UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

DETECTING ABANDONED VEHICLES IN PUBLIC VEHICLE PARKING ENVIRONMENT-BASED ON TIME

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A RESEARCH PROJECT REPORT SUBMITTED TO THE SCHOOL OF COMPUTING AND INFORMATICS IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF M.SC. DISTRIBUTED COMPUTING TECHNOLOGY OF THE UNIVERSITY OF NAIROBI

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DECLARATION

This project, as it is, is my original work and has not been presented for the award of any degree in any other University.

Signature: ……. Date: …….

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This research has been submitted for examination with my approval as University Supervisor

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DEDICATION

I dedicate this study to two dear people, my caring Mother, and my loving wife.

ABSTRACT

It is common to come across Abandoned Vehicles (AVs) in many of the public Vehicle Parking Environment (VPE) facilities. Very few if any of these vehicles are really abandoned; in most scenarios Motorists drive into a public VPE facility then walk out, creating an impression that they are going to be back in a short while, only to return after a day or so. Lack of proper data sharing for Vehicle Verification (VV) is not making the situation any better. In some cases, vehicles are left and nobody turns-up to claim them for days. The public VPE company is left in limbo, not knowing what to do with such vehicles since they do not have a proper mechanism to verify vehicle ownership. AVs pose security risk to the company managing the VPE facility and the public. The results of the study established occurrences of AVs within the County of Nairobi, and developed a prototype named Owner Vehicle Verification System (OVVS), which did Vehicle Verification (VV) for AVs by remotely "fetching" for vehicle ownership information via the internet from a dummy KRA registry, and returned information on AV within 24 hours as per the definition of AV in this study for local context. The system managed to detect 12 AVs and hence a reduction in risks associated with AV.

Keywords:

Abandoned Vehicle, Vehicle Verification, Motorist, and Vehicle Parking Environment.

LIST OF ABBREVIATIONS AND ACCRONYMS

1	AV	Abandoned Vehicle.
2	ANPR	Automatic Number Plate Recognition.
3	EoS	End of Shift report
4	GPS	Global Positioning System.
5	HORB	Hand Over Report Book
6	KAPS Ltd	Kenya Airports Parking Services Limited.
7	KRA	Kenya Revenue Authority.
8	Ksh	Kenya Shillings.
9	MPS	Mobile Parking System.
10	OVVS	Owner Vehicle Verification System.
11	SDLC	Software Development Life Cycle.
12	Tuk tuk	Three-Wheeler Motorcycle.
13	VNP	Vehicle Number Plates.
14	VPE	Vehicle Parking Environment.
15	WIMP	Windows, Icons, Mouse, and Pull-down menus
16	XAMPP	Cross-Platform, Apache, MySQL, PHP, and Perl.

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DEFINITION OF KEY TERMS

1.	Abandoned Vehicle.	Any vehicle that remains parked either in a public or private Vehicle Parking Environment facility for more than 24 hours, without a notification of overstaying for such duration.
2.	Motorist.	Vehicle owner or a person who drives a vehicle.
3.	Vehicle Parking Environment.	A public vehicle parking environment that is available to Motorists to utilize at a fee.
4.	Vehicle Verification	A process of ascertaining that a vehicle belongs to a person by confirming details from an authoritative source.

CHAPTER ONE: INTRODUCTION

1.1 Background

Approximately 2 million vehicles were registered in Kenya in the year 2013, and about 60% of these vehicles were in Nairobi alone, creating an urgent demand for public Vehicle Parking Environment (VPE) services for Motorists. This was clearly evidenced and depicted on a policy briefing report on mitigation of road traffic in the metropolitan Nairobi. The report stated that the expected exponential growth of population in Nairobi alone will be in the range of 14 Million by the year 2030 (Gachanja, 2015). Growth in population comes with increased vehicle ownership. This is a challenge, especially with regards to the demand for scarce vehicle parking spaces. Also, vehicles must be parked somewhere at some point if they are on the road (Muema, et al., 2014).

The Kenya Airports Parking Services Limited (KAPS Ltd) comes in to satisfy the demand for public VPE services. KAPS Ltd is a company registered and headquartered in Kenya's capital city-Nairobi. It started operations in 1999 providing parking services within the County of Nairobi, then later expanded to the wider East African region. Initially, its core business was purely concentrating on parking services, but it has expanded over the years to implement technologies such as; Automatic Number Plate Recognition (ANPR), Access Control, Revenue Management Systems, and Facility Automation (Kenya Airports Parking Service Ltd, 2015).

To achieve the main and specific objectives of the study, the Parking Facility Managers (PFM), and the Parking Facility Officers (PFO) from selected VPE facilities managed by KAPS Ltd, were engaged for proper understanding of the daily operations at the VPE facilities. The PFMs and the PFOs could shade more light on activities involved when offering services at the public VPE managed by KAPS Ltd, and from that, the researcher could be able to apprehend how Motorists were being handled. The researcher was taken through policies that were drafted by KAPS Ltd, with regards to the use of public VPE. All Motorists, PFOs, and PFMs were required to follow these policies to ensure quality of service and safety within the public VPE.

1.2 Statement of the Problem

It is theoretically believed vehicles are abandoned in public VPE facilities, but there is no known authoritative research that has been done before to establish this in Kenya, and specifically Nairobi. According to Fujita (Fujita, 2011) AV qualify to be crime generators. For instance, Fujita (Fujita, 2011) narrated that a person noticed that every time he visited a shopping mall, there were many cars left unattended and unlocked in the parking lot for a long period. One day, the person stole a car and told his friends about his successful offense. Consequently, new thieves began to come to the mall's parking lots to take advantage of such criminal opportunity description.

Moutou (Moutou, 2013) stated that parking space is a scarce asset and should be open for sharing. He elaborated using a scenario that, a public VPE was full, only to be realized later that the same vehicles had occupied the same parking spaces for more than 24 hours, therefore denying other Motorists a fair opportunity to utilize the facility. This indicated clearly that the AV denied other Motorists-who were potential public VPE users, the opportunity to fairly utilize the scarce resource. The presence of bold public disclaimer signages in public VPE reading, "Park Vehicle at Your Own Risk", is an indicator that the publi VPE facilities companies are not interested in profits as they charge high fee peneaulty to those who abandone vehicles and want to distance themselves from risk liability in a case where an AV is vandalised.

1.3 General Objective

The objective of this study was to investigate occurrences of AVs in selected public VPE facilities within the County of Nairobi, and to develop a prototype called Owner Vehicle Verification System (OVVS), which detects AVs and hence, mitigate problems/risks associated with AVs.

1.4 The Specific Objectives

Below were the specific objectives;

a) To establish that there were cases of AVs.

b) To identify Motorists' preference for a secure public VPE facility.

c) To develop a Vehicle Verification prototype

d) To test the Vehicle Verification prototype.

1.5 Research Questions

a) How will cases of AVs be established?

b) What are the Motorists' preference for a secure public VPE facility?

c) How will the Vehicle Verification prototype be developed?

d) How will the Vehicle Verification prototype be tested?

1.6 Justification and Significance of the Study

KAPS Ltd is the primary beneficiary of this study. Other expected beneficiaries are Motorists and the County Government of Nairobi. The expected benefits from the study were; secure public VPE, better revenue collection, unique Vehicle Verification prototype for AV detection, and hence reduction in risks associated with AVs, as was correctly put by Hesterman that, previously studies indicated that international and domestic terrorists used vehicle parking facilities to plant bomb and stage a shooting with the intent to injure (Hesterman, 2014). The significance of the study relied upon the success of mitigating occurrences of AVs in public VPE. This was assured by developing a prototype which upheld security requirements as seen by both Motorists and the public VPE management.

The Vehicle Verification prototype was designed to flag any vehicle that had remained parked for more than 24 hours. This was in line with the definition for AV vehicle in the Kenyan context

as defined by the researcher. Flagged vehicles were branded as “abandoned”, and on detection, vehicle owners were contacted and advised to come and pick their vehicle. It is anticipated that on implementation and with the passage of time, there will be fewer cases of AVs, better security in the public VPE facilities and hence better revenue collection.

1.7 The Study Limitations and Scope

The study was concerned with Motorists utilizing public VPE facilities within the County of Nairobi, and did not include other forms of motor such as; motorcycles and three-wheeler motorcycles, also known as “tuk tuk”. Also, KAPS Ltd has geographical sub-division areas called zones (Kenya Airports Parking Service Ltd, 2015). This study covered area zones as designated by KAPS Ltd within the County of Nairobi.

1.8 Assumptions

The study strongly revolved around AVs in public VPE facilities. It was therefore assumed that data would be collected from Motorists who have utilized public VPE facilities, and from employees of a company managing public VPE facilities, and that a larger percentage of these people are literate.

1.9 Deliverables

The study delivered the following;

a) A functional OVVS-prototype which was used for the detection of AVs and vehicle ownership verification.

b) A project report, which described the functionalities of the OVVS-prototype.

CHAPTER TWO: REVIEW OF THE RELATED LITERATURE

2.1 Introduction

This chapter covered a review of related literature that had similarities or were related to the problem under study. The reviews included researches done by prominent researchers on problems revolving around the security and efficient management of public VPE facilities.

The reviews provided the researcher with a clear picture of how similar research problems were best solved elsewhere in the World. It must be noted that there was no guarantee that a specific approach used to solve a research problem elsewhere, could be implemented to solve a similar research problem and work effectively on a different environment. The researcher borrowed ideas from similar research and contextualized them to fit the current local context.

With respect to the statement that, a researcher must examine all available literature to familiarize himself /herself with the problem at hand, and that he/she may adopt any or both two types of literatures namely; (i) the conceptual literature-which concerns concepts and theories, and/or (ii) the empirical literature-which consist of studies done in the past and related to the proposed study. The following literatures were reviewed;

2.1.1 Definition for Abandoned Vehicle

The Vermont Government defined AV as a vehicle with or without a valid registration, and has been parked either on a public or private property, on or along a highway for more than 48 hours without the permission of the property owner (Vermont Government, 2016).

The Government authorities in Kenya, and specifically the County Government of Nairobi, does not have a specific definition for AV; this is probably an area that need to be addressed in future. For the purposes of this study, and in the Kenyan context, AV shall be defined as; any vehicle that remains parked either in a public or private Vehicle Parking Environment facility for more than 24 hours, without a notification of overstaying for such duration.

2.1.2 Instances of Abandoned Vehicles

As witnessed at the Milimani Courts parking yard in the heart of Nairobi, occurrences of AVs are real in Kenya (The Star, 2016). The situation was not different in Birmingham, where a very expensive Mercedes S-Class was abandoned in Broadway Plaza public VPE for over three years accumulating a total of £14000, equivalent to Ksh.1997708.69/= (Linning, 2014).

Figure 1: Abandoned Vehicles-Milimani Courts Nairobi (The Star, 2016)

Figure 2: Abandoned Mercedes Benz-Birmingham public VPE (Linning, 2014)

2.1.3 Automatic Number Plate Recognition

A variety of Automated Number Plate Recognition (ANPR) existed and were deployed for various use namely; traffic control, violation of traffic, control of access to cities, and vehicle parking facilities (Atanassov, 2012). The ANPR-is a technology with mechanisms that allowed for automatic reading of vehicles or number plates for stationery or moving vehicles. It was

originally utilized for traffic control and road toll collection then later adopted by other users like public VPE facility operators and lately by the law enforcement authorities (Kenya Airports Parking Service Ltd, 2015).

The scarcity of vehicle parking spaces is real, and the available public VPE facilities are not efficiently managed and utilized to guarantee security and quality of service. Action needed to be taken to avoid conflict and to provide economic, social, and environmental benefit for public VPE facility users (A.Yass, et al., 2010).

KAPS Ltd documented that their ANPR relies on a "hot" list of number plates created by ANPR- processor to recognize stolen vehicles (Kenya Airports Parking Service Ltd, 2015). This list is not comprehensive enough to include all registered vehicles in Kenya. A report on the inventory of vehicles in Kenya by the University of Nairobi confirmed that KRA is the only official body mandated to register all motor vehicles in Kenya (University of Nairobi Enterprise and Services Ltd, 2014). KRA remains the official source of Number Plate Repository. Therefore, ANPR system can only get a match for Vehicle Number Plates (VNP) that exists in its "hot" list; this creates a possibility of vehicles used for criminal activities to "beat" the system. The technology in use at KAPS Ltd for VNP recognition is not entirely new or unique. Similar technologies have been researched, designed, and proposed in the past by other prominent researchers (Shaikh, et al., 2015).

2.1.4 Intelligent Parking System

An intellegent parking systems was designed and tested, it consisted of five modules. The procedure to identify parking location was done by the System Initialization module, storing of digital images from camera was done by the Image Acquisition module, which linked to a processing unit. The Image Segementation unit seperated objects from background and adjusted pixels to improve on contrast, then Image Enhancement module was to remove noise and pixels not belonging to the concerned object. The last stage involved Image Detection module which was used to determine rounded image. The concept was to discover parking system by image processing rather than the use of sensor (Yusnita, et al., 2012).

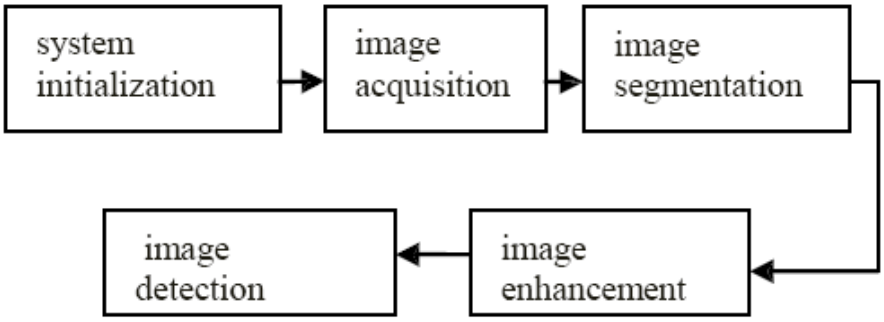

Figure 3: System Module (Yusnita, et al.,2012)

2.1.5 Automatic Parking Management System

According to (Olatinwo & Shoewu, 2013) an automatic parking lot management system was developed, and also (Rashid, et al., 2012) proposed to develop and implement a system called Automatic Parking Management Systems and Parking Fee Collection, which was based on vehicle registration number recognition. In this system, acquisition of data was done via ultrasonic sensors to count availability of parking space; which was followed by the acquisition of vehicle image at the entrance for analyzing then recording for future reference.

