VEHICLE LICENSING AND TOLLING APPLICATION

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BY

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ABSTRACT

This document provides a comprehensive overview of the Vehicle licensing and tolling application with the main aim of gathering and summarising facts, identifying as well as analysing alternatives thereby solving the problems faced at Zimbabwe National Roads Administration (ZINARA). Data gathering methodologies which include interviews, observations and questionnaires were used in identifying the problems currently being faced by the organisation. These included human errors and fraud as well as the poor handling of motorist inquiries. Their traditional way of issuing licenses was less effective since there was a limited motorist contribution in their system. The ever changing technology also led to the need for the android application to assist motorists and enhance their inquiry handling. Therefore the objectives of this research were to develop a system which allow the motorists to calculate their license fees on the application, remind the motorist when the motor vehicle is due for licensing and to create a platform that enable the motorists to make a calculation for the total fees required from a certain destination to the next. Android and MySQL technologies were used to develop the system meeting the objectives with the user requirements. In implementing the system several testing strategies were also used so as to mirror the user requirements and the system. User training was also done to the ZINARA employees and motorist so as to give them the understanding of the system. Maintenance schedules were also put in place after user training. Recommendations were also documented for further or future developments and this then will give an opportunity and ideas to the organisation in the future to improve the application.

DECLARATION

I, **Anold Mabhena,** hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: ……. Date: ……..

APPROVAL

This dissertation entitled **"Vehicle Licensing and Tolling Application"** by **Anold Mabhena** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University,** and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature: …….

Date: ……..

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DEDICATION

This dissertation is dedicated to my family, my supervisor and all my lovely friends whose unyielding love, support and encouragement have enriched my soul and inspired me to pursue and complete this research.

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LIST OF ACRONYMS

CBA	Cost Benefit Analysis
CCC	Customs Clearance Certificate
DBMS	Database Management System
DFD	Dataflow Diagram
EER	Enhanced Entity Relationship Diagram
EMAIL	Electronic Mail
GUI	Graphical User Interface
ID	Identity Number
ROI	Return On Investment
SQL	Structured Query Language
VID	Vehicle Inspection Department
WIMP	Windows Icons Menus Pointers
ZINARA	Zimbabwe National Roads Administration

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter mainly focuses on the application of Zimbabwe National Roads Administration (ZINARA) vehicle licensing and the tolling application. This modern world is characterised by the rapid change in technology that is being used, it is therefore vital for the motorists to harness the new ways of managing their vehicles as well as planning their road budgets. Technology has improved the various sectors of the motor industry from the online buying of vehicles to the tolling system which has led to efficiency in those lines of operation. This calls for an application that helps the motorists to be able to manage their vehicle licensing and tolling fees on the go. The main focus of this section is to show the background overview of the organisation, identify problems that led to the need of a vehicle licensing and tolling application, identify objectives of the system, clarify the system requirements, system instruments and to give the brief description of the system.

1.2 Background of the study

The increasing number of tollgates and the complexity of the vehicle registration process it provided the need for several advancements in the motor industry. After experiencing a budget misunderstanding with the truck driver on the exact amount of toll fees required from Beitbridge to Harare for a truck this brought out the idea for a tolling system for motorists. This raised debate since the actual number of tollgates along the way was not known. Therefore this brought out the need for the vehicle licensing and tolling application to assist motorists vying the long distances and those who would use a certain route for the first time to sort out the budget since it will be providing all the information one would require on the road.

1.2.1 Background of the organisation

ZINARA falls under the Ministry of Transport, Communication and Infrastructural Development. ZINARA is a body corporate established in terms of the road act (chapter 13:18). The body which was established in 2002 has prioritised the enhancement of good road network system throughout the country.

Its core business, in consultations with the minister of transport, communication and infrastructural development is fixing road user charges and collect such charges or any other revenue of the road fund. ZINARA is also responsible for auditing the use of the funds from the road fund by road authorities and ensure that disbursed funds are utilised for the purpose which they are intended in accordance with the rules prescribed by ZINARA.

It also monitors the implementation of road maintenance works by road authorities, and assists the Minister in setting maintenance, design, construction and technical standards and to monitor adherence to such standards by Road Authorities. Zinara.inc

1.2.2 Organisational structure

Morgan (2006) defines an organisational structure as a structure which shows the activities and tasks that include supervision, task allocation as well as the coordination of activities are aligned towards the achievement of organisational objectives. Different types of organisational structures exist and these include the traditional hierarchy, the flatter as well as the flat organisational structure.

The hierarchy is the most common structure adopted by many organisations. This is a structure whereby communication flows from the top to the bottom of the organisation and those at the top are considered to possess all the information as well as the power to do the decisions.

The flatter organisational structure is similar to the hierarchy in the sense that it has got layers. However this structure has fewer layers as compared to the hierarchy as it seeks to open up more lines of communication as well as enhancing collaboration. This model seeks to clarify to the management that they exist to provide support to the employees and not vice versa as the case with the traditional hierarchy.

The flat structure is an emerging organisational structure whereby everyone in the organisation is at the same level. It is considered as the self- managed organisational structure. This is the case with the Valve Gaming Company. In this case no one is assigned a job title and therefore there is no description attached to any employee and no one tells the other employee what to work on. In this structure employees identify projects to work on and one choses any project that suits his ability.

Fig 1.1 is the hierarchy type of an organisational structure adopted by ZINARA. The board of the company is the one at the top holding all the authority and the final decisions on some of the issues affecting the organisation. The company's Chief Executive Officer is the one who reports to the Board and behind him lay the Directors and the departmental Managers are the ones who report to the Directors. The job titles depicted in this are centred in the maintenance of the status quo of the company and this is experienced in the hierarchy organisational structure.

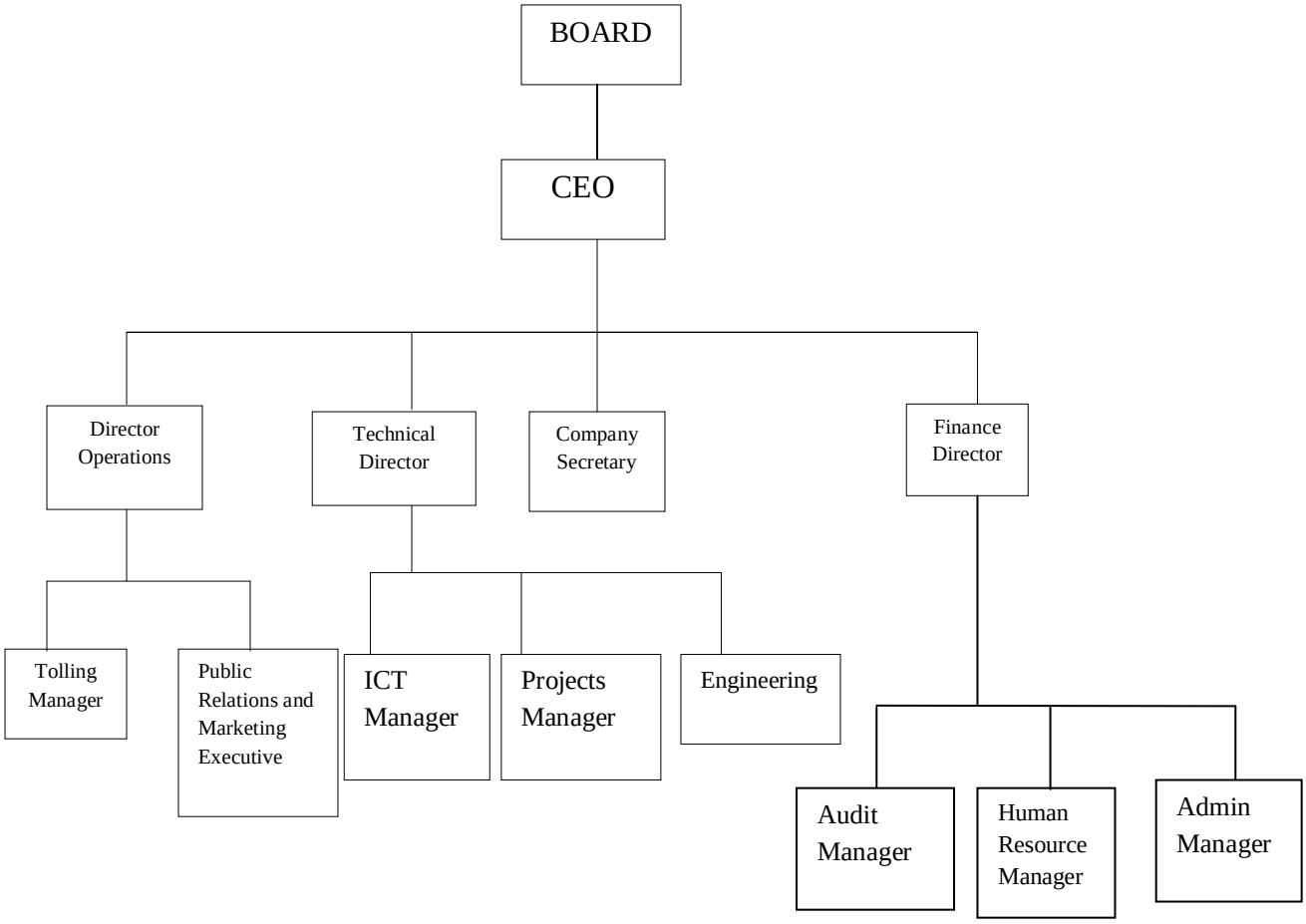


Fig 1.1 Organisational Structure

1.2.3 Vision

This business vision refers to the business organisation's declaration of the mid-term as well as its long term organisational objectives (Mccuen, 1996). The ZINARA's organisational vision is defined below:

To become the leading road fund manager for the development of a world class road network.

1.2.4 Mission

The business mission refers to the business statement that outline the organisation's core purpose and this remain unchanged over time (Abrahams, 1995). The ZINARA's organisational mission is defined below:

- To effectively collect funds for road development by road authorities

1.3 Problem definition

ZINARA is a gradually growing company and therefore the introduction of the tollgates as well as their increasing number has prompted the need of improved systems. ZINARA is responsible for the collection of all the vehicle registration fees in the country with their system. On payment of the registration fees, the motorists are provided with a license disk after the capturing of the details. The system should then be responsible for creating a continuing relationship with the motorists after the registration for example proving reminders to the motorists on the expiry dates of their licenses they have purchased since the company would have captured all the details. On the tolling side the current system is used by the ZINARA staff members only and the motorist's contribution is generally low if any. Therefore the system should further include motorist input in the system by allowing input from owners of vehicles to report a car hijacking incident to the tolling agents on his mobile application. This will be aimed at reducing the theft of cars since when the stolen vehicle passes through the tollgate the system should provide a warning to the cashiers and therefore the vehicle can be recovered easily. The current system is providing restrictive platforms for the motorists to actually view the necessary information concerning the tolling stations or the tollgates along the routes in the country. This then calls for a more informative platform providing a map and locations of all the tollgates. This therefore helps the organisation in the achievement of the company vision of being the leading fund manager of a world class road network which is not only friendly to motorists but also secure.

1.4 Aim

To develop a system that will help motorists manage their road budget through developing an application that calculates total amount of tollgate fees and license fees for their vehicles.

1.5 Objectives

- To develop a platform that will allow the motorists to calculate their license fees on the vehicle licensing and tolling application.
- To develop application that will be able to remind the motorist when the motor vehicle is due for licensing.
- To create a platform that will enable the motorists to make a calculation for the total fees required from a certain destination to the next through multiplying the vehicle class fee with the number of tollgates along the way.
- To design an application that will provide a platform for motorists to report a car hijack or theft incident in their mobile application by providing location and registration number to the Central Vehicle Registry.
- To develop a system that will enable the management to view the number of users of the application so as to make decisions for managerial purposes.

1.6 Instruments and methods

To gather information so as to identify the problems being faced the data gathering methodologies were used. Therefore there is also a description of the software development tools to be used to develop the system.

1.6.1 Data gathering methodologies

The identification of the problems of the current system a pilot study was carried out using the data gathering techniques which include the interviews, observations as well as the questionnaires.

a) Interviews

This was done with the truck drivers who drive over long distances passing through several tollgates. Therefore the findings proved that they encounter challenges when they drive over long distances or use a certain route for the first time. This is due to the fact that some of the GPS technologies is not functional in the country hence to view the map of all the tollgates and then budget for the toll fees will then become a nightmare.

b) Observation

This was done on the sprinters vying the Gweru-Shurugwi route. The problem in this case could be encountered on the side of the those taxi owners who would require a report on the number of times the sprinter passed through the tollgate so as to estimate the daily income to be expected from his workers. Therefore after gathering all the information the need for the tolling application which could provide a report on the number of times the vehicle could have passed through a certain tollgate was needed.

c) Questionnaires

This was given to the ZINARA staff since the direct interviews could not be successful with them since they were busy with the clients and therefore questionnaires were given to them so that they complete them on their spare time. This then brought the need of the application since they further added to the questionnaire that a system capable of enabling motorists to report car hijacking incidents to tolling points as soon as it happens on their mobile applications will increase the reputation of the organisation in assisting the motorists to be secure when on the go.

1.6.2 Software development tools

These are the tools that are required in the development of the system and are outlined below:

a) Programming language (Android)

David (2007) defines the Android Studio as an IDE from Google providing all the necessary tools that are required in the development of applications that run on the Android Operating system platform. This will be used as a development platform to produce the Vehicle Registration and tolling application.

b) Server: (Xampp Application server).

David (2007) defines Xampp as a free and an open source cross platform web server solution package which interprets scripts written in PHP as well as the Perl programming languages. This will be used in the interpretation of the scripts on the admin side of the Vehicle Registration application written in PHP programming languages.

c) Database: (MySQL Database).

McCormack (2012) defines the MySQL database as an open source relational database management system (RDBMS) that is based on the structured query language (SQL). This will be used in the storage of the motorist's vehicle data as well as the management of the data. It is most compatible with the web based applications.

d) Photoshop software - is used for editing, and creating images. It is a graphic editor for manipulating high quality images.

1.7 Justification

The introduction of the vehicle licensing and tolling application using android technology in mobile phones can be of paramount importance to the organisation. Some of the motorists after acquiring a motor vehicle for the first time tend not to be aware of the procedures they should take in the registration and licensing process. Therefore the implementation of the vehicle licensing and tolling app will enable them to have all the procedures in the palm of their hands. The implementation of the vehicle licensing application will eliminate the issue of under budget in the amount of cash one would want to spend in the road for tolling fees as one will be able to calculate before the journey. The implementation of the application will also make it easier for the ZINARA staff in the enquiries from motorist since most of the information will be provided on the application thereby reduction in queues at their offices. The implementation of the system will reduce the theft of cars since when the stolen vehicle passes through the tollgate the system should provide a warning to the cashiers and therefore the vehicle can be recovered easily. License related fines are also being incurred by motorists in tollgates after their expiry and this has been usually due to the fact that the motorists would have forgotten, and hence the

introduction of the tolling application through its reminder function will reduce such inconveniences.

1.8 Conclusion

The chapter managed to introduce the topic under study by first identifying the need for a new system and this was arrived at after undertaking the data collection exercise. This then brought out the need of the system as well as what is expected of the proposed system. This includes the objectives of the proposed system which were then stated .The chapter also identified and described the software tools required in the development of that proposed system. The system justification also showed that the implementation of the vehicle registration and tolling application is vital. The planning phase that follows analyses the proposed system in terms of its feasibility to further justify the need of the vehicle licensing system.

CHAPTER TWO: PLANNING PHASE

2.1 Introduction

According to Richman (2002), the planning phase is the second stage in the system development life cycle which is concerned about creating a set of plans to be followed by the development team in the execution and development of the stages of the project. The benefits which will be brought by the introduction of the system will be analysed. This weighing process will be done through feasibility study which will be comparing the costs to its associated benefits that will be brought about by the system. The planning phase also takes into account the resources that are required in the development of the system. After the assessment of the feasibility studies then there is the drafting of a work plan. The work plan will be showing all the activities to be carried out as well as the associated period for each activity to be completed. This work plan or schedule should be adhered to so as to avoid project slacking.

2.2 Business value

According to Jewel (2004), the business value refers to the benefits which are gained from the development of a system so as to escalate the goodwill of the organisation on its effectiveness and efficiency of carrying out the business. The system will bring value and more benefits to ZINARA as an organisation through increasing the revenue collection on tollgates and increasing efficiency in the collection of vehicle registration fees. The proposed system will bring an increased value to the organisation as well as stakeholders of ZINARA. The benefits to each stakeholder are outlined below:

- **Stakeholder value:** The introduction of the Vehicle licensing and tolling application will bring more benefits to the organisation's shareholders since it will likely to increase the profits of the firm thereby increasing the shareholder value. The system will ensure that motorists are reminded to pay their license fees on time thereby increasing revenue of the organisation.
- **Customer value:** Customer value will increase among motorists as they will value their toll fees they pay on the tollgates. This will be due to ability of the system to recover stolen vehicles through the application. Therefore customers will feel that their toll fees are being used wisely in the creation of a world class road network.

- **Employee knowledge:** The system will increase the employee knowledge as well as their way of serving clients in the organisation. This will be achieved through the system by providing the necessary details concerning the tollgate fees as well as the criterion in which vehicle license is calculated so as to provide assistance to clients who would be encountering problems in licensing their tollgate fees.
- **Managerial value:** The implementation of the vehicle licensing and tolling application will likely to further increase managerial value as it will reduce the risks in the decision making process. The system will increase the way in which managerial decisions will be carried since it will provide reports on the reported cases of vehicle theft on a specific area and therefore giving the management with the required statistics to come with decisions.
- **Societal value:** The society is an important stakeholder in a business organisation and therefore every change that will be made should be assessed so as to identify its effect to the society. Motorists are also the part of the society and hence the introduction of the vehicle licensing and tolling application will ensure that their grievances are directed towards the management and hence they will then feel part and parcel of the organisation.

The implementation of this application will likely to bring more value to the organisation across its stakeholders. Therefore the implementation of the system will be of benefit to the organisation.

2.3 Feasibility Study

Davis (1998) defines the feasibility study as an analysis of how successful a project can be completed considering factors that affect it such as economic, social, technical as well as operational factors. To determine the worthiness of the project to the organisation the system developers has to undergo the feasibility study so as to come up with a decision whether to implement or discard the project. There a number of feasibility studies are carried so as to determine the worthiness and these include economic feasibility, technical feasibility, operational feasibility as well as the social feasibility. Stimpson (2004) identifies the following feasibility studies that have to be analysed so as to identify the worthiness of a project under study.

2.3.1 Technical Feasibility

Technical feasibility is the assessment of the technical equipment or resources of an organisation taking into account their applicability to the expected needs of the proposed system requirements (Rodger, 2005). This feasibility aims to identify all the equipment that will be required in the development of the Vehicle licensing and tolling application assessing all the equipment that will be required to successfully implement the system without problems.

The software as well as the hardware requirements are outlined on table 2.1 to check on the expected equipment and their availability in specified quantities.

2.3.1.1 Hardware requirements

Table 2.1: Hardware requirements

Quantity	Component	Specifications	Status
1	Hp Client Server	• 1TB Hardrive. • 4 GB RAM. • Core i5 Processor. • Speed of 2.7 GHz.	This component is available in the organisation.
1	Backup Server	• 1TB Hardrive. • 4 GB RAM. • Core i5 Processor. • Speed of 2.7 GHz.	This component is currently not available and needs to be acquired.
1	Laptop	• 500 GB Hardrive. • 4 GB RAM. • Core i3 processor or better. • Speed of 2.3 GHz.	The laptop is available meeting the minimum specifications but needs a RAM upgrade
1	CISCO router	• 2.4 to 2.5 GHz frequency range • 4 dB1 peak gain	The router is not available and needs to be acquired
2	Tablet	• 9.7 Inch screen or better • 16 GB memory or better	The tablet is currently not available and needs to be acquired.
1	CISCO switch	• 24 port • Multi-mode fibre	This also needs to be acquired.

2.3.1.2 Software requirements

Table 2.2: Software requirements

Quantity	Component	Specifications	Status
1	Android Studio	• Android Studio 3.0 CANARY 9	This is free for download on the internet.
2	Operating System	• 64-bit Windows 7 or better • Red Hat Linux 64-bit operating system	These have to be acquired for installation on client server and backup machines.
1	Dreamweaver	Adobe dreamweaver preferably version CS6	This is available for free download the latest version on the internet.
1	Xampp	Xampp version 5.6 or better	This is available for free download the latest version on the internet.

2.3.1.3 Technical expertise

This involves the identification of the technical abilities of the available employees to be able to use the proposed system. ZINARA has got employees capable enough to operate and debug the application in the event of an error through its ICT department. Therefore the system will be directed implemented in the organisation since there will be little training required so as to able to put the proposed system into full operation. Hence the organisation is rich in technical expertise and hence implementing the system will not bring problems to the organisation as a whole.

2.3.2 Economic Feasibility

Economic feasibility is concerned about the economic benefits which will be brought by the

implementation of the system. Kendal (2006) states that the economic feasibility puts much focus on the costs that are incurred in the development of the system and making sure they are kept at minimum. The costs of the proposed system should be brought into light and be weighed against the possible benefits to be enjoyed after the implementation of the system. The benefits should outweigh the associated costs. Therefore if this condition is met then the system can then be developed. When the proposed system becomes functional the system benefits will outweigh the costs since the operational costs are likely to be low. The costs of acquiring the hardware and software is low since most of the equipment is readily available which is also compatible and can accommodate the requirements of the proposed system.

2.3.2.1 Development Costs

According to Jewell (2000), the development costs are the total expenses that are incurred in the development of the project. Development costs are the costs ZINARA is to incur in the development of the vehicle licensing and tolling application. Table 2.3 indicate the development costs to be incurred in developing the licensing system.

Table 2.3: **Development costs**

Component	**Quantity**	**Costs**
Hp backup Server	1	$700
CISCO switch	1	$544
Tablet	1	$250
RAM upgrade	1	$45
Windows 7 operating system	1	$150
Red hat Linux OS	1	$500
CISCO router	1	$1,100
Total developments costs		**$3289**

2.3.2.2 Operational Costs

The operation costs are the costs which are incurred and associated with the day to day running of the developed system (Cadle and Yeats, 2008). The costs incurred in the day to day running of the system can be grouped into fixed and variable costs. Fixed costs can be in form of all the costs incurred in the licensing of all the software to be used. Variable costs on the other hand can be in form all the electricity bills. Table 2.4 outlines the operational costs to be incurred when using the system:

Table 2.4: Operational Costs

Operational Cost Description	**2018**	**2019**	**2020**	**2021**	**Total**
Hardware maintenance	$500	$200	$100	$50	**$850**
Software maintenance	$1000	$900	$500	$100	**$2500**
Training and consultation	$300	$150	$20	$20	**$490**
IT services and Networking	$500	$250	$100	$70	**$920**
Total Operational costs	**$2300**	**$1500**	**$720**	**$240**	**$4760**

2.3.2.3 Benefits

According to Lucey (2002), benefits are the favourable circumstances or advantages that are obtained from the implementation of the proposed system. These benefits can be grouped into tangible and intangible benefits. This implies that these some can be associated with a value that is tangible, and some cannot be assigned with a value that is intangible.

a) **Tangible benefits**

According to Lucey (2002), tangible benefits are the favourable circumstances that can be expressed in figurative terms or in monetary terms. These benefits can be further explained on table 2.5.

Table 2.5: Tangible Benefits

Description	**2018**	**2019**	**2020**	**2021**	**Total**
Reduced recurring costs	$800	$1000	$1100	$1500	**$4,400**
Time enquiries reduction	$750	$900	$1000	$1200	**$3,850**
Reduced labour	$900	$1000	$1100	$1250	**$4,250**
Total tangible benefits	**$2,450**	**$2,900**	**$3,200**	**$3950**	**$12,500**

b) Intangible benefits

These are the favourable circumstances that are enjoyed by an organisation but these cannot be quantifiable, measured or assigned a monetary value (Lucey, 2002). Therefore no one can touch or feel these benefits. The non-tangible benefits likely to be enjoyed are outlined below:

- Reduced employee workload on handling motorists' queries.
- Customer satisfaction will be increased.
- Reduced risk in the management's decision making process since the system will provide reports on a specific subject.
- Increased motorist morale and that of employees as well.

2.3.2.4 Cost Benefit Analysis (CBA)

According to Cadle and Yeats (2008), the cost benefit analysis is a technique used in the business to analyse the benefits of a certain course of action, whereby the benefits are summed up against the associated costs of that particular action. To undertake this action the list of all the benefits and the costs should be listed. The benefits in this case should include all the direct benefits, indirect benefits that are for example increased customer satisfaction. Table 2.6 shows the cost benefit analysis table which bring out all the benefits to be enjoyed after the implementation of the proposed system:

Table 2.6: Cost benefit analysis

Description	**2018**	**2019**	**2020**	**2021**	**Total**
Benefits	**($)**	**($)**	**($)**	**($)**	**($)**
Tangible benefits	2,450	2,900	3,200	3,950	8,500
Total benefits	**2,450**	**2,900**	**3,200**	**3,950**	**12,500**
Costs					
Operational Costs	2,300	1500	720	240	4760
Total costs	**(2,300)**	**(1500)**	**(720)**	**(240)**	**(4760)**
Net Benefits	**105**	**1,400**	**2,480**	**3,710**	**7,740**

2.3.2.6 Net Present Value

Net present value refers to an investment evaluation technique which takes into account the profitability of the project as well as the timing of the cash flows that are produced (Lucey, 2002). In the development of the project a 15% Discount rate was used as shown on table 2.7.

$$\text{Net Present Value} = \frac{\text{Total benefits} - \text{Total costs}}{(1 + r)\, n}$$

Whereby N: number of years and r: interest rate.

Table 2.7: Net Present Value

Year	**Net Cash flow** **US $**	**Discount Factor** **US $**	**N.P.V** **US $**
0	(3,289)	1,000	(3,289)
1	105	0.870	91.35
2	1400	0.756	1058.4
3	2480	0.658	1631.84
4	3710	0.572	2122.12
N.P.V			**1614.71**

The net present value of $1,614.71 shows that the system is viable enough to be implemented and hence a feasible project.

2.3.2.6 Return On Investment (ROI)

According to Randall (1996), Return on Investment refers to a profitability measure, calculated through dividing profit or income by the investment required in obtaining that income. ROI is expressed as a percentage of the total investment benefits divided by its associated costs.

$$\text{Return On Investment} = \frac{\text{Average Annual Profit}}{\text{Development Costs}} * 100$$

$$\frac{\$1{,}935}{\$3{,}289} * 100 = 59\%$$

The positive Return on Investment implies that the project being undertaken is viable and fruitful hence the 59% result calculated above shows that the project is worthwhile to implement.

Economic feasibility brought out the monetary analysis of the implementation of the vehicle licensing and tolling application. The analysis showed that the application will bring more benefits than costs to ZINARA as an organisation through the cost benefit analysis. Therefore the implementation of the system will be of benefit to the organisation considering the economic feasibility.

2.3.3 Social Feasibility

Social feasibility is the assessment of the proposed system to determine the positive and negative impacts of the proposed system to the people and the organisation and how it is accepted (Kendal, 2006). The implementation of the vehicle licensing and tolling application will lessen the workload among the ZINARA employees resulting in more time with their families thereby enhancing their social life. The introduction of features like the one which enables motorists to manage their fleet of cars also create some form of loyalty as well as transparency to the employees since there will be a report to the owner of the vehicle if one of his cars pass through the tollgate.

The development of the application will reduce the motorist's grievances and bias towards ZINARA as an organisation as the majority of the motorists always feel they are always robbed of their hard earned cash in paying tolling fees. The development of the vehicle licensing and tolling application however brought out some panic among the ZINARA employees who had insecurities over their jobs. This on the other hand was tackled by explaining to them the functionalities of the application since it did not replace their capabilities, but could be a useful tool in making their work much easier through reducing number of client enquiries.

However the system will have a negative impact on the side of the ZINARA employees since the number of employees required in handling customer request will be reduced. This will have a negative impact in their social life since some will be retrenched and hence the system will be a threat to their jobs.

Therefore the social feasibility highlighted issues which had to be addressed but however this showed that the application would be useful to many in their workplaces, hence its implementation will be a good decision.

2.3.4 Operational Feasibility

According to Rodger (2005), operational feasibility refers to the measure in which the proposed system is going to tackle and eliminate the problems currently being faced by the organisation. The problems to be addressed are the ones identified in the problem definition. This feasibility study also measures the extent or the way in which is going to be used if it is to be successfully implemented in the organisation. The ZINARA employees accepted the idea of the system thereby contributing towards their perceived ease of use of the application since throughout the development they all provided their input. Therefore no resistance could be encountered among the workforce and hence the stakeholders of the organisation supported the initiative. This is due to the following reasons:

- The implementation of the vehicle licensing and tolling application could improve the workload among the ZINARA employees in handling customers' enquiries.
- It will bring about transparency between the owners of large fleet of cars with their drivers since a notification will be sent to the owner when his vehicle passes through a tollgate.

2.4 Risk Analysis

Chavas (2004) defines risk analysis as the threats that can be encountered in the implementation of the system and finding ways or techniques to react to those risks in a proficient viable way. In the development of any project several risks are always a threat. However some of the risks outlined are those that are likely to be encountered and the ways to mitigate them. Table 2.8 outlines the risks with their associated probabilities of occurrence as well as the ways to mitigate them if they arise along the way.

Table 2.8: Risk analysis table

Risk Description	Probability Of occurrence	Prevention strategy
Resistance among the employees to use the system.	Medium	This was avoided in the initial development of the system whereby the employees were involved in the development process so as to avoid future resistance.
Failure to finish the project according to the schedule.	High	This could be tackled through drafting a work plan with the associated activities and completion times. These were to be adhered to so as to avoid project slacking.
Lack of resources	Medium	A project budget was communicated to the organisation so as to try and avoid such occurrences since the expected equipment required was well drafted with their associated market prices.
Virus and malicious software attack	High	The ZINARA workstations are to be installed with the Avira antivirus software to be updated regularly so as to minimise such an occurrence.

2.5 Stakeholder analysis

According to Chavas (2004), stakeholder refers to a forensic study and identification of the various stakeholders and their reactions to the system. The stakeholder interests that affect the system under development should be taken into consideration so to identify how one influences the development. The stakeholders include several stakeholders who include the motorists, ZINARA employees and management and the potential investors. Therefore the reactions of these is analysed next.

2.5.1 Motorists

These are the important stakeholders to ZINARA since they are their main source of revenue. The introduction of the vehicle licensing and tolling application will increase their conveniences. The system addresses the problems they are currently facing in getting their services and by so doing their interests are catered for to a greater extent.

2.5.2 Employees

The service delivery will be increased through the introduction of the vehicle licensing application will increase their throughput. This lightens up their job in serving the clients even when operating from a remote location. Therefore the amount of work load is reduced by the system and hence addressing the employee concerns.

2.5.3 ZINARA management

The management through the introduction of the application can benefit largely through its use by making use of reports facilities rather than collecting a lot of paperwork. Therefore the easiness to arrive to crucial decision is further simplified. Therefore the application caters for the management interests of making decision making easier.

2.5.4 Potential Investors

The application is available on the company website being available for anyone to use further attracts other investors in the organisation who would envy to be part of the successful and transparent organisation.

2.6 Project Work plan

Richman (2002) defines a project work plan as a summary that outlines the objectives of the project refined giving a summary of the schedule that includes the tasks that are to be completed so as to achieve the stated goals. The waterfall model was adopted in this research due to the way in which its activities are undertaken that is its successive approach in completing the activities. The time allocation to each activity is shown below through the use of the project work plan as well as the Gantt chart. Table 2.9 shows the project work plan to be adhered to.

