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SUBMITTED BY

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PROJECT TITLE

E-Mechanic

A project submitted to the Department of Computer Science in the School of Computer Science and Information Technology in partial fulfillment of the requirements for the award of the degree of the Computer Science Dedan Kimathi University of Technology.

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DECLARATION

I hereby declare that the project entitled E-Mechanic submitted for the B.Sc. Computer Science degree is my original work and has not formed the basis of an award of any degree, diploma or any other similar titles.

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This project has been submitted for university examination with my approval as the University Supervisor.

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ABSTRACT

Motor vehicles have been breaking down ever since they were invented and if a repair was not possible, then a recovery or tow was usually required. In early days, this was often achieved by pushing or pulling it home. Many of the first vehicle repair shops had been bicycle repairers or blacksmiths, and they quickly adapted to recovering their customers' disabled vehicles. In addition, the motorists were often capable of carrying out minor repairs themselves, but as vehicles become more complicated, this becomes harder. Nowadays, vehicles are towed to a garage of choice for specialized diagnosis and repair.

This study addresses the relationship between road transport infrastructure and the growing economic opportunities specifically in the informal sector i.e. mechanic within Kenya and how this relation enhances economic growth and development in the region.

The notion is that improved road transport hugely contributes to regional integration and hence enhances economic growth and development. There is a need to ensure that integration works as a means to achieve development objectives. In so doing, this will facilitate the movement of goods and services across all the regions with subsequent related benefits.

The study gives informed recommendation and solution aimed at addressing challenges facing the road transport infrastructure and drivers especially in the case of a car breakdown. The study looks into the real challenge facing the drivers along the road especially during the instance of car breakdown and there is need to get a mechanic to repair/fix the problem. It also looks at the issues caused by car breakdowns such as road accidents, road jams, and insecurity issues.

The solution illuminates the need to develop an effective system to help drivers search for mechanics on Google Map based on the current location of the driver and display the distance between the driver and the mechanic. The system should allow the mechanic to remotely locate the driver who has a car breakdown issue and easily communicate to know more about the problem the driver is facing prior to visiting the site of a car breakdown. It should also allow for the administrator to verify the user's details i.e. driver/mechanic before displaying on the client’s side for the purpose of attaining security issues. This is done to prove for the valid users.

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ABBREVIATIONS

ERS - Economic Recovery Strategy…….9

GDP - Gross Domestic Product…….9

1. CHAPTER ONE

1.1 Background Information

Transportation developments have taken place since the beginning of the industrial revolution have been linked to growing economic opportunities. At each stage of societal development, a particular transport technology has been developed or adapted with impacts. Transportation influences economic opportunities for production and consumption.

In Kenya for example, the transport sector contributes between 5 to 15 % of the GDP(Summary, 2007). However, the impact of transport goes well beyond its share of the economy as it serves as an intermediary service to all sectors and is therefore critical to economic growth and poverty eradication. For instance, by identifying the transport sector as one of the main pillars of the economic recovery effort in the "Economic Recovery Strategy for Wealth and Employment Creation 2003-2007" (ERS), the Government of Kenya has shown recognition of the transport sector contribution towards facilitation of rapid economic growth and reconstruction, poverty eradication and in employment creation.

Because of its intensive use of infrastructure, the transport sector is an important component of the economy and a common tool used for development. This is even more so in a global economy where economic opportunities have been increasingly related to the mobility of people, goods, and information (Sarah Anyango, 2014). A relation between the quantity and quality of transport infrastructure and the level of economic development is apparent. they provide economic and social opportunities and benefits such as better accessibility to markets, employment (both in the informal and formal sector) and additional investments. The added value and employment effects of transport services usually extend beyond those generated by that activity. For instance, transportation companies purchase a part of their inputs (fuel, supplies, maintenance) from local suppliers. The production of these inputs generates additional value-added and employment in the local economy. The importance of specific transport activities is the employment creation in the informal sector i.e. mechanics. Many youths with skills have been employed as mechanics and are now able to earn a living through this sector.

Due to the good transport sector, goods and services have been able to reach the market on time. Unfortunately, there are other issues that have affected this sector negatively causing transported goods to the market perish. The main one being car breakdown on the roads causing traffic jams

along the roads especially on the road highways and road accidents mainly on the black spot's road sections for example in Kenya we have the black spot along Nakuru-Eldoret; Salgaa. This has led to the loss of lives and destructions of property during the incident. Car breakdown along the road is also associated with insecurity especially when the driver experience car breakdown while driving in new areas and can't find a nearest trusted mechanic and can find ending up being attacked by someone pretending to be a mechanic. Mechanics also aren't aware that there is a vehicle that has broken down on the remote areas. Therefore, there is a need to develop a platform to help drivers find nearby mechanics in case of a car breakdown.