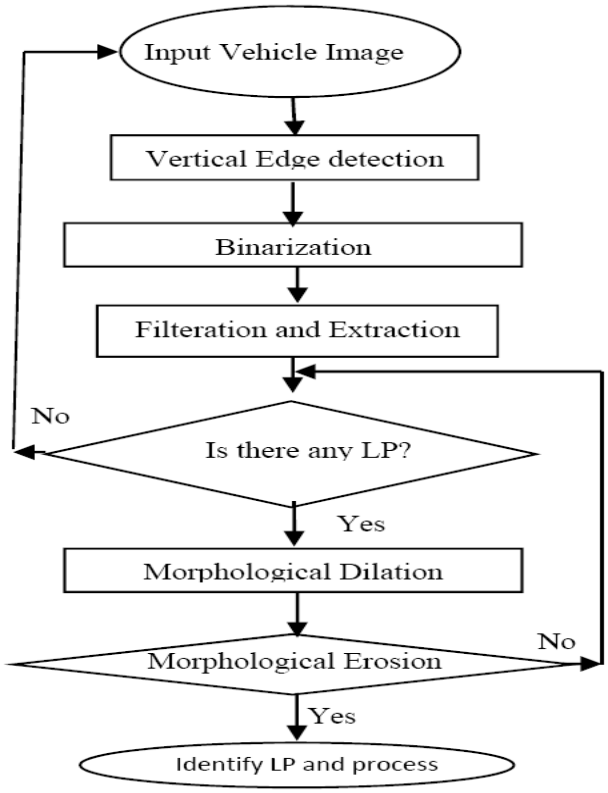

Figure 4: License Plate Recognition Flow Chart (Rashid, et al., 2012)

2.1.6 Wireless Parking Management System

A Wireless Parking System was proposed. In this system, various transactions were carried out wirelessly-for instance, a driver could be informed of the available parking space via a GPS navigation system installed in the vehicle. An algorithm was used to assist drivers to choose a parking slot. Different cities and methods were used for demonstration. Any challenges experienced were noted (Rane, et al., 2014).

2.1.7 Mobile Parking System

Assessment was done on the adoption of Mobile Parking System (MPS) in Nairobi, and it was realised that majority of respondents were attracted to MPS because a bigger percentage of respondents had access to mobile phone, and 87% to 88% of the respondents were of the opinion that adoption of such systems will maximize effeciency of the payment, and 81% agreed that it will improve customer experience (Muema, et al., 2014).

2.1.8 Mobile Phone-Based Parking System

An elaborate Mobile Phone-Based Parking System was proposed with the objective of automating the management of parking facilities within the City of Nairobi. The system could allow Motorists to identify vacant parking slot within a parking facility using a mobile phone, and effectively be able to transact for the motorist (Kinyanjui & Kahonge, 2013).

2.1.9 Abandoned Vehicles, and Associated Risks

Acts of terrorism were not the only risks that could be propagated using AVs as was evidenced in Kisumu County, where two young children suffocated and died while playing in an AV (KTN, 2016). Government vehicles were abandoned and vandalized in a public VPE in Nairobi (The Star, 2016). On a report borne out of their 24th meeting (Eastern and Southern Africa Anti-Money Loundering Group, 2012) considered motor vehicle smuggling a global problem. In one way or another, these smuggled vehicles eventually utilized public VPE facilities and (Muema, et al., 2014) argued that only 43% of the respondents in Nairobi felt that number plate recognition was an important feature in parking system oblivion of the fact that a vehicle number plate recognition can help a great deal in reducing risks associated with AVs. The scarcity of parking space in the County of Nairobi and the ever-increasing population of vehicles on the

roads have resulted to the emergence of numerous problems to both the County Government of Nairobi and Motorists (Ongeche, 2016). Attempts have been registered in the past to develop a system to detect AVs using real time occlusion tolerant detection approach (Hassan, et al., 2012).

2.1.10 Software Development Models

The Software Development Life Cycle (SDLC) model has continued to evolve (Jamwal, 2010). Comparison was done relating to three previous models namely; Waterfall Model, Prototype Model, and Incremental Model with regards to their advantages, disadvantages, how they work, deployment method, client satisfaction, quality, budgetary allocation and completion time. From the findings, a new software development model named the New SDLC-2013 Model was developed (Kumar, et al., 2013).

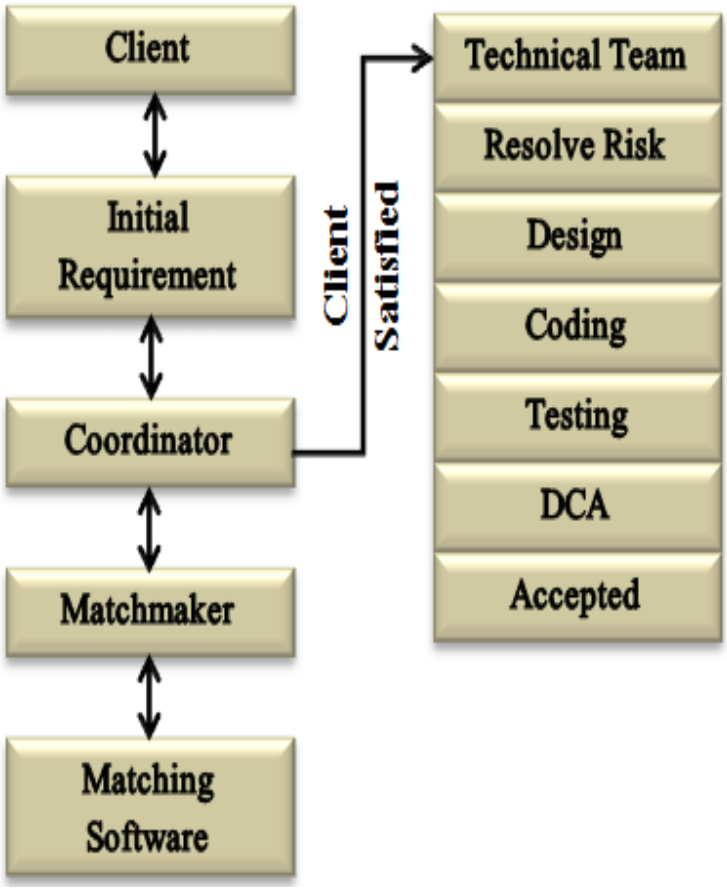

Figure 5: SDLC-2013Model (Kumar, et al., 2013)

2.2 Theoretical Framework

2.2.1 The Prototyping Software Development Model

Many approaches of software development models do exist and most of them share a combination of stages such as; market research, problem analysis, software implementation, software testing, software deployment, and maintenance. Analysis was done on Waterfall, Prototype, Spiral, Iterative, and Agile models (Jamwal, 2010). The phases involved in prototyping is clearly depicted in the model diagram below;

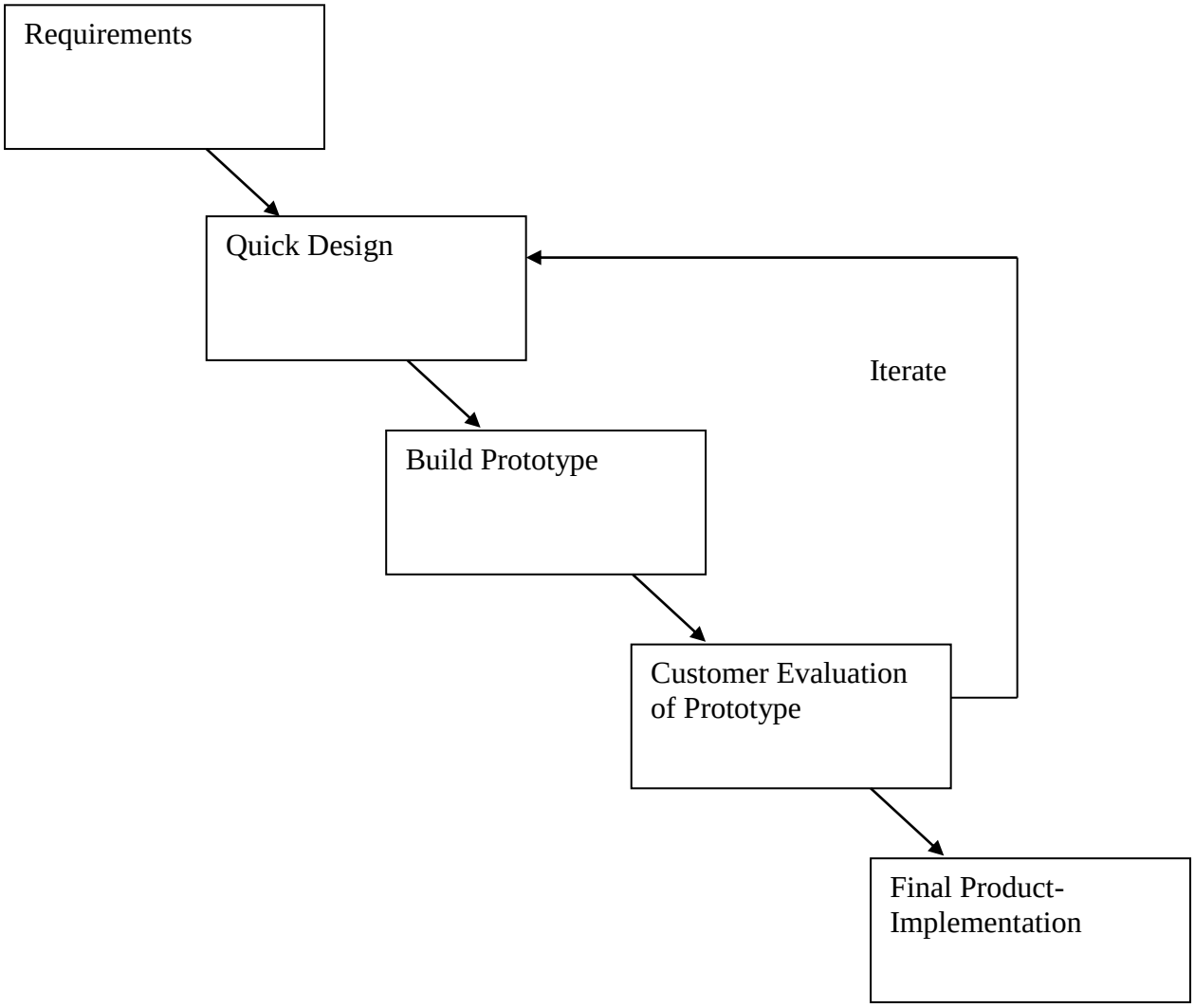

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Figure 6: Prototyping Model Approach (Nguyen & Vai, 2010)

2.2.2 Software Architecture Models

Software architecture refers to a structured solution aimed at achieving the technical and operational requirements of a system and optimizing common quality attributes like security, performance, and manageability. The choice of software architecture style greatly determines how data can be shared.

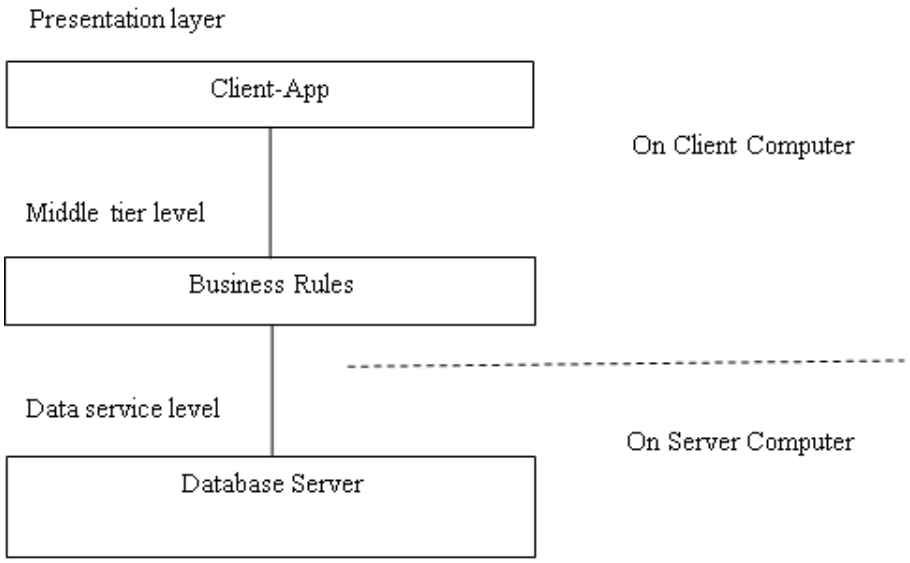

Figure 7: A 3-Tier Architecture

The architecture of a system can be single tier or multi-tier where in a single-tier architecture, the database will sit where the user directly sits on the DBMS and uses it, while in a multi-tier the whole system is divided into related but independent modules with the ability to be modified, altered, changed, or replaced. Figure () is a multi-tier architecture which the proposed system is going to ape.

2.2.3 Distributed Computing Approach

Distributed computing ideology was key when developing the prototype. The research agenda of, detection of AVs in public-VPE using a prototype, lies within the heart of distributed computing in the sense that, remote access of information via a network/internet will be required. Toor described a Web service, as a distributed application able to publish functions, interface, and hide implementation details from a client in such a manner that the client can communicate with standard protocols oblivious of the implementation details and platform (Toor, 2010). Many

technologies that support distributed approach do exist, examples include but are not limited to; J2EE, CORBA, AXIS Java Web services, and .NET among others (Tutorialspoint, 2017).

2.2.4 Data Sharing/Verification Strategy in Kenya

The Kenya National ICT Master plan explained the importance of institutionalizing legal framework to allow free sharing of data among citizens and institutions (Ministry of Information and Communications Technology, 2013). With respect to this, it is expected that future research endevours will get Government support even where it was previously viewed as illegal to share data from Government authorities. Currently, it is difficult to link the proposed prototype with the real KRA vehicle registry due to the existing policies and bereaucrasy in the Government authorities, therefore the researcher developed a dummy KRA vehicle registry so as to prove the workability of the research idea.

2.3 The Proposed Conceptual Model

The conceptual model structure for the OVVS prototype was based on three key processes namely; data capturing for vehicles, parking process, and vehicle ownership query. Details are entered into the system during the data capture process and then a parking lot is allocated to the vehicle. The vehicle status checker process allows the user (in this case, it would be a PFO) to determine if a vehicle has been abandoned or not based on time. The vehicle status checker flags any vehicle that has stayed parked for over 24 hours and brands it as abandoned. The vehicle ownership query process comes in to verify the ownership of the abandoned vehicle by way of fetching for vehicle ownership information from a reliable and authoritative source, in this case- the dummy KRA database after which, the clearance process will allow for a vehicle to exit the public VPE facility in either of two situations namely; if the vehicle was not abandoned, or after calling the vehicle owner (in the case of an abandoned vehicle). All processes for the proposed OVVS are summarized as depicted in Figure10 below.