Table 2.9: Timing project schedule

Phase	Start	End	Duration (weeks)
Introduction	20/02/17	06/03/17	3
Planning	06/03/17	03/04/17	5
Analysis	03/04/17	17/04/17	2
Design	17/04/17	15/05/17	5
Coding	15/05/17	03/07/17	7
Testing	03/07/17	07/08/17	5
Implementation	07/08/17	11/09/17	5
Maintenance	11/09/17	15/10/17	4

2.6.1 Gantt Chart

A Gantt chart is a horizontal chart which depicts the task and their associated time frames (Richman, 2002). The assignments on the Gantt chart are recorded on its left side and the weeks are the time scales on the top depicting the time frames for the project to be completed. Table 2.10 shows the Gantt chart depicting the activities to be done and time.

Table 2.10: Project Gantt chart

Months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Introduction											
Planning											
Analysis											
Design											
Coding											
Testing											
Implementation											
Maintenance											
Documentation											

2.7 Conclusion

The chapter managed to analyse the system through the use of several evaluation techniques which include the feasibility study and risk analysis. The feasibility analysis showed that the benefits of the system outweigh the costs through the cost benefit analysis. The projects benefits outweighed its associated costs and as a result this shows that the implementation of the system will bring more good than harm financially to the organisation. There is also lower risk associated with the system as the risk analysis suggest. The chapter also moves on to the work plan which then outlines the schedule of the tasks to be completed. The analysis phase that follows analyses the current system as the work plan suggest.

CHAPTER THREE: ANALYSIS PHASE

3.1 Introduction

This chapter is aimed at the analysis of the existing vehicle licensing system at ZINARA and thereby exposing the shortcomings with the use of the system. This will thereby bring the need to justify the importance of implementing the proposed system. In analysing the system several data gathering methodologies are used in this chapter in gathering the required information so as to come up with the solutions of the current system. After coming up with the weaknesses of the system, the chapter further evaluates the alternatives so as to address the weaknesses of the current system. These include the improvement of the current system, outsourcing and in-house development and thereby the best alternative is then selected. The functional requirements are also evaluated before the chapter end.

3.2 Data gathering methodologies

In a bid to obtain more accurate information or results, fact findings strategies were undertaken. To investigate the actual operation of the current so as to gather all the data requirements which might be of use in the development of the proposed system, techniques which include observations, questionnaires as well as interviews were carried out. The three most common fact finding techniques include observations, questionnaires and interviews (Shelly and Rosenblatt, 2010). An understanding of the current system was achieved through the use of these three most common fact finding strategies and the findings helped in coming up with solutions to the constraints of the existing system.

3.2.1 Interviews

Seidman (2013) defines an interview as a fact finding methodology that is intended to attain information from a person's oral reaction or requests. An interview is the most appropriate fact finding methodology and in most cases in a research bring out most information and clarity as compared to other fact finding strategies. The interviews were directed to the licensing officers who use the system daily as well as the motorists who will be using the proposed application. The interview questions which were directed to each stakeholder are attached to the appendix section of this system documentation. The findings as well as the advantages and the associated disadvantages of carrying out the fact finding using the interviews are discussed next:

3.2.1.1 Advantages

- There was direct interaction with the ZINARA employees who are the daily users of the existing system.
- Some of the facts which could be difficult to be put into writing were discussed and this further widened the discussion.
- Gestures as well as emotions were also captured during the interviews and this proved useful in mining some information relevant to the research.
- The use of interviews as a fact finding was not taken seriously by the respondents and therefore they brought out their views freely while also attending to the clients.

3.2.1.2 Disadvantages

- There was danger of capturing incorrect information since the interviewee was attending clients while at the same time responding to the interview questions.
- Time was wasted in conducting the interview since there was some clarification needed in some instances from both sides of the interviewer and the interviewee.

3.2.1.3 Findings from Interviews

The interviews were conducted targeting the ZINARA employees which are the Licensing officers who use the existing system frequently. The interviewer discovered that some of these employees were resistant to change. These employees in general sense thought of a new workplace after the proposed system has been implemented. The system in reality would enhance their productivity in giving out the licensing as well as making their job much easier which was then an issue in which the interviewer addressed during the interview so as to bring to bed all the fear among the employees such retrenchment issues. The interviews were also done with the truck drivers who drive over long distances passing through several tollgates. Therefore the findings proved that they encounter challenges when they drive over long distances or use a certain route for the first time. This is due to the fact that some of the GPS technologies is not functional in the country hence to view the map of all the tollgates and then budget for the toll fees will then become a nightmare

3.2.2 Questionnaires

According to Kimberly (2006), questionnaires are a set of prepared questions answered by a predefined order by a selected population so as to obtain information for a certain research. This is a fact finding technique which is mostly suited when the targeted population is large and therefore the views gathered will be large.

3.2.2.1 Advantages

- Respondents attended to the questionnaires at their free time.
- Information which was given by the responded was mostly direct and specific and therefore easy to analyse.
- Unbiased information was obtained since the methodology eliminates the fear of victimisation.

3.2.2.2 Disadvantages

- Some respondents decided against responding to certain questions which were the most crucial areas in the research.
- The respondents needed follow up in submitting back the questionnaires since some threw them away since they were commuting.
- The other respondents were biased towards pleasing and some responses were disappointing.

3.2.2.3 Findings from Questionnaires

Different motorists were issued questionnaires at different points. These were issued out at different intervals only to a restricted number of motorists. This was done so as to curb the danger of obtaining similar results as one can influence the answer of the other motorists if issued at the same time. This was done so as to eliminate the chances of acquiring similar responses thereby obtain similar information which lacks variety of ideas and opinions.

The questionnaires also provided an optional option for one to fill in the personal details on the questionnaire. This was done so as to curb the fear of victimisation among the responded since their information was to be kept anonymous. The answers obtained by the investigator undoubtedly contributed a larger extent to the successful progression of the proposed vehicle

licensing and tolling application. The specimen of the issued out questionnaire is attached to the Appendix section of this documentation.

3.2.3 Observations

An observation is a fact finding technique where one gathers data by watching a certain procedure or a routine being performed (Seidman, 2013). The fundamental objective in observing the routine was to find if there is a problem existing within the procedures taken in the process.

3.2.3.1 Advantages

- First-hand information without bias was obtained since nothing was hidden from the interviewer.
- No disturbances to the operations of the organisations since the information will be obtained by observation.

3.2.3.2 Disadvantages

- There is no direct contact with the users of the system therefore limited facts are obtained.
- There is risk of misinterpretation of the situation since there is no room for clarification from the users of the system.

3.2.3.3 Findings from Observations

This was done at the ZINARA office viewing the day to day operations of the current system of vehicle licensing. The general morale was very high in the early hours of work and this reduced with time and queues started moving slowly. This also helped as the information obtained was not biased as the employees were not aware that they were operating under surveillance. The observation was also done to the sprinters vying the Gweru-Shurugwi route. The problem in this case could be encountered on the side of the those taxi owners who would require a report on the number of times the sprinter passed through the tollgate so as to estimate the daily income to be expected from his workers. Therefore after gathering all the information the need for the tolling application which could provide a report on the number of times the vehicle could have passed through a certain tollgate was needed.

3.3 Analysis of the existing system

Stair and Reynolds (2012) argue that analysis of the existing system is done to expose weaknesses and strengths of the current system so that areas that need to be improved or added are discovered. To develop a meaningful system, there is need to fully understand the system that is currently in use. Jumping into developing the new ZINARA system can be equated to a doctor who jumps into treating a patient without diagnosing the disease first. According to Gupta (2005), analysis of the existing system is done with a finished goal of exposing weaknesses and strengths of the current system. The current manual ZINARA license application and tolling system has more disadvantages than advantages. These advantages and disadvantages are listed below.

3.3.1 Advantages of the existing system

- The current system is easy to use and anyone can use without much training and thus on-job training is possible.
- The system in place is easy to maintain and operate.
- It is easy to understand how the current system works.

3.3.2 Disadvantages of the current system

- The current system is slow in processing vehicle licenses to the point of taking twenty minutes from the moments an applicant submits an application and the moment the license is granted.
- The current system lacks security, for example at one time a client sneaked into the ZINARA offices and issued a license for himself resulting in the organisation losing revenue.
- It is current difficult for any motorists to determine the number of tollgates along their routes and hence they cannot budget their toll fees. For example, a tourist who is touring the country for the first time may need information regarding the number of toll gates along a certain route and such information is currently not available.
- The current system does not address data security issues since all data such as vehicle license details is stored in flat files which are prone to any form of physical damage.

- It is costly to maintain the current system since it requires huge spending in stationary costs. And, it is costly for applicants to travel to the organisational premises.
- Application and approval of licenses process is restricted to business hours only, thus applicants who may be tied by work during the day cannot make applications outside business hours.
- Nepotism and corruption is rampant since the current system promotes face to face interaction between clients and the ZINARA employees.

3.3.3 Description of current system.

After buying a vehicle by import or buying from local dealers, the vehicle owner will be issued a Customs Clearance Certificate (CCC) and a temporary number plate that contains vehicle and personal details by the Zimbabwe Revenue Authority. The vehicle owner is given a maximum period of 14days from the date of issue of these documents for the owner to fully register and license the vehicle. The owner will have to get the vehicle cleared by the Zimbabwe Republic Police VTS Department. After the vehicle has been cleared the owner will proceed to the Vehicle Inspection Department (VID) to get the vehicle weighed and inspected. The owner will be issued with a document that contains vehicle chassis number, engine number, colour, type, weight and its model. After acquiring these documents the vehicle owner will have to visit the nearest ZINARA, Zimpost or ZIMRA to apply for number plates. After getting the vehicle number plates, the owner will proceed to the nearest ZINARA offices or Agents to get the vehicle licenced. Upon being issued a license the vehicle details which include the vehicle class, type and colour are captured in the ZINARA licensing system. This information will then be used by the tolling officers when the vehicle passes through a tollgate to assign charges based on the vehicle class and to check on the expiry of the vehicle licenses.

3.4 Process analysis

Dixit (2010) defines a process as managed periods of a process that have been broken down, that are used to communicate inputs together with outputs and operations that take place at each stage. The upgrade of knowledge on the capacities of a process, and the potential system's centres that can change and extending adequacy can all be identified through process investigation. An activity diagram was utilised to demonstrate how information flows from one

stage to another. An activity diagram is a tool for modelling business process independent of objects (Stair and Reynolds, 2012). Activity diagrams are almost similar to a dataflow diagrams but they are used to model concurrent processes and the disregard data stores. Fig 3.1 shows the activity diagram for the current system.

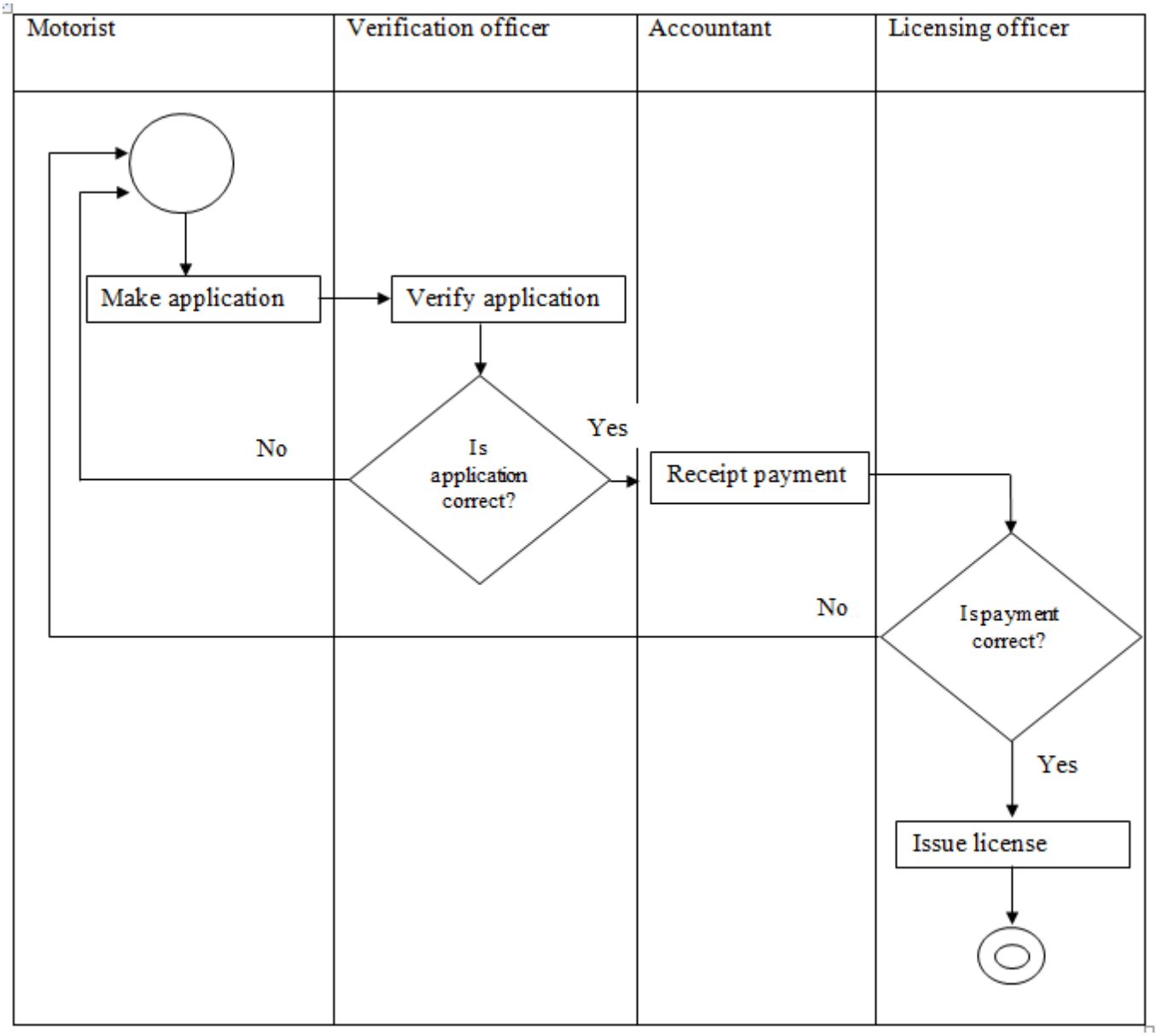
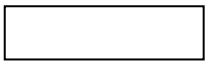


Fig 3.1: Activity diagram for the current vehicle licensing system

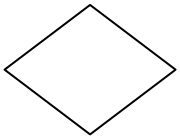
Key

Process

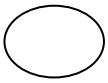


Flow of data

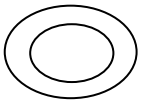
Decision



Start node



End node



3.5 Data analysis

According to Bentley and Whitten (2007), data analysis is a tool that seeks to enhance the representation of organisational data when there is need to implement the business database. Data analysis promotes clarity on what data flows within the organisation and how it flows from one process to another. According to Berthold and Land (2007), data analysis is carefully taken into consideration and is a key facet in decision making upon deciding the most useful and important data that must be taken not of. In short, data analysis can be loosely viewed as an activity that includes the modelling, inspection and transformation of data into useful information. Data analysis uses other tools in data representation and these are data flow diagrams and context diagrams. These tools are discussed next.

3.5. 1 Context diagram

Grady (2006) states that a system is represented as it is blended in its operating environment in a context diagram. Dixit (2010) add that the context diagram displays all the information relevant to the system in the environment in which it operates. Fig 3.2 shows the context diagram for the ZINARA current licensing system.

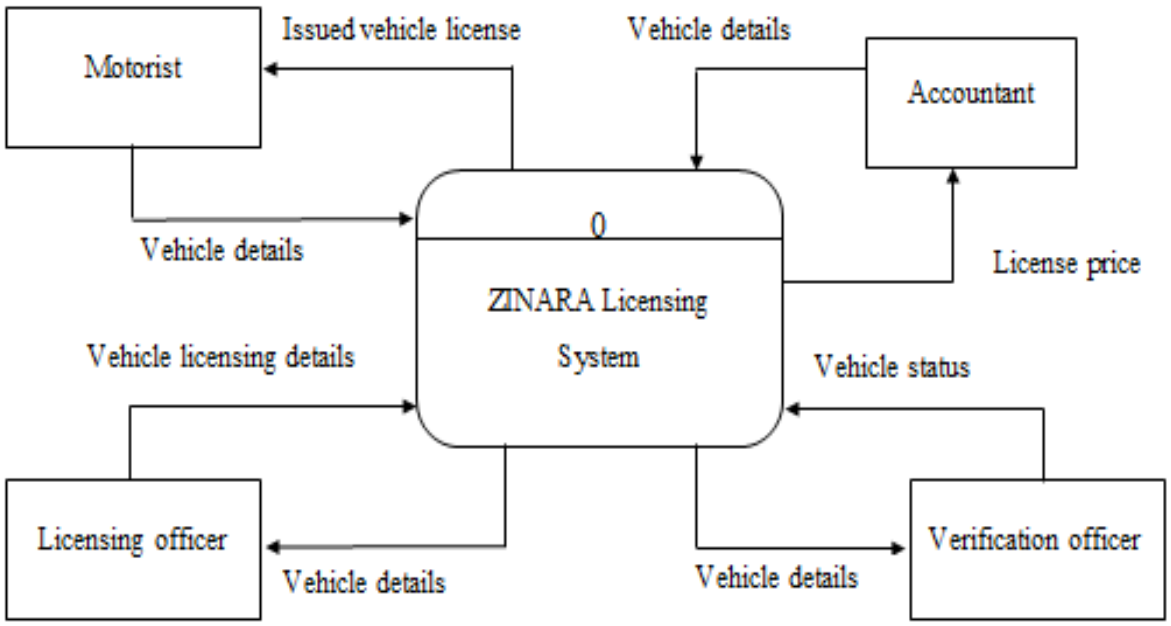
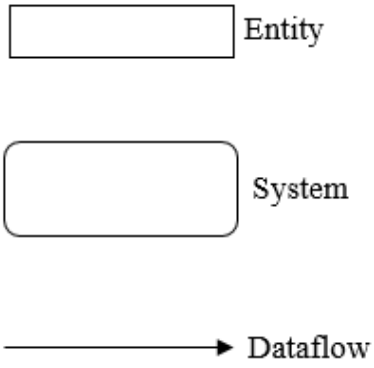


Fig 3.2: Context diagram for the current system

Key



3.5.2 Dataflow diagram

Dataflow diagrams are another tool for data analysis and they also help in understanding how data flows within an organisation. Dixit (2010) argues that dataflow diagrams demonstrate the system's most important features. Rajaraman (2016) also defines a dataflow diagram as a diagrammatic tool that represents how data flows into and out of a system. A dataflow diagram is an illustration of connected activities of functional requirements that are identified for a system (Dixit, 2010). From an abstract point of view a dataflow diagram contains entities on the left-

hand side and processes in the middle and data stores on the far-right hand side. The arrows will be pointing the direction in which data is flowing. The current system being used by ZINARA has three entities as shown in fig 3.3.

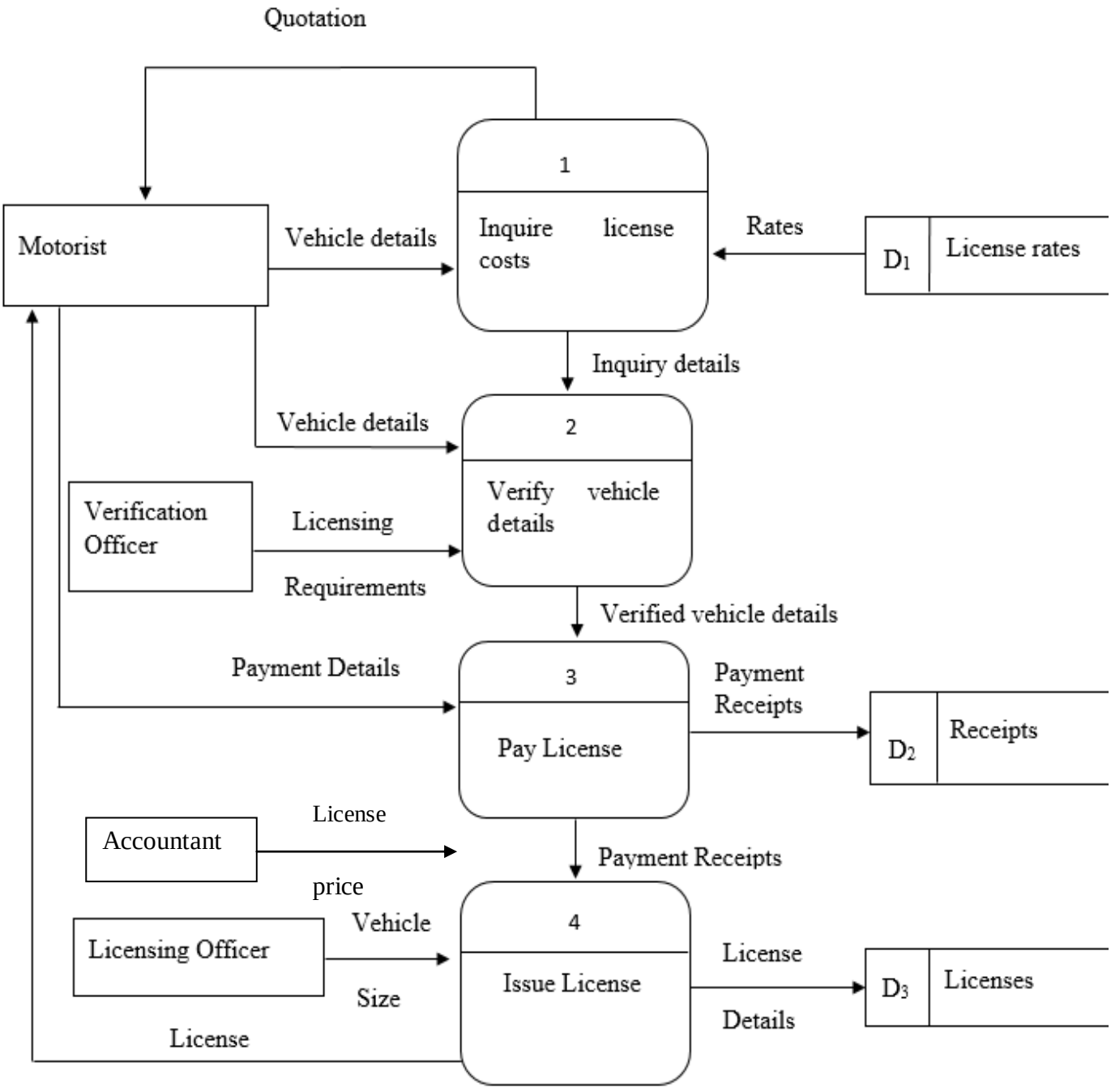
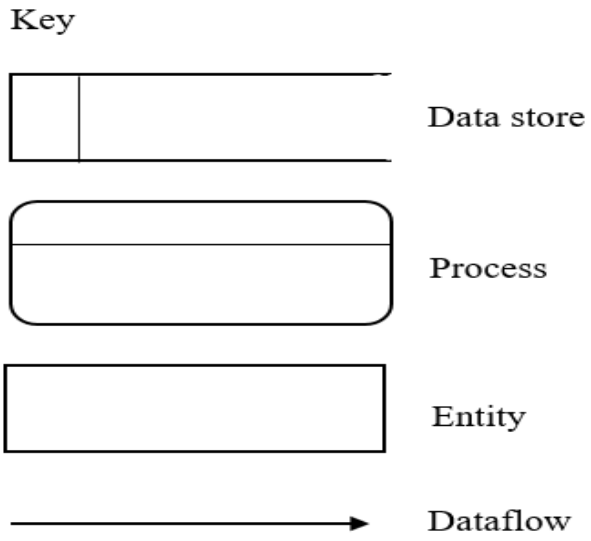


Fig 3.3: Dataflow diagram for the current system



3.6 Weaknesses of the current system

- The current system is prone to forgery since records are kept in cabinet where anyone can get access to whenever he gets the keys.
- The system is tiresome to use since it cannot compute any statistical data for decision making. For example, calculating monthly collections from issue of licenses.
- The current system does not offer a 24/7 service for motorists.
- Clients cannot trace the progress of their applications.
- The system in not cost effective due to large spending in stationary.
- It is current difficult for any motorists to determine the number of tollgates along their routes and hence they cannot budget their toll fees. For example, a tourist who is touring the country for the first time may need information regarding the number of toll gates along a certain route and such information is currently not available.
- The current system does not address data security issues since all data such as vehicle license details is stored in flat files which are prone to termites' attack, fire and any form of physical damage.
- Nepotism and corruption is rampant since the current system promotes face to face interaction between clients and the ZINARA employees.

3.7 Evaluation of alternatives

According to Davis (1998), evaluation of alternatives is done to uncover the advantages and disadvantages of each alternative. At this juncture the various alternatives will be looked at that are available for ZINARA giving advantages and disadvantages of each alternative so that the best alternative is arrived at. Generally, the options that ZINARA can turn to address the weaknesses identified above are: improvement of the existing, outsourcing registration and tolling application and in-house development. These alternatives are discussed below.

3.7.1 Improving the existing system

This means giving a face to the existing system to address the weaknesses identified. The most important point to note about improvement is that it does not do away with the existing system but simply give other functionalities to the existing system. This may mean computerisation of other sections or departments but the old will still be in place. Improvement has its advantages and disadvantages and these are discussed below.

3.7.1.1 Advantages

- Security and privacy of organisational information is guaranteed.
- Costs related to stationary will be reduced for example with the computerisation of other departments or sections of the organisation.
- Lower training costs will be incurred since the system will be slightly different from the existing system.

3.7.1.2 Disadvantages

- Improving the existing system will not eliminate or reduce nepotism significantly.
- The improved system will be bound to be challenging to maintain since it will consist of two different parts, one part being manual and the other being computerised.
- Data inconsistences will occur if regular updating of records is not done properly resulting in differences in data being stored by electronic means and that which will be stored in flat files.

3.7.2 Outsourcing

According to Cadle and Yeats (2008), outsourcing is the process of surrendering the organisation's internal activities and decision rights to an external service provider. In this case the ZINARA will buy already made licensing software and the organisation will be highly reliant to the external service provider. Shelly and Rosenblatt (2010) argue that outsourcing is the act of acquiring a software product from an external organisation and the organisation that supplies the software can customise the software to suit the needs of the customer organisation or the company can buy already made software that has similar functions that address the business needs. Gupta (2005) best defines outsourcing as the acquisition from an external source of software services that are similar to those that the organisation could have provided for itself.

3.7.2.1 Advantages

- New ways of doing business can be shipped into the organisation (Seidman, 2013), for example if the ZINARA licensing software is outsourced from a country like South Africa it means South African licensing technology would have been shipped into Zimbabwe and the organisation will embrace it.
- Requirements of technical personnel will be lower. This means the IT department will have time to prepare the organisation so that it can support the new technology, for example buying servers, switches and installing them.
- Organisational daily activities are not affected by the software development as the employees will be attending to their day to day activities unlike in-house development.

3.7.2.2 Disadvantages

- The system will be costly to maintain for example all upgrades will require the service provider's service and this will attract some charges. In the event that the organisation wants some modifications to be applied to the system for example when the license fees go up, this again will attract some charges.
- Organisation's information security can be compromised during the requirements gathering stage and the information can end up in the wrong hands and used for malicious purposes.

- The source code provided may be vague and difficult to understand so as to make it difficult to upgrade the system.
- The move can demotivate the ICT department since it may insinuate their incapacity it software development.

3.7.3 In-house development

According to Shelly and Rosenblatt (2010), in-house development refers to the development of software internally by the ICT department in order to address the organisation needs. The option of in-house development has become increasingly more viable and common due to expansion of the software industry and the coming of open source software development tools such as android studio and PHP.

3.7.3.1 Advantages

- The software product usually meets the requirements of the organisation since it highly involves user involvement during software development
- The organisation will incur lower maintenance costs since the system upgrades will be undertaken by the ICT department unlike by the external entity.
- A comprehensive documentation will be kept for references purposes.
- Lower development costs will be incurred by the organisation since the personnel will be readily available.
- In-house development also motivates the ICT department personnel since they will be trusted by the users they support and supporting the users will be easy since the ICT staff will be highly vested with the system's operations.
- Organisation's security is guaranteed since data gathered during data gathering stage will be kept and used internally by the ICT department.

3.7.3.2 Disadvantages

- Software development process usually takes longer since the ICT department does not specialise in software development.
- This shuts thee door for new innovations and new ways of doing business which could be shipped into the organisation by outsourcing process.

From the above information one may not be far away from the truth to conclude that in-house development is the best option. This is so because it has a lot of crucial advantages and also the development costs of **US$3289** calculated in chapter 2 of this document. Outsourcing the software can also be a tempting option with a price of **US$1900** for the licensing software on the Amazon website. However this option is not viable due to the fact that the organisation will incur costs such as maintenance and upgrading costs in the long term. Improving the system can leave can also lead to higher costs since costs such as stationery with the other part being a manual system will remain. This will cost the organisation close to **US$1300** a year in stationery and maintenance and hence can cost the organisation in the long run. Therefore we can conclude that the in-house development can be afforded by the organisation and the benefits that will be enjoyed by the organisation can justify this option.

3.8 Requirements Analysis

Grady (2006) insists that the analysis of the user requirements should be done properly so as to match or tally during the design phase with the development concepts. According to Kendal (2006), requirements analysis involves scrutinizing the whole system's domain which incorporates the hardware, software and the human resources in terms of how they interact and depend on each other. These requirements are grouped into functional and non-functional requirements. These will be discussed separately starting with the functional requirements.

3.8.1 Functional requirements

According to Thompson (2013), functional requirements are the targets of the real design of the system. During the system development at the design phase, the functional requirements may be ascertained as the requirements that are initially identified and are difficult to identify (Dufresne, 2008). In short, functional requirements are specific functionalities that describe what the system is supposed to accomplish. The new ZINARA vehicle licensing and tolling application will enable the following key functions:

- Concurrent access to the information and usage of the system
- 24/7 service will be provided
- Online tracking of applications and calculation of toll fees.

- The new system will also support uploading and downloading of files for example, downloading a license form.

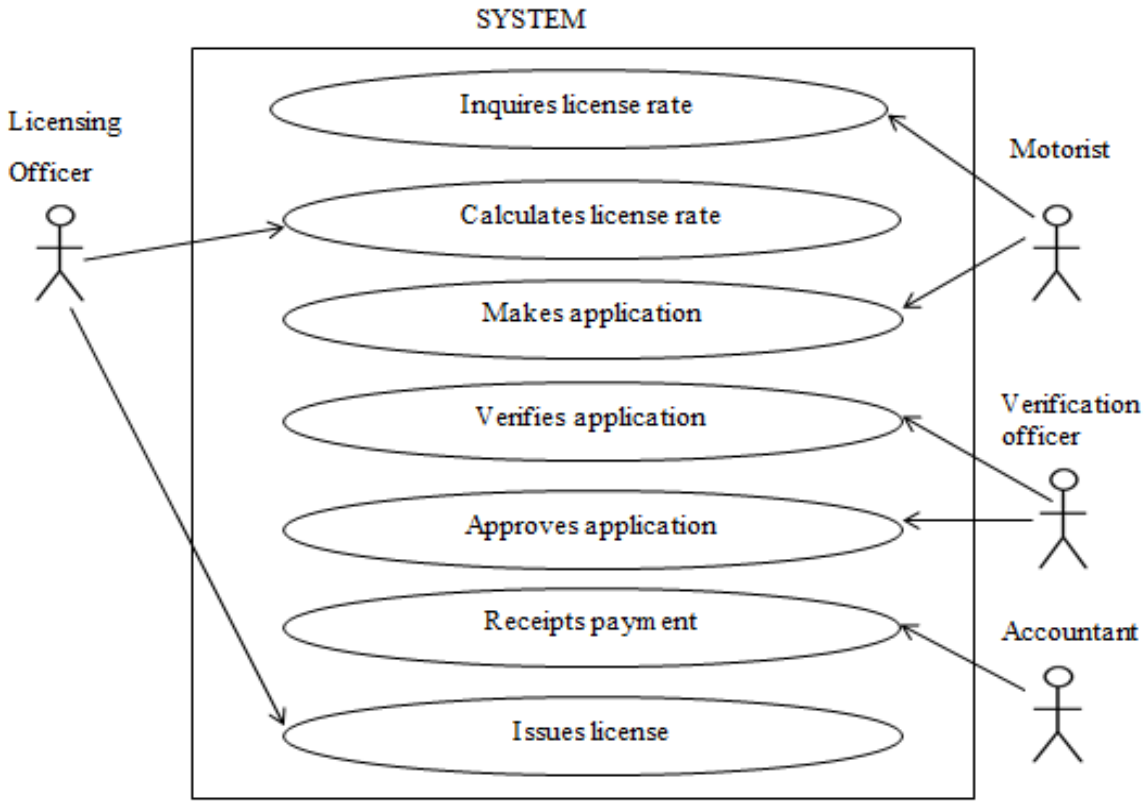


Fig 3.4: Use Case diagram

3.8.2 Non-functional requirements

Kasse (2008) argues that the way in which a system will work is ignored by the non-functional requirements. More so, according to Rozanski and Woods (2012), it is easy to identify non-functional requirements during the survey of the functional requirements because the pair is interconnected. After carrying out a detailed analysis of the existing system the non-functional requirements for the ZINARA new system were found which include:

- Security- Access control methods such as the use of strong onetime passwords and usernames will restrict those without necessary privileges to gain unauthorised access to the system will be enforced.