According to the latest sector statistics from the Communications Authority, Kenya now has over 90% mobile penetration (Kemibaro et al., 2019). In the period April to June 2016, mobile subscriptions reached 39.7 million up from 38.3 million subscriptions recorded last quarter. This translates to an increase of 3.7 percent or 1.4 million new mobile subscriptions during the quarter. According to Google's Consumer Barometer, smartphone uptake in Kenya was at 44% in 2016. This is a massive jump from 2014 when smartphone uptake was measured in the same survey as being only 27%. This suggests inexpensive smartphones that are now going for as little as Kes. 3,000.00 are clearly driving a massive shift from feature phones which used to be the dominant mobile device in Kenya (Google's Consumer Barometer, smartphone uptake in Kenya, 2019).

1.2 Problem Statement

Currently, drivers, especially in the remote areas, encounter difficulty in accessing the nearest mechanic in the cases of experiencing car breakdown due to the barrier in communication between them and the mechanics. Also, the mechanics can't notice that there is a vehicle that is broken down in the remote areas and needs to be repaired because they only operate in their station; garage/petrol station waiting for the clients to come to them physically or respond to phone calls from the clients who have been referred to them. Sometimes when they receive a call from a stuck driver, they gather some information from the drivers prior to them traveling to the car breakdown site. Secondly, those operating at the garage have two types of breakdown they do which include major breakdown and minor breakdown. Major breakdown includes engine knock gearbox failure and deferral failure. This will be done at the garage because it requires more time and tools. Therefore, they normally offer recovery/toy services to transport the car to the garage station. Minor breakdown includes brakes, clutch, and fuse wiring failure. This will be repaired at the site of a car breakdown. In the scenario where a driver is new in an area and knows no-one, it's very hard to find a trusted mechanic since there is no means to find them. This poses a challenge to the transportation of goods and services to the market due to delay in the process of finding a mechanic. The drivers are the ones mostly affected this problem mainly in accessing the nearest mechanic within their current location site of a car breakdown. To find the nearest mechanic is only limited to physical means and making inquiries from the local people residences. The study addresses the need to develop an E-Mechanic application to help drivers find the nearest mechanics in the case of car breakdown to cater to the process of using physical means It focusses on connecting the drivers with mechanics at the comfort of the smartphone in a safer, faster and convenient way.

1.3 Research Objective

1.3.1 General Objective

The main objective of this study was to develop an ɛ-Mechanic Mobile Application that helps drivers locate nearby mechanics in case of a breakdown in a simplified and convenient way.

1.3.2 Specific Objectives

To develop a platform that:

1. display mechanics' location from the driver's location via Google Maps.
2. enables driver search mechanics based on distance.
3. displays the path between the driver and mechanic via Google Map
4. enables drivers rate Mechanics based on their work.

1.3.2 Justification of the study

Car breakdown is one type of incident that often occurs on motorways and it is a nonrecurrent event. It is not a planned closure of a road nor a special event; therefore, there is no advanced notice. Car breakdown along the roads have become one of the main causes of traffic congestion, risk of secondary crashes for other road users, burglary and increased fuel consumption caused by the congestion especially along the highways and the black spot road regions in Kenya. This has become a threat to national security and slow growth rate in economic activities. In 2014, it was estimated that traffic in Nairobi costs $570,000 per day. This is a significant amount and can be used productively elsewhere. One of the main reasons for this congestion is seen to be the ever-expanding population and hence the increase in the number of vehicles growing at a higher rate than the road capacity. The population of Nairobi has grown from 350,000 in 1963 to about 3.3 million. The number of vehicles in Nairobi was estimated at over 300,000 in 2008. In the same period, there has been a limited increase in the existing road infrastructure capacity (Attri, 2016). This shows us that the problem is one that cannot be ignored and therefore, this problem needs to be tackled as soon as possible. As car breakdown cause more congestion, more congestion brings with it more incidents of traffic jams and accidents especially in the urban areas and along the highways. Many Kenyans utilize different transport modes to reach their various destinations on a daily basis. Nearly 3000 people are killed on Kenyan roads annually. This translates to approximately 68 deaths per 10,000 registered vehicles, which is 30-40 times greater than in highly

motorized countries. Nairobi County has one of the highest road fatality rates in relation to vehicle ownership in Kenya, with an average of 7 deaths from the 35 road crashes that occur each day. Despite the huge burden the major causes of accidents in Nairobi, have not been modeled so as to outline the major causes and their inter-relatedness. Current interventions are scattered, uncoordinated and less effective despite the huge economic burden exerted by RTAs (Daniel, 2016). There was need for E-Mechanics to be developed to help drivers in searching and locating nearby mechanics thereby facilitating easy communication between the driver and the mechanic in the event of car breakdown and the driver knows no-one especially when driving in new areas. E-Mechanic will also help mechanics to locate the drivers from the remote areas who are stuck due to a car breakdown. This will solve the problem of traffic jams and road accidents since it will be faster to find a mechanic to solve the problem of a car breakdown.