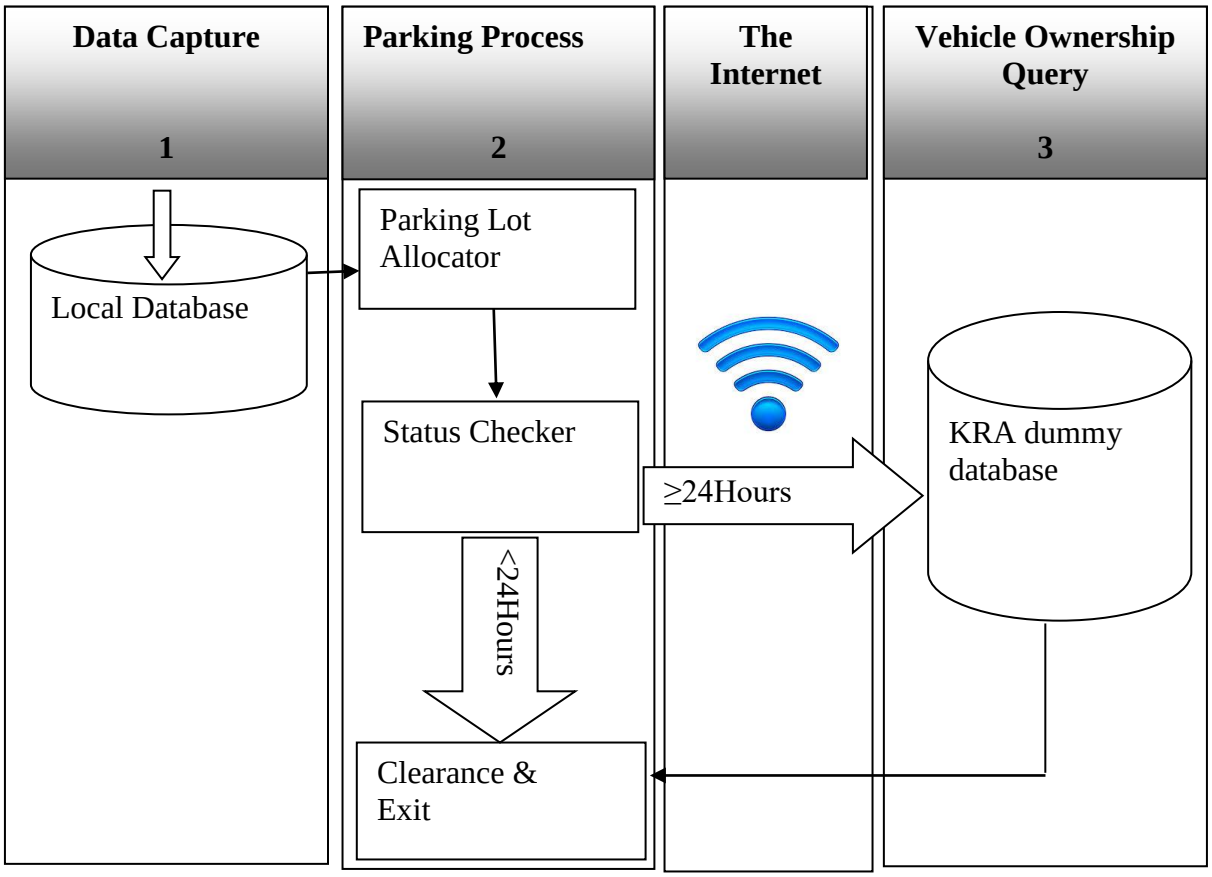

Figure 8: The Proposed Conceptual Model

CHAPTER THREE: METHODOLOGY

3.1 Introduction

According to (C.R.Kothari, 2004), it is important for a researcher to know not only the research methods and techniques, but also the methodologies and how to go about designing a research methodology befitting the research problem at hand. He elaborated with relevant examples on how, why, and which methodologies to implement in different situations. This chapter explains who is the target group, how data was collected from the target group, and procedural activities involved during the development of the OVVS.

3.2 Methods of Data Collection and Sources

3.2.1 The Target Group

The study focused on Motorists as the main target group. A vehicle cannot park itself in a public VPE, it must be driven or remotely controlled and be parked by someone. This was the reason as to why Motorists were selected as the main target group. The study relied upon primary data collected from the main target group, and the VPE facility employees.

3.2.2 Questionnaire Forms

The use of questionnaire forms is said to be best suited for acquiring data from literate people (C.R.Kothari, 2004). In this case, the Motorists who utilized the VPE facilities that are managed by KAPS Ltd were served with questionnaire forms. The questionnaire forms were designed to have closed ended questions, and to get information from Motorists with respect to their parking behavior and security in public VPE facilities with regards to AVs.

3.2.3 One-on-One Interview

The researcher got detailed information through a one-on-one interview that targeted 6 PFMs. The PFMs informed the researcher that work at VPE facility was done on shifts of 8 hours, and the number of PFOs for a single shift depended on how busy the VPE facility was. The PFMs took the researcher though a systematic process of how the current system was used in detection of AVs.

3.2.4 Manual Report and Documentations

Information was collected from available written materials such as the "End-of-Shift" (EoS) report, and other hand-written documentations. Each PFO was required to prepare the EoS report before handing-over shift to the next PFO. The EoS report was used to record information such as; the number of vehicles that had remained parked overnight, and any case of crime such as vandalism.

3.3 The Development Methodology

The prototyping software development methodology was used for the development of the OVVS prototype.

3.3.1 Justification

The justification for using prototyping approach was based on Jamwal's analysis, where prototyping software development model stood out as a model with no risk analysis, high user involvement, good guaranteed success, simple, and was found to be more flexible (Jamwal, 2010). Also (Nguyen & Vai, 2010) shared a similar perspective, where they stated that a Rapid Prototyping is customer oriented and puts emphasis on validation, and strong advantages such as; very low risk of inappropriate user requirements, uncommitted and accommodates new changes during development, and has a good support for market.

3.4 Design

The researcher used his knowledge and the information collected from Motorists and the KAPS Ltd employees to come up with a blue-print design for the OVVS prototype. Some of the phases involved during design were; User Interface (UI) design, the Database design for both local and the dummy KRA Database, and the structure of Reports. The architecture of the OVVS prototype was defined during the design phase, and the preferred development platform was chosen. The .Net software development platform was preferred because of its easy availability across almost all Windows based OS. The OVVS prototype architecture is as explained below;

a) The User Interface (UI).
b) The local, and the dummy KRA databases.
c) Logical operations.

3.4.1 The User Interface (UI)

The UI was designed to be as simple as possible, strategically positioning screen elements for the user to easily locate them, re-enforced clarity, user-centered, and with a high degree of better results. Objects like, Menus, Buttons, Scrollbars, and such like were used to increase the ease of use. Sense of security was provided by the provision for user login authentication. It was included to ensure some level of security and integrity of the stored data. It made sure that only a legitimate user gained access to the system and rights to other system modules via the UI.

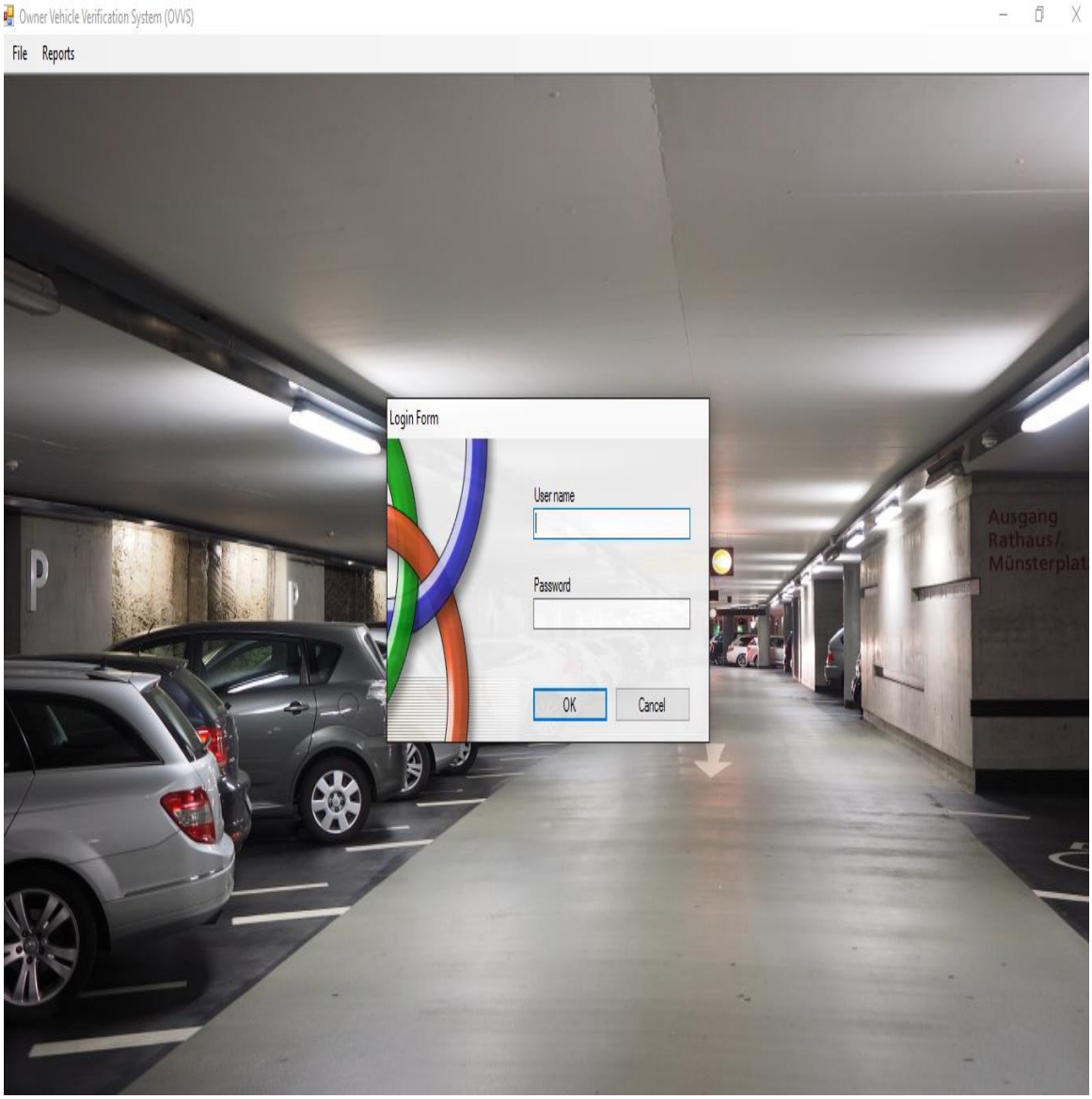

Figure 9: The Login Interface for the OVVS

3.4.2 The Local, and the dummy KRA Databases

The OVVS was designed to have a local database, which was used for storing data regarding parked vehicles. SQL was used to create both data bases. Data such as; make of a vehicle, vehicle number plate, color, and login/log out date/time were stored in the local database. The local database did not contain enough data/information to authoritatively match the vehicle details to a vehicle owner, for the purposes of identifying the vehicle owner. In this respect, the dummy KRA database was designed to fill the gap.

The researcher used a dummy KRA database in the project because of the many Government bureaucracy, and policies which could not allow the researcher to link the prototype to the real KRA database. The choice of simulating the KRA database was inspired by the fact that KRA is the only authority that is mandated by the Government to register all vehicles in Kenya, and as such, it is the only authority that has a comprehensive register of all vehicles/owner registered in Kenya. The dummy KRA vehicle database was hosted remotely on a hired domain address that was included as a path in the prototype coding, and could be reached so long as the internet is available. The link; https://www.sawai.co.ke/ovvs/query_kra.php?reg_no=, allowed for remote access to detailed information from the dummy KRA database.

When AV was detected, a query was made to the dummy KRA database with respect to the data of the abandoned vehicle in the local database, and when a match was found, the vehicle owner details such as, phone number, National Identification number/Passport number, or other contacts, were used to locate and contact the vehicle owner, who was advised to pick his/her vehicle.

3.5 The System Architecture

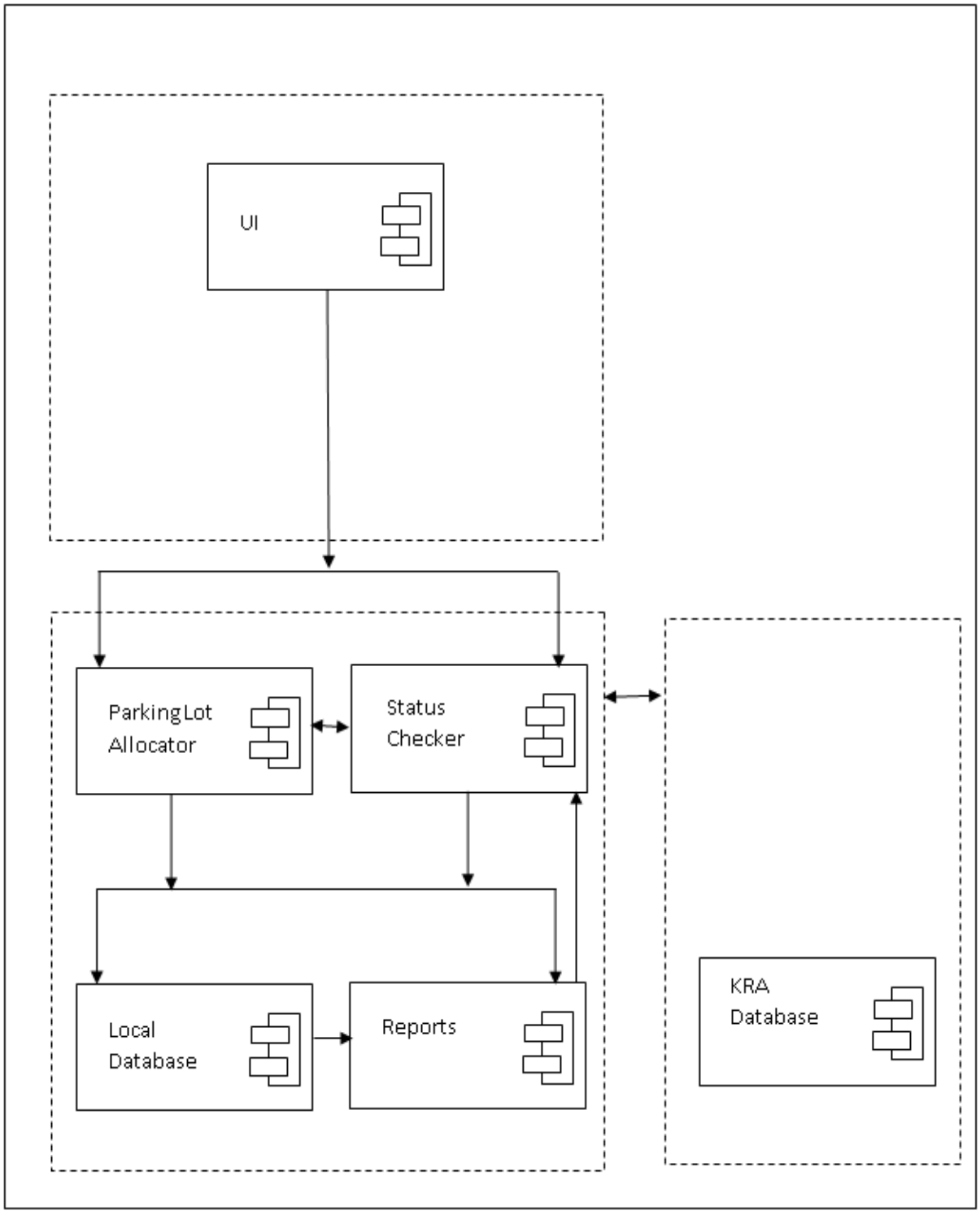

Figure 10: The Proposed OVVS Architecture

The system architecture is used to show specific components of a system, how they are structured and interconnected (Coulouris, et al., 2011). The system architecture for the OVVS was arrived at after a scrutiny of the current system and preliminary requirements collection from the Motorists and PFOs. The OVVS architecture is as depicted Figure12. The system architecture shows components of a system how they are structured and interconnected. The OVVS architecture has 6 components namely; UI (User Interface)-responsible for interacting with the user, Parking Allocator-responsible for assigning a vehicle a slot for parking, Status Checker-responsible for defining an abandoned vehicle by determining the whether a vehicle has overstayed parking as per the definition of AV in this context, Local Database-responsible for holding data for future use, Reports-responsible for returning various reports using certain defined criteria, and lastly the KRA Database-it is remotely hosted in a different domain and does not reside within the same computer where the OVVS itself is installed, it is responsible for granting access to authoritative information for vehicle ownership confirmation/verification purposes. specific components of a system, The OVVS architecture is depicted in Figure4 above.