- Reliability- the system will be highly reliable since a backup server will be installed so that if that if one fails the other will take over. This will not affect the user information since there will be hard disk mappings such that every transaction that takes place in one server will be simultaneously duplicated in another server.
- Supportability- the proposed system shall be easy to install, configure and maintain.
- Operation- the new ZINARA vehicle licensing and tolling system will be accessible both in the intranet and through the World Wide Web (www) and anyone can access the services from any part of the country as long they have internet connection.
- Usability- the new system will be efficient to use for example it will take about a minute for the applicant to make an application and submit online. The author took his time in addressing user perceived ease of use and systems perceived usefulness and he managed to balance the two aspects to ensure easy task accomplishment. The system will also be easy to use.

3.8.3 Constraints of the success of the system development

Along the way from the system development through its implementation to its usage, a handful of drawbacks can be expected and this calls for a lot of measures so as to manage the severity of these constraints. In any case, the challenges perhaps are experienced in the midst of various motivations behind the improvement procedure of the new system. The users of the system may be resistant to change due to fear of loss of jobs. Some of the constraints are as follows:

- The implementation process will require some considerable amount of time since the organisation has a lot of branches and agents scattered throughout the country.
- Also resources constraints will come as a major blow to the organisation since it is currently facing liquidity crisis.
- The accomplishment of the new system is not flawless in any case since programming errors and also the generation of the required algorithms may present itself as a challenge.
- Time- it is a challenging task to develop a system that meets all the user requirements within the stipulated time.

3.9 Conclusion

This chapter concentrated of the analysis of the existing system with the help of several data gathering tools such as interviews, questionnaires and observation. Other tools such as data flow diagrams were also of great use in acquiring the detailed information about the existing system. The chapter also articulated several options that are available for grab by the ZINARA. The chapter consequently concluded that in-house development is the best after considering the advantages of in-house and also the affordability of developing the system in-house. After making this conclusion the project will now have to go straight to the next chapter which is the design phase where the proposed system functionality on how the system is going to work since the proposed system will be developed internally.

CHAPTER FOUR: DESIGN PHASE

4.1 Introduction

With all the information gathered and conclusion being made that there is need for a new system, concentration is now being put on designing the new system. This chapter covers the system design of the system, database design and architectural design. Use will be made of graphical and tabular presentation to show how the new system will work. Input and output forms will also be shown and by the end of this chapter the reader will have a clear picture of the system and a detailed knowledge of the security issues that will be addressed and the reader will be left with no doubt that the new system addresses the needs of the ZINARA and its stake holders. The author begins the chapter by looking at system design as part of the design phase.

4.2 System design

According to Stair and Reynolds (2012), system design can be loosely defined as a system development phase that concentrate on how the proposed system is going to work with the objective of addressing a particular problem(s). System design is most regarded by most authors as the summary of the dataflow diagram and the context diagram. This part of the design phase also outlines the sequence of execution of tasks or the sequence of processes one after the other. User needs should be met, however it should be noted and observed that these needs should not conflict with the system's objectives that were stated in chapter one. For example users may need a system that is easy to use, a system that has very little authentication whilst exposing the system to network threats such as hacking and other forms of harm.

4.2.1 Description of the proposed system

After fully understanding the problems of the current system whereby motorists fail to know in advance their budgets for tollgates proposal is now being made for a new system whereby motorists will download the ZINARA licensing and tolling android application that will be readily available for download. After downloading and installing the application, motorists will be required to sign up for an account with the ZINARA. The application will contain options for registering a new vehicle, application for a vehicle license and vehicle tracking option. Motorists will be able to calculate the total bill for tollgates on the application by simply selecting the route that they would wish to use, for example a tourist in Victoria may wish to complete his tour by

visiting the Matopo hills and there would need to know how much money to spare for tollgates. In addition to that, motorists can also register their vehicles on the application and the application will notify the owner each time the vehicle passes any of the country's tollgates.

This will help those commuter omnibus owners to monitor the movement of their fleet. The application functions will also give the vehicle owners option to view a report of the number of tollgates that their vehicles would have passed and the total amount that they would have spent within a certain time interval. This will allow transport owners to plan well. Furthermore, the application enables the motorists to track their vehicles and help them recover them. When a motorist loses a vehicle, he will simply notify the ZINARA through the application and the lost vehicle will be put on the wanted vehicles and upon passing any of Zimbabwean tollgates the tolling system will give a signal to the officials that the vehicle is on the wanted list before it passes the tollgate. This will be made by using the vehicle registration number as the primary key. With the growing importation of vehicles from Japan it has become a challenge for ZINARA to register and issue vehicle licenses hence to alleviate this challenge the new application will also allow motorist to apply for vehicle license and renew their vehicle licenses. This feature will also reduce the congestion of vehicle owners at ZINARA offices at the end of quarter periods when vehicle licenses expire. The ZINARA officials will also be able to issue and disburse vehicle licenses right into the account of the license applicant.

4.2.2 Context diagram and Dataflow diagram

According to Barnes (2001), a context diagram is a diagram that gives system boundaries and shows what data is entered into the system and what data is extracted from the system each user or entity. Shelly and Rosenblatt (2011) summarize the definition of a context diagram to simply a diagram that gives an aerial view of an organisation's business scope and limits. In order to equip the reader with an abstract picture of the proposed system, a context diagram was constructed for the ZINARA's new system and is shown in fig 4.1. The new system consists of five entities namely the licensing officer, the motorist, tollgate officer, police officer and the system administrator.

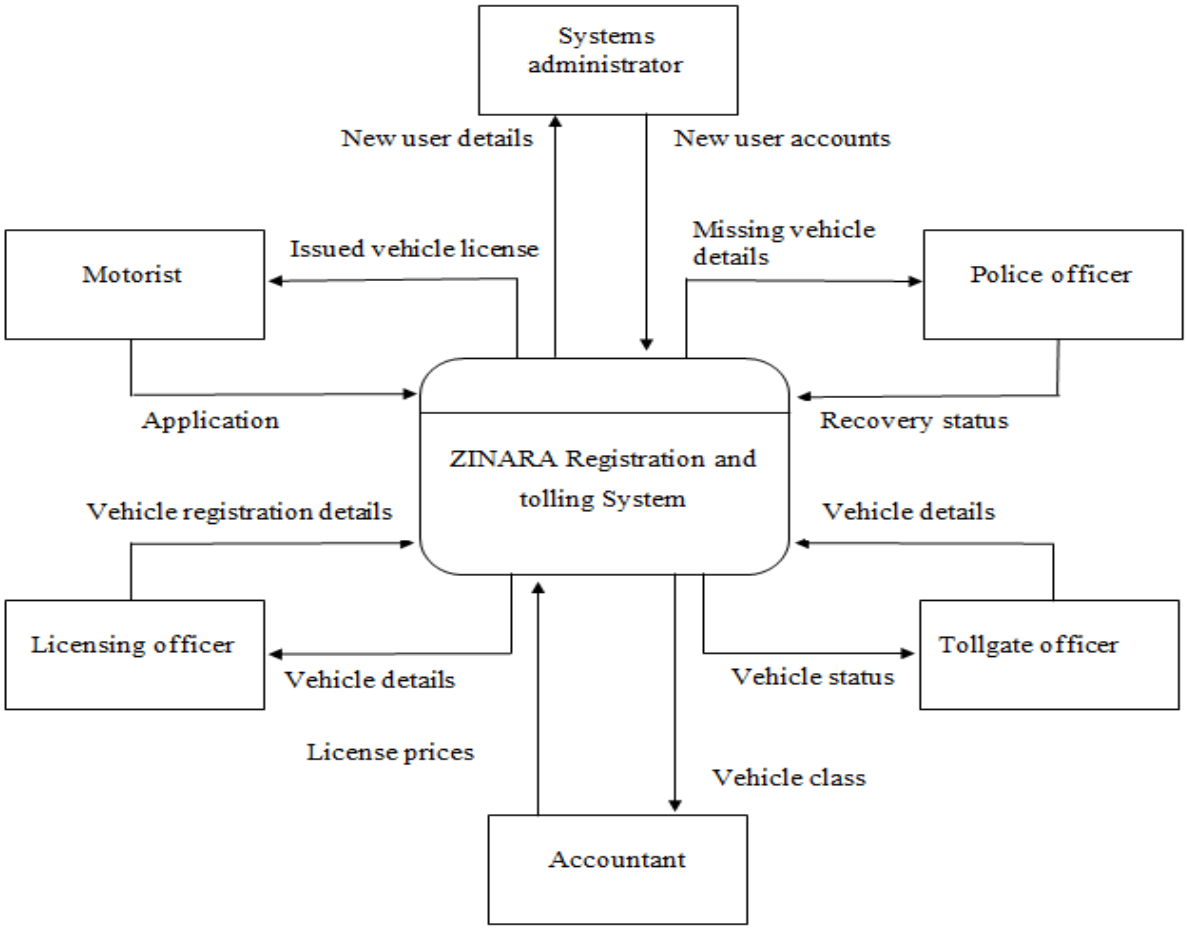
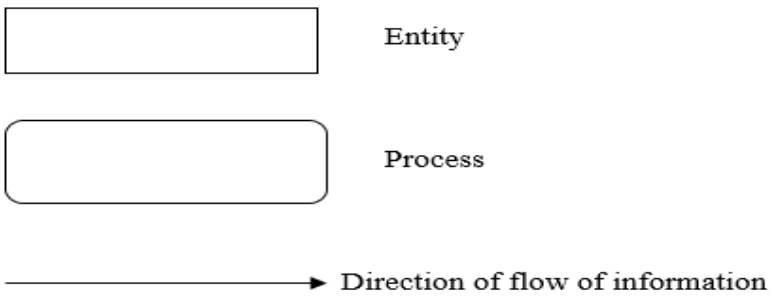


Fig 4.1: Context diagram for the ZINARA vehicle Registration and Tolling new system

Key



4.2.3 Dataflow diagram of the proposed system

The new system's most fundamental areas were shown by the context diagram drawn so far however the context diagram did not show how exactly the information flows within the proposed system. This calls for use of the dataflow diagram to show the flow of information inside this new. Gupta (2005) denotes that a dataflow diagram is a tool that is used for representing how data flows within a system. Barnes (2001) highlights that a dataflow diagram are a tool used by analysts to understand how data moves in and out of a system in order to get an appreciation of how a system works. According to Hartley and Pirbhai (1987), a dataflow diagrams is an illustration of interconnected activities of functional requirements that are identified for a certain system. A dataflow diagram contains entities to the left side and processes in the middle and lastly data stores on the right side. Processes are numbered from number one going on in ascending order showing the order in which data moves in the system. Dataflow diagrams demonstrate the system's most fundamental features or functions graphically through the use of well-defined or organized symbols. Fig 4.2 shows the dataflow diagram for the new ZINARA system.

The application is in two parts that is the vehicle licensing section and the tolling section. Therefore the first dataflow diagram on fig 4.2 outlines the processes that occur in the vehicle licensing section. The second dataflow diagram on fig 4.3 also indicates the process that takes place in the tolling section which includes reporting a car hijack.

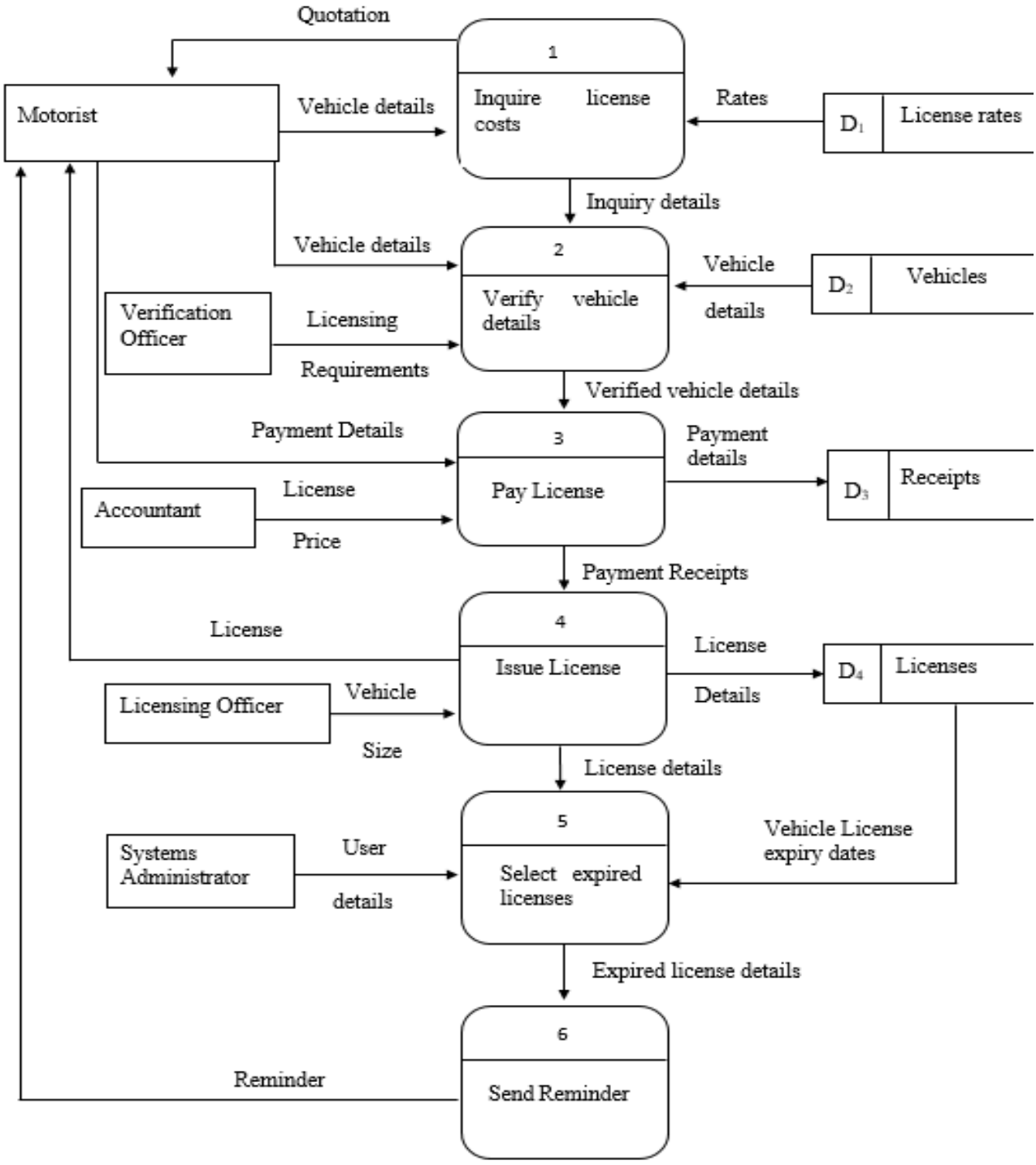


Fig 4.2: Dataflow diagram one for the proposed system

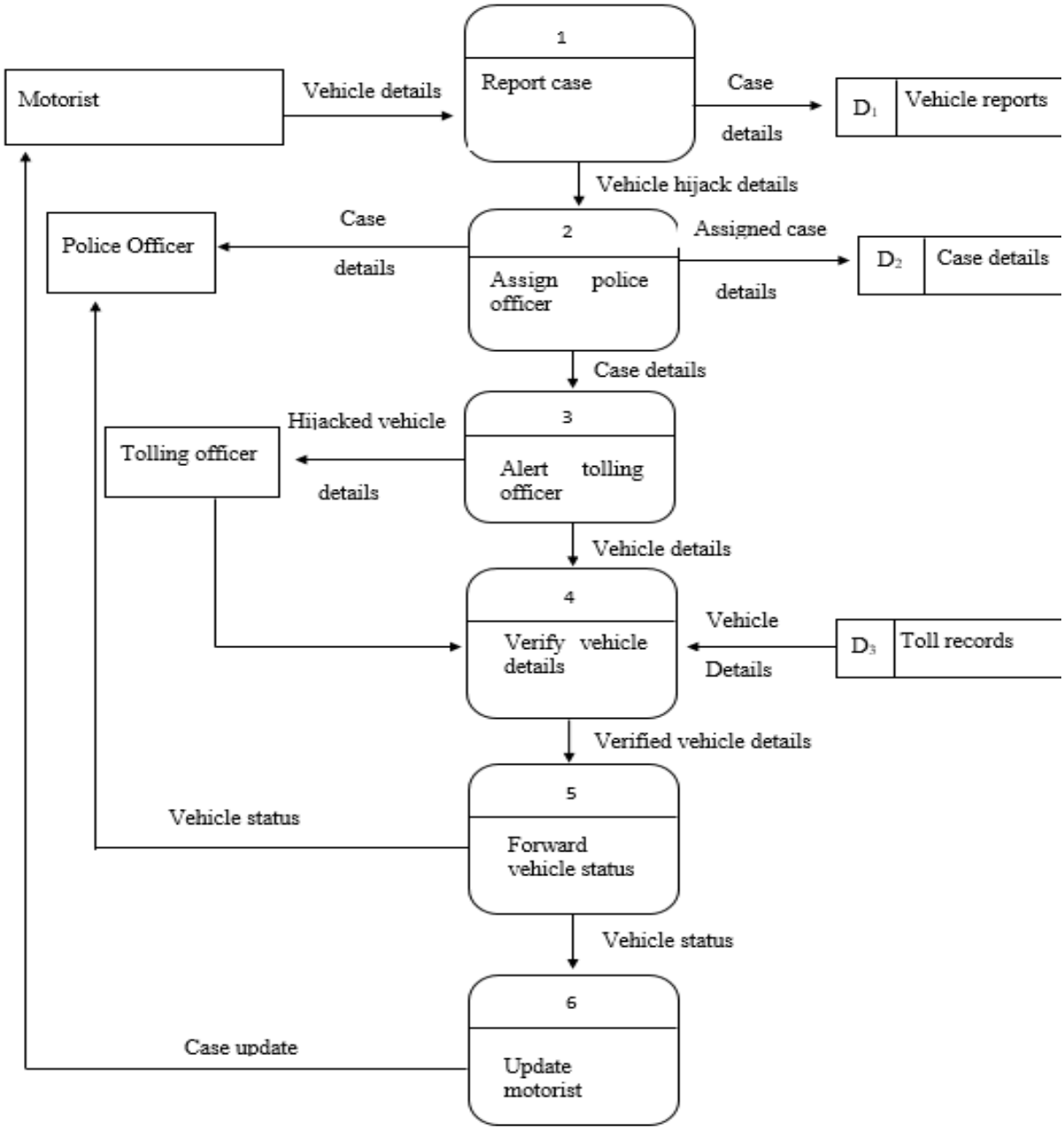
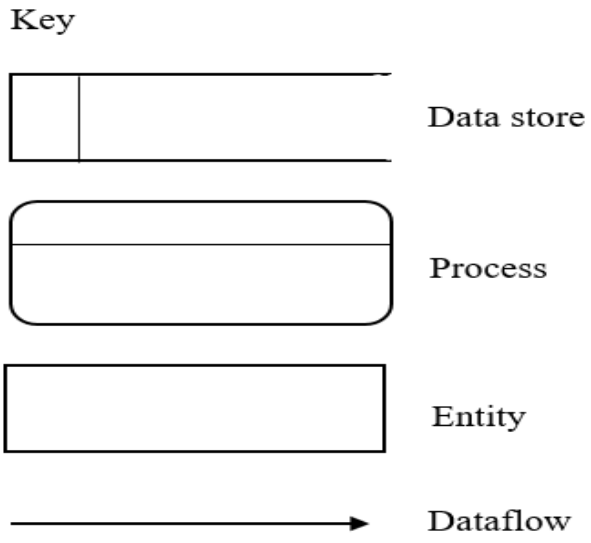


Fig 4.3: Dataflow diagram two for the proposed system



4.3 Architectural design

The main emphasis of the architectural design is to split a system into its distinct components and into the relationships that are present within these components with the objective of matching the representations of the system requirements either functional or non-functional (Albin, 2003). Architectural design is generally regarded as the description of the logical and physical components of the system. These system components include hardware, software procedures, and the users of the system who are involved in the operation of the system. This section also encompasses the relationship between these components and how it is physically represented. One needs to see these components graphically in order to quickly understand the architecture under discussion hence, fig 4.3 was supplied to show these components, but before that the components that make up the system have to be established and these are discussed below.

- **Client machines** –these are user machines such as desktop and laptop computers. These will be used mainly by ZINARA staff members such as the licensing officer, the tollgate officer and the system administrator.
- **Server** –this is where the new system will be hosted and since the system is going to run on Apache HTTP Server 2.0.64. The server will have a minimum of 64 gig random access memory (RAM) and it will be kept at the ZINARA head offices in Harare.
- **LAN cables** –these local area cables will be laid from the switch to the user computers to provide link to the system and internet.

- **2 ruckus Wi-Fi routers –**these will be used to offer internet access to the users who will be using tablets, other mobile devices and laptop users can connect on this device.
- **Internet proxy server** –to enable users to connect to the internet. The proxy server will have 16 gig RAM and 1 TB hard drive.

The architectural design of the ZINARA proposed system.

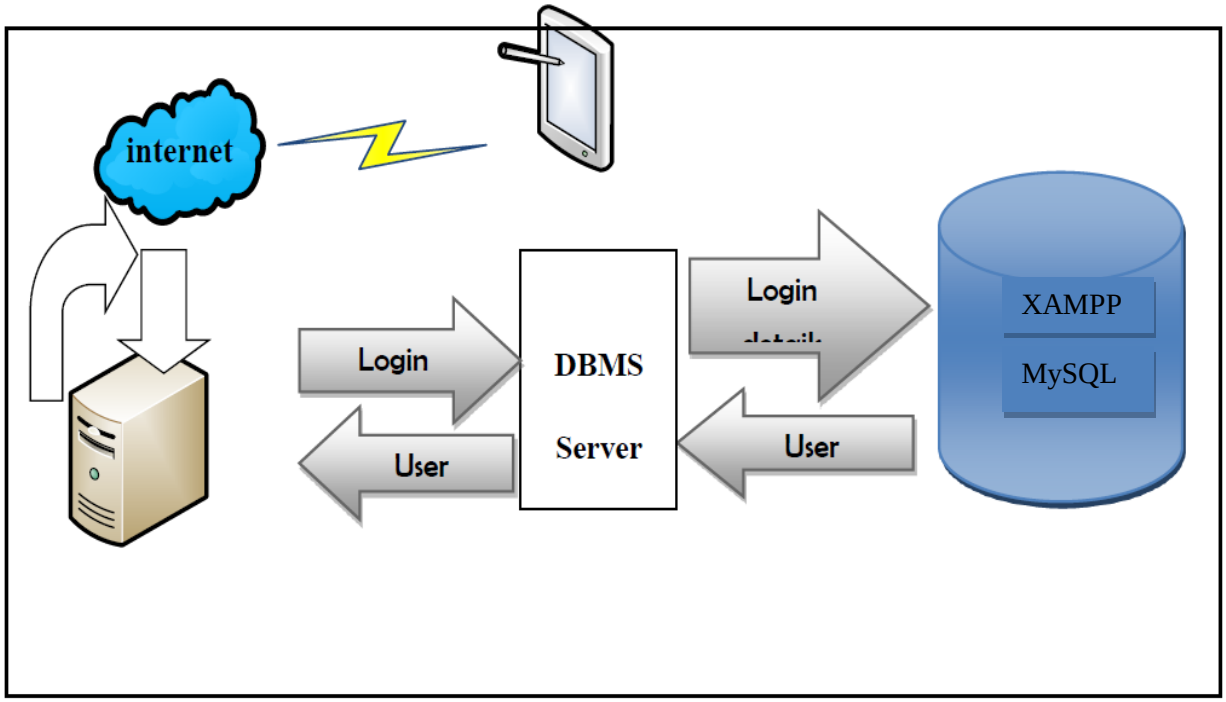


Fig 4.4: Architectural design of the new system.

Source: Dixit (2007)

4.4 Physical design

When one hears the word 'physical' what comes into mind is the word tangible. Hence the physical design mostly touches hardware components and not software components. Gupta (2005) states that systems analysts make use of the physical design to successfully design a system. Other leading proponents in system design, Stair and Reynolds (2012), define physical design as the description of hardware components that are required to develop a system. The new system will need an environment where it will operate and this calls for other components such as the servers, network. ZINARA is an organisation that has some of its operations computerized

and for that reason it is pleasing that some of the hardware components are already in place and there is no need to buy them what is only required is to buy the remainder that facilitates the operation of the system. One of the biggest tasks that are left is the installation of one more router and another 24 port switch. Below are the physical design requirements that are necessary for the operation of the new system.

4.4.1 Hardware requirements for the proposed system

- One laptop computer and a backup server all with the following specifications
  - 8gb RAM
  - 500 HDD
  - Corei5 microprocessors

These will be used by the licensing officer to issue licenses and by the systems administrator to create user accounts and for general systems administration such as monitoring network quality and troubleshooting networking problems.

- **Server** –this is where the new system will be hosted and since the system is going to run on Apache HTTP Server 2.0.64. The server will have a minimum random access memory of 16 gigabytes and a Hard Disk Drive of 1 Terabytes.
- **CISCO router** –this will be responsible for assigning Internet Protocol addresses to user computers and network printers so that they can connect to the network. It is from this device that an uplink cable will be run to the switch.
- **A 24 port CISCO switch**– this switch will be used to link all client computers to the internet and or intranet. All network cables will be constructed from this switch to user computers.
- **LAN cables**- these will be used to link the users to the network. Cables will be laid from the server room where the switch will be installed to the user offices.
- **Internet proxy server**- the proxy server will be there to link users to the internet and also monitor and control sites what sites users should visit and restricting them to some of them.
- **One LaserJet printer**- the printer will be configured on the network so that all the printers will be able to print on this printer via network. This will save resources such as

costs involved in buying other printers and printer cartridge costs. The printer will be used to print any necessary documents.

4.4.2 Software requirements

- MySQL version 5.3 or better
- **Android studio-** for developing the ZINARA android application
- **System center endpoint protection-** software for protecting machines against computer virus.
- **Windows 7 or better-** this will act as platform on which the system will run and other supporting applications.
- **PHP scripting language** –for development of web application

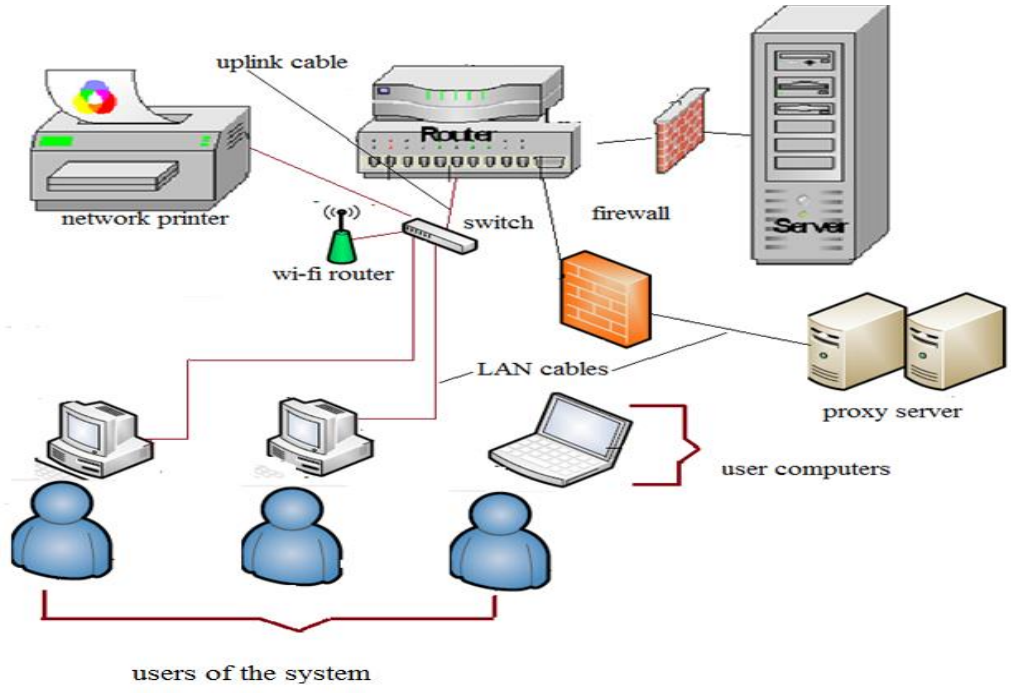


Fig 4.5 Network diagram for the proposed system

Source: Rajaraman (2006).

4.5 Database design

For the new system to function properly it requires a database where all the records will be stored. These records may include registered vehicle details, user accounts details, to mention, but a few. Due to this reason there is need to design the database properly. According to Adams (2010), database design is a vital process that covers how the proposed system's database is going to be designed. This also includes aspects such as what data and how it is going to be stored in the database that is it defines the structure of data that will be stored in the database and accessed. It is at this that one should appreciate the good work that is carried out by the database management system (DBMS). The database management system's functions include managing all the activities in the database including ensuring data consistency, data integrity and making sure that all records are accessed and stored in a way that does not affect its structure.

4.5.1 Database architectural design

Database has a three level architecture (Howe, 2001). Howe names these three distinct levels as follows: external level, conceptual level and internal level. These levels resemble different access levels. This concept will be utilized in the development of the ZINARA database architecture. The objective of the three-level architecture is to separate the users' view of the database from the way that it is physically represented. Fig 4.5 is a diagram for the three level database architecture.