1.3.3 Scope of the study

The study was limited to developing an E-Mechanic System, an Android smartphone system that facilitates searching and locating the nearest mechanic along the roads in the case of a car breakdown. The target market for this system includes the drivers and a mechanic. However, this study was undertaken within Nyeri Town, King'ongo', Mweiga and Othaya so as to help in establishing a general problem and a solution under investigation.

1.4 Limitations

The system is only limited to drivers and mechanics who own an Android smartphone. The system uses Google Maps API which needs regular payment on a yearly basis. It also needs data to displays the Map which needs regular purchase from a network service provider.

2 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the discussion of the literature found important to this study, a review of the available case studies, theoretical literature, review of the critical literature, the summary of the topic, gaps to be filled and in conclusion the proposed system. Also, it focuses on describing their structures, architectures and their implementation.

2.2 Case Studies

2.2.1 Case Study 1: J&F Auto Repair

An analysis of a system developed by J&F Auto Repair found the following features and functionalities:

- Auto repair appointment booking functionality
- Contact details
- Car towing and recovery services

It is a web-based system auto-repair shop located just outside of Indianapolis in the town of Clermont. They strive to provide high-quality repairs at a fair price to keep the customers happy. They provide an online auto-repair booking appointment to its customers(drivers) either for a routine inspection or an oil change, alignment or engine replacement. It has mechanics who are all certified and have over 65 years of experience, knowledgeable and friendly. They also offer towing services in case of car breakdown along the road. The driver can find the contact details listed on the website. The driver can visit the website and check for routine service prices and the small amount of information about the services and if satisfied with the service, the driver can contact the company using the contacts provided at the bottom of their website for assistance in getting to know more about the service and how they can reach the station.

At J&F Auto Repair, the driver has followed the guidelines on the website, he/she will add to the list of those who have booked for the service (Repair, 2019). However, drivers have to be careful since they can find that at the time of booking, the mechanic is busy with other customers and can't help them at that moment. This may frustrate them before resuming for other income generating activities. Currently, there is no way the drivers can be advised on the right time to book for the mechanic before they come to the garage. The system above is a web-based which

can be improved by making it android hence reducing the time required searching through a series of web-pages. It focusses only on providing routine auto-repair online booking services to its customers. The e-Mechanic app is more competitive in that it focuses on driver satisfaction based on the real-time access of the mechanic/garage anywhere from the mobile app in a safer, faster and secure way.

2.2.2 Case Study 2: Openbay

An analysis of the system developed by Openbay found the following features and functionalities:

- Online booking of the auto mechanic services
- List of mechanics

Openbay is a web-based online platform where drivers can compare, book and pay for auto mechanic services online. It was launched last year October and is easy for the drivers to use. It is a platform where mechanics can submit their details and then drivers can find them here. It has a dashboard for drivers to access all the account activities and even offers the ability to sign into the account via Facebook. The driver has to establish an account, during which time he/she can list his/her vehicle, enter billing information and complete a few other profile details. When the driver needs a repair, he/she select Request Service for a particular car and state preferences: for instance, the driver not only enters the need of a wheel alignment but also use a dropdown menu to say how soon they want the repair. Additionally, they can select what kind of amenities they desire from a list that includes loaner car, early drop-off, shuttle service. If they don't exactly know what is wrong with the car, they can submit a Custom Service Request or select General Diagnosis and provide a detailed description in the Notes box. Once they submit the request, Openbay will contact providers on their behalf. They'll receive a list of nearby mechanics, who will respond to them with offers. They can compare their prices, locations, and amenities as well as user ratings and reviews before booking the service appointment.

Openbay is also a web-based which can be improved by making it android hence reducing the time required searching through a series of web-pages. It allows for online booking of a mechanic but does not have a mechanism of contacting a mechanic in case of an emergency breakdown. Openbay also provides a list of mechanics but not the exact location (openbay.com, 2019).

The e-Mechanic app is different in that it focuses on driver satisfaction based on the real-time access of the mechanic/garage anywhere from the mobile app via Google Map in case of

emergency car breakdown and needs repair or towing services in a safer, faster and secure way instead of visiting web pages.

2.2.3 Case Study 3: Auto Connect

An analysis of the system developed by Auto Connect (CodeCanyon, 2019) found the following features and functionalities:

- User sign up
- List of the nearest mechanics
- Online booking of auto repair services

Auto-Connect is a High-end mobile application for automotive technicians or Auto Mechanics, Auto Repair Chains and small, medium and large shops. It facilitates online mechanic booking for any vehicles from any time anywhere. Auto-Connect helps drivers book a full auto service or repair by finding the nearest mechanic. This app is meant for auto repair companies situated in towns.

