion about this system

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
**POLICEMEN QUESTIONNAIRE**

1. What is your age range

<table>
<thead>
<tr>
<th>Age Range</th>
<th>16-20 years</th>
<th>21-30 years</th>
<th>31-40 years</th>
<th>41-50 years</th>
<th>51 &amp; above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

2. Do you have a smartphone

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

3. Would you like to use like system if brought implemented and would agree to the implementation of the system

<table>
<thead>
<tr>
<th>Agreement Level</th>
<th>Strongly agree</th>
<th>agree</th>
<th>indifferent</th>
<th>disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

5. What are your comments of suggestion about this system

………………………………………………………………………………………………………………………………………………
6 How many years do you work in the Traffic Department?

<table>
<thead>
<tr>
<th>Less than 1 year</th>
<th>Between 1 to 3 years</th>
<th>More than 3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**DRIVER QUESTIONNAIRE**

1. What is your age range

<table>
<thead>
<tr>
<th>16-20 years</th>
<th>21-30 years</th>
<th>31-40 years</th>
<th>41-50 years</th>
<th>51 &amp; above</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

2. Would you like to use like system if brought implemented and would agree to the implementation of the system

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>agree</th>
<th>indifferent</th>
<th>disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

7 What are your comments of suggestion about this system
8 How many years do you own a license

<table>
<thead>
<tr>
<th>Less than 1 year</th>
<th>Between 1 to 3 years</th>
<th>More than 3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


17. http://www.egovja.com/content/traffic-ticket-management-system-ttms