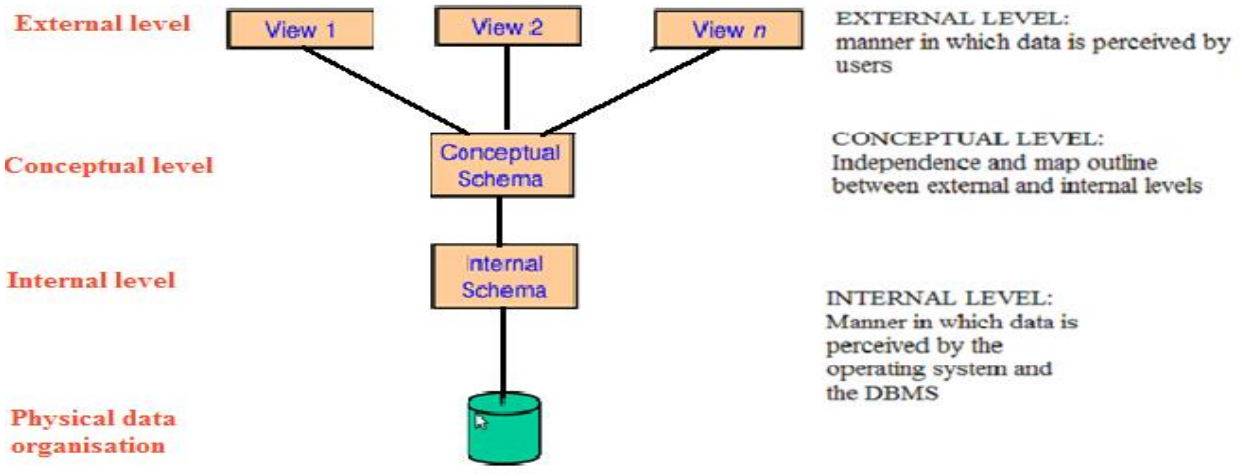


Fig 4.6: Database architecture

Source: Howe (2001).

a) External level

According to Howe (2001), external level of a database is the local representation of the database that any database application might desire. This level gives a customer's view of the database through indexing information or data which is relevant only to a particular user (Coronel and Morris, 2014). This means that each user gets a customized view of the database. External level of a database also includes graphical representation of information such as interfaces. This helps to ensure data security as each user will get only information that is relevant to him/her. For instance each applicant will only view applications that he has made and he cannot view applications made by others or track other applicants' applications. This also describes part of the database that is particular to a certain user. For instance a large organisation like ZINARA contains many departments and users in one department will need different user interface of the information stored in the database. Some views may require derived of calculated data. For example a licensing officer may see payments paid at tollgates by motorists but the vehicle will see the total of the too fees that he would have paid in a specific time interval.

b) Conceptual level

According to Coronel and Morris (2014), entities, data types, relationships and client limitations are the core areas of the conceptual view. Howe (2001) also supports this idea and adds that data that an organisation may be interested in storing is described by the conceptual level. This level also shows the entities, attributes and relationships that exist between entities for example the relation between the motorist and the licensing officer. This level is also represents constraints on data, security and integrity information.

c) The internal view

The internal level covers the physical representation of the database on the computer and may be specified in some programming language. It describes how data is physically stored in terms of file organisation and data structures. Howe (2001) states that the internal view shows how data that has been stored in a database is diffused into that database at the level of storage. Thus the internal level addresses how the machine interacts with data as supported by Coronel and Morris (2014) who argue that the internal level has its own distinct mechanism that defines the actual

physical structure of storage of the database. The internal level is also concerned with the allocation of memory spaces for data and indexes and describing the forms that will be taken by records when stored. Data compression and encryption, assembling records into files also take place in this level.

4.5.2 Logical design

Stair and Reynolds (2012) define logical design as the description of functional requirement of an information system. The entity relationship diagram for the new system was constructed with the goal of making the reader understand the relationship between entities for example the relationship between the applicant and economist. Bearing in mind that the new system is simply a modified version of the existing, no much challenges were encountered in coming up with the entity relationship diagrams since information of the existing system was used. Entity relationship diagrams are used when an analyst wants to bring several views of different views together (Mylopoulos and Brodie, 1989). Two techniques were employed in the representation of the structure of the ZIMRA's proposed system's database. Tables were first and entity relationship diagram was constructed later. Table 4.1 to table 4.8 shows tables and their data types and description of several fields.

Table 4.1: Motorist table

Field	Description	Data type
First Name	Name of motorist	Text
Last name	Surname of motorist	Text
ID number	National Identification number of the motorist	Text
Vehicle registration number	Reg. number of vehicle	Text
Password	Password of the motorist account- created by motorist upon account sign up.	Text
Username	Username used to logion to the ZINARA application	Text
Phone number	Cellphone number of the motorist- phone number will be used update the motorist of the recovery status of the vehicle in case of theft.	Text

Table 4.2: Administrator table

Field	Description	Data type
First name	Name of the systems administrator	Text
Last name	Surname of the systems administrator	Text
E.C number	A unique number given to any employee by the human resources personnel	Text
Password	Password for the systems administrator account	Text

Table 4.3: Licensing officer table

Field	Description	Data type
First name	Name of the licensing officer	Text
Last name	Surname of the licensing officer	Text
E.C number	A unique number given to any employee by the human resources personnel	Text
Password	Password used by the licensing officer to log into the ZINARA system.	Text
Access level	Licensing officer's system privileges	Text

Table 4.4: Police officer table

Field	Description	Data type
First name	Name of the police officer	Text
Last name	Surname of the police officer	Text
E.C number	A unique number given to any employee by the human resources personnel	Text
Password	Password used by the police officer to log into the ZINARA system.	Text
Location	The police camp address for the police officer	Text
Phone number	Name of the police officer	Text

Table 4.5: Tollgate officer table

Field	Description	Data type
First name	Name of the tollgate officer	Text
Last name	Surname of the tollgate officer	Text
E.C number	A unique number given to any employee by the human resources personnel	Text
Password	Password used by the tollgate officer to log into the ZINARA system.	Text
Access level	Tollgate officer's system privileges	Text

Table 4.6: Vehicle license

Field	Description	Data type
License number	Unique number given to a vehicle license by the system	Text
Holder name	Name of the owner of the vehicle license	Text
ID number	National identification number of the license holder.	Text
Date of issue	Date on which the vehicle license was issued or renewed	Date
Expiry date	Date on which the vehicle license expires	Date
Amount paid	Amount of money paid for the license.	Integer

Table 4.7: Vehicle license application table

Field	Description	Data type
Applicant First name	Name of the applicant	Text
Applicant second name	Surname of the applicant	Text
ID number	National identification number of the applicant.	Text
Vehicle category	The size of the vehicle, classed as light vehicle and heavy vehicle	Text

Table 4.8: Vehicle license renewal table

Field	Description	Data type
Applicant First name	Name of the applicant	Text
Applicant second name	Surname of the applicant	Text
ID number	National identification number of the applicant.	Text
Vehicle registration number	Registration number of the vehicle	Text
Vehicle category	The size of the vehicle, classed as light vehicle and heavy vehicle	Text

4.5.3 Entity Relationship Diagram

Database architectural design also encompasses entity relationship diagrams. This technique allows us to show all the entities shown in the dataflow diagram graphically to enhance deeper understanding of how one entity is related to another and the type of relationship that exist among them. Several authors have written works on entity relationships. Although they explained entity relationship diagrams in different wording, it was noted that all these authors tend to agree that the entity relationship diagram is an important tool in developing database

architecture or a new system's database. According to Conger (1994), an entity relationship diagram is the graphical representation of the relationships between entities and is an important facet when developing a new system for an organisation. Excellent identification of entities and relationship ensures development of a system's database. Entity relationship diagrams are high level data models for higher level description of the conceptual schema of the database. Enhanced Entity relationship diagrams use entities, relationships and attributes and their cardinalities to show important information about a system's database. Fig 4.6 shows the enhanced entity relationship diagram for the new system.

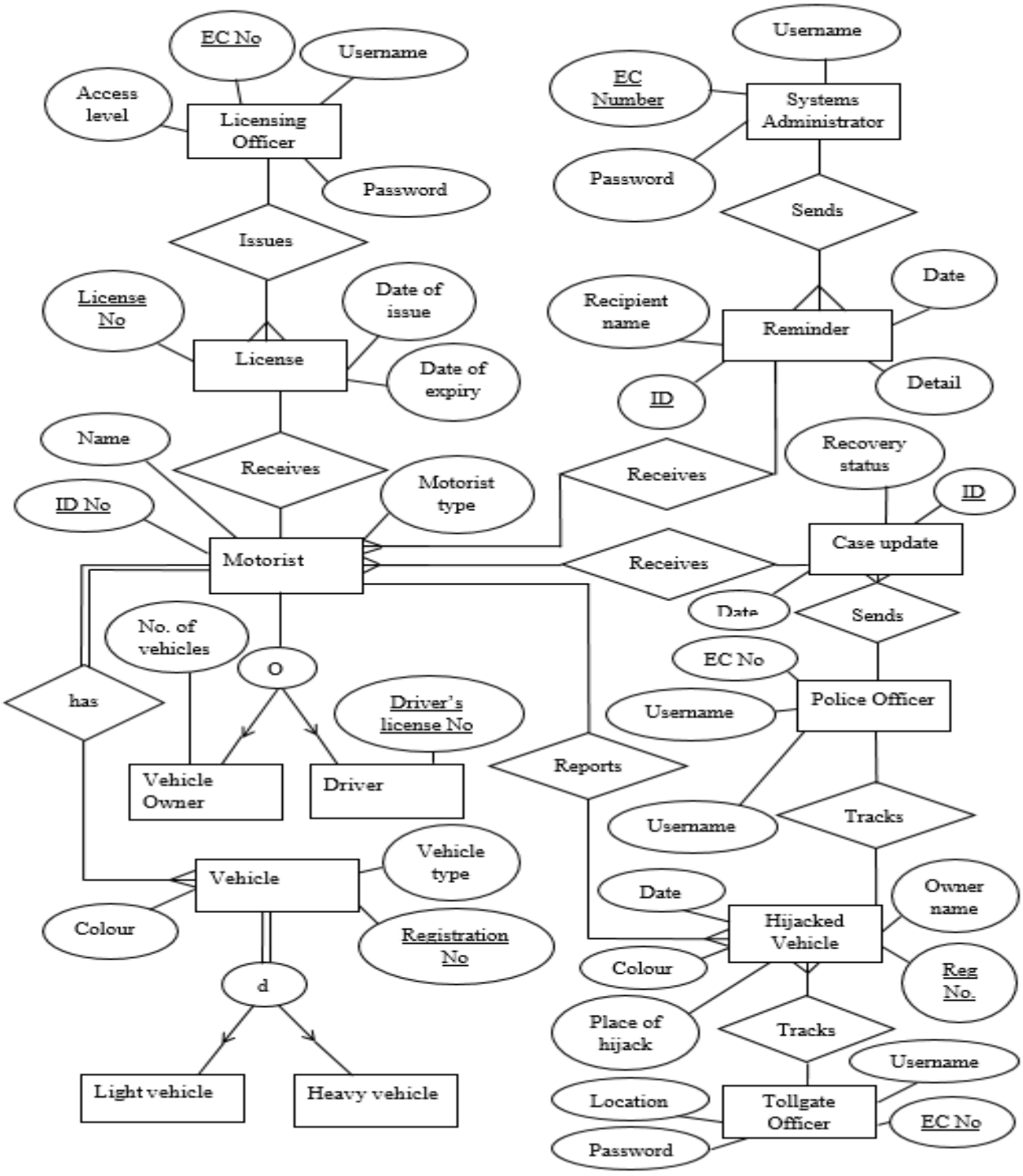


Fig 4.7: Enhanced entity relationship diagram for the new system

4.6 Program Design

A program is a set of instructions that tell a computer what to do. Hence, Ulrich (2000) argue that program design covers program modules, classes, and functions of a system that are interfaced to the users of the system. In the context of the ZINARA new system program design will thus include all processes involved from the moment an applicant applies for a vehicle license until he is granted the license, all the sequence of processes from the moment the motorist or vehicle owner reports theft of a vehicle until it is recovered are all covered under this section. Studies have shown that users prefer systems that are easy to use to those that are complex although they may accomplish their tasks. The system's Ease of Use affects its acceptability. In this regard, a Graphical User interface was preferred in the interface design to facilitate communication between the users and the new ZINARA application. Hence, it is now clear that the new system will be easy to implement. Each and every component will be looked at separately starting with the package diagram.

4.6.1 Package Diagram

According to Conger (1994), a package diagram is a unique diagrammatical representation of the whole system highlighting the main composition of the system modules and how they are connected to one another. The new ZINARA android system offers vehicle license applications facility to apply for vehicle license and receive license on the application in the comfort of their home. Fig 4.7 shows the package diagram for the ZINARA's new system.

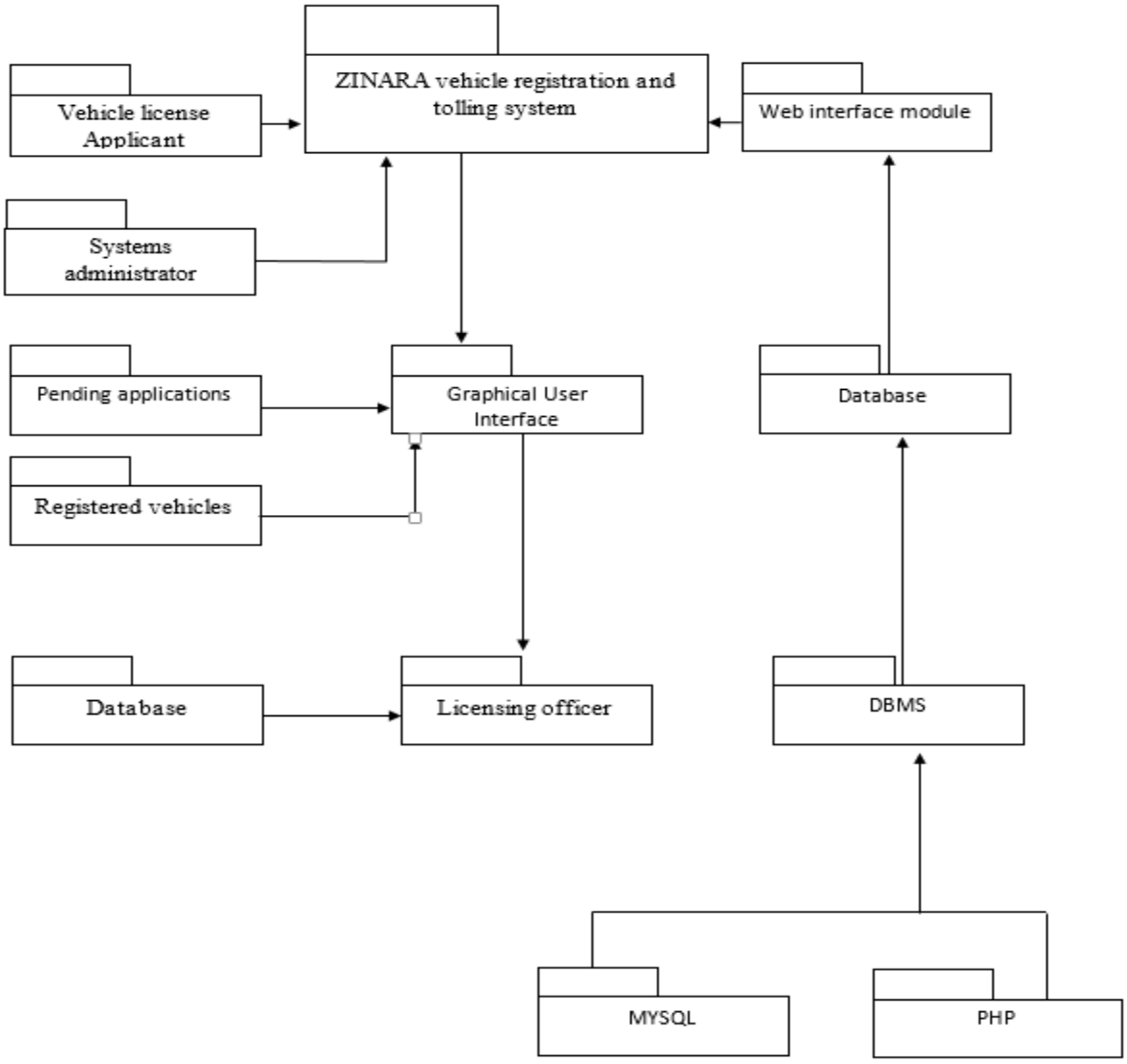


Fig 4.8: Package diagram for the proposed system

4.6.2 Class Diagram

According to Conger (1994), a class diagram is a graphical representation of the system by showing all the classes found within a system, their attributes and their relationships. Generally, the total number of entities in a system equals the total number of classes hence all the entities identified in fig 4.2 will be represented in class diagram below. Two ways are used to show classes and these are association and inheritance. Instances within each class are connected relationships called association whilst inheritance is the relationship between super classes and

subclasses. Fig 4.9 shows the class diagram for the ZINARA's vehicle registration and tolling system.

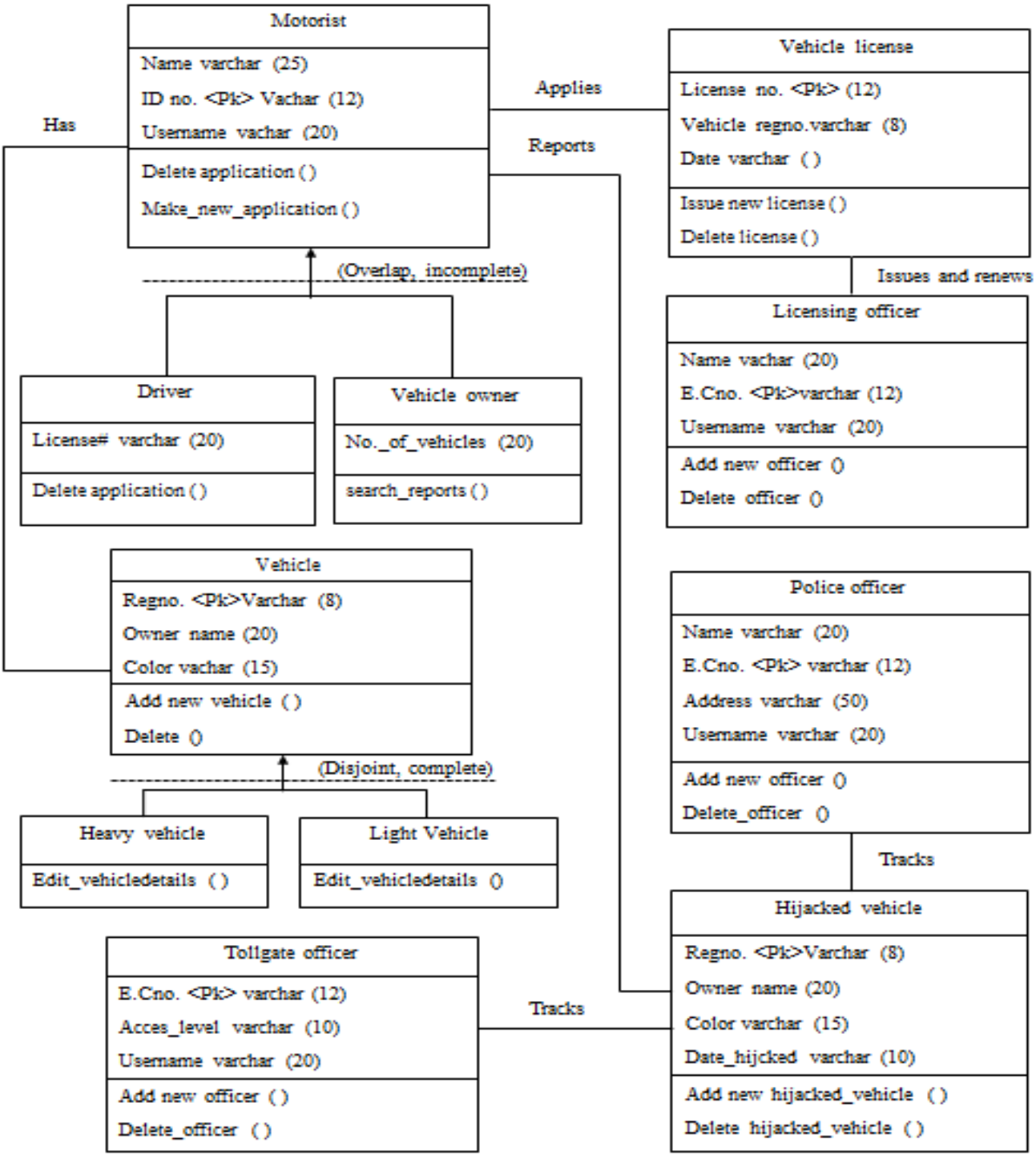
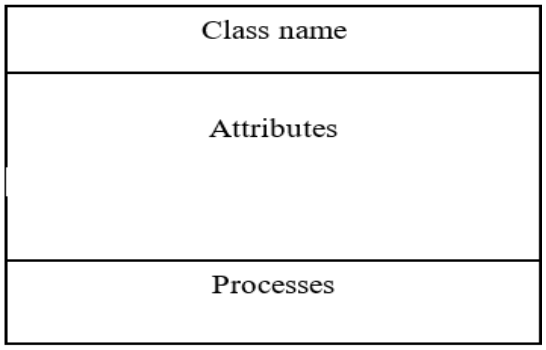


Fig 4.9: Class diagram for the new system

Key



4.6.3 Sequence Diagram

A sequence diagram can be imagined as an x-ray of the system showing the internal composition of the internal composition of the system so that a detailed picture of the overall system can be drawn about the logic behind the design of the system. To enlighten the reader about the logic of the ZINARA's internal system, a sequence diagram for the ZINARA's new system was included and it is shown in fig 4.9.

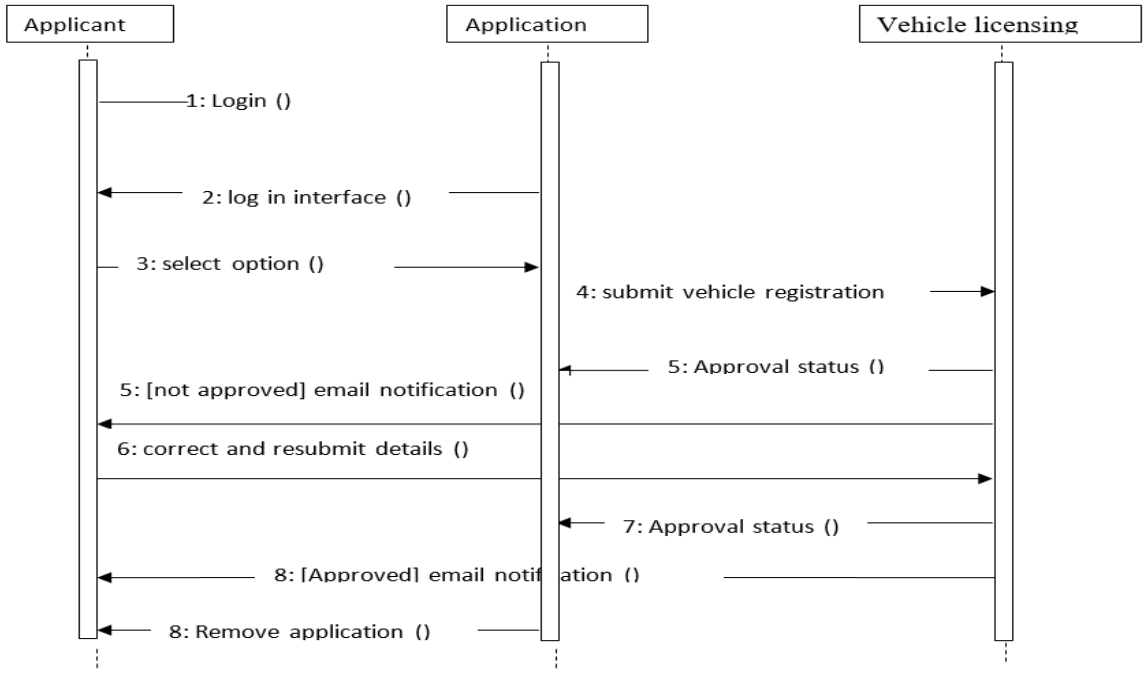


Fig 4.10: Sequence diagram for the proposed system

4.7 Interface design

According to Galitz (2000), several practices have been put in place pertaining interface design. The everyday use of computers is largely dependent of the interface design in the first place (Stone, 2005). Stone's idea clearly suggests that a system's interface design has a greater effect on the users' attitude towards use. Users usually prefer systems that are ease to and that require less effort to use that is systems that have less processes and procedures. To counter this, the ZINARA's interfaces were designed in such a way that it will be difficult to spell one's name than to use the new system. Given two forms of communication between the computer and the user, the GUI was chosen compared to the command based that is more daunting and strenuous to the users which requires the user to known the commands by heart. A graphical user interface (GUI) is a form of communication between the user and the computer through windows, icons, and menus and pointers (WIMP). This minimizes errors since the user will be required not to know the commands by heart. Bearing in mind that the most important part of the system is the interaction between the system and its users, adequate time was set aside for interface design to allow accurate presentation of ideas and system functionalities by showing how data will be fed into the system and the format of the output that users get. Interface design will be looked at first before moving on to menus, submenus and output design later.

4.7.1 Input design

Perfection should be ensured at the input design stage to reduce errors by users (Rajaraman, 2006). The ZINARA's proposed system will contain several input forms for data input by users for example vehicle license application form, login form, user creation forms, to mention a few. The most important aspect in the design phase is probably the input design (Teixeira & Iradley, 2003). To ensure that input from users will be accurate and less erroneous use will m made of data validation and verification. The system will accept only input that is relevant in the field it will be entered and of correct data type. For example, the system will not accept integers where text is needed.

a) Applicant sign up form.

For the motorists to start using the organisation's system they have to sign up for an account and login later after successful signing up. Fig 4.11 shows the layout and the corresponding details upon client signing up

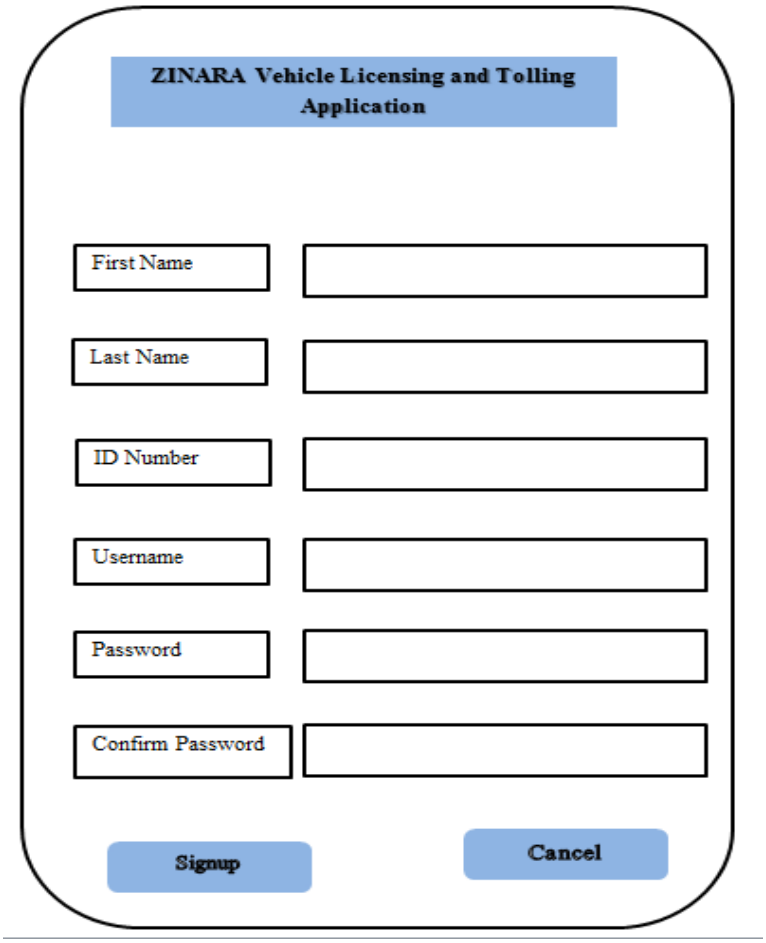


Fig 4.11: Client sign up form

b) Applicant Login form

After successful signup the user will be redirected to the client login page so that he can login for the first time. And also so that he can test his credentials and start to enjoy the organisation's unlimited services. Fig 4.12 is the client login.

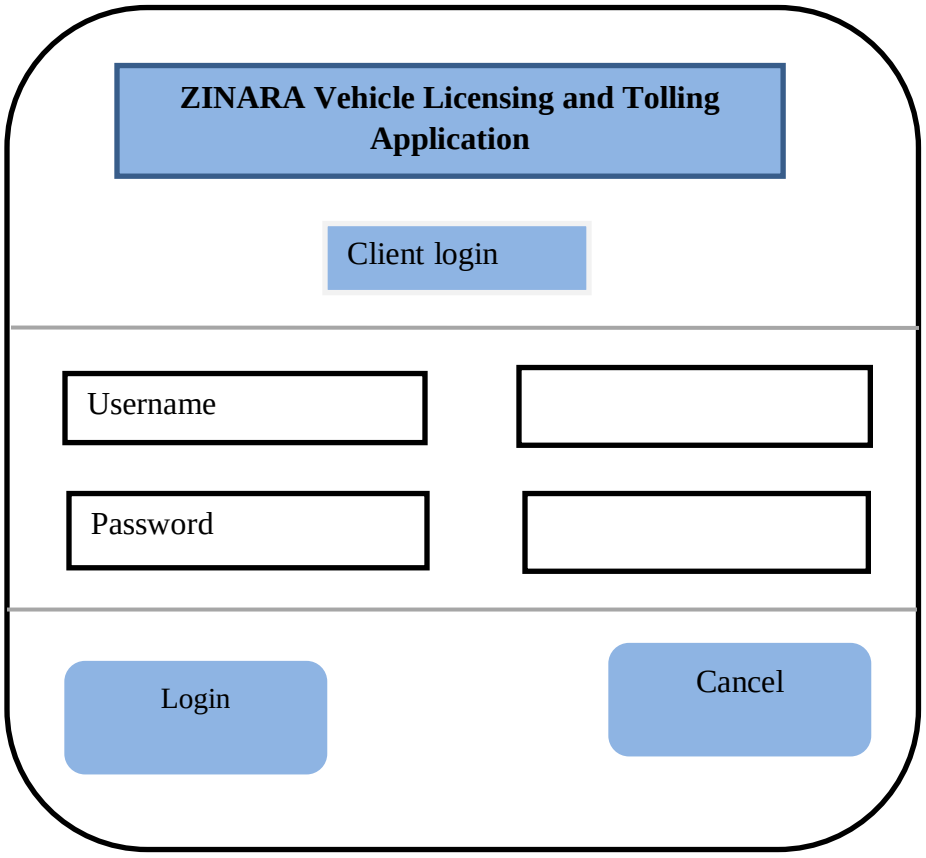


Fig 4.12: Client login form

c) Vehicle license application form

Generally, clients will not take time before applying for a vehicle license since it is the main reason for signing although there are some functions. Fig 4.13 is the vehicle license application form.