The app has an interface where a drive can sign up and find a list of mechanics but it has no exact location where the driver can find the mechanic and it is only meant for booking of a mechanic but does not provide emergency services especially in case of a car breakdown. Also, Auto Connect does not provide exact location where the mechanic is located. E-mechanic is different from Auto Connect in that it focusses on providing drivers a list of nearest mechanic. It is also competitive in that it focuses on driver satisfaction based on the real-time access of the mechanic/garage anywhere from the mobile app in a safer, faster and secure way.

2.2.4 Case Study 4: Engie

An analysis of the system developed by Engie (Play.google.com, 2019) found the following features and functionalities:

- List of mechanics
- Monitoring of parts of a car
- Mechanics ratings

However, for many years, drivers have been facing the challenge of being unable to monitor parts of a car and get regular information on the performance of the car. Engie was developed to solve this challenge. It aims at solving this problem of providing regular updates on the performance of all the parts of a vehicle in a timely manner. The driver has to purchase the Engie device through the app and plug it in under the dash. Engie simplifies car repair and maintenance and once paired

with the Bluetooth device, the app scans and reports on over 10,000 car faults, as well as provides analytics on fuel consumption, trip tracking, and parked car location.

Engie aims at assisting drivers diagnoses when the car malfunctions and immediately provide a warning. Automatic warnings of a car's motor's status are sent text to the phone number of the driver; therefore, the driver will know when they need a repair. It also provides simple explanations of over 10,000 malfunctions, from warning lights to issues under the bonnet.

Engie also provides a list of local mechanics, so that the driver can't travel with a check engine warning light for long. Mechanics also have ratings so that the drivers are confident they will accurately and affordably repair their car. It has a list including multiple mechanics with various specialties and prices. Engie aims at helping the driver understand how the car works and keep up with maintenance, monitors important parameters, such as battery life, oil and petrol volume, and fuel consumption, alerts the driver when they have upcoming maintenance.

The e-Mechanic app is more competitive in that it will cater for the issue of finding the nearest mechanic within the drivers' location .It also provides the distance from the driver to a nearby mechanic.

2.2.5 Case Study 5: Breakdown Recovery Vehicles

An analysis of the system developed by Breaking Recovery Vehicles found the following features and functionalities:

- Company Location
- Contact details
- Services offered by the company

Breakdown Recovery company is a 24-hour local Car breakdown recovery service situated in Hurlingham Nairobi with safe and secure overnight storage facilities. They are able to provide full support to assist car drivers, along with drivers of vans and the light commercial vehicle drivers in the case of an accident or simply when the car has broken down. The e-Mechanic app is different in that it focuses on driver satisfaction based on the real-time access of the mechanic/garage anywhere from the mobile app in a safer, faster and secure way. The app will provide the nearest mechanic registered to operate.

2.2.6 Case Study 6: Breakdown, Towing & Recovery Services

An analysis of the system developed by Breakdown, Towing and Recovery Services found the following features and functionalities:

- Company Location
- Contact details
- Services offered by the company

They offer vehicle towing and recovery services within and outside Nairobi at affordable costs. Their flatbeds are modern and available to transport cars countrywide. They guarantee the safety of cars from one location to the final destination. The driver can find the contact details listed at the bottom of the company website. The e-Mechanic is more competitive in that it focuses on driver satisfaction based on the real-time access of the mechanic/garage anywhere from the mobile app in a safer, faster and secure way.

2.3 Summary

Most of the systems identified from the case studies are having certain concepts of locating mechanics while lacking others. For instance, the J&F Auto Repair web-based system is an Indianapolis online mechanic booking system which can be improved by making it android hence reducing the time required searching through a series of web-pages.

Auto-Connect is an android app that facilitates the booking of mechanics and also displays a list of mechanics. It does not show exactly where the mechanic is located from the driver's location. This can be improved by adding the functionality of Google Maps to help drivers search for mechanics and view them in Google Map. Engie is a hardware that is embedded to the hardware of a car to help in detecting the malfunctioning of the car parts then an SMS to the driver's phone. It will also help update the driver of when to visit the mechanic for the service. This can be improved by developing an android app that helps in finding the nearest mechanic to fix the problem identified by the Engie.

The e-Mechanic app will be different from Engie in that it is running on the Android platform and cater to the problem of locating mechanics to respond to an emergency car breakdown. It caters for contacting the nearest mechanic to fix the problem.

2.4 Proposed System

e-Mechanic app helps drivers locate nearby mechanics in case of a breakdown in a simplified way using their mobile phones. It displays the mechanics' location and distance from the drivers' location via Google Maps. Finally, the system also help drivers search mechanics based on distance.