3.6 The OVVS Process Flow Chart

From the OVVS system architecture, the researcher derived a flow chart plan as is diagrammatically represented below;

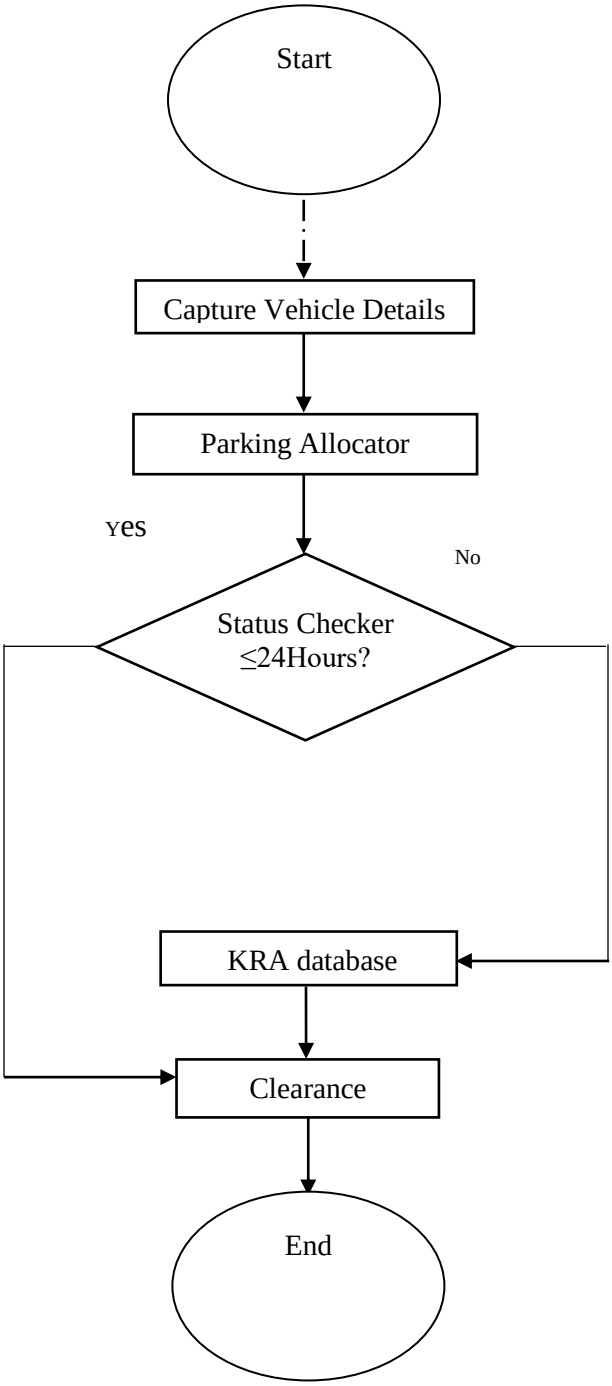

Figure 11: The OVVS "Flow" Process

The OVVS flow chart was used to depict the "flow" of activities from the moment the vehicle logs into the public VPE facility, to the time it is cleared for exit from the public VPE facility. Below is a point by point narration on the activities involved;

i. Vehicle information such as; login time/date, number plate, vehicle color, make, and model are entered in the system, and are saved in the local database when the vehicle moves into the VPE facility.
ii. The Parking Lot Allocator module is used to assign parking lot to the vehicle. The parking lot is where the vehicle will physically be located for the duration it remains parked in the public VPE facility.
iii. The Status Checker module is used to confirm the status of a vehicle in the parking area, or the parking slot. It compares the login time for the vehicle, and if the login time exceeds 24 hours, the vehicle is branded as "abandoned" and flagged.
iv. For those vehicles that have been flagged as abandoned, the status checker will query for vehicle ownership information from the KRA dummy database for further vehicle verification.
v. The clearance module allows for the PFO to use the vehicle ownership and verification information received from the KRA dummy database to contact the vehicle owner and advise to pick the vehicle.
vi. The Exit module is used to allow exit for all vehicles that have been cleared by the Status Checker module.

3.7 Coding and Development

The choice of .NET for the development of the OVVS prototype was informed by the fact that Microsoft widely supports it, and that, it is widely available in almost all Windows based OS (Tutorialspoint, 2017). There were key phases which the researcher had to perform according to the demands of the Prototyping model design. These phases were; Requirements, Design, Prototype Development, Customer evaluation of prototype, and finally the Final product implementation phase (Nguyen & Vai, 2010). During coding, each module/component was repeatedly subjected to the user and recommended changes were included, in line with the Prototyping requirements which dictates that the three middle phases namely; Design, Prototype Development, and Customer evaluation phases must iterate to improve acceptance by customer.

This approach was a plus for the proposed OVVS as it went a long way to deliver the expected results.

3.8 Distributed Computing Technology

Distributed computing technology was at the core of this research. Developing the system was just one part of solving the problem, but the inclusion of distributed technology was used to cement the core functionality of the proposed system. The system was designed to sit on any computer that has internet connectivity. The internet was used to provide a distributed platform within which remote connectivity for communication and sharing of resources such as a vehicle registry could be allowed from computing devices sitting on different computing platforms, and even fetch for vehicle ownership information that is supposed to be only available from an authoritative source, in this case the KRA vehicle registry. Due to Government bureaucracy and strict regulations, it proved to be difficult to get permission to connect to the only authoritative Vehicle registry-KRA. This did not stop the researcher from pursuing the research idea, and so after thorough consultation, it was allowed that a dummy database should be developed to resemble the actual KRA vehicle registry and be hosted remotely for the purposes of the study. The internet being the perfect distributed environment was ideal to be used for remote connectivity to the dummy KRA registry which was developed and hosted in a different domain. A path which enabled distributed connection via a protocol used in the internet connectivity also known as http, was included during coding of the system as follows; Public kraPath=https://www.sawai.co.ke/ovvs/query_kra.php?reg_no= . The http is an abbreviation for Hypertext Transfer Protocol which is widely used in computing devices that require to communicate, and or share resources over the internet with no regard to any specific platform standard (it is universal).

3.9 Testing

The OVVS prototype was tested on one public VPE facility for 7 days. The researcher adopted two types of testing namely;

i. User testing, and
ii. Functionality testing

3.9.1 Usability Testing

User testing focused on the ease of use where 1 PFO was invited to participate in using the OVVS and thereafter, he was asked questions targeting to find out the usability issues/challenges. The issues/challenges that were reported in the questionnaire forms were addressed in the prototype and then the prototype was subjected repeatedly to the PFO until he was satisfied on the ease of use.

Features and objects such as; Windows, Icons, Mouse, and Pull-down menus (WIMP) were strategically included to address the ease of use issues/challenges, see appendices C, and D summary test results respectively. Recommendations from the user were noted and subsequently the changes included in the system, the system was then subjected back to the user (PFO) who confirmed that the recommended inclusions worked as anticipated.

3.9.2 Functionality Testing

The functionality test helped the researcher to address objective (b). A user (in this case, the PFO) could capture vehicle details (such as; number plate, color, model) into the prototype at the entrance. The user could also allocate a parking slot for the vehicle. After 24 hours, the status of vehicles was checked, just to verify whether AVs were detected. The user could remotely download vehicle ownership information from the dummy KRA database for those vehicles whose status had changed to “abandoned”. See appendices C and D respectively for test results summary.

XAMPP, an abbreviation for Cross-Platform, Apache, MySQL, PHP, and Perl (Walia & Gill, 2014), and a combination of four web servers namely; Apache, MySQL, PHP, and Perl, was used to test how the OVVS prototype could interact remotely with the dummy KRA database for vehicle verification without necessarily having to access the internet. According to (Klumpp, 2013) anything digital may be distributed or shared via the internet to any other remote computer. With regards to this, the OVVS was designed to accommodate such capabilities, and as such-the idea of hosting the dummy KRA vehicle registry on a server to allow for remote access, is open to the researcher.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter discussed the results of the study based on findings of the research with regards to the research objectives, and the functionality of the OVVS prototype.

4.2 Cases of Abandoned Vehicles

The researcher sort to establish that there were cases of AV to fulfill objective (a). This was made possible in two ways namely; through the analysis of questionnaire form data collected from Motorists, and the available documentations and reports at KAPS Ltd. The results from analysis and available records are as discussed;

The documentations and reports provided evident cases of AVs which were recorded in documents such as the EoS report and the List of AVs. Also, the EoS reports from 3 public VPE facilities within the County of Nairobi, recorded cases of AVs as follows; Nakumatt-Lifestyle-2 vehicles, Eastmatt Supermarket-1 vehicle, and Valley Arcade-2 vehicles. See Appendix E for an instance of AV.

A total of 400 Motorists from 6 public VPE facilities (managed by KAPS Ltd within Nairobi) were served with questionnaire forms to fill. Data from the questionnaires were coded using the SPSS version16, and descriptive analysis was done. The findings of the analysis targeted objective (a), and indicated that a solid 60% of the 400 Motorists who filled the questionnaire form agreed that they have utilized public VPE at some point. 40% of the 400 Motorists who were served with the questionnaire forms, agreed that at one point, they left their vehicles parked for more than 24 hours in public VPE, and as such, these vehicles were deemed to be abandoned with regards to the definition for AV in this study. Figure14 shows results of case of AVs in terms of percentage. To satisfy objective (b), that is, “To assess how the current system detects AVs”, the researcher carried out an assessment of the system in use and interviewed 6 PFMs with the aim of understanding how it detects AVs. The researcher invited six PFMs for an interview-see Appendix B, and appendix C for interview and ease of use and functionality questionnaire forms respectively.

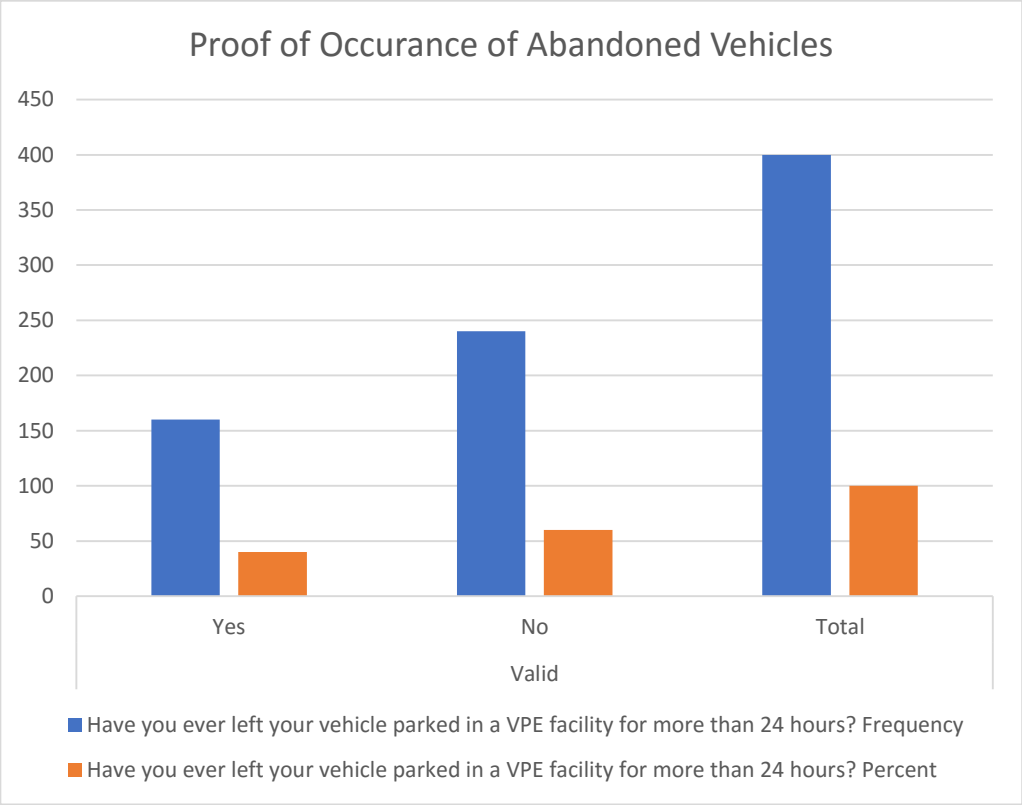

Figure 12: Establishing Occurrences of Abandoning Vehicles

4.3 Level of Security and Preference in Public VPE Facility

Objective (c) required the researcher to identify security preference for a public VPE facility. This was done through a questionnaire form which were served to 400 Motorists from 6 public VPE facilities within Nairobi. Analysis was done after three options of requirements were presented to the Motorists for them to choose as depicted in the Motorist Questionnaire form in Appendix A. Findings from the analysis showed that more than 49% of Motorists preferred that CCTV should be implemented to improve security, followed closely by 31% of Motorists, who preferred a new system (OVVS) to be implemented, while about 19% preferred that a 24-hour security guard should be implemented.