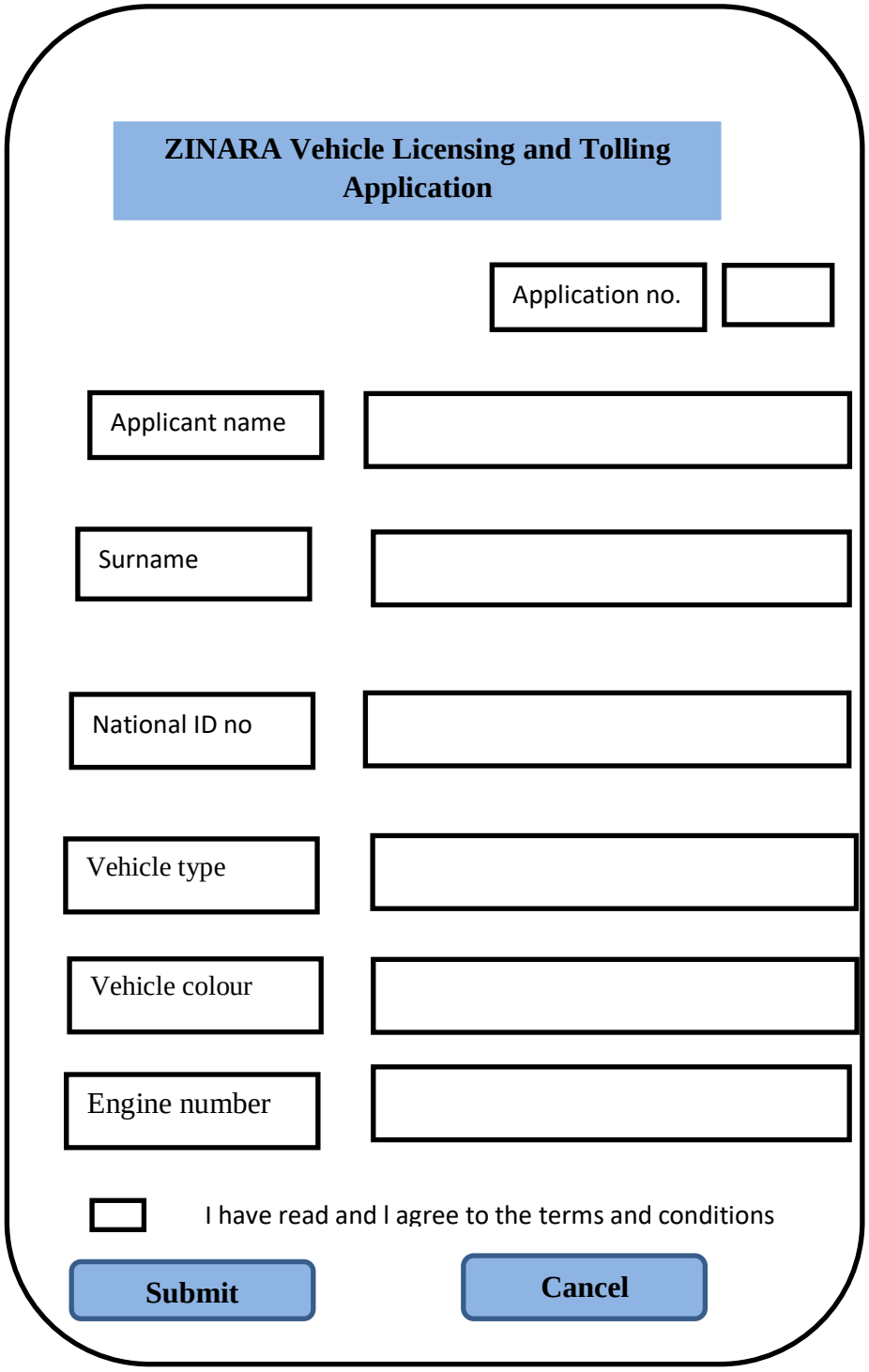


Fig 4.13: Vehicle license application form

d) Toll fees calculation form

As mention in the description of the proposed system, the new ZINARA system will help tourist and motorist to ascertain their toll fees budget when travelling from one point to another, below is a diagram showing the form that assists users in making calculations. The information that the user needs to know is the destination and the route. Fig 4.14 shows the toll fees calculation form.

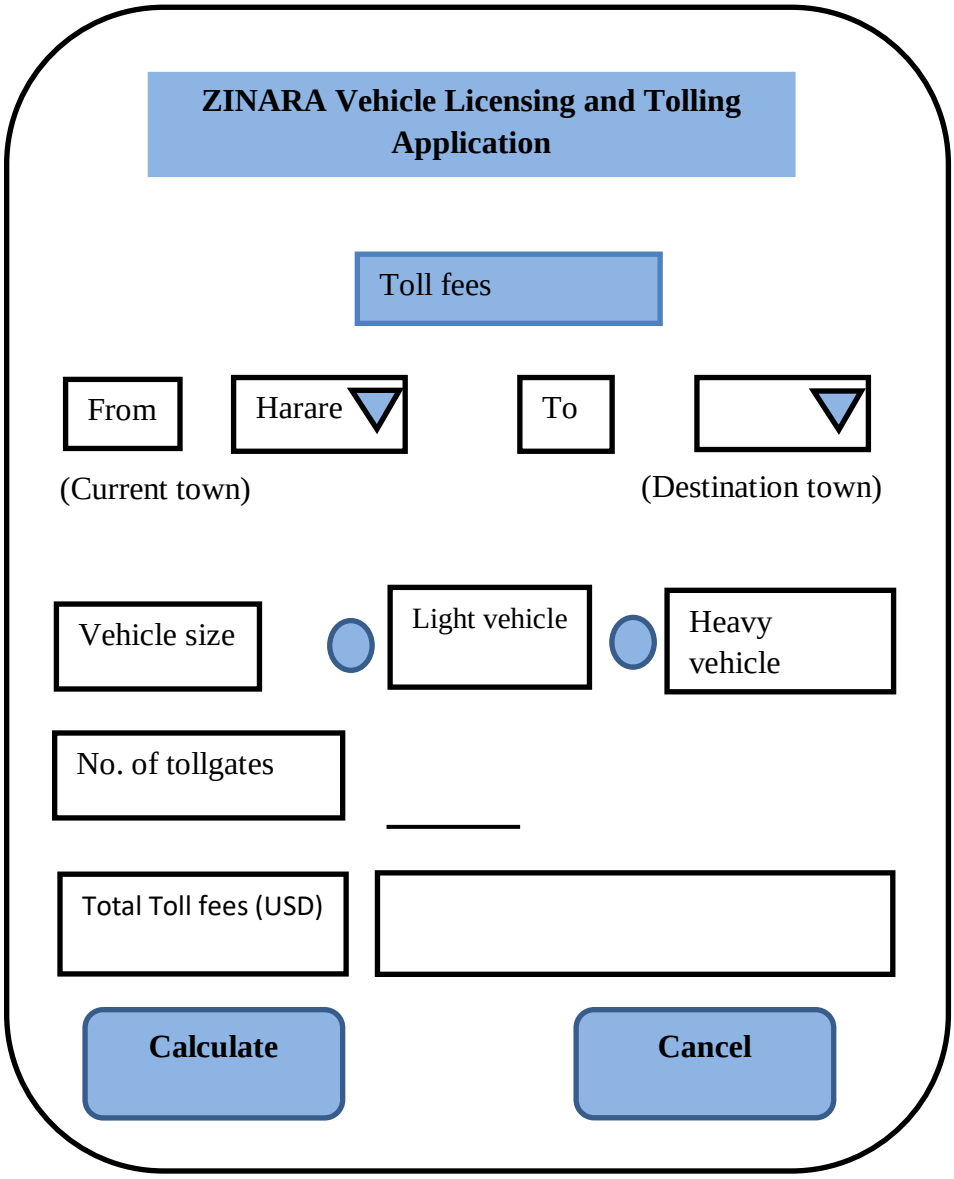


Fig 4.14: Toll fees calculation form

e) Administrator staff account creation form

The systems administrator is will be responsible for staff account creation. This is because the staff members will be having higher privileges in the system hence their accounts should be created by the systems administrator who will in turn monitor their actions since they can be tracked if anything goes wrong. Only those staff members who have a direct role in the vehicle registration and tracking system will have their accounts created by the systems administrator. Fig 4.15 shows the account creation form.

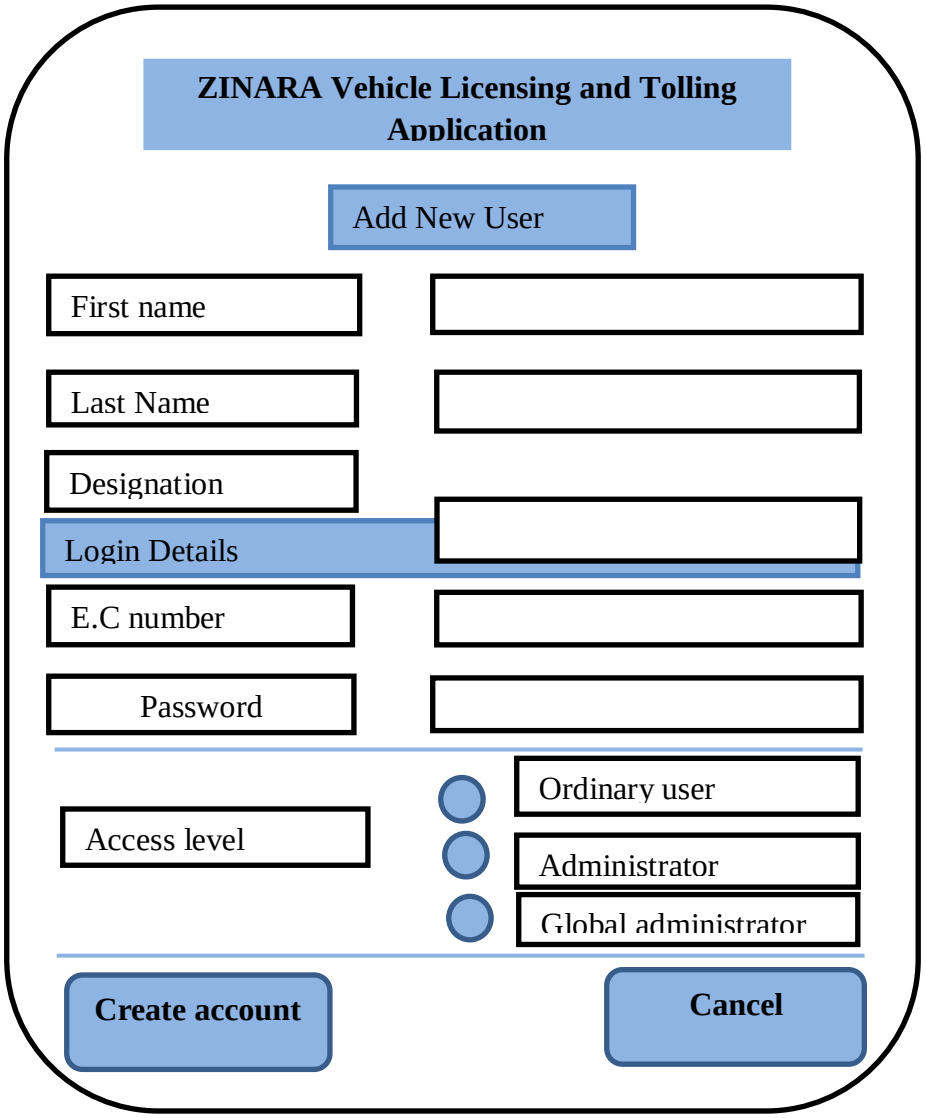


Fig 4.15: Account creation

f) Staff login form

After all the staff accounts have been created staff members can login on the following form. The licensing officer, the police officer and the tollgate officer can login on this page. Fig 4.16 shows staff login page.

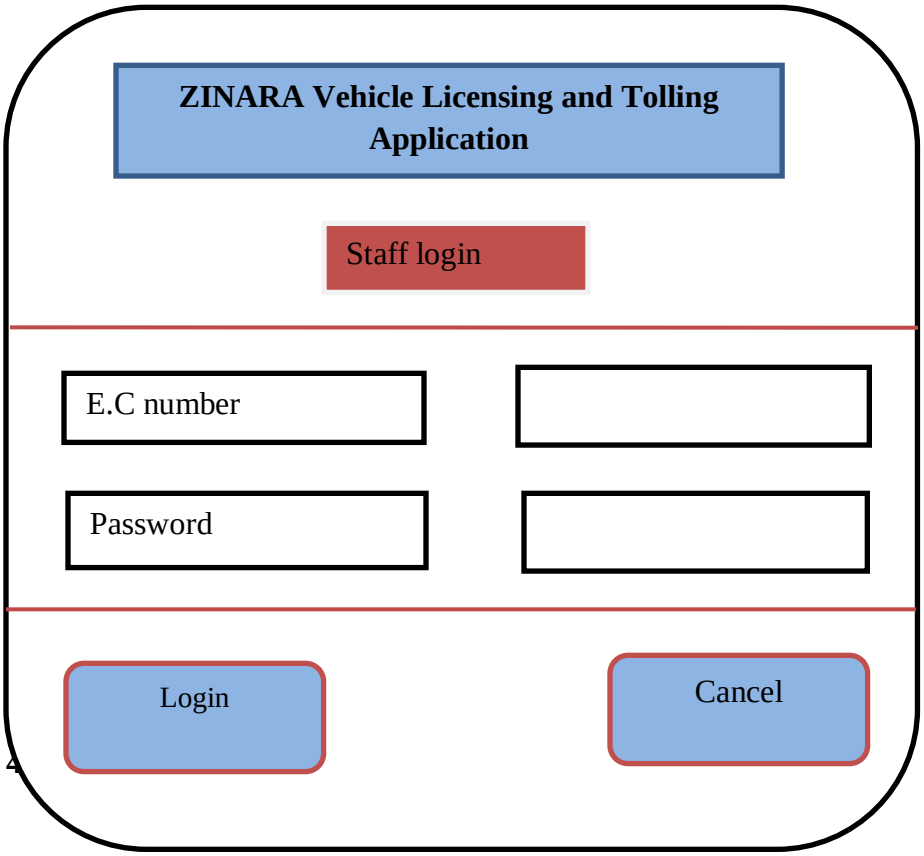


Fig 4.16: Staff login form

g) Administrator login form

The systems administrator logs in from a different login page. This was done with a finished objective of eliminating confusion and also the login page index and the static IP address for the systems administrator's computer will be defined in the hub hence restricting access to the administrator login page. The systems administrator uses his/her E.C number and password to login into the system and his access level is defined in the system. Fig 4.17 shows administrator login page.

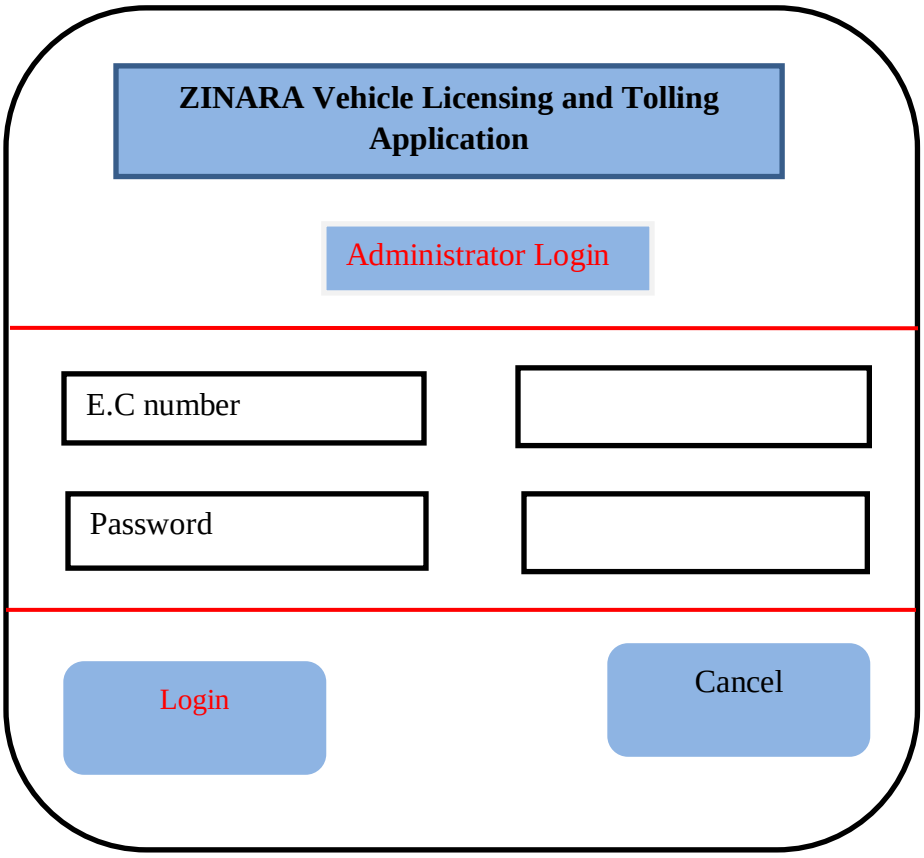


Fig 4.17: Administrator login form

4.7.2 Main menu

The main menu of a system refers to the main page or home page that contains all the necessary links to other sub-menus or pages. The ZINARA new system home page was developed with the main intention to give users a simplified but yet comprehensive home page with all links leading to other pages.

a) Staff main menu

Since the ZINARA new system contains an android application and the PHP system that will be used mainly by the ZINARA staff, the menus and sub-menus will be shown differently in order not to confuse the reader on these menus. The main menu for clients, for the administrator and for the staff members (licensing officer, tollgate officer and police officer) will be shown separately. Fig 4.18 shows main menu for ZINARA staff.

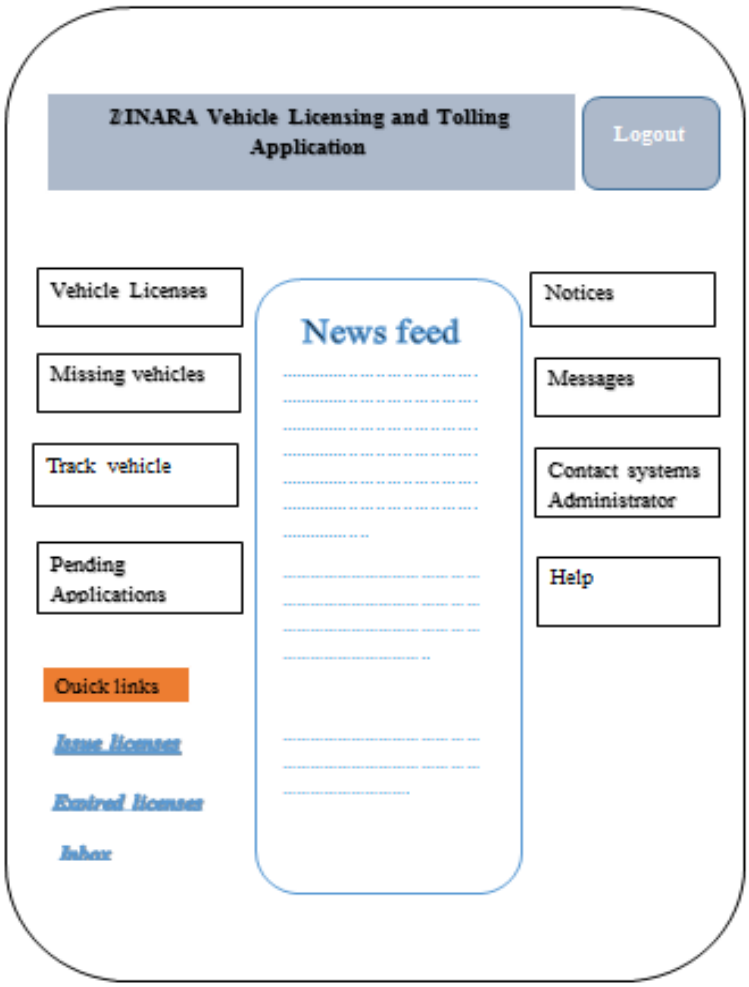


Fig 4.18: Staff main menu

Client main menu

Applicant or client after logging in will be directed to the home page where he will be presented with several options ranging from license application to vehicle tracking among other options. Fig 4.19 shows the client main menu.

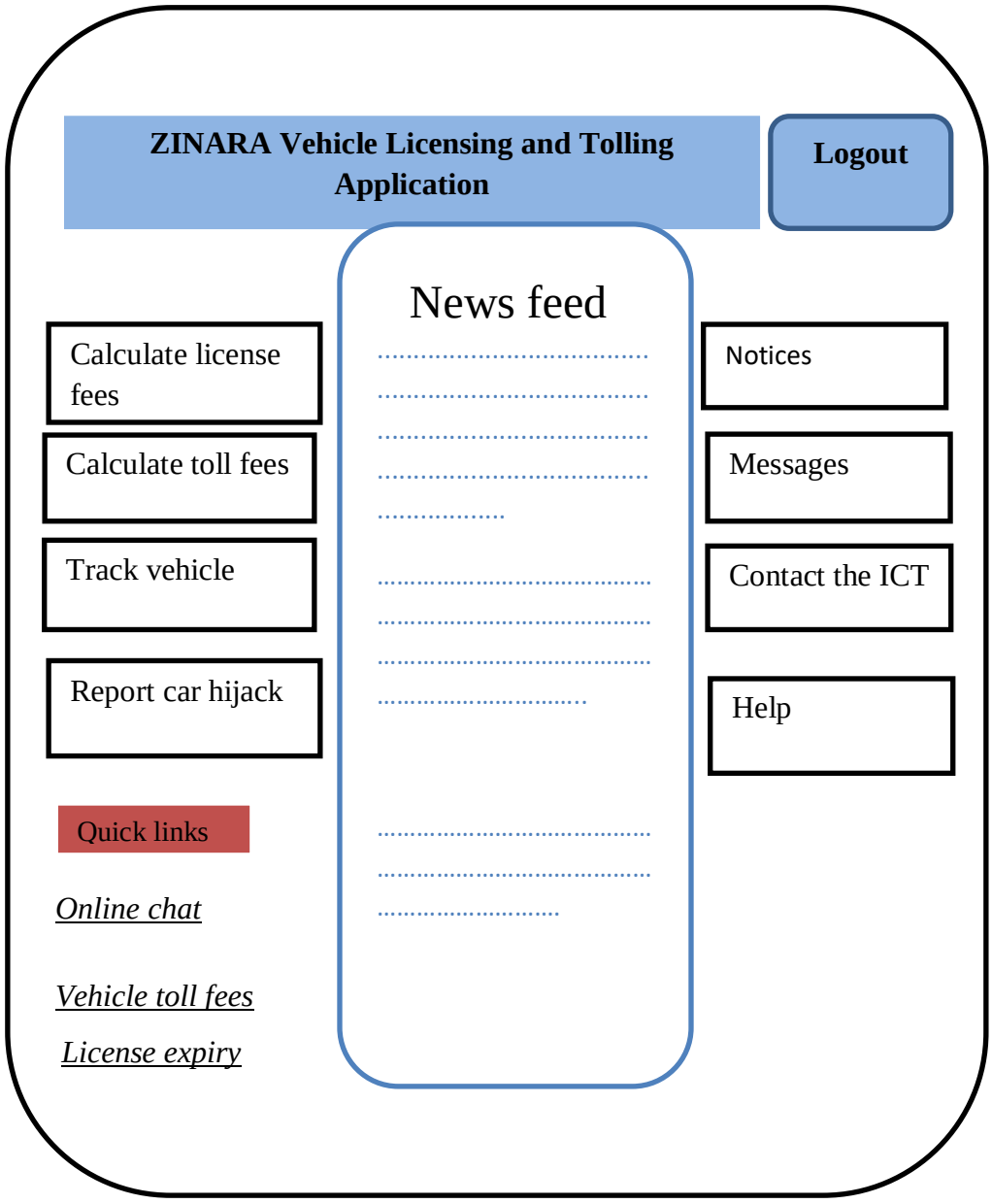


Fig 4.19: Client main menu

Administrator main menu

The systems administrator has a simple main menu with few options since the systems administrator role in the system is account creation and to monitor user actions. Fig 4.18 shows the systems administrator main menu.

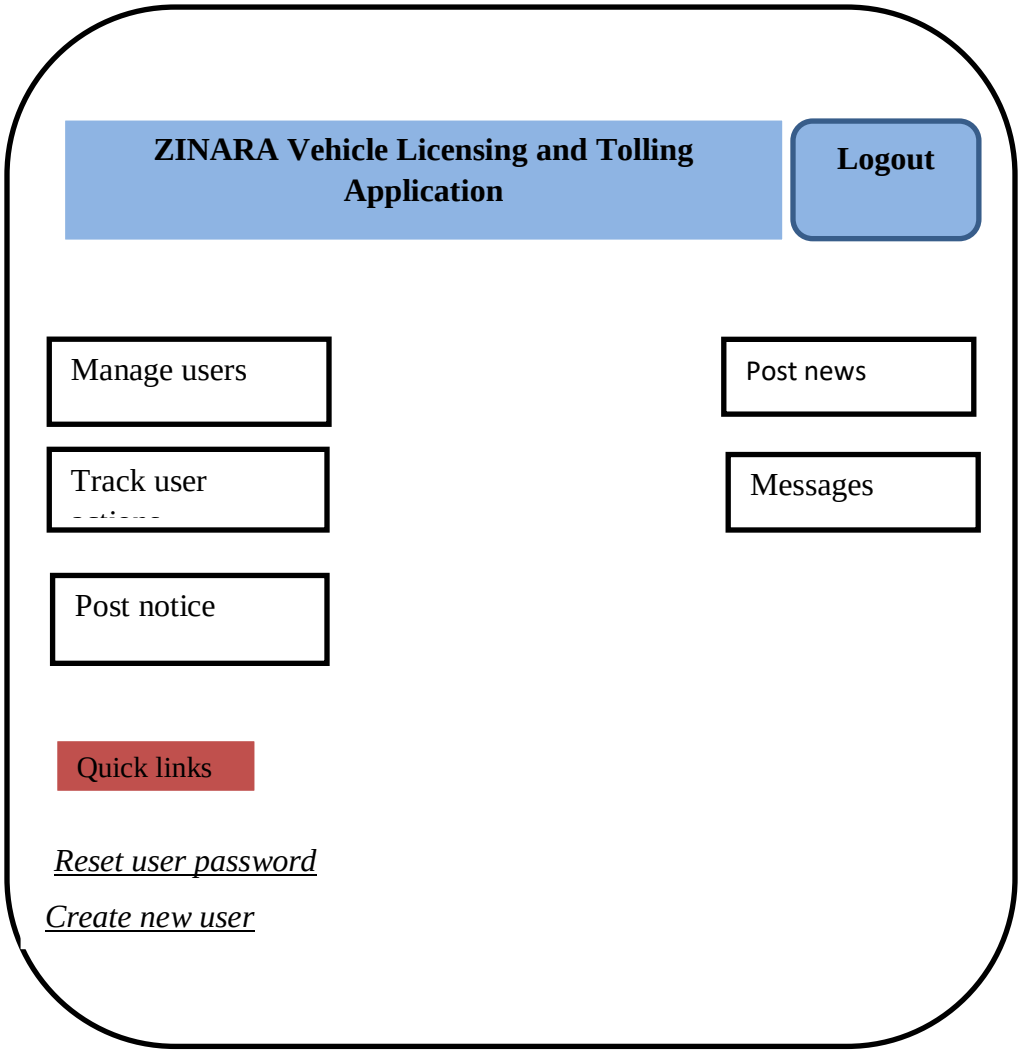


Fig 4.20: Administrator main menu

4.7.2.1 Sub-menus

Sub-menus are options that pop up upon clicking an option or link on the home page. Submenus vary from user to user, with some users having many sub-menus whilst others have few sub-menus.

a) Staff sub-menus

On the main menu each and every staff member will select an option that is relevant to him. The option will redirect him to other options, for example the button '**Licenses**' will direct to a submenu where the licensing officer will be splashed with actions that one can take on licenses.

1) **Licenses sub-menu**

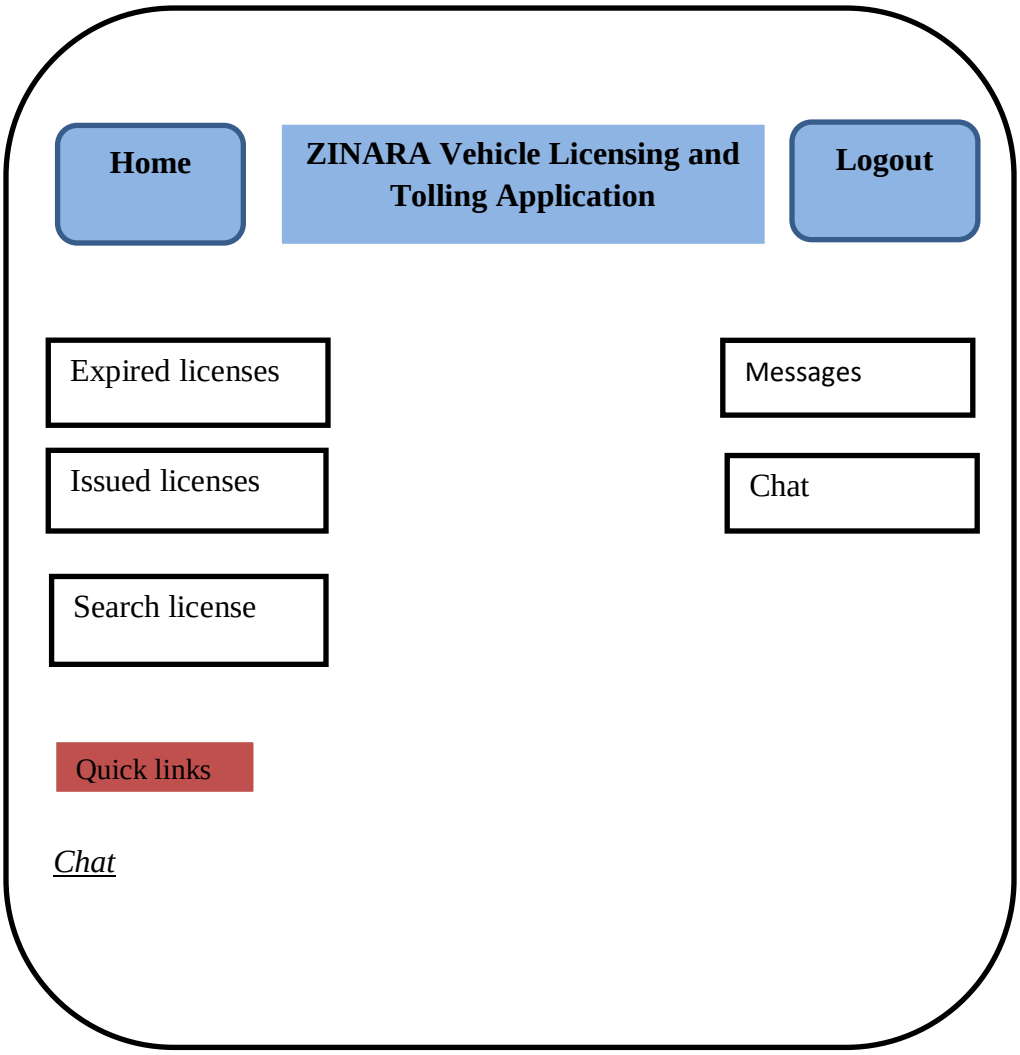


Fig 4.21: Licenses sub-menu

2) **Pending applications sub-menu**

Upon clicking the pending applications button the following interface will appear. This is where the licensing officer will approve and issue vehicle licenses. Fig 4.22 shows the sub-menu.