2.5 Comparison of Features

Feature	J&FAutoRepair	Openbay	Auto-Connect	Engie	My Solution (E-Mechanic)
Location on Maps	×		×	×	
Emergency repair	×	×	×		
Contact	×			×	
Search functionality	×	×	×	×	

Table 1: Comparison of Feature

3 CHAPTER THREE: SYSTEM METHODOLOGY

3.1 Introduction

In this chapter, the focus is fact-finding techniques that is used in the preparation of developing the system, population, sample, sampling technique, and requirements gathering technique are discussed. The information system development methodology used to develop the E-Mechanic is also specifically described. The techniques were to enable the gathering of facts that concern the development of this project. The facts are used as a user and functional requirements of the application because they depict what the users expect the application to do on its completion.

3.2 System Development Methodology

The Agile development model was appropriate for the development of this project because of its interactive and iterative nature. The development is based on stages, and with the use of the model, once the first phase of the project is done, it is released to the users and if they have any feedback the process is repeated from stage one after which it will be released again. The process iterates several times till the whole project is complete and the customer is satisfied. The model goes through the following activities.

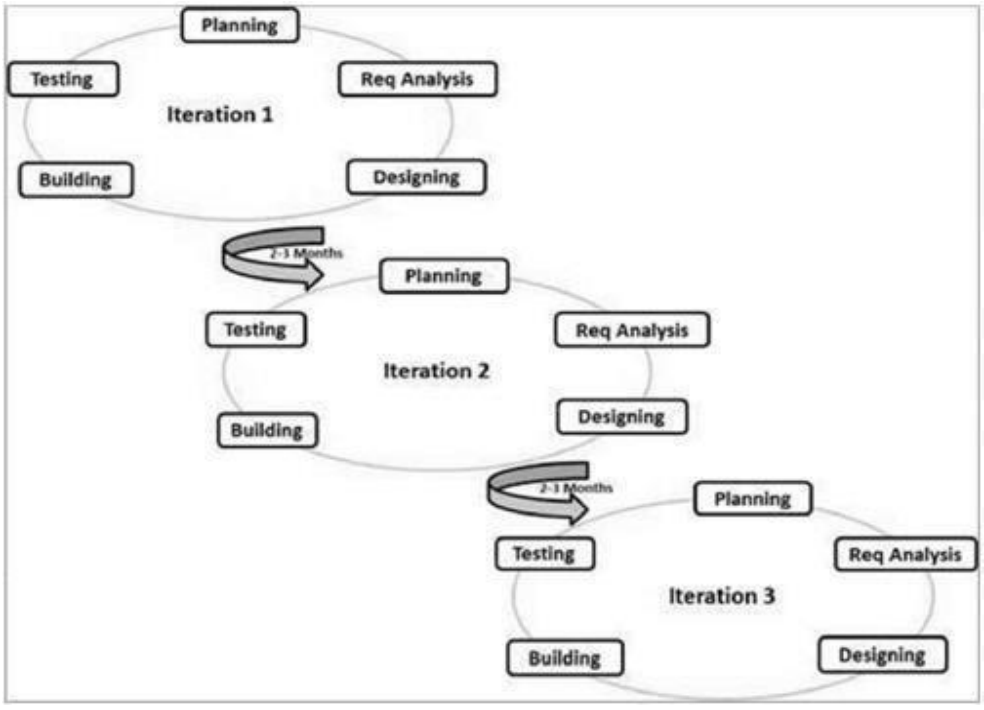


Figure 1: Agile Development Methodology

For iteration one, the aim is to develop a user interface for both the driver and mechanic to register and log in. This phase is released for users to check for all the details they need and provide the feedback on issues needed to be addressed if they are not satisfied it.

During iteration two once the user interface for authentication has been done to its completion, the user current location is captured and whether he/she is the driver or mechanic. This is done to help during car breakdown on who has encountered the difficulty, for this case is the driver who needs the mechanic. It is then deployed to the users of the system (drivers and mechanics) to test and ascertain that all the requirements needed have been captured. They will then provide any feedback for the sections they are not satisfied with. If they are not satisfied with the system at this stage and they provide the feedback, the process is repeated again to include all the requirements and deployed again.

The final iteration is an iteration 3. At this stage, user authentication is connected with the current location on Map with the details of that user whether he or she is the driver or mechanic. The app is then deployed for the drivers and mechanics to ascertain that it is working according to their needs.

3.2.1 Stage 1: Planning

The planning phase is helpful in the identification of stakeholders (drivers and mechanics) and the infrastructure and components required in developing the system. It is useful in security-related information gathering requirements for the drivers and mechanics. Tasks are then prioritized to build the system.

3.2.2 Stage 2: Requirements analysis

All possible requirements of the e-Mechanic app were captured in this phase and documented in a requirement specification document. Interviews and questionnaires techniques was used to collect data from the drivers who will be searching for mechanics through the system in case of a car breakdown. This was helpful in getting a deeper understanding of the challenge drivers to undergo. With this, existing challenges were established and the possible solutions on the modules being developed. The gathered information from the planning phase were used for requirements analysis whereby charts has been drawn, tables and pie charts.