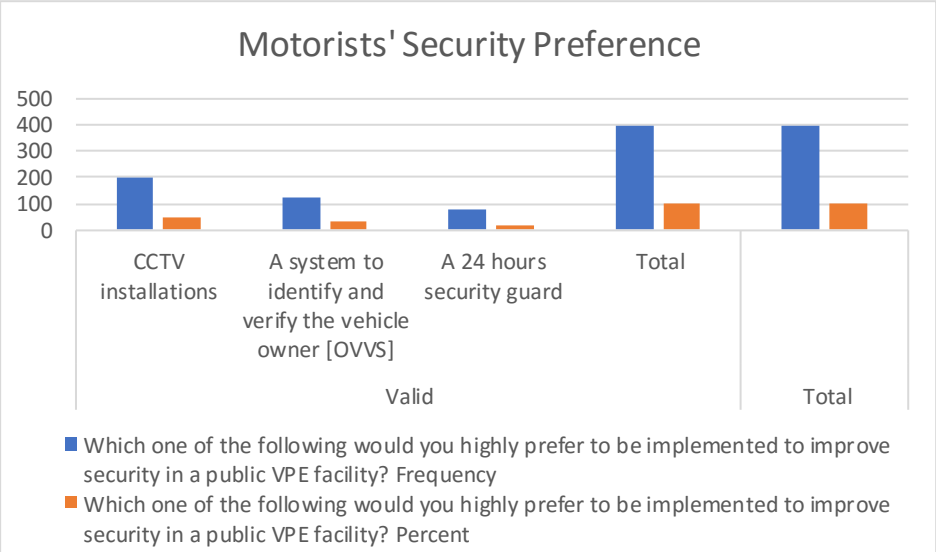

Figure 13: Motorists' Security Preference

4.4 The OVVS Prototype

The OVVS was developed to deal with objective (d), to detect AVs in public VPE, and to verify vehicle ownership for AV. The User Interface (UI) for the prototype allowed the user to perform vehicle data entry into the system, easy management of scarce resource, vehicle ownership verification by querying the external dummy KRA vehicle registry, and parking management

4.4.1 The User Interface (UI)

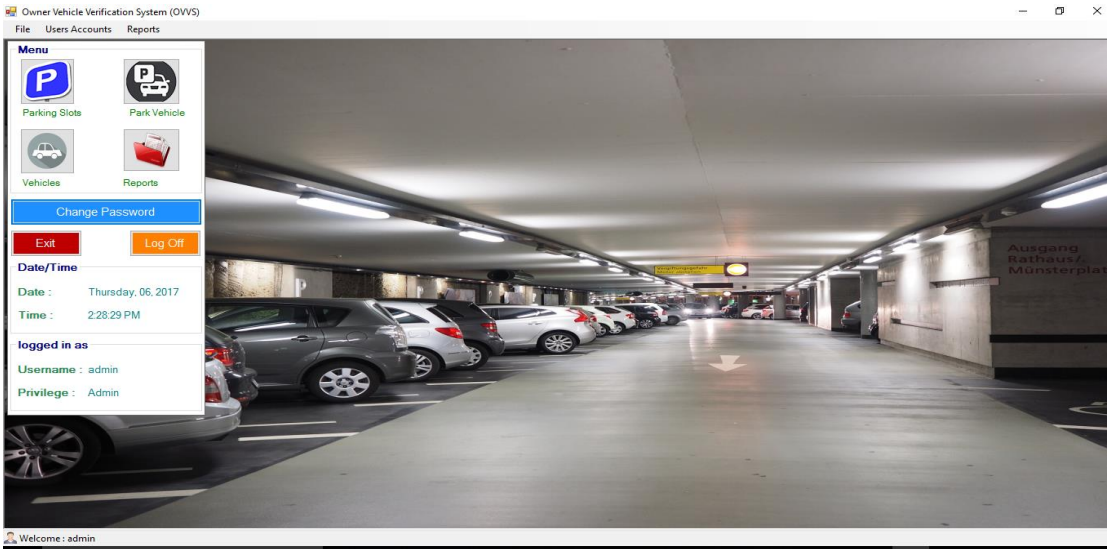

Figure 14: The OVVS User Interface

4.4.2 Database/Storage

The local database was used to capture vehicle data and other information on vehicles that are either parked in the public VPE facility or information on vehicles that have utilized the public VPE facility in the past. Vehicle login information such as; time logged in, time logged out, date, model, make, color, and number plate registration are very critical and are entered in the system at the point of entry/login, and stored in the local database. Below is the form for capturing vehicle information into the local database when a log into to utilize the public VPE facility.

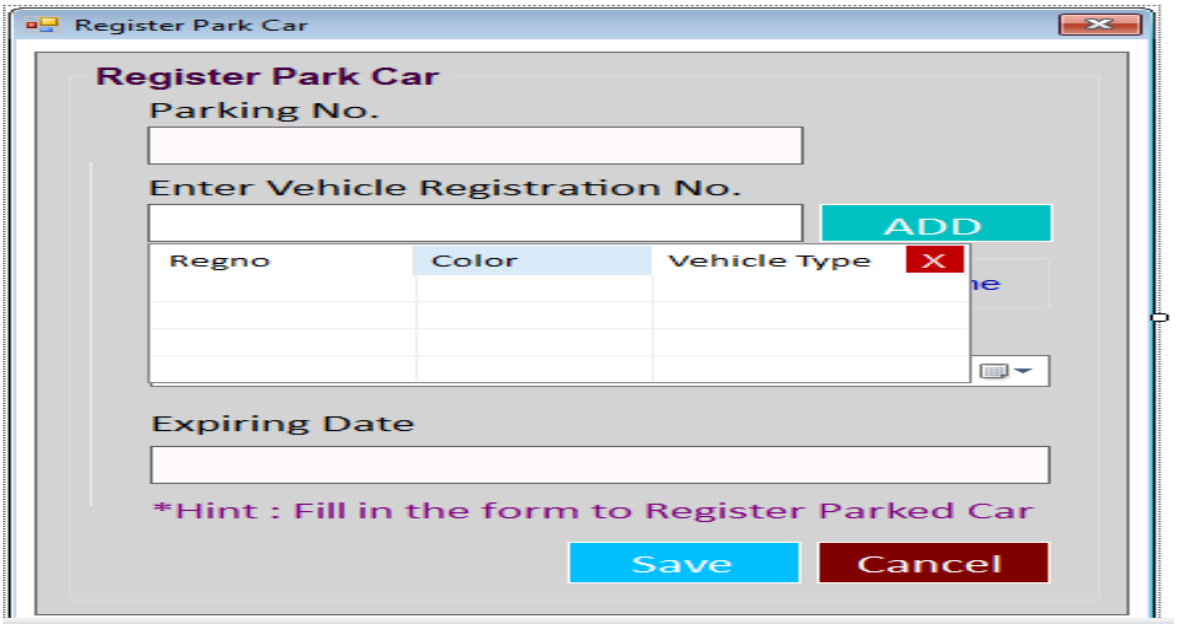

Figure 15: A Form for Capturing Vehicle Information into Local Database

4.4.3 Logical Operations

The logical operations included in the coding were used in instances where the user was required to determine the status of a vehicle in the public VPE facility. For instance, a logic code that was pegged on time-duration could check how long a vehicle has remained parked in the public VPE facility and compare with the normal hours required for any vehicle to remain parked. In this case, and with accordance to the definition for AV in this study, a vehicle that has remained parked for more than 24 hours was flagged as abandoned. On the other hand, a vehicle that has remained parked for less than 24 hours was cleared for exit.

Querying logics were also used when detailed vehicle ownership information was for the purposes of authenticating the genuine owner of the parked vehicle. This logic operation was

carried out where the system needed to “fetch” for information from a remote resource-in this case, the external resource was the dummy KRA registry. Excerpts indicating operations/functions that allocates parking slot, and connects to the dummy KRA vehicle registry, and to “fetch” for information are respectively depicted as follows;

```
Public kraPath = "https://www.sawai.co.ke/ovvs/query_kra.php?reg_no="
```

Figure 16: A Path for OVVS connection to the dummy KRA vehicle registry

```
If selected_parking_slot = “Not Occupied” Then
  Dim options = New Formparkcar_enter
  If options.ShowDialog( )=Windows.Forms.DialogResult.OK Then
     refreshData( )
  End If
Else
Dim options =New FormParkCar_Exit
If options.ShowDialog( ) = Windows.Forms.DialogResult.OK Then
    refreshData( )
Else
```

Figure 17: An Excerpt of Codes for Parking Lot Allocation to a Vehicle

```
Public Sub view_krainfo()
    ConnOpenKra()

    ComKra.CommandText = "SELECT * FROM tblkra_sample WHERE car_number_reg = '" & selected_krainfo_car_plates & "'"
    ComKra.Connection = CnnKra
    Dim dbDR As MySqlDataReader = ComKra.ExecuteReader
    dbDR.Read()
    If dbDR.HasRows = True Then
        txtvehicleRegno.Text = dbDR("car_number_reg")
        txtfname.Text = dbDR("first_name")
        txtlname.Text = dbDR("last_name")
        txtmname.Text = dbDR("middle_name")
        txtgender.Text = dbDR("gender")
        txtkrapin.Text = dbDR("KRA_PIN")
    Else
        Me.Close()
        MsgBox("No records found in KRA DATABASE")
    End If
```