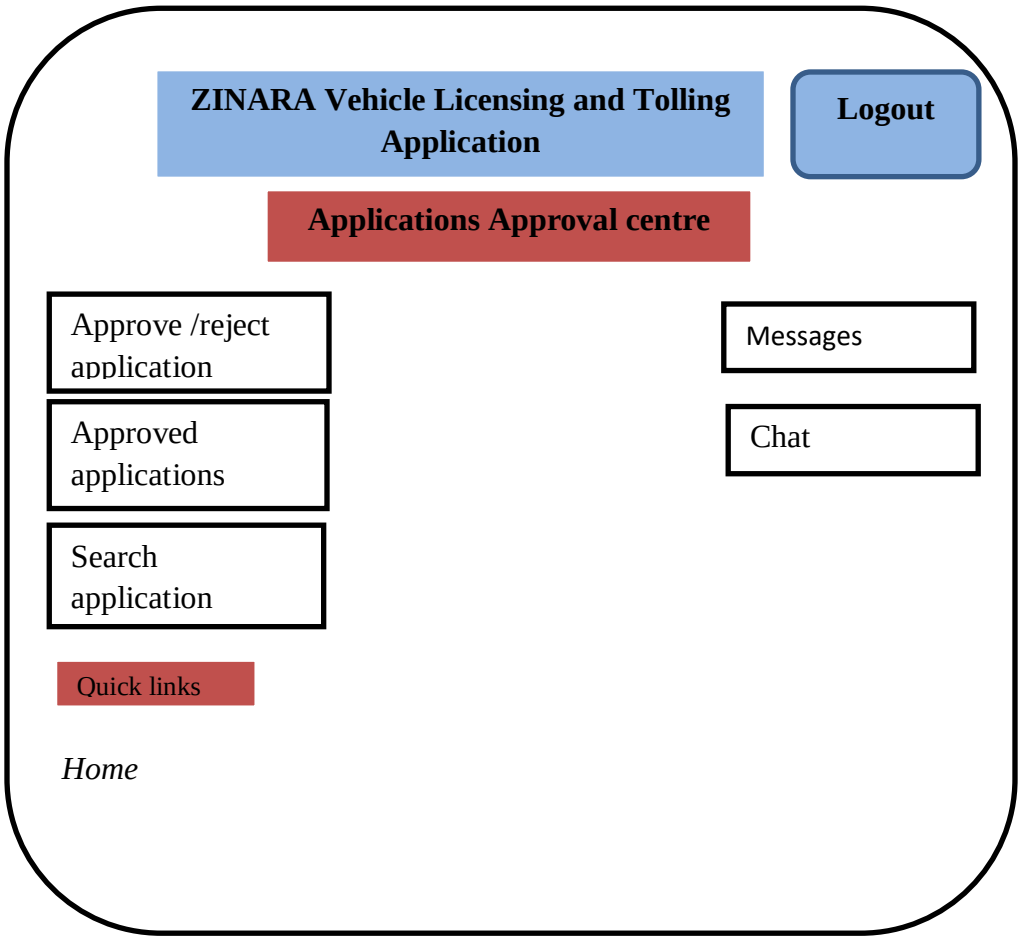


Fig 4.22: Pending applications sub-menu

b) System administrator sub-menu

Upon clicking the 'Manage users' the lick will redirect the administrator to the page where he will be awash with several actions that can be made on the users. The following is the administrator sub-menu.

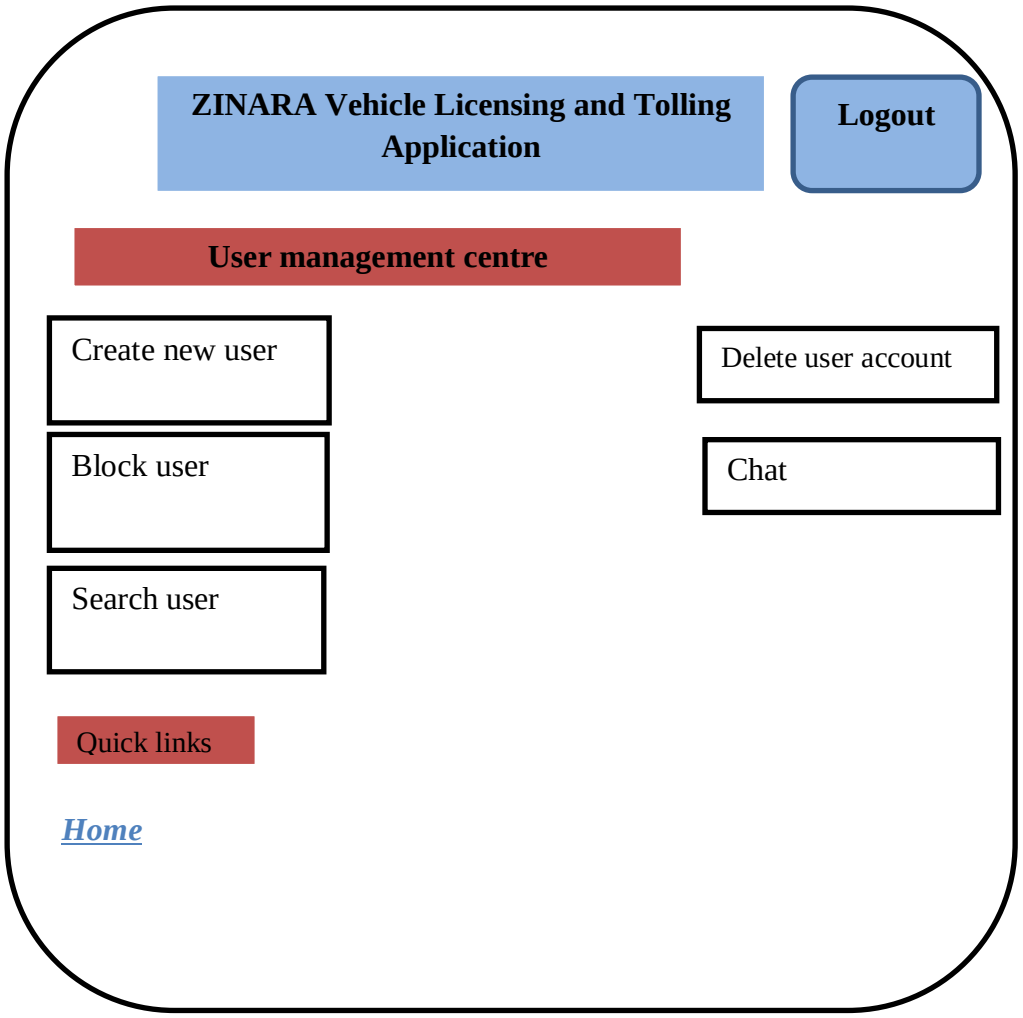


Fig 4.23: Administrator sub-menu

4.7.3 Output design

Output design is represents the format of the results that users get from the system after processing of the input. At this point in time the reader can now be shown the format and type of the output that the users will get from the system.

a) Vehicle license

After approval of a vehicle license application, the licensing officer will issue a vehicle license and dispatch it into the inbox of the applicant. Fig 4.24 shows how the vehicle license will look like.

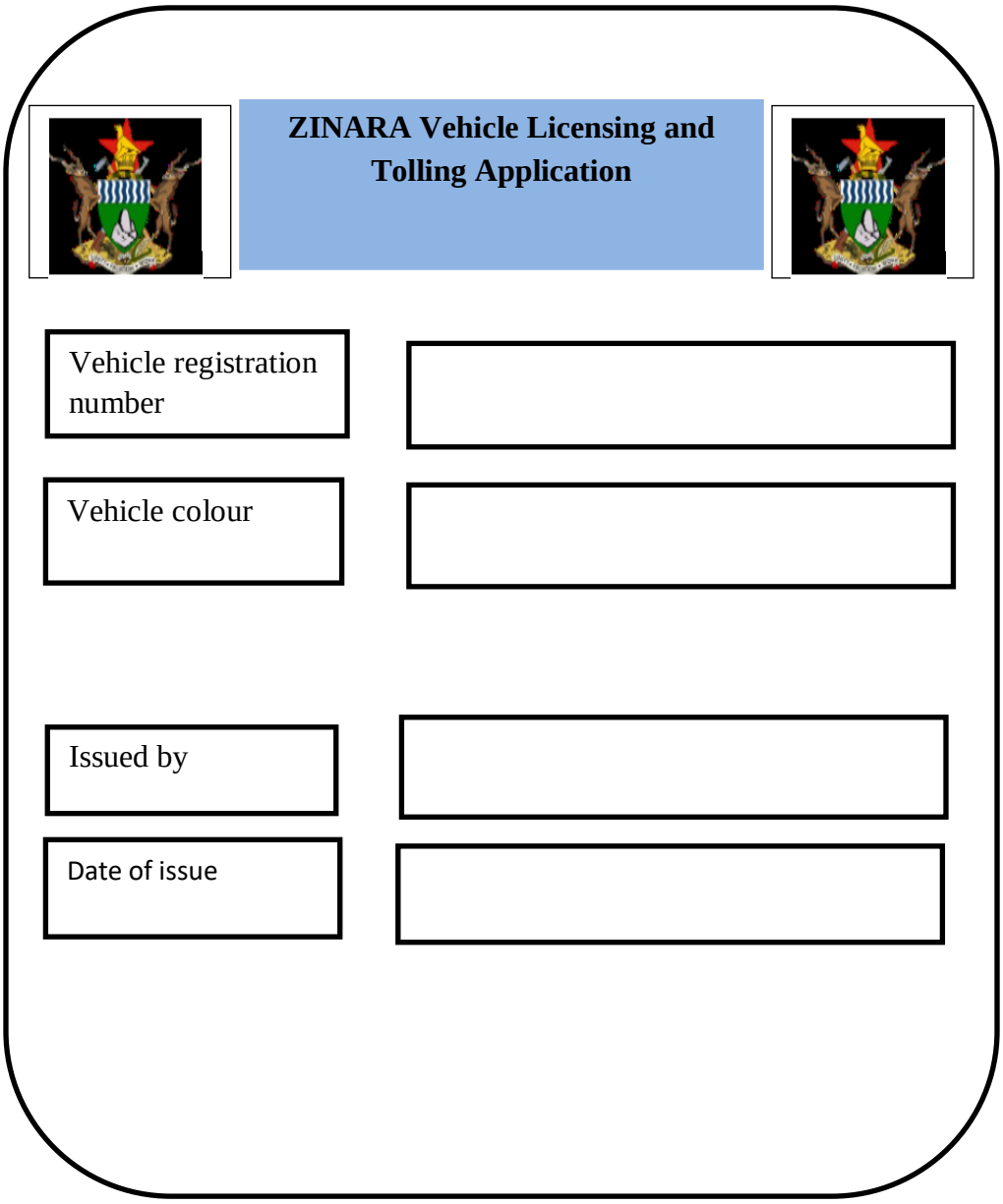


Fig 4.24: Vehicle License form

Vehicle toll fees statement

A client can get a report from the system showing the number of tollgates his vehicle passed within a certain time interval and the total amount of money charged. This helps the motorist to plan their budget for toll fees. Fig 4.25 shows the toll fees statement for ZINARA new system.

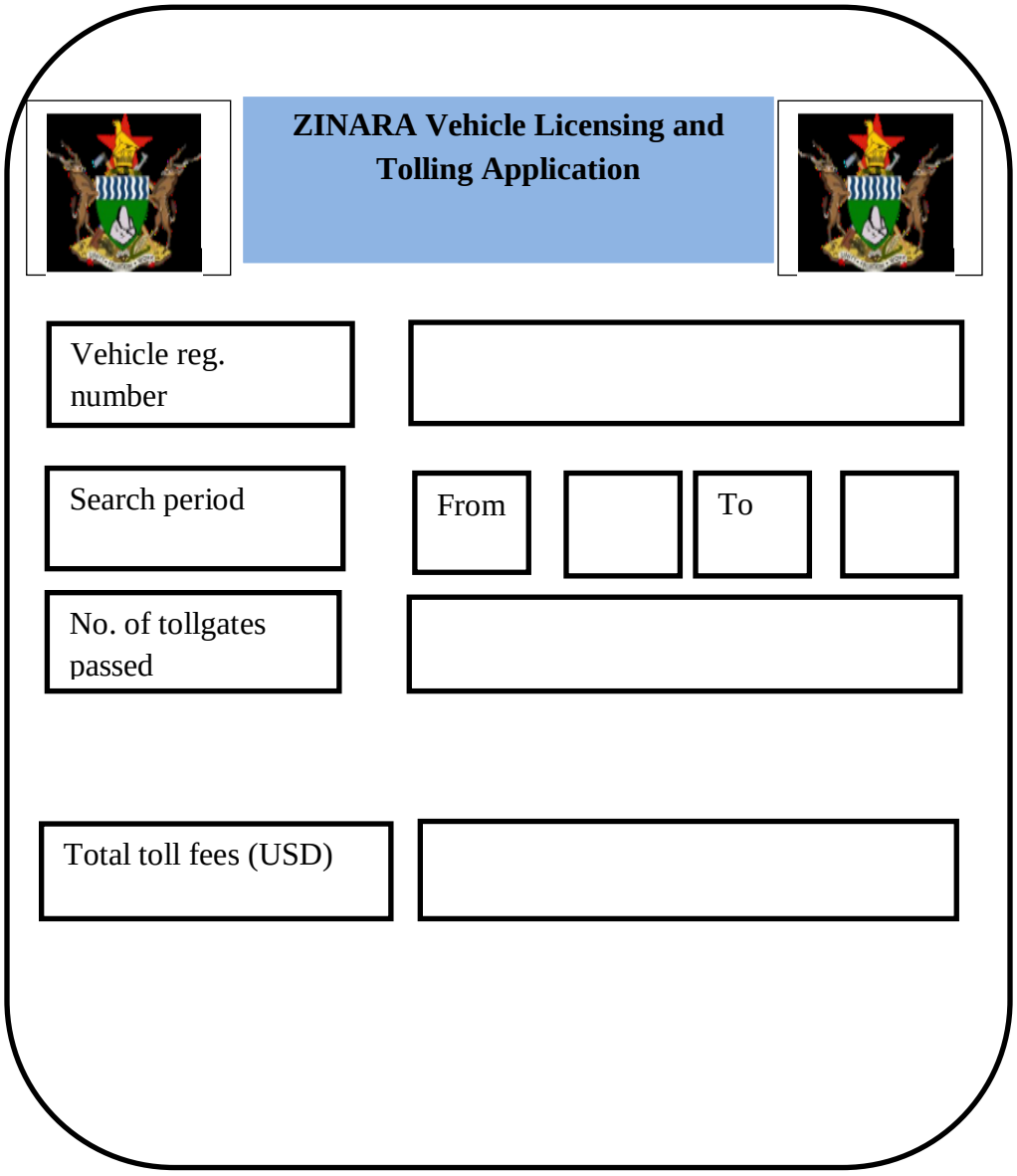


Fig 4.25: Vehicle toll fees statement

4.8 Pseudo code

Admin login

Enter login details

IF username and password are correct THEN

{

Go To admin home page

}

Else

{

Return to login page and error reporting

}

Staff Login

Enter staff login details

IF login credentials are correct THEN

{

Go To staff home page

}

Else

{

Error reporting

}

Updating a record

Check if entered record exists

If it does exist then

{

Validate information and update record

}

Else

{

Error reporting

}

4.9 Security design

The design could not be complete without looking at the security issues of the new ZINARA vehicle licensing and tolling android application system. At this juncture focus is now put on the security design of the new system. A security threat or danger is any activity or occasion that can cause harm or loss of software, hardware, information, data or the normal operation of the system. According to Pierce (1992), security design is a process within hardware and software development that seeks to reduce the vulnerability to security threats of a system through several measures and techniques that include authentication, backup and encryption to mention, but a few. This will be achieved by ensuring that access to the Information Technology infrastructure and its functionalities will be strictly granted to those who deserve privileges. Several access control methods will be enforced and these include one-time passwords, view controls and other access control methods. Security design encompasses aspects such as physical security, network security and operational security and these will be discussed separately.

4.9.1 Physical Security

Physical security mainly focuses on physical threats. Physical threats are those threats that harm the system physically and they include burglary, theft of IT infrastructures, vandalism and natural disasters. The new ZINARA licensing and tolling system's physical security will be guaranteed by making sure that the server room is burglar barred and kept locked all the time. Physical security will be strengthened more through the use of biometric systems such as figure print, access cards and facial recognition. Access cards will be configured and given to the systems administrator and his immediate subordinates only. The same will be done with figure prints and facial recognition. Whilst physical security is widely underestimated with much

priority being given to other more specialized and sensational issues such as hacking and viral attack security issues will be addressed with equal importance in the development of the ZINARA's new system. There are two principle segments to physical security that will be put in place by the ZINARA to protect the vehicle licensing and tolling system. To begin with, such measures can incorporate various locks, fencing, dividers, flame resistant safes, and water sprinklers. Second, reconnaissance and notifying systems can be set up, for example, lighting, heat sensors, smoke detectors, intrusion detection systems, cautions, and cameras.

4.9.2 Network security

According to Pierce (1992), physical and software measures all facilitate the shielding of basic systems networking foundation from unapproved access, abuse, breakdown modification and breakdowns. The evaluating procedure for the security of a network requires a check back on authorization measures to identify how well they have adjusted to the security arrangement. Auditing or evaluation promotes nonstop change by obliging organisations to consider the usage of their approach on a continuous basis. Network security also involves the threats that are paused by the internet such as virus attack, denial of service and system hacking. If these viruses are allowed enter the organisation they could cause data loss, and also case machines to malfunction. To reduce these network threats a firewall is going to be installed as indicated in fig 4.4. The firewall will scan all material from the internet before it creeps into the organisation's network. Frantic efforts will be made to ensure that the ZINARA new system will be safe from computer hackers by assigning static IP addresses to each and every machine in the organisation and a router will work alongside the hub such that only machines with the defined IP addresses will be allowed to access the staff login page.

4.9.3 Operational security

This is a procedure of distinguishing basic data and consequently examining cordial activities specialist to network improvement and vehicle license issuing and different exercises to: (a) choose and execute measures that take out or decrease to a worthy level the vulnerabilities of neighbourly activities to foe misuse (b) recognize those activities that can be seen by different intelligence systems.(c) decide markers that threatening intelligent systems may acquire that could be deciphered or sorted out to determine basic data so as to be helpful to other different systems (Langer, 2013).

4.10 Conclusion

A more practical approach was used in the design phase to give a more detailed view of the system. Several data representation tools were used such as dataflow diagrams, tables, entity relationship diagrams. Also all the input forms and output forms and menus were shown and gave a clear picture of what the new system will look like and how it is going to work. At this point in time it can be concluded, without doubt, that the reader is now curious to see how the system will be implemented. Implementation of the ZINARA's new system is going to be covered in chapter five which is the next and last chapter in this research.

CHAPTER FIVE: IMPLEMENTATION PHASE

5.1 Introduction

After the system has passed through the design phase there is need to test the designed system for errors. This will be done through validation and verification and the detected errors should be corrected before the system is implemented. User training is to be undertaken to maximize the use of the system to its maximum capacity. The implementation phase is the last stage in the system development and this is the stage where the developed system is introduced to the users of the system (Dennis et al., 2012). Objectives stated in the first chapter of this documented are also tested so as to determine if they tally with the needs of the targeted users. According to Stair and Reynolds (2013), the implementation is the procedure by which the issues which have to do with the technical, workforce and issues with administration are attended to.

5.2 Coding

Coding is the process which involves the conversion of a plane text into syntax that a fixed channel or a medium can be used to transmit the code (Reynolds, 2013). This implies that the process of coding refers to the conversion of the system design phase into a sequence of structured code syntaxes that can be implemented as a suite to produce a functional system and this involves the creation of a pseudo code. A pseudo code is a structured-English or program-design- language that is created in programming so as to imitate or simulate the instructions in real programming code (Craig and Jaskiel, 2002). The use of the pseudo code has got the advantage in the sense that it is easier to understand and also enables one to use any programming language one can wish to use.

5.3 Testing

System testing assures or makes sure that processes such as validation and verification, quality assurance and estimation of reliability are all achieved (Fujita and Zualkerman, 2008). System testing should be confined to the specifications of that particular system hence revisiting the needs of the users is vital in testing the system. Thereby the verification and validation processes are done in order to ensure that the user specifications are being me by the developed system. This will make the system run smoothly eliminating all the negative deviations which could have

been encountered in the actual operation of the system and hence minimise system errors. Testing follows a sequence of steps and fig 5.1 illustrates the steps.

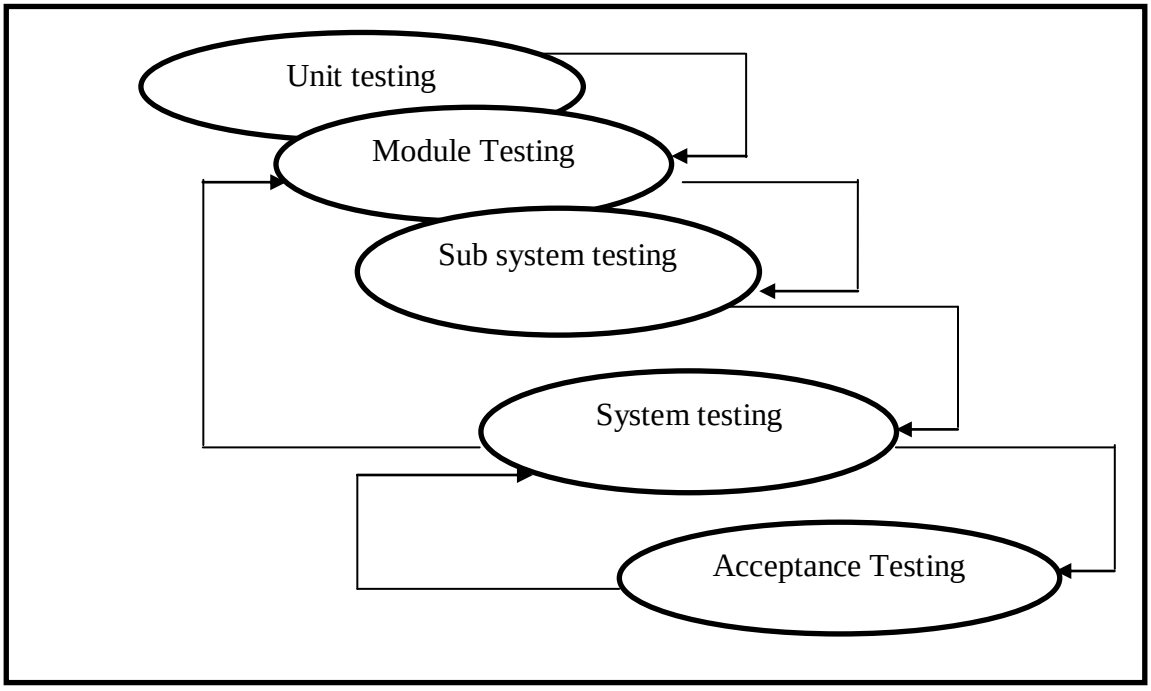


Fig 5.1: Stages in system Testing

Source**:** Craig and Jaskiel (2002).

5.3.1 Unit testing

According to Whitten (2013), unit testing involves the trying and testing the small bits of software that can be composed to produce software. This implies that unit testing involves the validation and the verification of the smallest component of a software module. Independent testing was carried out on the individual system components so as to determine their functionality when being implemented independently. Upon carrying the unit testing independent forms were tested to determine whether the inputted information was being stored in the database. The system went through this process successfully as the Motorist information was successfully added into the MySQL database. Several other units were tested for error in the system with various user inputs provided by the ZINARA employees as well as selected motorists and errors encountered were corrected.

5.3.2 Module testing

Module testing strategy combines the linked software abilities or units and is examined to authenticate whether the different dependent units are functioning hand in hand as this is important to the system (Saleh, 2009).

5.3.3 Integration Testing

According to Shelly and Rosenblatt (2011), integration testing combines the software elements and the hardware elements and is tested up until the application software has been integrated. The objective of integration testing is to make sure that the design objectives are met and they comply with the operational and user requirements. Integration testing tests the individual units that are to be later integrated or combined are functioning without errors. Modules in the ZINARA licensing application which include the licensing and tolling units were tested and all the errors detected were corrected. This process was done repeatedly as illustrated in Fig 5.1, where the diagram illustrates the stage being done repeatedly.

5.3.4 System Testing

System testing technique evaluates the execution of the combined system by combining the different sub-systems (Limaye, 2009). This is the stage where the productivity of the system is measured that is the system will be assessed or measured against the user requirements. The system will be tested so as to identify those errors that arise due to the fusion of the different modules. System testing includes the two types of testing which includes white box and black box testing.

a) **Black box Testing**

   Black box testing includes the usage of tests whereby the inner structures of the developed or the system source code are unclear to the analyser (Saleh, 2009). The black box testing strategy includes the analysis of the different sections of the system conduction for assessing the relations between inputs, output and its functionality as per customer requirements. It is a programming testing technique whereby the inputs are controlled and yields are then seen to check whether the resulting outputs are the ones anticipated.

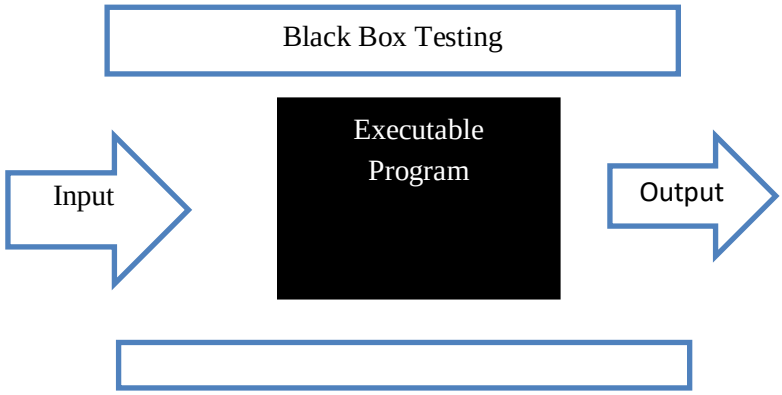


Fig 5.2 black box testing

Source: Rozanski and Woods (2012).

b) White Box Testing

White box testing refers to the software testing technique whereby the internal structure, the design as well as the implementation of the items being tested are known to the tester (Limaye, 2009). In this case the tester chooses the path that exists in the code as well as determining the suitable outputs. White box testing mechanism took into account the internal or inner architecture of the system or the system components. It is also known as the glass box testing or the structural testing indicating that there is transparency in the inner workings of the system that is the logic and the structure of the code.

5.3.5 Acceptance Testing

Acceptance testing is a formal software testing technique which is undertaken so as to determine if the developed system satisfies the acceptance criteria and at the same time determining the customers to choose to use the system or not (Agarwal, Tayal and Gupta, 2010). This technique is used in determining whether the system met all the user specifications and that all the objectives are met. This is the final stage of testing which will determine the success factor of the system since it is the stage where the users of the system chose whether to use it or not. Acceptance testing involves the use of the two sorts of tests which include:

a) Alpha Testing

According to Craig and Jaskiel (2002), alpha testing is a sort of acceptance testing that is carried out at the site for development. The technique involves the use of past information obtained from the old system so as to compare and evaluate the effectiveness of the new system in error handling. This is where any abnormal system behavior is identified and rectified so as to eliminate errors.

b) Beta Testing

The site of the targeted client environment is where the system is tested (Agarwal et al., 2010). The organisation in which the system is designed for is given the system so that the users of the system familiarize with the developed system. This is done so as to allow them to get a feel of the system with the objective of finding errors which might still exist in the system. These identified errors are then brought up so that they can be corrected.

5.3.6 System security testing

After the successful completion of integration testing the system was tested for security. According to Bentley and Whitten (1995), system security testing is one of the most crucial areas in system development and also added that secure software is highly unlikely to fail. Thus the system should have highly secure mechanisms so that they guard against unauthorised access into the system. The ZINARA licensing and tolling application was developed and the use of user authentication as well as access levels was implemented and thereby guarding against unauthorised access. Therefore the several testing mechanisms were implemented and the system yielded positive results through those stages.

5.3.7 Validation

According to Bentley and Whitten (1995), validation refers to the process of ensuring that the input is correct and can be accepted by the system. The data entered in the system should be consistent as well as being correct and any errors made should not be entered in the system. The system will therefore validate all the input parameters entered in the system through various techniques which include the following.

Screenshots of the various test cases

Fig 5.3 illustrates the data type validation screenshot. This is when the user has to provide the correct data type for example the user has to provide the correct format of a vehicle registration number. The vehicle registration number should start with the letter A. this is shown on fig 5.3.

Fig 5.3: Data type validation screenshot

Fig 5.4 illustrates the user is authenticated before being allowed to gain access to the system. Therefore the correct details must be provided by the user so as to be granted access into the system that is the correct username and password must be provided. Fig 5.4 illustrates a situation where the user entered incorrect car registration number, username and password upon login into the system and therefore an error message was generated.

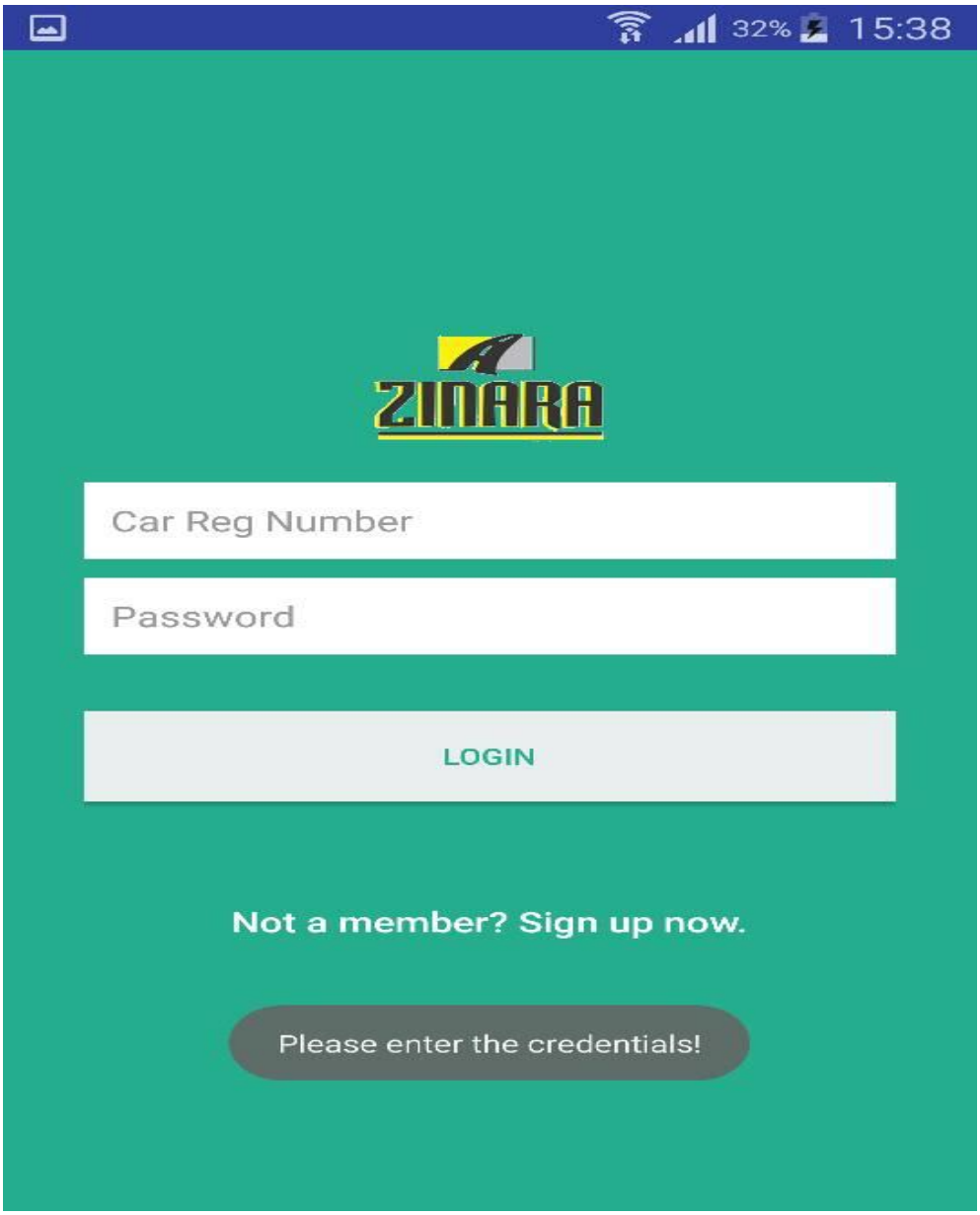


Fig 5.4: Login security screenshot

Fig 5.5 shows the password match validation screenshot. After entering the correct login details the motorist is allowed to gain access to the main modules of the licensing and tolling system. The following interface will include the sections where one calculates the license cost as well as the tollgate fees. Fig 5.5 illustrates the interface where the Motorists view the main options of the system.