3.2.3 Stage 3: System analysis and design

Based on the information gathered from the research of the current takeholders(drivers/mechanics); all the challenges and recommendation from the current system have been obtained. This system design is helpful in specifying hardware and system requirements and helps in defining the overall system architecture. The requirements of the users have been taken into account. Moreover, evolving requirements will be considered as they come up to make the system better every day. At this stage, designing of the system began. Different diagrams have been drawn which includes class diagram, activity diagram, state transition diagrams etc. They are done on paper before the actual implementation.

3.2.4 Stage 4: Coding/Building

After gathering enough system requirements, the process of system implementation and actual coding will commenced using Firebase in conjunction with other web-based languages for the administration side and Android for other system users. Also, Firebase database is used for data storage. The aim of all this is to come up with a working system that meets its requirements and the defined functionality.

3.2.5 Stage 5: Testing

Testing is carried out by system users and will continue to be undertaken to verify that the modules are achieving the intended objective. This involve activities such as checking for data validations and correctness of processes. The various test types include unit test, integration test, system test, and acceptance test

Unit testing specifically White Box Testing will be carried out for each individual units/ components of an E-Mechanic System. The purpose is to validate that each unit of the E-Mechanic System performs as designed. Integration testing level was done where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing. After the Integration Test, system testing is done where a complete and integrated is tested. The purpose of this test is to evaluate the system’s compliance with the specified requirements. Finally, acceptance testing was carried out to test for acceptability by the users. The purpose of this test is to evaluate the system’s compliance with the business requirements and

assess whether it is acceptable for delivery. It is the last phase of the testing, after which the E-Mechanic System goes into production. This is also called User Acceptance Testing (UAT).

3.3 TOTAL POPULATION

The study focused on the drivers who are dealing directly with the transportation of goods and services from one region to another. It also targeted the owners of garages and mechanics. Mugenda and Mugenda (2003), explains that the target population should have some observable features, to which the research should generalize the results. And therefore, the assumption of the definition is that the population is not homogenous.

3.3.1 Sample Size

According to Mugenda & Mugenda (2003), good study research should have a well-formulated procedure of selecting the subject or cases that should be included in the sample thus the importance of a sampling frame which forms the unit of observation in a study. A sample population will be drawn from the sampling frame. A sampling frame includes the actual list of individuals included in the population (Nesbary, 2000). According to Patten (2004), the quality of the sample affects the quality of the research generalizations. Nesbary (2000), suggests the larger the sample size, the greater the probability the sample will reflect the general population (Карaштин, Шлюгаев, & Гуревич, 2005).The sample size is calculated from the total population and there are formulas for calculations.

The respondents above were drawn from 4NTE Matatu SACCO and National Petrol Station (Nyeri). However, for objectivity purposes, other respondents were drawn from the private transport sector, mechanics from within Nyeri and other key informants from main garages from Nairobi who are well conversant with the car repair and maintenance issues.

3.3.2 Sampling Design

The research study for this project was to adopt a simple random sampling technique. Simple random sampling was adopted in the selection of 10 respondents from 4NTE SACCO

The initial task was to obtain a sample frame, which is a list of drivers from this SACCO. Being that the sample frame consists of a maximum of 10 respondents,5 respondents were eligible to participate in the study. During planning, requirement analysis, design, development and testing the project has been and will be working with a sample size of six drivers and six mechanics.

3.4 Requirements Gathering Techniques

It is the process of collection of data and information usually based on techniques. I will engage in these techniques in coming up with my project using data facts to create useful information, process functions to perform the objectives and interface designs to interact with users. The techniques are interviews, document analysis and questionnaires. The goal of this study is to determine whether the current platforms are available and improve on them. The methods for data collection include:

3.4.1 Questionnaires

The project prepared ten structured forms with a relevant set of questions that were designed to collect information from the potential users of the e-Mechanic. These respondents were required to write answers, tick checkboxes, suggest ranges and give their personal opinions concerning the development of the e-Mechanic System.

3.4.2 Interviews

This is the most commonly used requirement elicitation technique. Interviews were useful during the study to get to talk with the drivers and mechanics to know how they operate and also if they think having an app will be useful. The main target drivers and mechanics that was used in the interview study was from within Nyeri and also outside Nyeri Town. It is the main fact-finding technique since it's accurate, reliable and it allow for clearing and cross-checking the doubts in real time.

4 CHAPTER FOUR: RESULTS

4.1 Questionnaire Results

This technique aimed at collecting data from 6 mechanics and 6 drivers within Nyeri Town. Hence the survey managed to collect data from all the 6 drivers and mechanics.