Figure 18: Operation to "fetch" for Vehicle Ownership

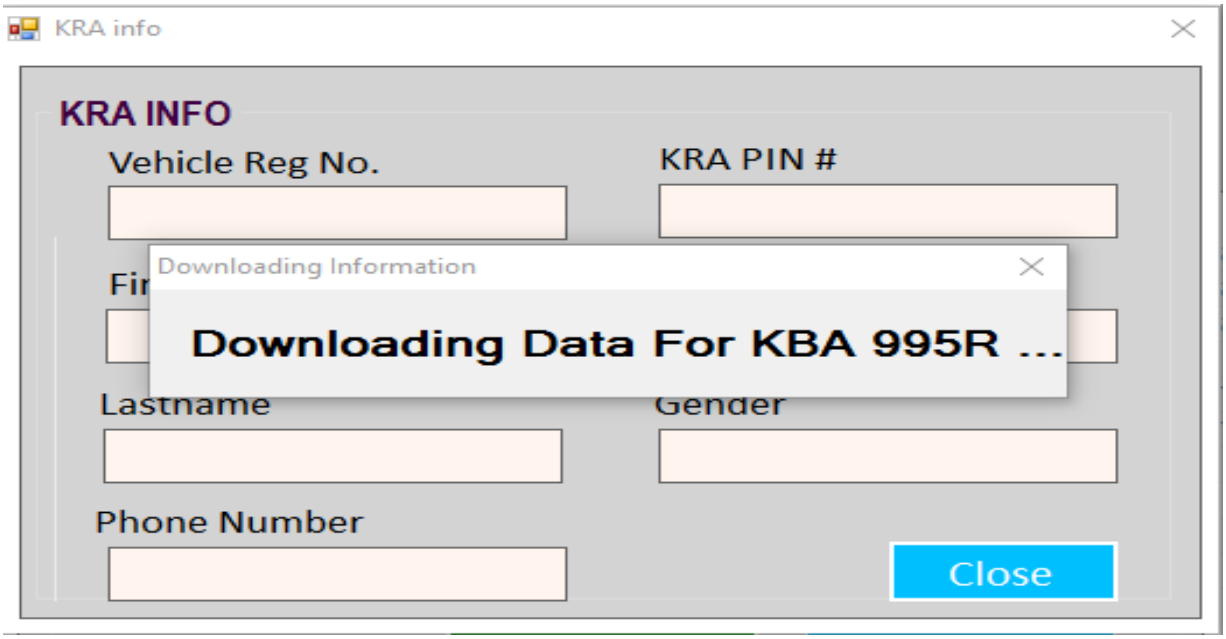

Figure 19: Downloading Vehicle Ownership Information

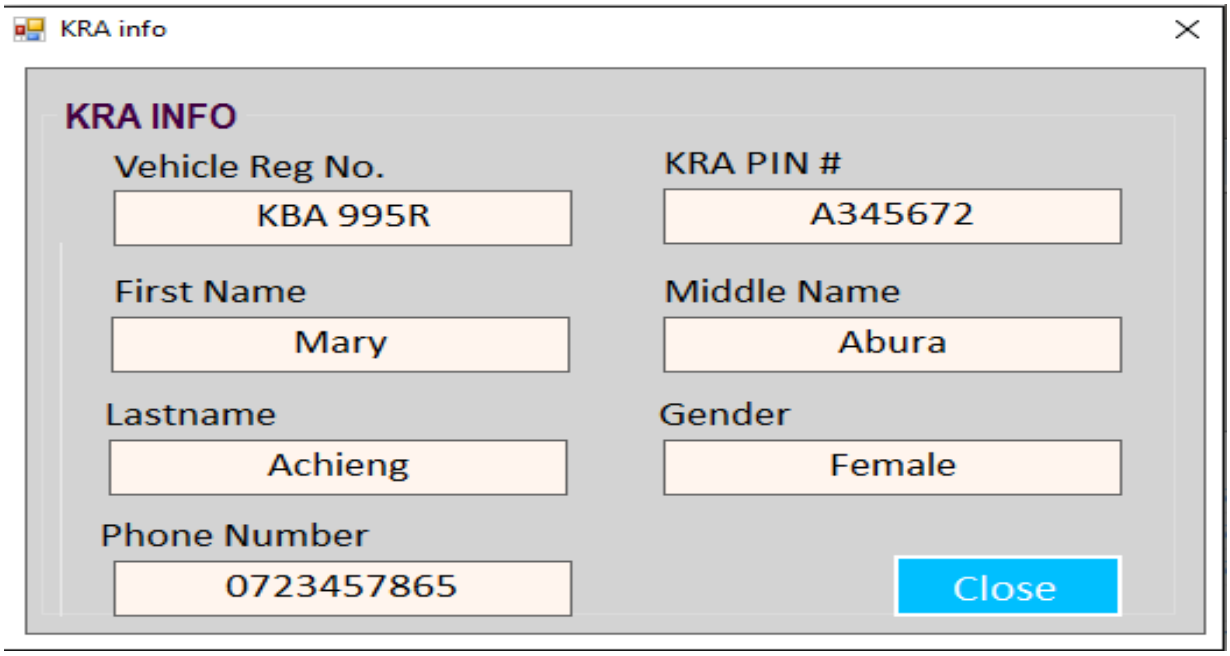

Figure 20: The Downloaded Vehicle Ownership Information

4.4.4 Reporting and Reports Capabilities

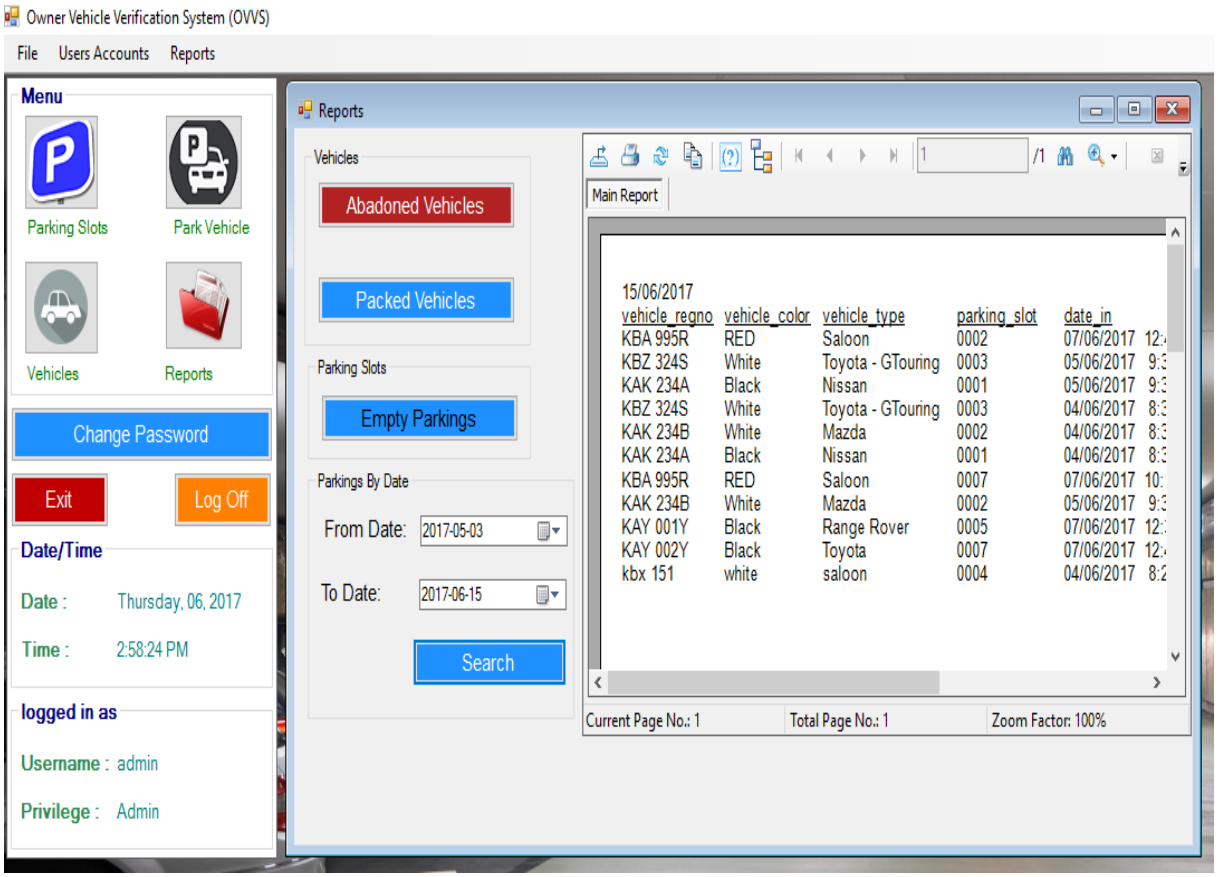

Figure 21: The OVVS Reports Interface

The OVVS prototype provided a reporting provision which could allow a user to get various reports on a given search criteria. Depending on the search criteria, a user could identify whether he wants a report on AVs, parked vehicles, or empty parking slots. Reports on AVs could easily be accessed by defining the search criteria and then selecting the "Abandoned" vehicles button.

Abandoned Vehicles Report					
05/12/2017					
vehicle_regno	vehicle_color	vehicle_type	owner_name	date_in	parking_slot
KAK 234A	Black	Nissan	John Kamau Maina	2017-06-05 09:30:10	0001
KBA 995R	RED	Saloon	Mary Abura Achieng	2017-06-07 12:40:57	0002
KBZ 324S	White	Toyota - GTouring	George Gatheca Njoroge	2017-06-05 09:30:10	0003
KAK 675P	Black	Nissan Bluebird	Laura Joy Achieng	2017-08-01 11:21:44	0008
KCD 576T	Black	Toyota	Martin Luther King	2017-08-01 11:23:19	0009
KCD 563Y	White	Nissan Bluebird	Ann B Akinyi	2017-08-01 11:23:49	0010
KCA 456P	White	Toyota	Mary M Jane	2017-08-01 11:24:07	0011
KBA 567T	White	Nissan Bluebird	Jane M Doe	2017-08-01 11:24:44	0012
KCL 256Y	White	Nissan Bluebird	Antony A Ahindu	2017-08-01 11:25:06	0013
KCL 001X	Black	Nissan Bluebird	James J Bond	2017-08-01 11:26:00	0014

Figure 22: System Generated Result on Abandoned Vehicles

Figure 22 is a system generated result on AV, it successfully returned important information that is critical when vehicle owner is to be contacted. Information such as the vehicle registration number, color, type, owner name, date checked in, and the specific parking slot where the AV is physically parked all form the content of the system generated report on AV.

4.4.5 Summary of Test Results

The ease of use and functionality tests showed that the OVVS responded very well. See Appendix D for the test summary results, where 1 PFO volunteered to use the OVVS for 7 days in a public VPE facility managed by KAPS Ltd. The PFO agreed that the OVVS was user friendly and recommended for more inclusion of scroll bars. In terms of functionality, the system could detect AV within 24 hours, and a total of 12 vehicles were detected as abandoned in a

period of 7 days. The system correctly returned vehicle owner information for the purposes of vehicle ownership verification.

4.5 The Proposed System Vs Other Systems

There were differences in terms of functionality and capability between the OVVS system and other similar systems which are either in used in public VPE facilities or have been proposed in the past. Below were the differences as discussed according to functionalities;

4.5.1 Automatic Number Plate Recognition Functionality

The system in use at KAPS Ltd has incorporated a module that implements ANPR functionality. This system comprises of very high-tech cameras that have been placed strategically at the entrance. It uses the cameras to capture the vehicle image with a special focus on the number plate registration. Through this system, important information such as, the vehicle model/type, time of entry/exit, and most importantly the vehicle number plate is recorded in the system and can be used for future referencing. The same is not true for the proposed system (OVVS) which does not include ANPR functionality, even though vehicle details are supposed to be captured in the system at the entrance. Once images have been captured by the camera, live checks can be performed remotely through secure connection for suspicious vehicles. Inbuilt GPS was used to tell the exact location. The system worked in three basic steps as follows; (i) Camera targets and captures the vehicle number plate (i) Compares the number plate against a locally created “hot” list database (iii) The driver/operator is alerted of the “hot” list match details (Kenya Airports Parking Service Ltd, 2015). Since the ANPR records vehicle details at the entrance, it can produce a report of vehicles that have parked, but it does not single-out vehicles that have been abandoned, it lacks the functionality that can allow it to flag abandoned vehicles and fetch for vehicle ownership information. The ANPR operates on a three-tiered procedure model namely; Entrance, Payment, and Exit, where each tier performs crucial functionality as described. See Figure25, and Figure26 respectively.

Figure 23: ANPR Technology (Kenya Airports Parking Service Ltd, 2015)

Tier1: Entrance process

At the entrance, the vehicles are detected, and the number plate and time stamp are captured via high tech camera along with a still image of the vehicle see Figure26. The data is captured and entered into the and record.

Figure 24: High Tech Camera for ANPR (Kenya Airports Parking Service Ltd, 2015)

Tier2: Payment process

Customers can pay using normal cashier mode or choose to pay through our seamless Mobile application for Point of Sales (PoS). At this point, the PFO enters the car registration plate on the mobile payment terminal, and the system displays the parking fee amount owing to the screen. Alternatively, Motorists can pay using KAPS cashless mobile payment option.

Tier3: Exit process

The vehicle approaches the exit point, it is detected, and an ANPR camera and validation are done automatically or through the mobile app exit point. Once the payment has been validated, the PFO is alerted, and he/she allows the vehicle to leave the public VPE facility.

4.5.2 Abandoned Vehicle Recognition Functionality

The details of any non-compliant vehicles are stored in a blacklist database for enforcement action which is very bureaucratic as it involves engagement of various authorities (Kenya Airports Parking Service Ltd, 2015). The black list database cannot be used to verify vehicle

ownership, and this is where the OVVS has an edge over the ANPR with regards to its capability to query the KRA database.

Unlike the OVVS which can remotely link with the dummy KRA database for detection of AVs and vehicle ownership verification information see Fihure22, and Figure23, the system at KAPS Ltd relies on an alternative manual process for the detection and verification of AV. The PFMs confirmed that the PFOs played a major role in the process of detecting AV. The PFOs were required to prepare the End-of-Shift (EoS) report on a black book called the "Hand Over Report Book" or simply the HORB see Appendix F for an excerpt of the EoS report indicating AV marked in bold letters. The EoS report contained a list of all vehicles that remained parked at the time of handing over shift to the next PFO. It took very keen eyes to identify and detect AV in the HORB. Details such as; the time when a specific vehicle moved in to park, duration/time the vehicle remained parked, the vehicle registration number, and where the vehicle was/is physically parked, are crucial information that were used to determine whether a vehicle was abandoned or not.

Work in the VPE facilities was done on shifts and due to shortage of staffing, sometimes PFOs were forced to work beyond normal working hours. This caused them to suffer fatigue and contributed to a lot of human error and inconsistencies in the preparation of the EoS report, which was very important for the manual identification of AVs. According to the PFM, there were reported cases of vehicle vandalism, especially on AVs. Cases of stolen vehicle parts such as; headlamps, side mirrors, and wheel-caps were reported and recorded in the EoS report. The public company managing the public VPE facility anticipated such criminal occurrences and took measures to protect itself using signages with warning such as, "Park Vehicle at Your Own Risk". These signages were meant to remove any liability for any form of loss or damage that could occur in the public VPE facility-see Appendices G.

There is a challenge of getting vehicle owner information on vehicles that are parked in the public VPE. Details on vehicle ownership such as, full name of the vehicle owner, contacts of vehicle owner, PIN/ID of the vehicle owner, and or next of kin information could not be readily available, though this information was viewed to be crucial for follow-up purposes. According to the PFMs, the availability of these details could play an important role in the improvement of

security in public VPE facility by making it easy to locate the owner of the AV. The County authority policies and laws are silent on AVs, sometimes PFMs don't know how to handle the issue of AVs. This contributes to the increased cases of AVs that have remained parking for years in public VPE facilities.

Ideally, if the definition for AV as is put in this study is to be followed, the PFO should be able to identify and detect AV after the third shift, but this is not usually the case-because, PFOs are humans and are prone to errors such as; forgetting to write a report, suffer fatigue, omission/commission errors, or just failing to go through the EoS report. Therefore, there were documented evidence of vehicles being abandoned for 3 months, 3 years, and even 5 years. All these makes the current system to be unreliable and inconsistent in terms of detecting AV.

4.5.3 Wireless and, or Mobile Parking Functionality

Other systems that focused on enhancing management of public VPE facilities have been proposed in the past. A Wireless Parking System proposed by Rane targeted on making it easier for a Motorist to locate available parking via GPS in his vehicle (Rane, et al., 2014). Also, a proposed Mobile Phone-Based Parking System focused on automating the management of parking facilities within the City of Nairobi. The system was meant to allow Motorists to identify vacant parking slot within a parking facility using a mobile phone (Kinyanjui & Kahonge, 2013). Whereas the OVVS relies on internet connectivity for it to achieve its goal, it fails to accommodate additional wireless functionalities such as mobile-phone or GPS.

Unlike other systems in the review, the OVVS does components such as a camera component for capturing vehicle images (Atanassov, 2012), ANPR has also been used in other systems for automatic number plate recognition (Kenya Airports Parking Service Ltd, 2015), and mobile technology using cellphone has also been proposed (Kinyanjui & Kahonge, 2013). The OVVS might be like other systems in the review in the sense that they are all being used in vehicle parking facilities, but it greatly differs with these systems for the fact that, it stands out as the only system with the capability of utilizing the distributed technology to verify ownership of AVs from an authoritative source efficiently and reliably for vehicles in a public VPE and subsequently be able to reduce if not eliminate crime generators as is correctly stated by (Fujita, 2011).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter was used to conclude and recommend based on the results of the study. The conclusions and recommendations were made with respect to the objectives set in the study. This chapter also considered the future and gave viable recommendations.

5.2 Conclusions

The project created a good opportunity to confirm that cases of abandoning vehicles are real in Kenya and specifically in Nairobi where the study was carried out. Objective (a) was satisfied by establishing that cases of AV are real in public VPE, especially in Nairobi. This was done by distributing questionnaire forms to Motorists who were the prime users of public VPE facilities. The study confirmed from the analyzed data that out of the 400 Motorists who were questioned, 40% of them agreed having abandoned a vehicle according to the definition of AV in the context of this study. Objective (b) was satisfied alongside objective (a) through questions in the questionnaire where objective (b) was satisfied by the different indication for Motorists' preference for security in a public VPE where a preference rating in percentage for OVVS was rated at 49%. This serves as an evident from the analysis that insecurity was also an issue for Motorists. To satisfy objectives (c), and (d). Interview involving 6 PFOs was done to understanding how the current system detects AV, and questionnaire forms-which were subjected to system user with the intention of carrying-out the ease of use and functionality test allowed for objective (d) to be satisfied where it was confirmed from the user (PFO) that the system was user friendly, and was able to detect AV as correctly defined in the study. See Table1, and Table2 for ease of use and functionality tests respectively

In addition to satisfying the specific objectives of the study, other benefits were also achieved just to narrate but a few such as; the OVVS could reduce cases of vandalism. Where a vehicle was identified as abandoned, the vehicle owner was contacted in good time and advised to remove his vehicle from the public VPE facility. This in turn improved security in the public VPE facility. The OVVS made way for fair sharing of the public VPE which is a scarce resource to Motorists who utilize the public VPE facility

The OVVS addressed the issue of AV. The detection of AV was maintained within 24hours, counting from the moment a vehicle was parked in the public VPE. This could not be said to be the same when using the manual system which was adversely affected by factors like; human error, user fatigue, thereby creating a possibility of detecting AVs even after one week. The time taken to verify vehicle ownership for the AV was also drastically reduced to a matter of few seconds, because the OVVS prototype allowed a for direct link to the dummy KRA vehicle registry, unlike the manual system which heavily relied on bureaucratic processes which could take many days.

5.3 Recommendations

Based on the findings and the results of the study, the following were the could recommendations given;

Further research to confirm the applicability and success of this study and its deliverables to other regions within or without the country is recommended.

Manual mechanism of identifying AVs was found to be very prone to error, ineffective, unreliable, and inconsistent. Inclusion/implementation of automated system such as the OVVS in public VPE is recommended.