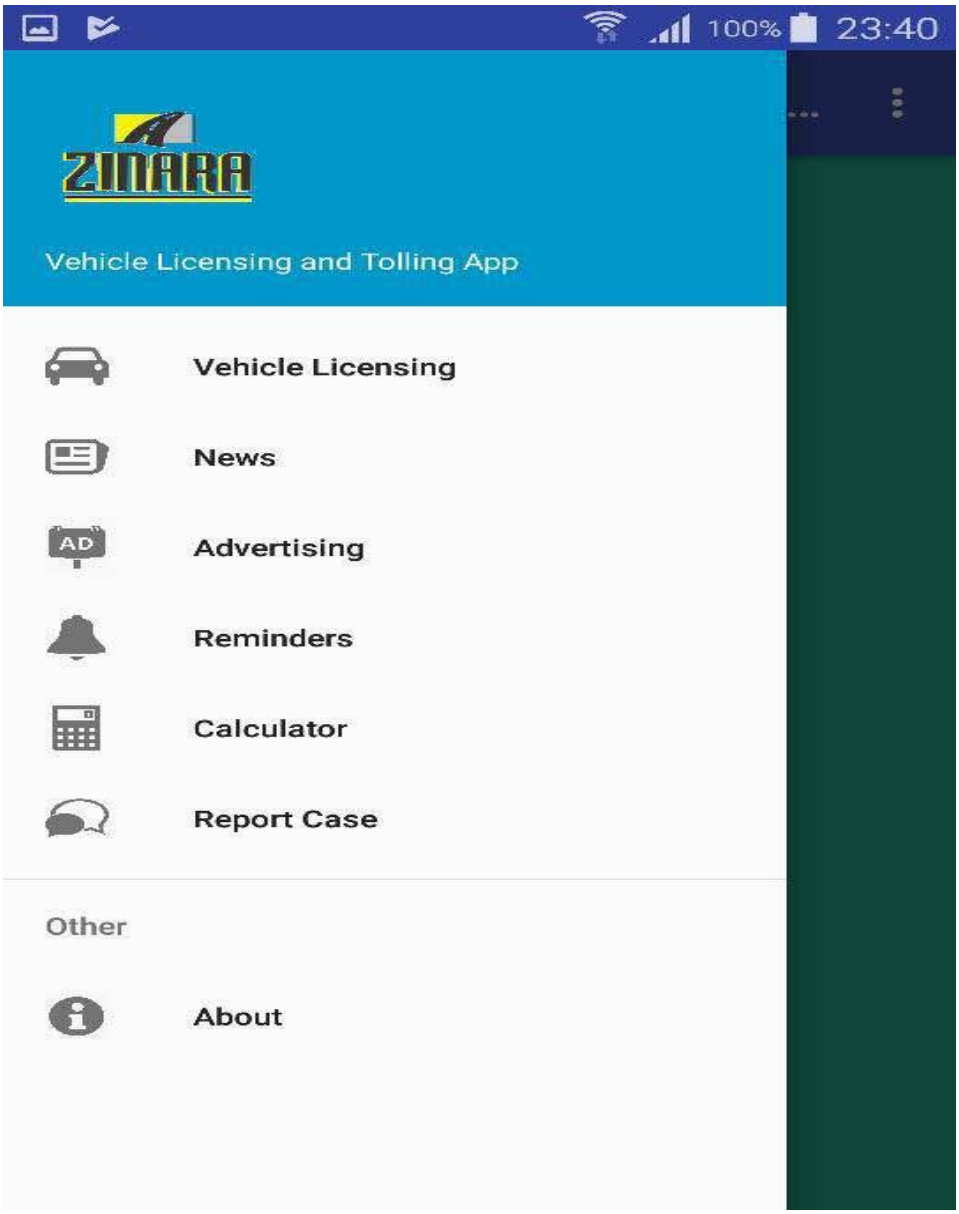


Fig 5.5: Password match validation screenshot

Fig 5.6 shows the omission validation screenshot where the user has to fill in all the required fields in the form. It is important otherwise the system will not submit the details and the user has to fill in everything. This illustrated in fig 5.6 whereby the Motorist has to first fill in the fields so as to be able to register the vehicle in the system.

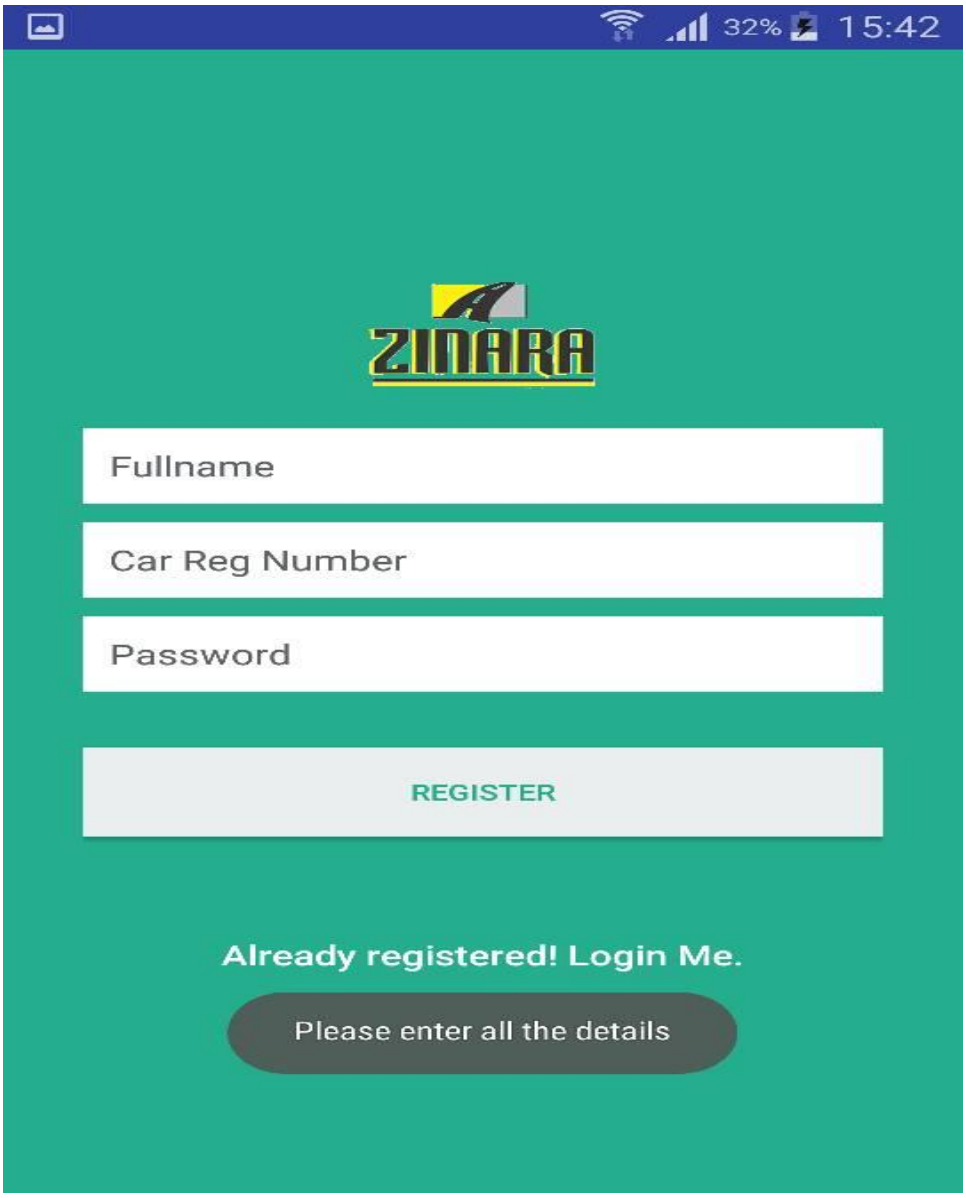


Fig 5.6: Omission validation screenshot

Fig 5.7 is an input type validation screenshot whereby the user has to provide the correct format of the vehicle registration number. In this case all the Registration numbers start with the letter A and therefore the error should appear in the event that a Motorist punches in anything other than that as shown in fig 5.7.

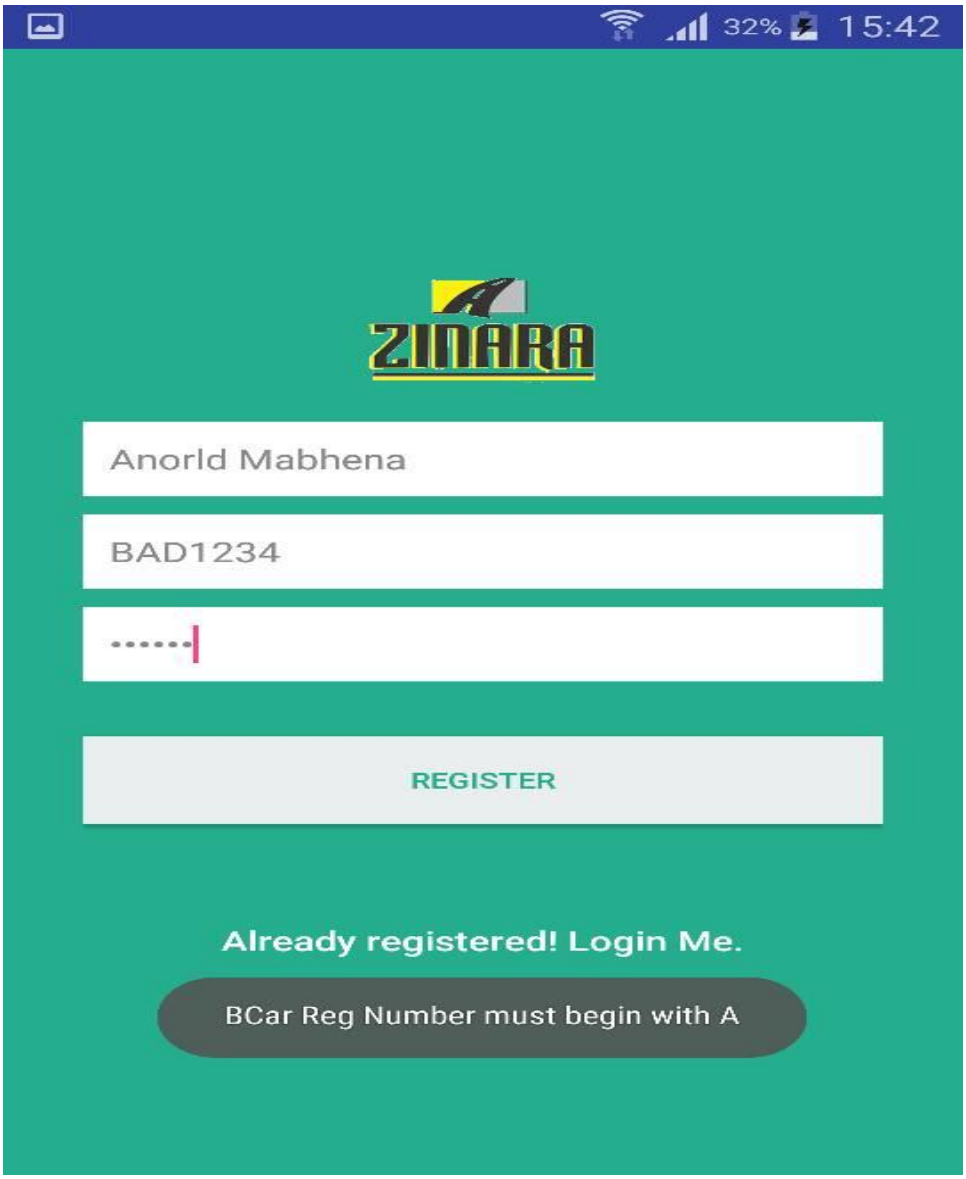


Fig 5.7: Input type validation screenshot

5.3.8 Verification

According to Limaye (2009), verification refers to a process of inspecting and ensuring that the system meets its expectations and the expected use. It ensures that the system performs the functions that it is claimed to be performing.

5.4 Installation

According to Rozanski and Woods (2012), installation refers to a process of establishing or introducing the developed system to the organisation so that it starts its intended purpose. This implies that the users of the old ZINARA licensing system will now be required to utilise the introduced licensing application. The system installation process is done on the production site where the system is supposed to be operating on that is its operational environment. This process is done after the final system has been produced and all the errors are attended to and corrected. The installation process consists of the following strategies to be carried out that are system changeover and user training.

5.4.1 User Training

According to Limaye (2009), user training involves the introduction of the developed system to the endorser so as to allow and promote familiarisation. This implies that the users of the system are shown the system so that they can make use of the modules and the programs that are relevant to them. The daily operations of the organisation are not supposed to be disturbed and therefore user training is vital so as to improve the productivity of the proposed system. In the development of the vehicle licensing and tolling application, the user training exercise arranged by the ZINARA Human resource department. The elements as well as the combined modules were discussed and explained making it clear to the user how the modules actually function so as to avoid error in using the system.

5.4.2 System Changeover

After the system has gone through the testing stages and all the errors found in the testing stages were identified the system moves next to the installation process. system changeover has got four alternate strategies which follows.

a) Direct Changeover

According to Shelly and Rosenblatt (2011), the direct changeover technique in which the old system is stopped and the new system starts to work. This approach involves phasing out the current system so as to pave way for the developed system when it is ready for use.

Assessment of direct changeover

The immediate seizure of the current ZINARA licensing system might possess risk since the old system and its data will be abandoned. This is so because in the event that the developed system fails reverting back to the old licensing system will be impossible and hence the organisation's operations will be stopped. The direct changeover strategy however tend to be a cheaper option since only one system will have to be implemented and therefore all the efforts will be directed on system which is a cheaper option. Due to the high risk possessed by the direct changeover strategy it is not a recommended technique since we can risk organisational operations as well as losing important motorist information.

b) Pilot changeover

According to Lancaster (2001), pilot changeover refers to a technique whereby the developed system is implemented on a lower scale that is implementing the system only to a certain part of the organisation and also the modules that are relevant to that section. This technique just like the direct changeover, switches to the new system but only on the selected section of the organisation. That is the old system is totally phased out due to the introduction of the new system.

Assessment of Pilot changeover

The pilot technique is less risk as compared to the direct changeover strategy but however this also has got its own limitations. The pilot changeover will imply that the developed system will only be installed in the tollgates. This will not be recommended since the Licensing system will equally require the information from the licensing department and

therefore there can be loss of information in the event that the tolling application fails. Therefore the pilot changeover strategy is not recommended in this case.

c) Phased changeover

This refers to a step by step technique whereby the developed system substitutes the old system module by module at any given time (Shelly and Rosenblatt, 2011). This approach is the slowest but it tends to be a safer approach. The phased changeover strategy in the event of a failure only affects that specific module and the whole system operations is not crippled as seen in the direct changeover strategy.

Assessment of the Phased changeover

The phased changeover also has got a risk of data loss since the system will be a specific module and in the event of a failure that module data is lost since we cannot revert back to the old manual system. Installation costs will be higher in this strategy since the ZINARA staff will require step by step training and this can end up being a lengthy process which can then exceed the budget of the system. Therefore the ZINARA licensing and tolling application cannot be implemented with this strategy since it can lead to higher costs and that the system will require to be installed as a whole and therefore it is not recommended.

d) Parallel changeover

Parallel changeover implies that the new system is introduced to the environment and works simultaneously with the old system for a certain period of time (Shelly and Rosenblatt, 2011). This strategy is done so as to compare the results produced by both systems and also as a counter measure in the event the new system fails. Therefore the parallel changeover is the less risk of all the other changeover strategies.

Assessment of the Parallel changeover (Recommended).

The parallel changeover is the most expensive of all the other changeover strategies. This is so because the two systems will be both in use meaning that there is duplication of effort and data and therefore more workload for the employees. On the other hand it is the least risky of all the strategies and since we cannot afford to lose any data in

implementing the ZINARA licensing and tolling application. This also allows a period of time where there can be a comparison of the systems in terms of results produced. The users can then choose between the two eliminating any risk of resistance among users in using the system. Therefore despite the costs of the parallel changeover it is the recommended technique due to the fact that data loss is not an option in implementing this system. Therefore running the two up until to stage where the new system is error free.

5.5 Maintenance

According to Ramesh and Bhattiprolu (2006), maintenance is a stage where the system is regularly monitored and tested for errors. The main objective of this strategy is to find and correct these errors so that the system functions as intended. The maintenance process can be done in four ways include corrective, adaptive, perfective and preventive maintenance.

a) Corrective maintenance

Saleh (2009) states that corrective maintenance as the process of attending to errors faced by users as they occur and the measures to mitigate them or reduce these errors are put into place. The corrective maintenance technique is usually done just after the system is implemented. Errors in this case are reported through feedback from clients and they are attended to instantly before the bugs complicate the whole operation of the system. This is recommended in the implementation of the ZINARA licensing and tolling application correcting all the errors which could have been omitted in the testing stages.

b) Adaptive maintenance

Saleh (2009) states adaptive maintenance involves the integration of the system with the current software and hardware so that there is continuity in the operation of the system in its environment. Therefore in adaptive maintenance makes sure that the system is changed so as to suit the ever changing trends in the operating environment. Adaptive maintenance is the most suitable technique in the industry where there is a rapid change in the software and hardware equipment. Hence to maintain the relevance and continuity in the operation of the system, the system has to adapt to those changes.

c) Perfective maintenance

Perfective maintenance is done on the functional and the non-functional areas of the system making changes so as to maximize performance in a flexible way (Saleh, 2009). Therefore this approach involves changing the system so that it continuously meets the user needs. That is it has to be changed to be user friendly as well as changing selected functions so that the system can be more effective and efficient. The system should justify its existence through having positive impacts in the organisation and this can be achieved through continuously perfecting the system in terms of its efficiency and user friendliness.

d) Preventive Maintenance

Preventive maintenance refers to a pro-active technique whereby the system is improved as a counter measure to avoid errors which can be encountered in the future before they can occur in real time. Therefore the system is patched so as to eliminate any future threats to the system. The system has to be pro- active other than re-active so as to avoid inconveniences in its operations. Preventive maintenance is the safest of all the other types of maintenance but also the most difficult of them all. This is so because the future errors are very difficult to predict and therefore to make a counter measure of the unknown can be a nightmare. Therefore it is recommended that the ZINARA's ICT department to be proactive so as to eliminate other future that that can cripple the operation of the whole system.

5.6 Recommendations to stakeholders

The implementation of the vehicle licensing and tolling application will bring more good than harm to all the ZINARA stakeholders. Therefore each of the stakeholders is recommended next on the importance of the developed ZINARA vehicle licensing and tolling application when put into good use.

a) Motorists

This application is recommended for all the motorists due to the services that it offers and therefore one is recommended to install and this will surely be of good use. All calculations are made easy on the go and therefore to improve efficiency as well as the

drafting of the road budget the vehicle licensing and tolling application assist the motorists to a larger extent.

b) Employees

The service delivery will be increased through the introduction of the vehicle licensing application will increase their throughput. This lightens up their job in serving the clients even when operating from a remote location. Therefore the employees have to harness the use of the application at the same time finding other ways to further improve the application since they use on a daily basis.

c) Management

The management being responsible for the entire decision making should also promote the further development at same time harnessing its use in the organisation. The application further speeds up revenue collection through use of the application and hence the management has to allocate more financial resources toward the further development of the vehicle licensing and tolling application.

5.7 Recommendations for further/ future developments

The systems development is an iterative process whereby the system has to be continuously improve and thereby keeping in track with the gradually changing operating environment. Therefore enough resource has to be allocated in the continuous development or improvement of the system. Therefore it is recommended that the ZINARA licensing and tolling application should be integrated with the Tollgate prepayment system so as to increase the functionalities to increase efficiency and reduce the risk of inconveniences in the road for the motorists. Also additional features can be added on the application which includes payment the vehicle license, vehicle insurance as well as the radio through the Ecocash platform. This can further reduce customer requests as well as queues at the ZINARA offices. This can at the same time reduce the workload on the employees thereby they will focus on other specifications

5.8 Conclusion

This was the last chapter which also demonstrated the success factors of the ZINARA licensing and tolling application. The vital techniques all necessary to determine the viability of the system were carried out. Other techniques like testing were also carried out to determine the usefulness of the system to the users. After successfully going through the testing phases the system maintenance also takes over this will be done so as to ensure that the system continuously operates smoothly eliminating errors. The system also has to be adaptive to the environment it is operating on so as to ensure its continuous relevance in the industry. With all the techniques implemented in this document the system will be a success mission and the system is also ready for use as well.

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Appendices

Appendix A: User manual

Vehicle licensing and tolling application

a) Introduction

The user manual has been written so as to assist the users to navigate and use the different functionalities of the modules in the vehicle licensing and tolling application.

Mandatory requirements:

The internal users of the licensing and tolling application have to undergo a training exercise to familiarise with the functions of the system since the changes they make in the system will be permanent. User accounts are then created for these users by the systems administrator. Login details are provided for each therefore they have to be provided correctly upon login

For a better view of the application a 9.7 inch tablet computer with a 4.2 or better of android version is recommended.

b) Getting started

Accessing the system

The motorists can obtain the application on the ZINARA website (www.zinara.co.zw)

c) Registration page

This is the initial stage whereby the motorist is required to create an account with the system. The car registration number is required as well as the username and password of the motorist in order to create an account.

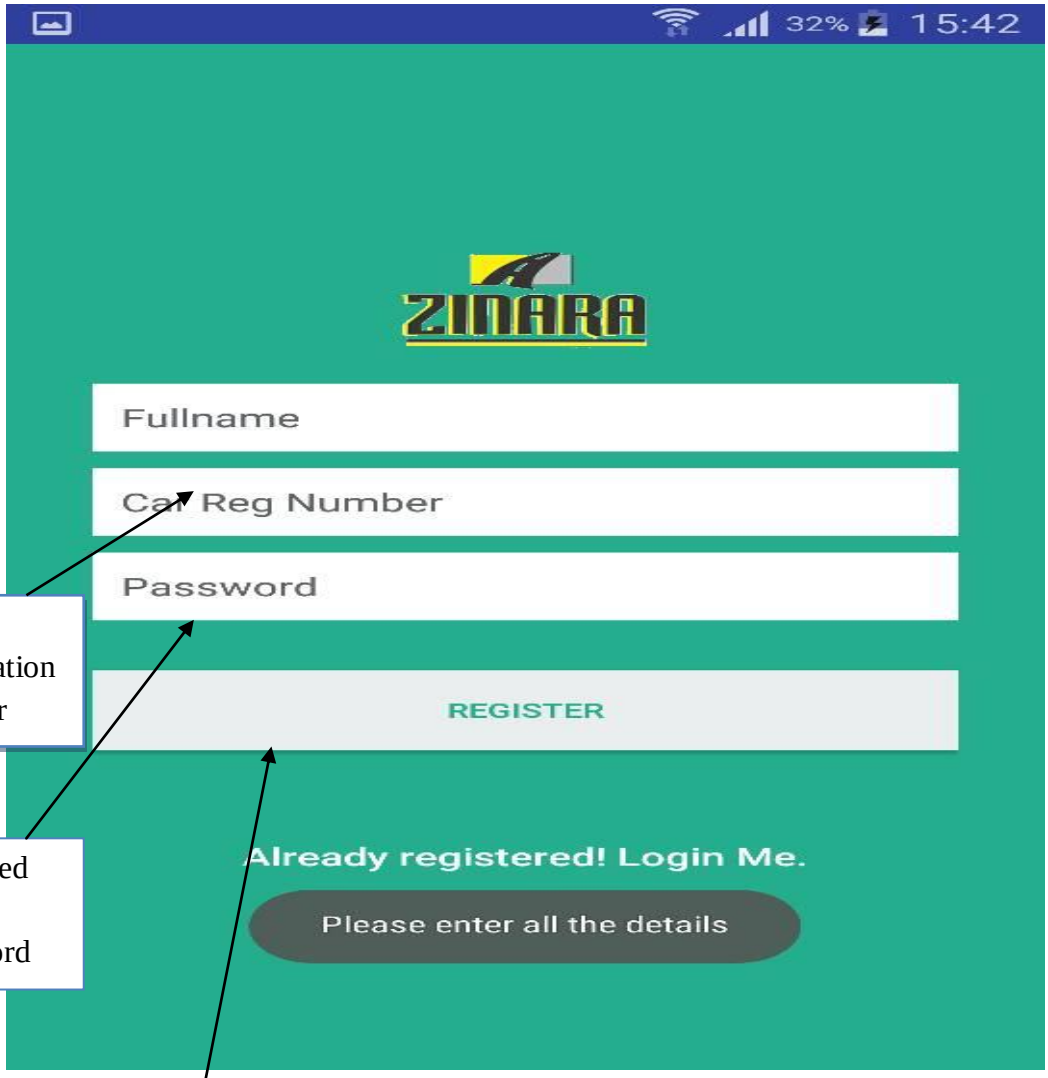


Fig A1: Registration page

d) Login page

After successfully registering into the system a login page is displayed for the user to provide the credentials provided upon registering.

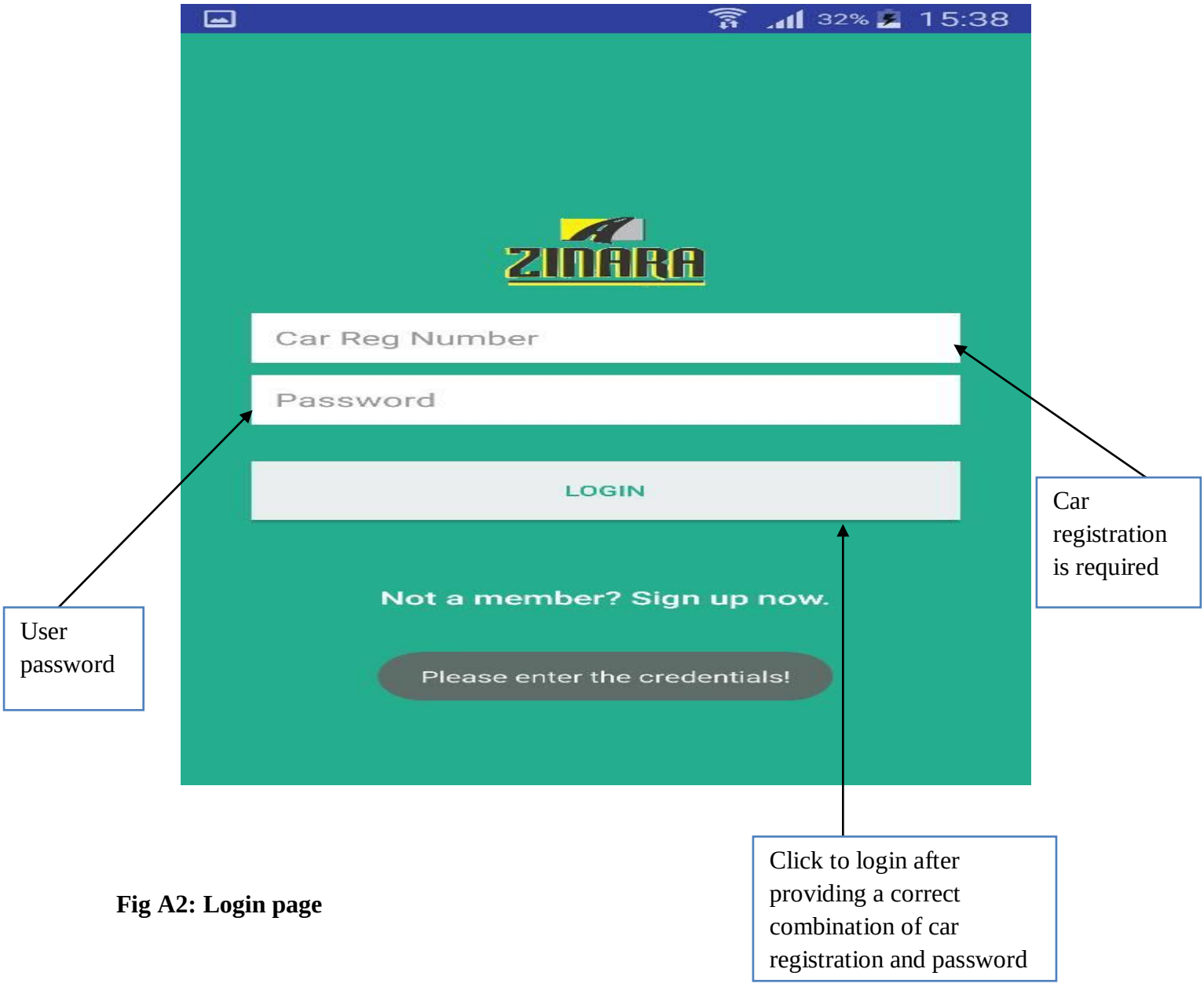


Fig A2: Login page

e) Welcome page

This is the page displayed after successfully providing correct car registration and password in the login page. The car registration number as well as the motorist name is displayed. The user has to proceed to the main menu to view the available functions.

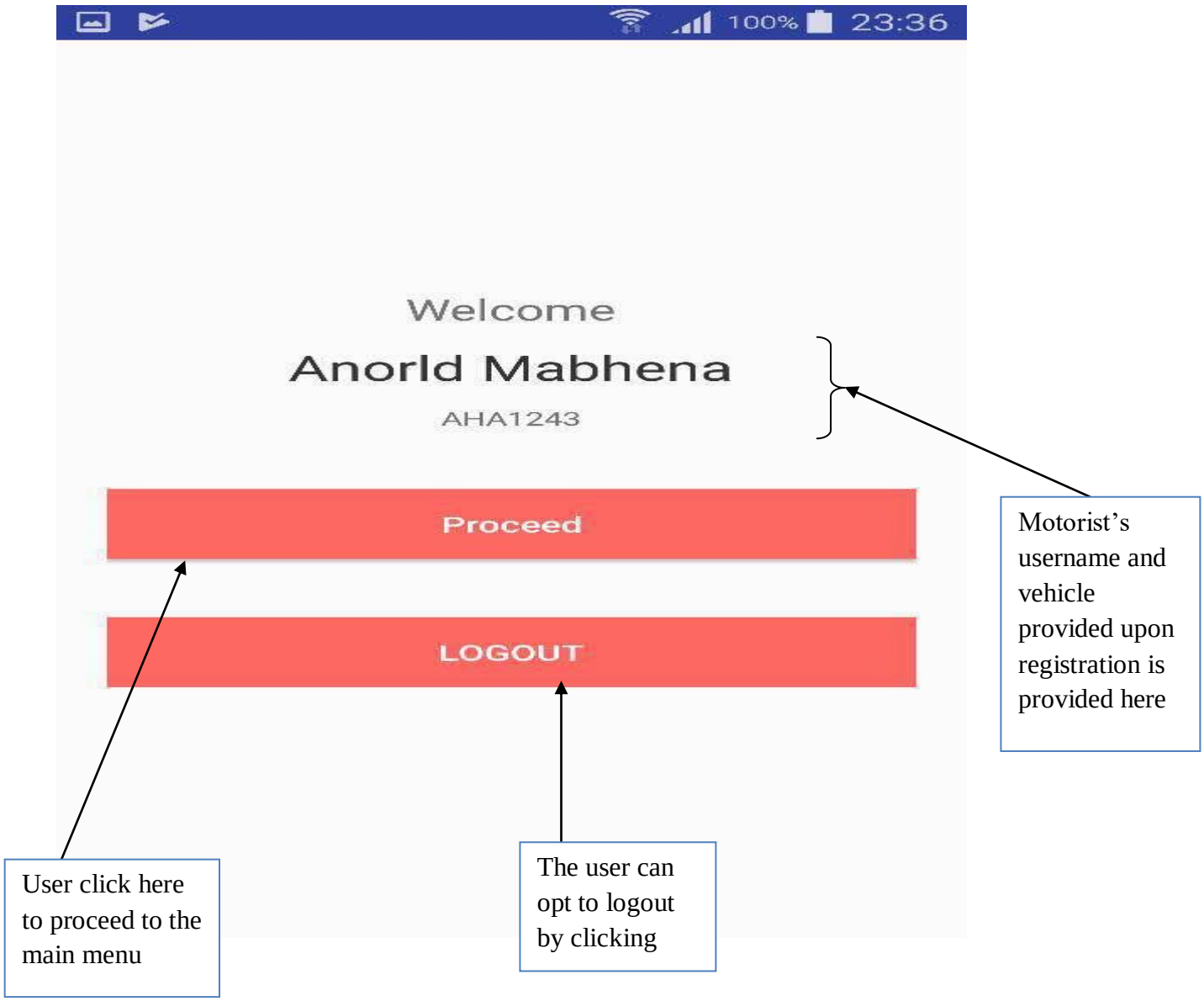


Fig A3: Welcome page

f) Main Menu

Upon clicking proceed button in the welcome page the main menu is displayed which contains the functions that are performed by the application. The user can then select the preferred option in the main menu.