4.2.1 Questionnaire Analysis

Driver

QUESTIONS	RESPONSES	RESPONDENTS
1. Have you ever encountered mechanical car breakdown?	Yes No	Yes = 5 No = 1
2. How do you get assistance?	Stop an Incoming Car Online Asked a friend	4 0 2
3 How long did it take to get help from the mechanic?	0-3 hours 3-5 hours More than 5 hours	3 1 2
4. How far did you did you get help from the car breakdown site?	0-3 Kilometres 3-5 Kilometres 5-20 Kilometres More than 20 Km	2 3 1 1

5. Are you aware of any app/tool that can connect you to the mechanic?	Yes No	0 6
6.If an app that displays the nearest mechanic and distance between you and the mechanic was provided would such an app be useful? And would you support and use it?	Yes No	Yes = 5 No = 1
7 Would recommend such an app/tool to someone?	Strongly recommend Recommend Least recommend Not at all	3 2 1 0

Mechanic

QUESTIONS	**RESPONSES**	**RESPONDENTS**
1. Have you ever been to a car breakdown site in the emergency notification from the driver?	Yes No	Yes = 5 No = 1
2 **When** did you last visited the site of car breakdown for the service?	0-3 Months 4-12 Months More than a year	4 0 2

3. How did you get notified that there is a driver that needs his/car repaired?	Through a friend Phone Call Through a driver	2 3 1
4 Do most of the drivers prefer/get specific mechanic	Yes No	4 2
5. Do you normally get customers/drivers coming to your garage for the services in the case of car breakdown?	Yes No	6 0
6. Do you get notified about the drivers whose vehicles have encountered breakdown on the remote areas?	Yes No	Yes = 5 No = 1
7 Is the procedure of getting the remotely locating the driver efficient, reliable and accurate?	Yes No	0 6
8 Are you aware of any app/tool that can help in connecting drivers and mechanics?	Yes No	0 6
9 If you had an app that remotely locate the driver and displays the distance was provided would you use such an app?	Yes No	5 1
10 Do you think an app provided would help?	Yes No	5 1

11 Would you recommend such an app to your friend?	Strongly recommend Recommend Not at all	4 2 0

4.2.2 Interviews

I interviewed 10 stakeholders who are drivers and mechanics.

Recommendation for a new system interview table.

Number of Respondents	Recommending for a new system	Not recommending for a new system
10	7	3

Table 1 Recommendation for a new system interview table

Percentage of those who recommend for a new system.

7/10*100=70%

Percentage of those who did not recommended for a new system.

3/10*100=30%

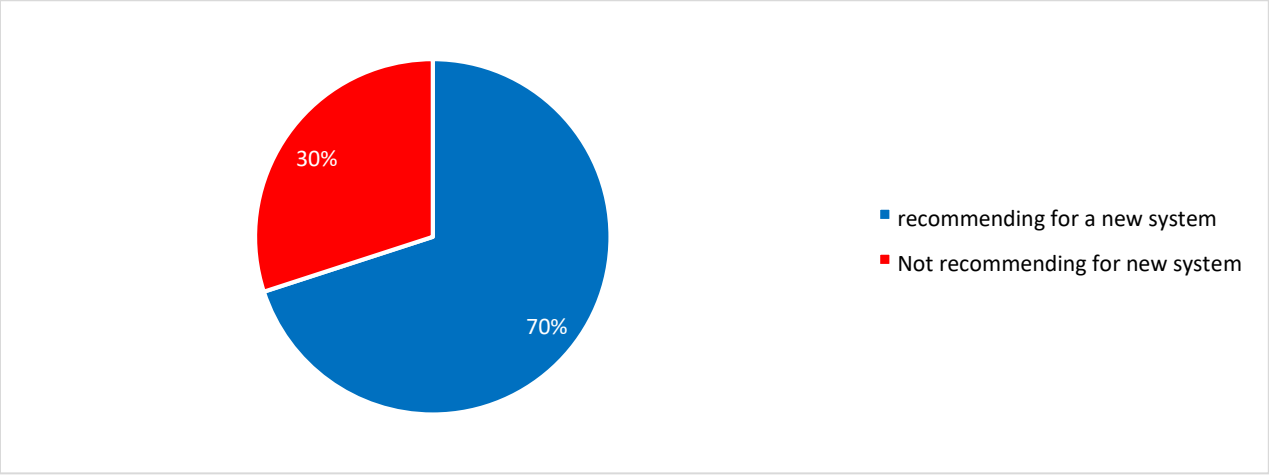


Figure 2: Recommendation for a new system interview pie chart

From the interviews, it was noted that:

The current systems used nowadays are prone to shortcomings. Most people cited that the shortcomings of the current systems make them not comfortable in using them requesting for a new system to address the shortcomings.

4 CHAPTER 5: SYSTEM DESIGN

4.1 Introduction

A requirement is simply a high-level, abstract statement of a service that a system should provide, or a constraint on a system. Requirements analysis is the process of developing software specifications that are intended to communicate the system needs of the users to the system developers.