Since the OVVS concentrated on the identification of AVs and vehicle owner verification, further studies on how the OVVS can be integrated to other existing public VPE systems is recommended.

Government authorities, both at the National and County levels don't have a clear definition for AV, and as such policies and regulations are silent on this. Further research is recommended on how policy and regulations can be used towards solving the problem of AVs, especially in Kenya.

There is need to have a Central Data Repository that shares data from Government authorities such as; KRA, Immigration Department, Registrar of Birth/Death, NTSA, and Insurance firms to enable free, faster, and easy access to data.

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APPENDICES

Appendix A: Motorist Questionnaire Form

MOTORIST QUESTIONNAIRE FORM

This questionnaire form is intended to get information from Motorists', their vehicle parking behavior, and their view on the security in public VPE facilities. The information is purely going to be used for the purposes of this research study and nothing else.

Note: Only check [✓] one of the options provided when answering the questions.

Question One [A]

Do you park your vehicle in public VPE facilities?.....[Yes] [No]

Question Two [B]

Have you ever left your vehicle parked in a VPE facility for more than 24 hours?.....[Yes] [No]

Question Three [C]

On a score of [0-4], where 0=Not Safe, 1=Not Very Safe, 2=Averagely Safe, 3=Safe, and 4=Excellently Safe. How safe do you think your vehicle is in the public VPE?.....[1], [2], [3], [4]

Question Four [D]

Which one of the following would you highly prefer to be implemented to improve security in a public VPE facility?

[1] CCTV installations

[2] A system to identify and verify the vehicle owner [OVVS]

[3] A 24 hours security guard

Appendix B: PFM Interview Questions

PARKING FACILITY MANAGER
INTERVIEW QUESTIONS

These interview questions are intended to get information from the Parking Facility Manager [PFM], on how the current system works with special interest on the process of detecting abandoned vehicles. The information is purely going to be used for the purposes of this research study and nothing else.

Question One [A]

What system do you use for the detection of abandoned vehicles in the VPE facility?

[1] Automated System

[2] Manual System

Question Two [B]

Briefly explain how the system is used to identify abandoned vehicles?

Question Three [C]

How effective is the current system with respect to obtaining abandoned vehicle information?

Question Four [D]

Have you received cases of vandalism, and theft in the public VPE facility?

Question Five [E]

What is the working pattern of the PFOs and how is it affecting security in public VPE?

Question Six [F]

What is your opinion on County authority policies and laws with regards to abandoned vehicles?

Appendix C: Ease of Use and Functionality Questionnaire

EASE OF USE AND FUNCTIONALITY TEST		
This questionnaire is intended for users of this system i.e. the PFOs. Please, select one option in each question		
	Questions on Ease of Use	
1	Was the system user friendly and easy to use?	(Yes) (No)
2	Was it easy to navigate the system?	(Yes) (No)
3	What would you like to be added to make the system more user friendly?	(Menus) (Icons) (None)
		(Scrollbar) (Windows)
	Questions on Functionality	
1	How long did it take to detect abandoned vehicle?	(≥24hours) (≤24hours)
2	How many vehicles in total were detected in 7 days?	( )
3	Was the system able to verify vehicle ownership?	(Yes) (No)

Appendix D: Ease of Use and Functionality Tests Result Summary

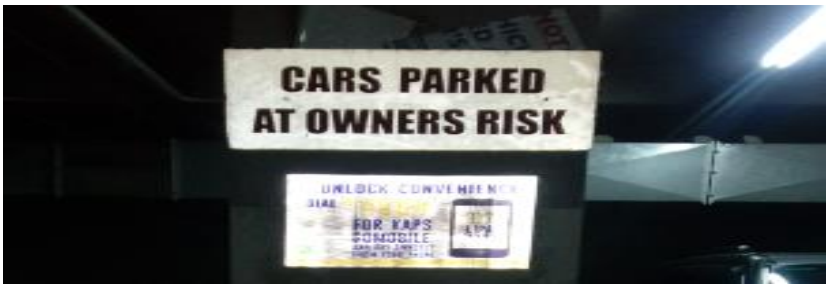
EASE OF USE TEST RESULTS				
Sno'	**Question asked**	**Purpose to achieve**	**Alternative options**	**Response from the respondent**
Ease of Use Questions				
1	Was the system user friendly and easy to use?	To know the ease of use	(Yes) (No)	(Yes)
2	Was it easy to navigate the system?	To know if the user could move from one window to another to locate functionalities and system resources	(Yes) (No)	(Yes)
3	What would you like to be added to make the system more user friendly?	To find-out deficiencies in terms of usability	(Menus) (Icons)(None) (Scrollbar) (W	(Scrollbar)
Functionality Questions				
1	How long did it take to detect abandoned vehicle?	To confirm that vehicles abandoned vehicles are detected within 24hours	(≥24hours) (≤24hours)	(≤24hours)
2	How many vehicles in total were detected in 7 days?	To know the total number of abandoned vehicles	( )	(12)
3	Was the system able to verify vehicle ownership?	To confirm whether the system could correctly query the dummy KRA database for vehicle ownership verification	(Yes) (No)	(Yes)

Appendix E: Abandoned Vehicle at Valley Arcade VPE

Appendix F: An Excerpt of the End-of-Shift Report

EASTMATT SUPERMARKET PARKING LOT			
	28/08/2016		
Vehicle Reg Number	Color	Make	Time
KCA 509A	BLACK	NISSAN	0030
KBJ 111G	**SILVER**	**HARRIER**	**0030**
KAB 221B	RED	TOYOTA	0030
KAB 455A	GREY	MITSUBISHI	0030
EASTMATT SUPERMARKET PARKING LOT			
	30/08/2016		
Vehicle Reg Number	Color	Make	Time
KBG 009A	WHITE	PEUGEOT	0040
KCA 519Z	BLACK	TOYOTA	0040
KBJ 111G	**SILVER**	**HARRIER**	**0040**
KAZ 626K	BLUE	SUBARU	0040

Appendix G: A Warning Signage at a public VPE facility



Appendix H: The Basic User Manual

For ease of use and navigation, the researcher has included some basic steps that are "key" when operating or using the OVVS prototype. The steps and processes are summarized and serve as a guide for users. Below are the basic processes and steps for performing key tasks;

1. Prerequisites for OVVS

For the OVVS prototype to work, you need to install and configure the XAMPP software. You will also need to ensure that the PC hosting the OVVS has adequate connection to the internet. This is to enable access to the vehicle owner information from the supposed dummy KRA vehicle registry.

2. How to Get Started with the OVVS

There are two ways to start-up or rather, to launch the OVVS. The first way is by double clicking on the OVVS icon on the Desktop, and the second way is by locating the OVVS icon and clicking on it. There are two kinds of users namely; Administrator, who is assigned absolute privileges, and just an ordinary User who is assigned limited privileges.

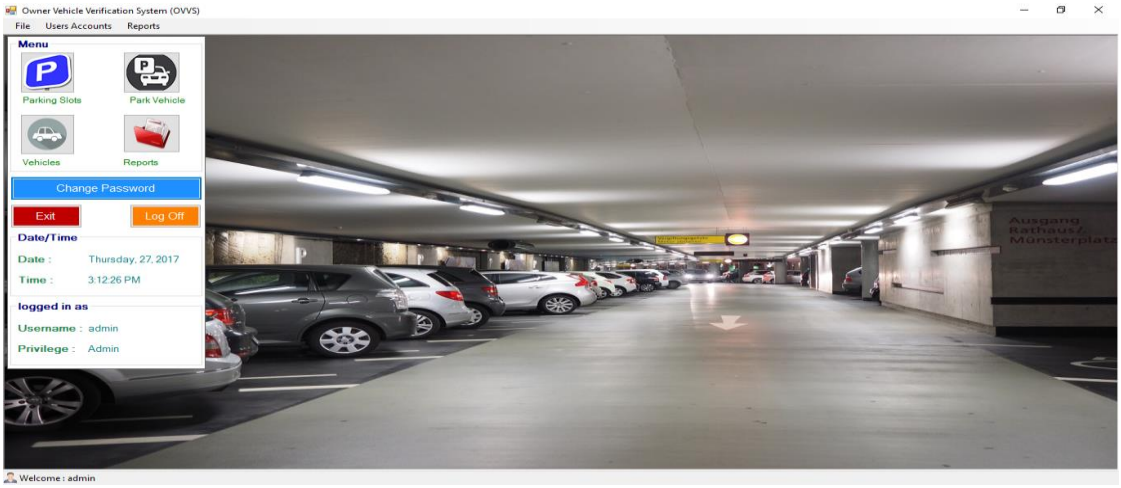


Figure 25: The OVVS Window

3. The OVVS Window Appearance

As shown in Figure24, the OVVS Window comprises of four key menus namely; the Parkin Slots, Park Vehicle, Vehicles, and Reports menus. There is also a provision for changing password and exiting the OVVS. The Window also shows who is logged in, privileges, date, and time.

4. The Parking Slot Window

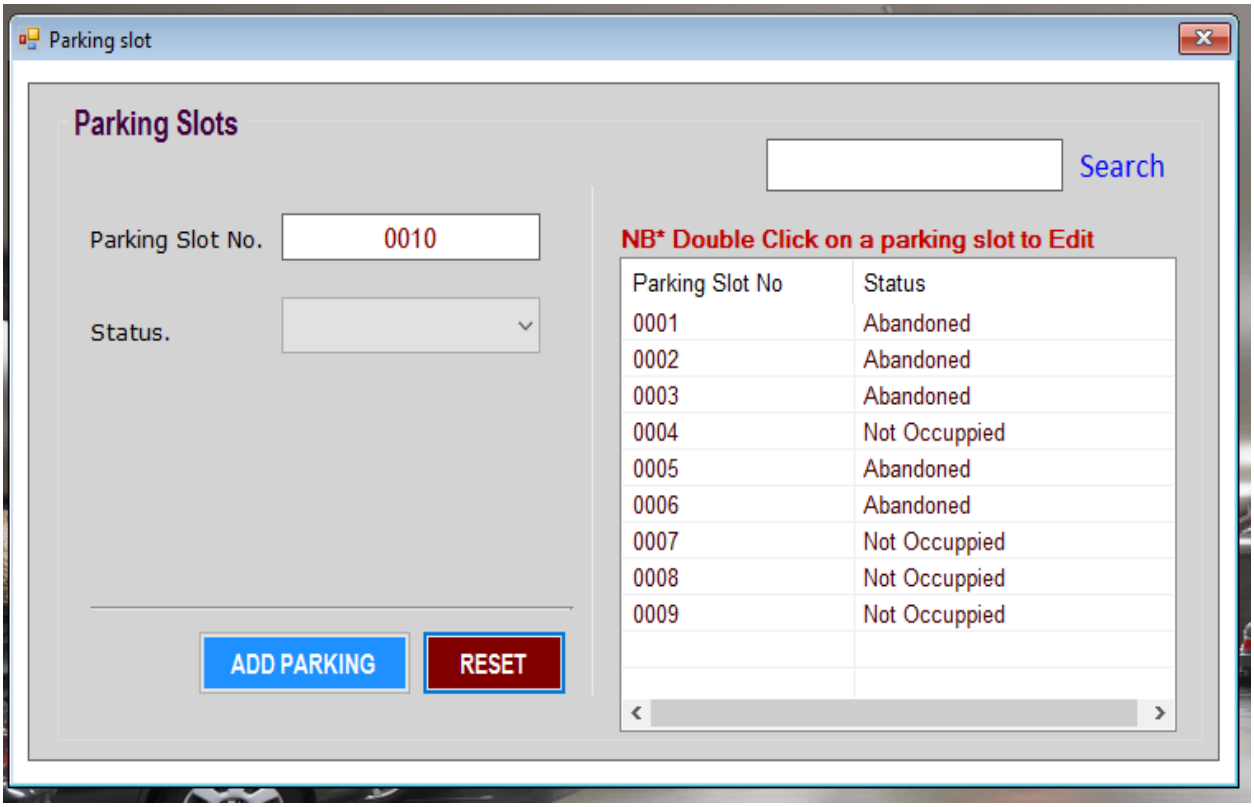


Figure 26: The Parking Slot Window

Figure25, above shows the Parking Slot Window. A user can get to this window by double clicking on the Parking Slot menu. This window allows a user to add a parking slot/space in the system. Any parking slot/space in the system can assume either of the status named; “Abandoned” or “Not Occupied”, meaning either “the parking slot is occupied for a period exceeding 24 ours, or the parking slot is empty/vacant”, respectively. If there are many parking slots/spaces and the user is interested to find a parking slot, the prototype provides a provision for a search engine-which can be used to do a search for a specific parking slot/space.

5. The Park Window

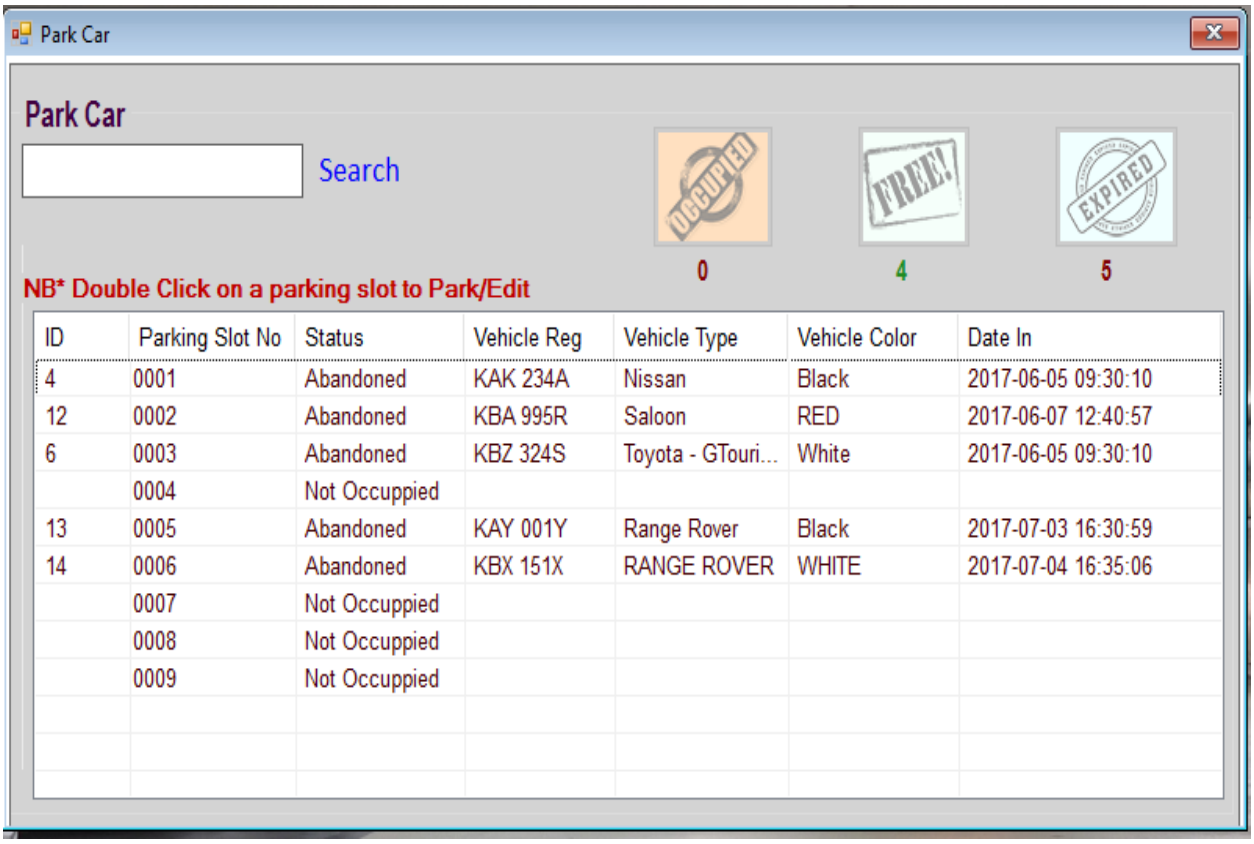


Figure 27: The Park Vehicle Window

The Figure26, above shows the Park Vehicle Window, which is accessed through the Park Vehicle menu. It displays information such as; the parking slot number, vehicle registration number, vehicle type, vehicle color, and the login date/time. This window allows the user to assign a parking slot/space to a vehicle. To park a vehicle, the user is supposed to double click on a parking slot number whose status is "Not Occupied". This event will trigger the "Register Park Car" window to pop-up, and the user will be prompted to enter the vehicle registration number and then save the transaction. The system will automatically capture the login time, and show the expiry time for the parking duration. The user can click on the "ADD" button to park many vehicles. A user can get information on AV from the "Park Car" window. This is an automatic "fetch" transaction which is initiated by double clicking on a vehicle whose status is abandoned. This action will trigger the "Car Exit" window indicated in Figure27, to pop-up.