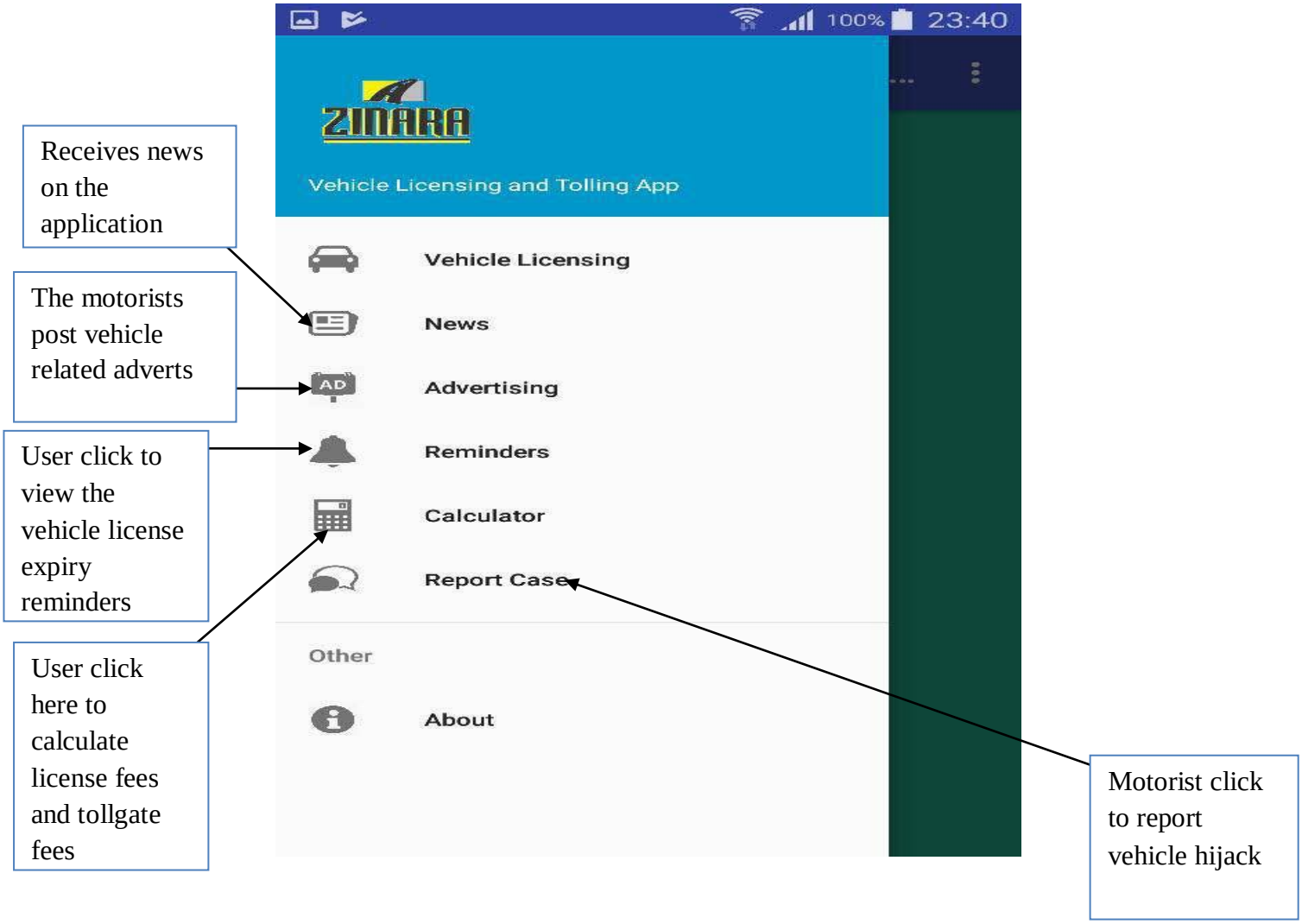


Fig A4: Main menu

g) Calculator

When the user clicks on the calculator the two options to calculate the vehicle license fee as well as that to calculate the total tollgate fees required from one destination to the next.

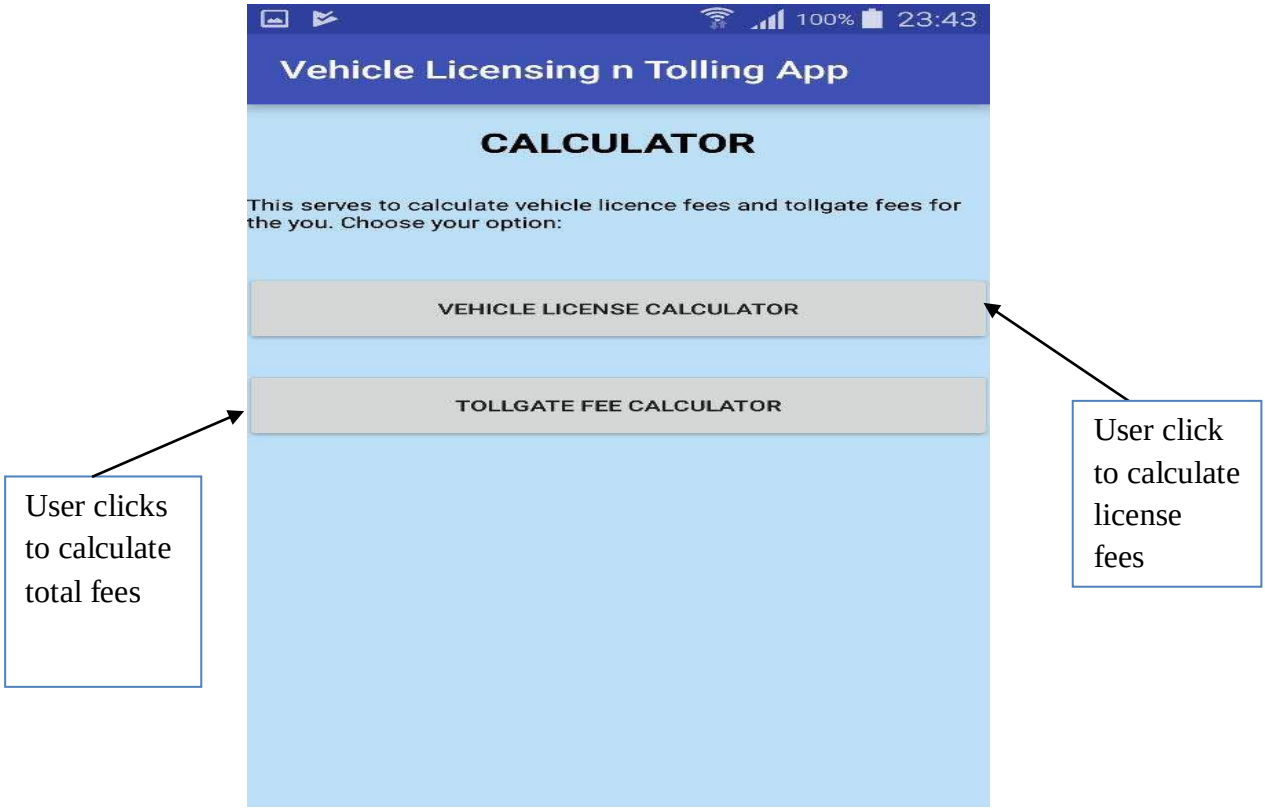


Fig A5: Calculator

h) Vehicle license calculator

This is where the user provides vehicle details which includes the vehicle details, net mass as well the license expiry date. Therefore the license amount to be for that vehicle will be displayed.

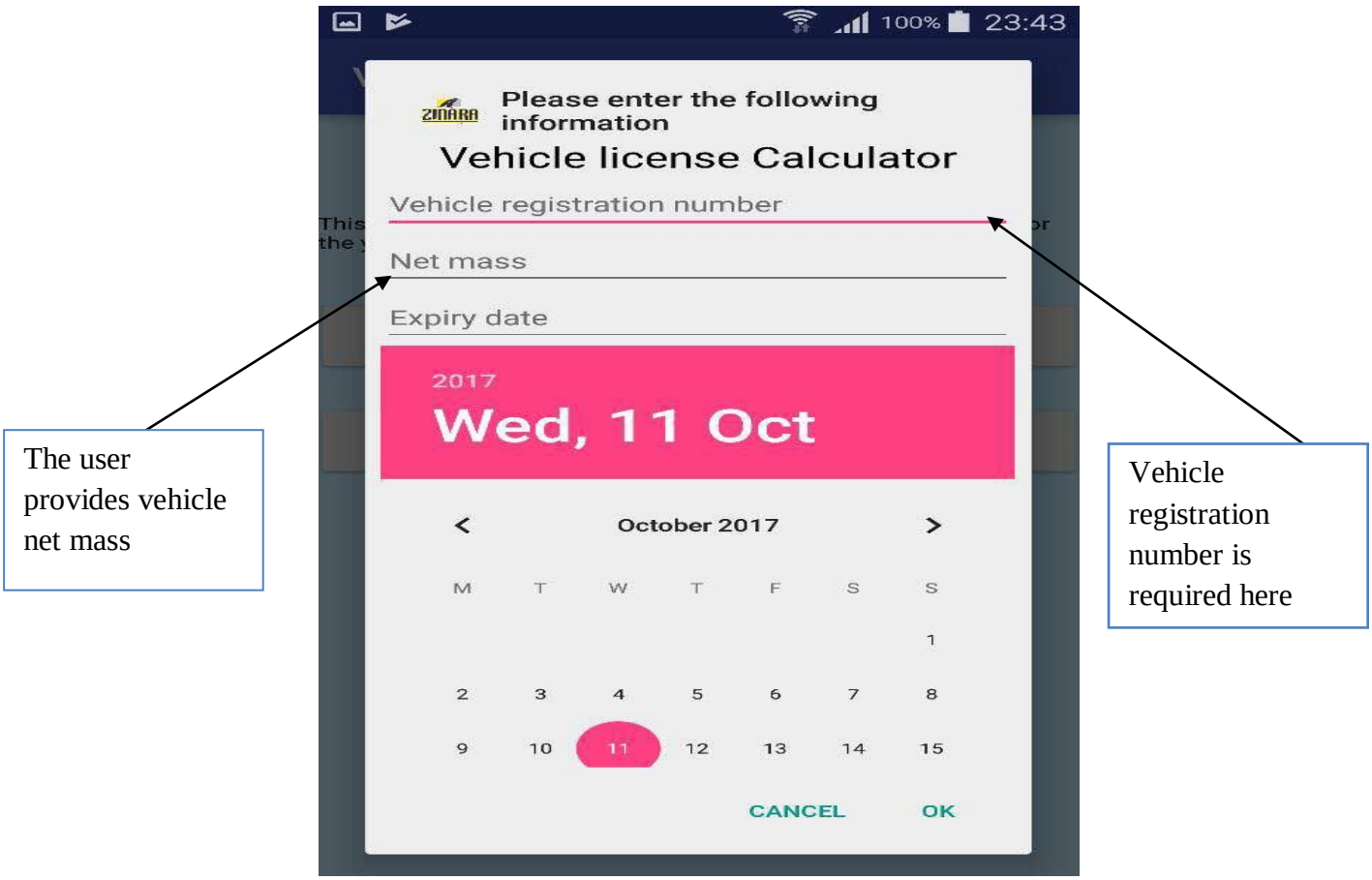


Fig A6: License fees calculator

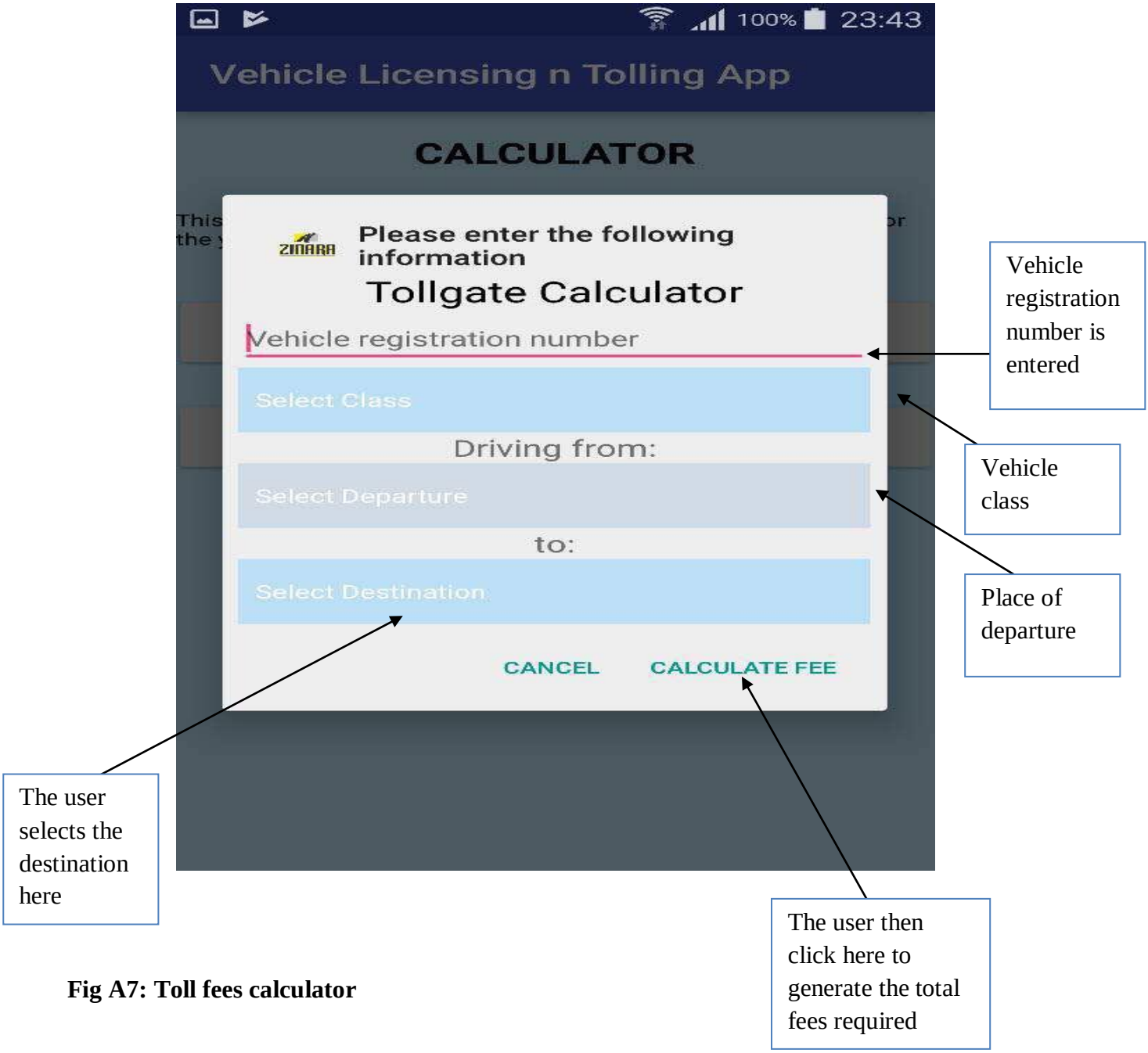


Fig A7: Toll fees calculator

i) Report case

This is where the motorist report the vehicle hijacks cases to the tolling officers. Therefore a username and password is required to login and report a case.

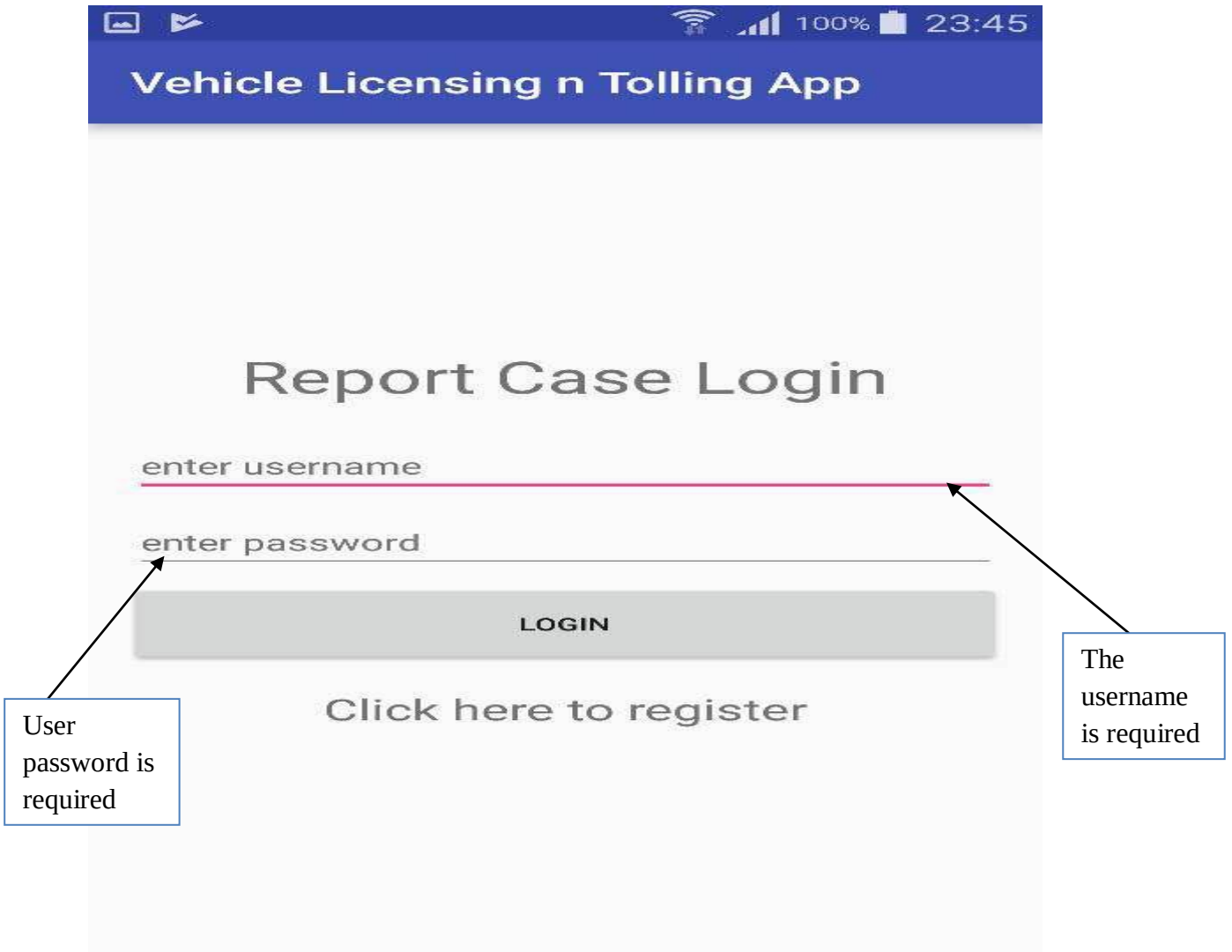
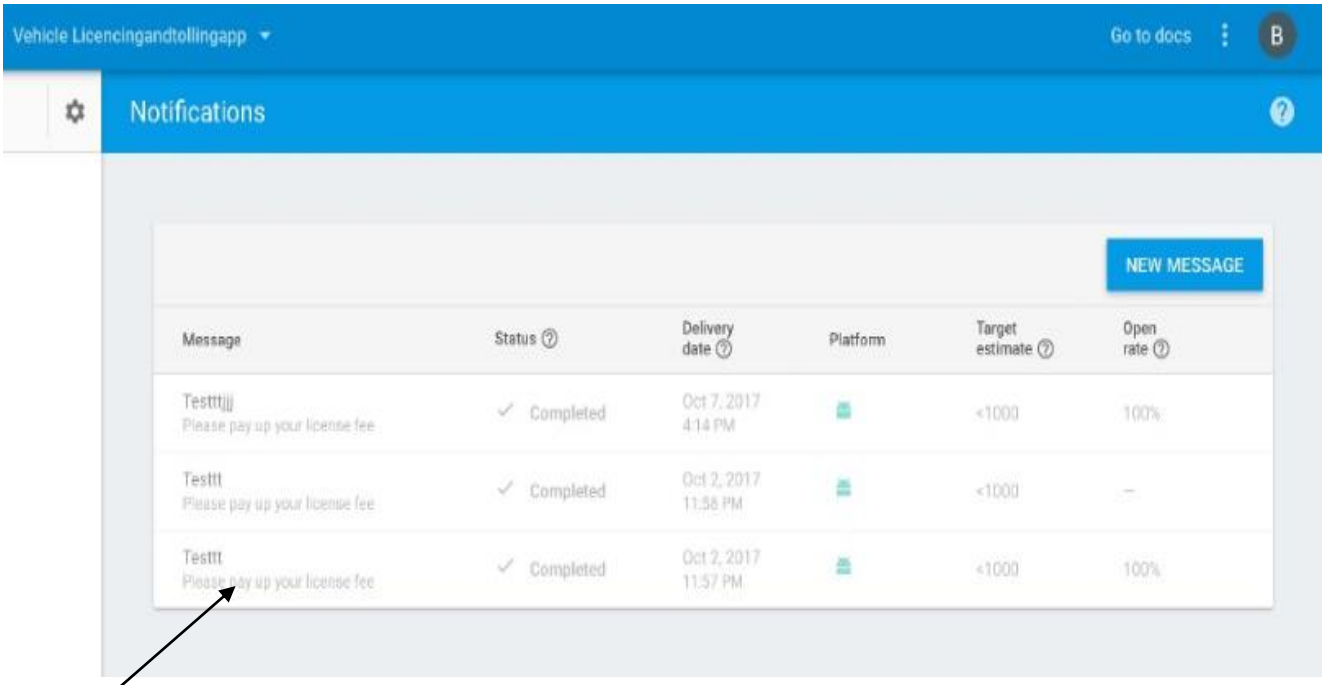


Fig A8: Report case

j) Reminders

This is the page whereby the motorists are reminded of the vehicle license expiry dates that is due.



Reminders received on the user account notifying the motorist on license expiry

Fig A9: Reminders

Appendix B: Interviews

Interview Checklist

The following are a set of the interview questions that were asked to the ZINARA employees that is the Licensing officer.

1. Approximately how long does it takes to process a vehicle license request and issue back a license or quotation?

   ……
   ……
   ……

2. In your own opinion do you think the current ZINARA licensing system should be improved through the use of information technology?

   ……
   ……
   ……

3. From your own perspective what areas do you think should be improved in the current licensing system?

   ……
   ……
   ……..

4. In your system besides the expiry date on the license disk is there any other means of notifying the motorist when the license is due for licensing?

   ……
   ……
   ……..

5. Have you ever recently faced difficulties in accepting or adopting any new technology that was brought into the organisation? If so, please state when and the type of the technology?

   ……

   ……

   ……

Date…….

Signature……..

Interview Checklist for Motorists

The following are a sample of interview questions asked to random motorists

1. With the current means of communication which includes visiting any nearby ZINARA office for clarity, is it convenient, accurate or time conscious?

   ……
   ……
   …….

2. Approximately how long does it takes for your various requests to be responded to when you visit the ZINARA offices?

   ……
   ……
   …….

3. If there is any chance that there can be an introduction of the new technology are you willing to accept that new technology? If no, please state your reason(s).

   ……
   ……
   ……
   ……..…

4. What effect do you think the introduction of the new licensing system will have on the relationship between ZINARA and the Motorists?

   ……
   ……
   …….

Appendix C: Observations

Table D1: Observation Scoresheet

Vehicle Licensing and Tolling Application

Observation Scoresheet

Date……../……../……..

Time…….

Observations

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Conclusion……
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Appendix D: Questionnaire

This questionnaire with a list of questions intended for the randomly selected motorists

SECTION A: Please draw a circle around your answer to indicate your choice

1. On average, how long does it take for your inquiries to be responded to after making inquiries?

a) 10 minutes b) 20 minutes c) 30 minutes d) one hour

2. Based on your above answer, how do you rate the current manual system?

a) Good b) average c) below average d) poor

3. What effect do you think the introduction of a computerised system will have on the current process of issuing licenses?

a) Negative b) positive c) no effect d) not sure

4. How would you rate the computer literacy rate of the users of the current manual system in your organisation?

a) Good b) average c) below average d) poor

SECTION B: Please tick the box to indicate your choice

1. Do you think the current manual system should be improved?

Yes ☐ No ☐

2. Do you believe the use of information and technology will improve the current manual system?

Yes ☐ No ☐

3. Basing on your experience and exposure into the organisation, do you think that a new computerised system is going to be accepted by the users?

Yes ☐ No ☐

4. Do you possess any knowledge on the basic use of information and technology?

Yes ☐ No ☐

Appendix E: Code Snippets

```
package anoe.mabhena.vehiclelicencingandtollingapp;

import android.content.Context;

import android.content.DialogInterface;

import android.os.Bundle;

import android.support.v7.app.AlertDialog;

import android.support.v7.app.AppCompatActivity;

import android.view.LayoutInflater;

import android.view.View;

import android.widget.ArrayAdapter;

import android.widget.Button;

import android.widget.EditText;

import android.widget.Spinner;

public class Calculator extends AppCompatActivity {

    final Context mContext = this;

    Button license_calc, tollgate_calc;

    int licenseFee;

    @Override

    protected void onCreate(Bundle savedInstanceState) {

        super.onCreate(savedInstanceState);

        setContentView(R.layout.activity_calculator);

        license_calc = (Button)findViewById(R.id.license_calculator);
```

```
tollgate_calc = (Button)findViewById(R.id.tollgate_calculator);
license_calc.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View v) {
        LayoutInflater li = LayoutInflater.from(mContext);
        View dialogView = li.inflate(R.layout.custom_dialog, null);
        AlertDialog.Builder alertDialogBuilder = new AlertDialog.Builder(mContext);
        //set title
        alertDialogBuilder.setTitle("Please enter the following information");
        alertDialogBuilder.setIcon(R.mipmap.iconn);
        alertDialogBuilder.setView(dialogView);
        final EditText registrationNo = (EditText) dialogView.findViewById(R.id.reg_no);
        final EditText netMass = (EditText) dialogView.findViewById(R.id.net_mass);
        final EditText arrears = (EditText) dialogView.findViewById(R.id.net_mass);
        final EditText penalties = (EditText) dialogView.findViewById(R.id.net_mass);
        final EditText months = (EditText) dialogView.findViewById(R.id.net_mass);
        final EditText currentLicense = (EditText) dialogView.findViewById(R.id.net_mass);
        final EditText expiryDate = (EditText) dialogView.findViewById(R.id.expiry_date);
       // {[(arrears+penalties)*months]+$5}+CURRENT LICENCE
        String netMasss = netMass.getText().toString();
        String arrearss = arrears.getText().toString();
```

```
        String penaltiess = penalties.getText().toString();
        String monthss = months.getText().toString();
        String currentLicenses = currentLicense.getText().toString();
        licenseFee = ((Integer.parseInt(arrearss) + Integer.parseInt(penaltiess))*
Integer.parseInt(monthss) + 5) + Integer.parseInt(currentLicenses);
        alertDialogBuilder
            .setCancelable(false)
            .setPositiveButton("Calculate Fee",
                new DialogInterface.OnClickListener() {
                  @Override
                  public void onClick(DialogInterface dialog, int which) {


                  }
                })
            .setNegativeButton("Cancel",
                new DialogInterface.OnClickListener() {
                  @Override
                  public void onClick(DialogInterface dialog, int which) {
                  }
                });
        //create alert dialog
```

```
            AlertDialog alertDialog = alertDialogBuilder.create();
            //show it
            alertDialog.show();
        }
    });
    tollgate_calc.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            LayoutInflater li2 = LayoutInflater.from(mContext);
            View dialogView2 = li2.inflate(R.layout.custom_dialog2, null);
            AlertDialog.Builder alertDialogBuilder = new AlertDialog.Builder(mContext);
            //set title
            alertDialogBuilder.setTitle("Please enter the following information");
            alertDialogBuilder.setIcon(R.mipmap.iconn);
            alertDialogBuilder.setView(dialogView2);
            final EditText registrationNo2 = (EditText) dialogView2.findViewById(R.id.reg2_no);
            final Spinner vehicleClass = (Spinner) dialogView2.findViewById(R.id.vehicle_class);
            final Spinner departure = (Spinner) dialogView2.findViewById(R.id.departure);
            final Spinner destination = (Spinner) dialogView2.findViewById(R.id.destination);
            //populating the spinners
```

String[] vehcleClass = new String[]{"Select Class", "Motor bikes", "light motor vehicles", "Commuter omnibus", "Buses", "Heavy Vehicles, lorry (UD trucks)", "Haulage Trucks"};

ArrayAdapter<String> adapterVehicleClass = new ArrayAdapter<String>(getApplicationContext(), android.R.layout.simple_spinner_dropdown_item, vehcleClass);

vehicleClass.setAdapter(adapterVehicleClass);

String[] deprtr = new String[]{"Select Departure","Harare", "Norton", "Chegutu", "Kadoma", "Kwekwe", "Gweru", "Bulawayo", "Plumtree", "Beatrice", "Chivhu", "Mvuma", "Masvingo", "Ngundu",

"Rutenga", "Beitbidge", "Shurugwi", "Zvishavane", "Marondera", "Murehwa", "Mazowe", "Chinhoyi", "Macheke", "Rusape", "Nyazura", "Mutare", "Chimanimani", "Chipinge",

"Chiredzi", "Hwange", "Victoria Falls", "Binga","Kariba", "Muzarabani", "Nyamapanda", "Mt Darwin", "Nyanga", "Mutoko"};

ArrayAdapter<String> adapterDeparture = new ArrayAdapter<String>(getApplicationContext(), android.R.layout.simple_spinner_dropdown_item, deprtr);

departure.setAdapter(adapterDeparture);

String[] destntin = new String[]{"Select Destination", "Harare", "Norton", "Chegutu", "Kadoma", "Kwekwe", "Gweru", "Bulawayo", "Plumtree", "Beatrice", "Chivhu", "Mvuma", "Masvingo", "Ngundu",

"Rutenga", "Beitbidge", "Shurugwi", "Zvishavane", "Marondera", "Murehwa", "Mazowe", "Chinhoyi", "Macheke", "Rusape", "Nyazura", "Mutare", "Chimanimani", "Chipinge",

"Chiredzi", "Hwange", "Victoria Falls", "Binga","Kariba", "Muzarabani", "Nyamapanda", "Mt Darwin", "Nyanga", "Mutoko"};

ArrayAdapter<String> adapterDestination = new ArrayAdapter<String>(getApplicationContext(), android.R.layout.simple_spinner_dropdown_item, destntin);

destination.setAdapter(adapterDestination);

alertDialogBuilder

.setCancelable(false)

.setPositiveButton("Calculate fee",

new DialogInterface.OnClickListener() {

@Override

public void onClick(DialogInterface dialog, int which) {

}

})

.setNegativeButton("Cancel",

new DialogInterface.OnClickListener() {

@Override

public void onClick(DialogInterface dialog, int which) {

}

```
                    });


            //create alert dialog
            AlertDialog alertDialog = alertDialogBuilder.create();
            //show it
            alertDialog.show();
        }
    });
}
public double calcLicense(){
    //double totalFee =
    return 0;
```