6. The Car Exit Window

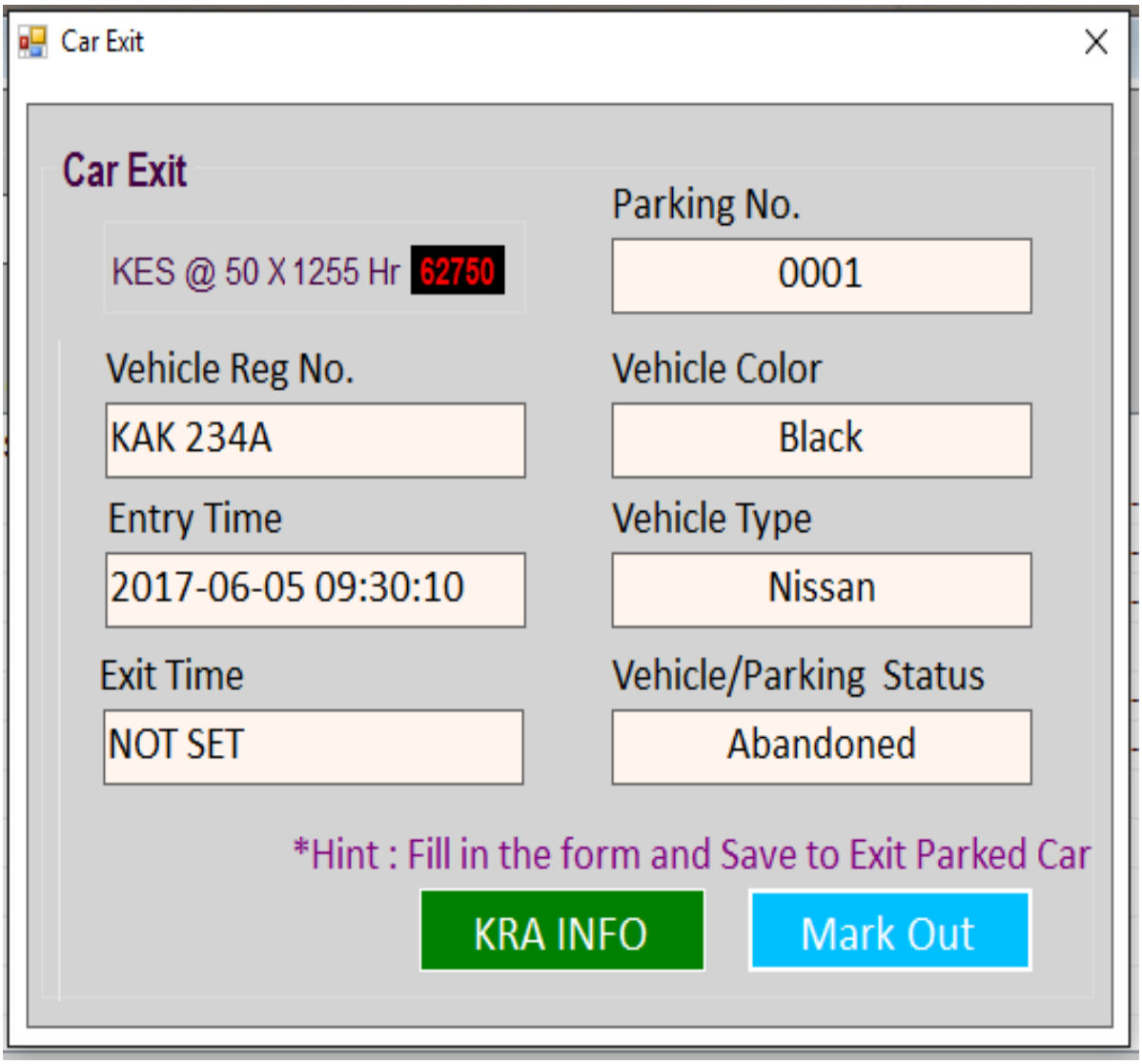


Figure 28: The Car Exit Window

This window has a summary of information on the AV as available on the local database. It also has a button called “KRA INFO”, which if clicked will automatically do a “fetch” or “pull” for information from the dummy KRA vehicle registry and return additional information on the AV in terms of vehicle ownership. The vehicle owner can then be reached through the contacts “fetched” / “pulled” from the dummy KRA vehicle registry. A search engine is also provided here to allow ease of locating vehicles.

7. The Vehicle Window

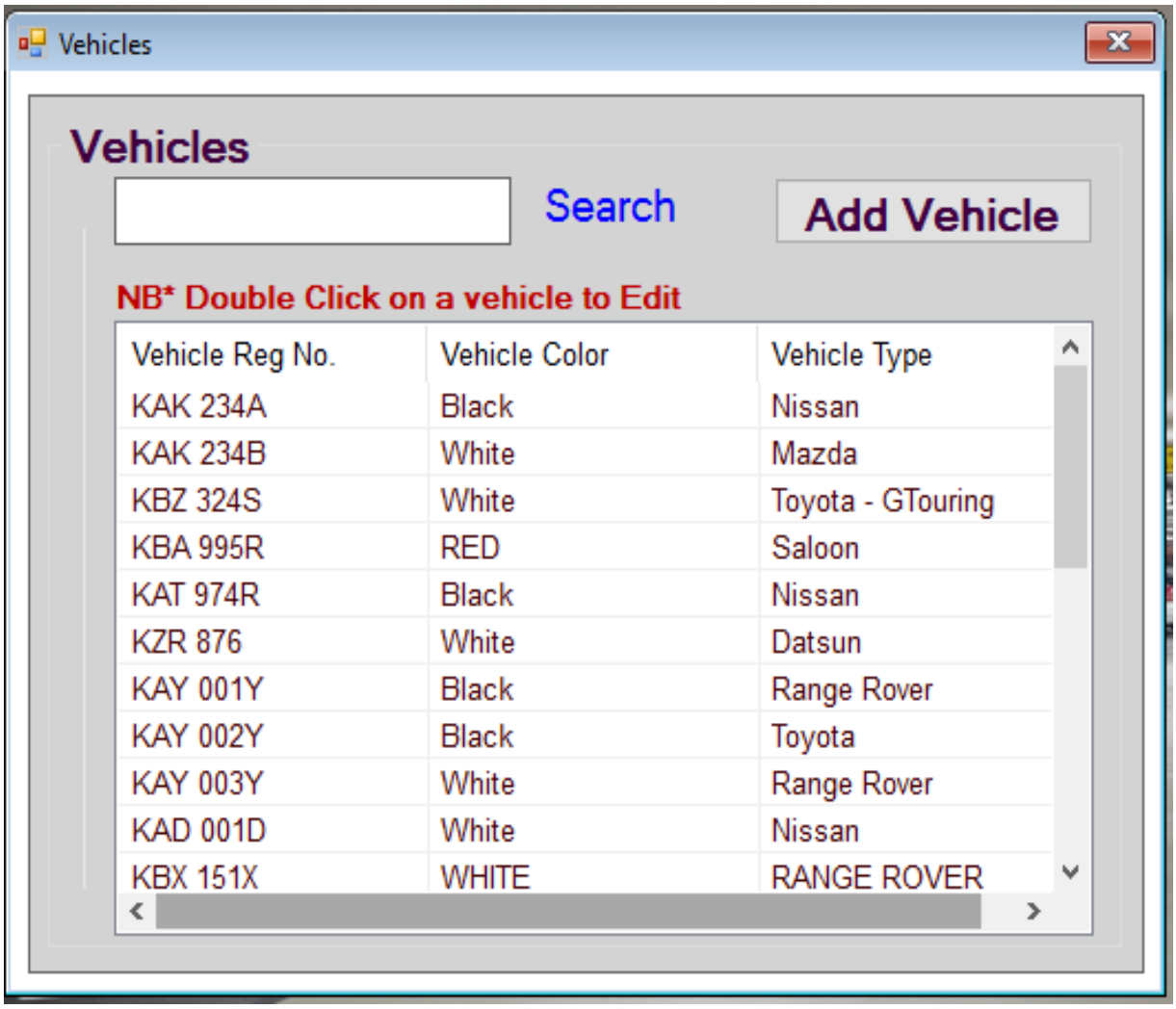


Figure 29:The Vehicle Window

The Figure28, above shows the Vehicle window which can be accessed through the Vehicles menu. This window allows the user to add vehicles into the system. All vehicles that have utilized the VPE facility must appear in this window. It serves as a tool for updating the local database with vehicles. The search engine can also be used here to locate any vehicle that was previously added in the system. In case of any error when entering vehicle information, the user can always correct by double clicking on the vehicle to edit.

8. Reports Window

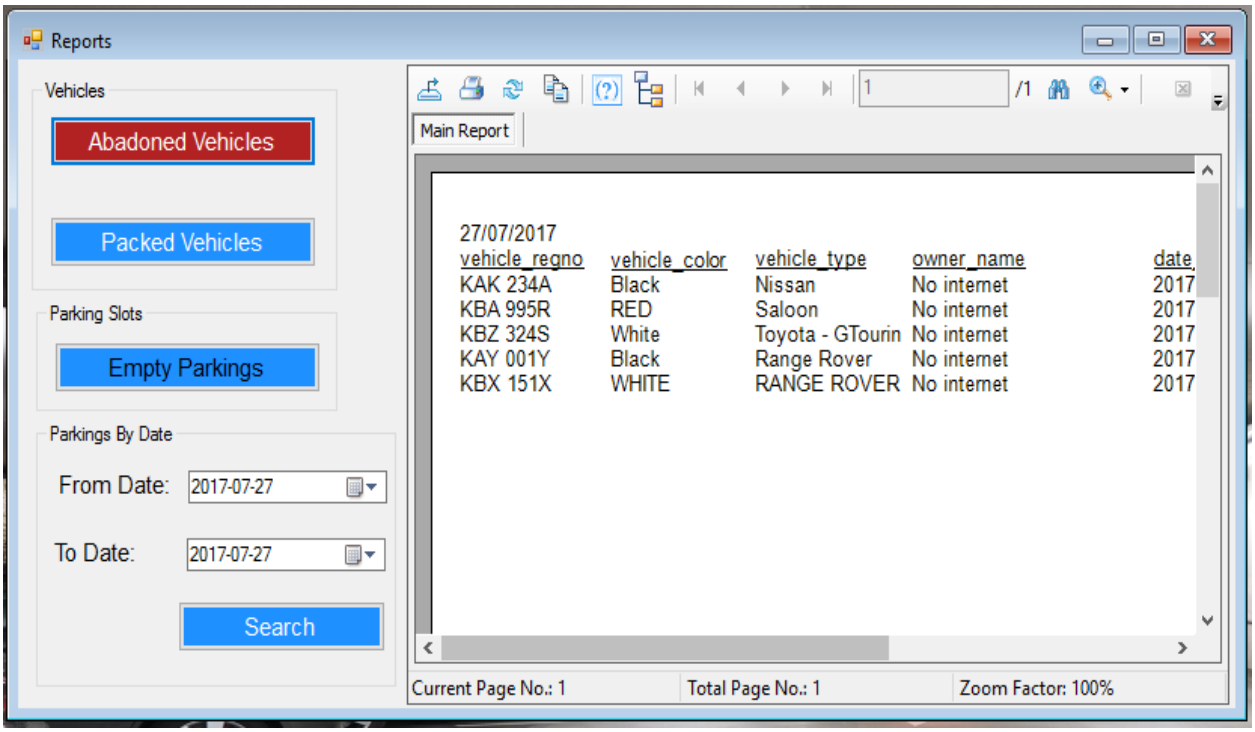


Figure 30: The Reports Window

The Figure29, above can be accessed through the Report menu, it is used to present reports on AV, packed vehicles, and empty parking lots. A user can select which button to click and set the date criteria when doing a search for a report. Figure30 below three critical provisions for changing user password, exiting, or logging-off the system.

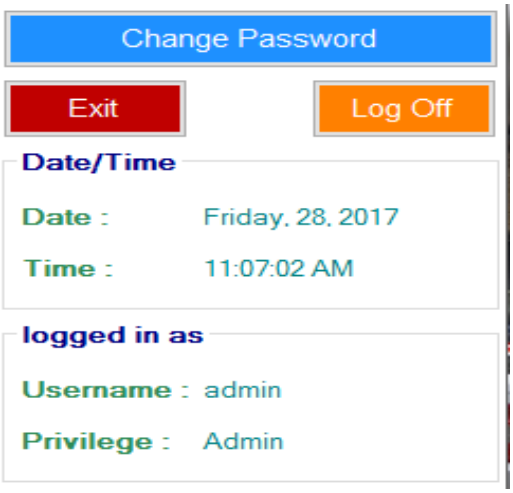


Figure 31: Password Change and Exit/Log Off Provisions