Software system requirements are often classified as functional or non-functional requirements.

4.2 Functional Requirements

It relates to a process the system has to perform. This described the core functionalities of the system. They included the following:

i. To allow the driver locate nearby mechanics
ii. To allow drivers find the distance between them and the mechanics
iii. To allow the driver find path to mechanics site
iv. To enable the driver rate mechanic

4.3 Non-Functional Requirements

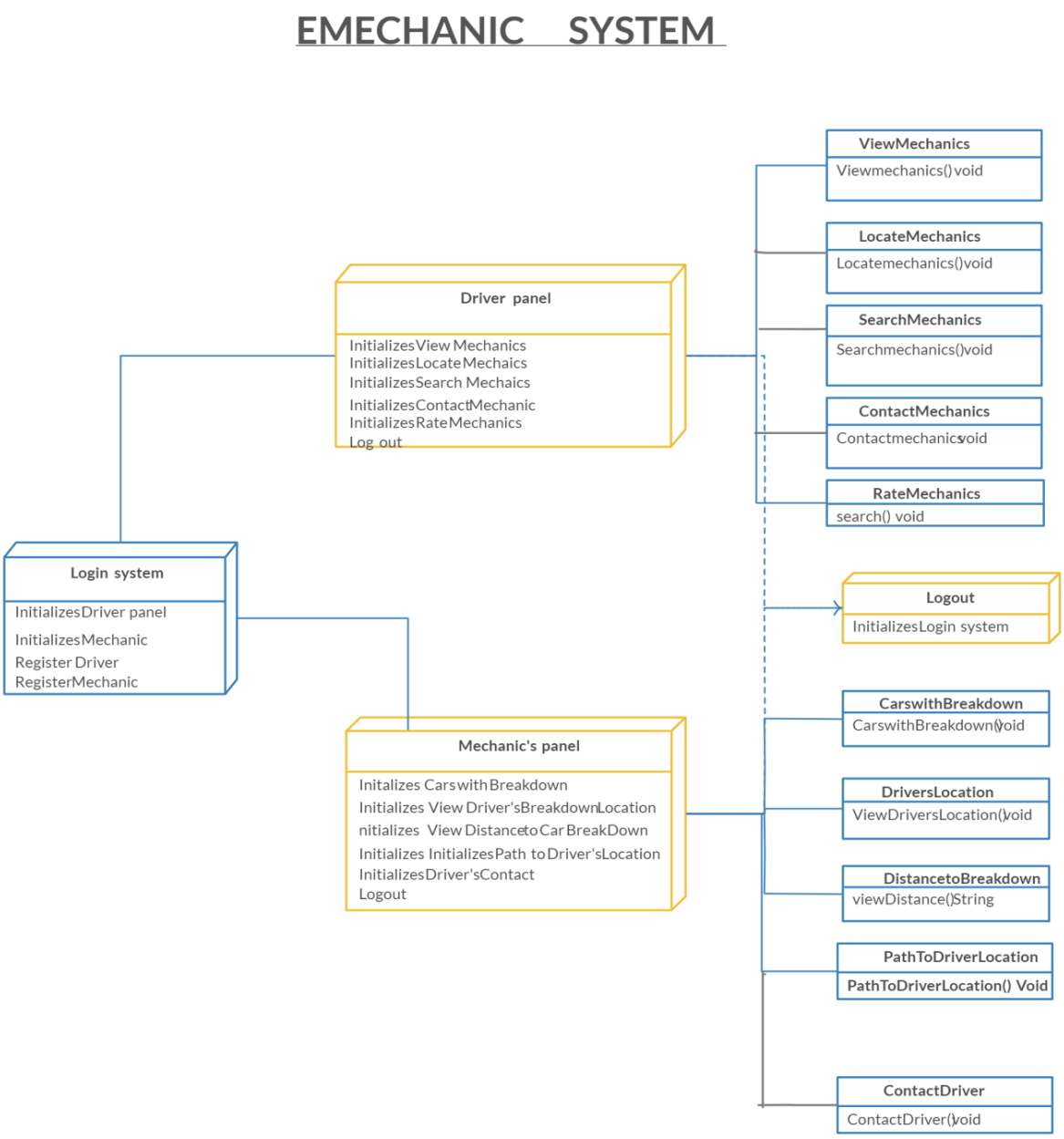
i. Ease of use - The application is easy to use for all type of users.
ii. Understandability- The system is easy to understand by new users from the very user-friendly interfaces. iii. Availability. The system will work 24 hours a day making it convenient for security user to access it at any time.
iii. Security - The system enhances data authentication by use of passwords to protect it from unauthorized users.

iv. Confidentiality - The system ensures confidentiality of users' information.

v. Reliability - The system ensures minimum meantime to failure, low probability of unavailability and rate of failure occurrence.

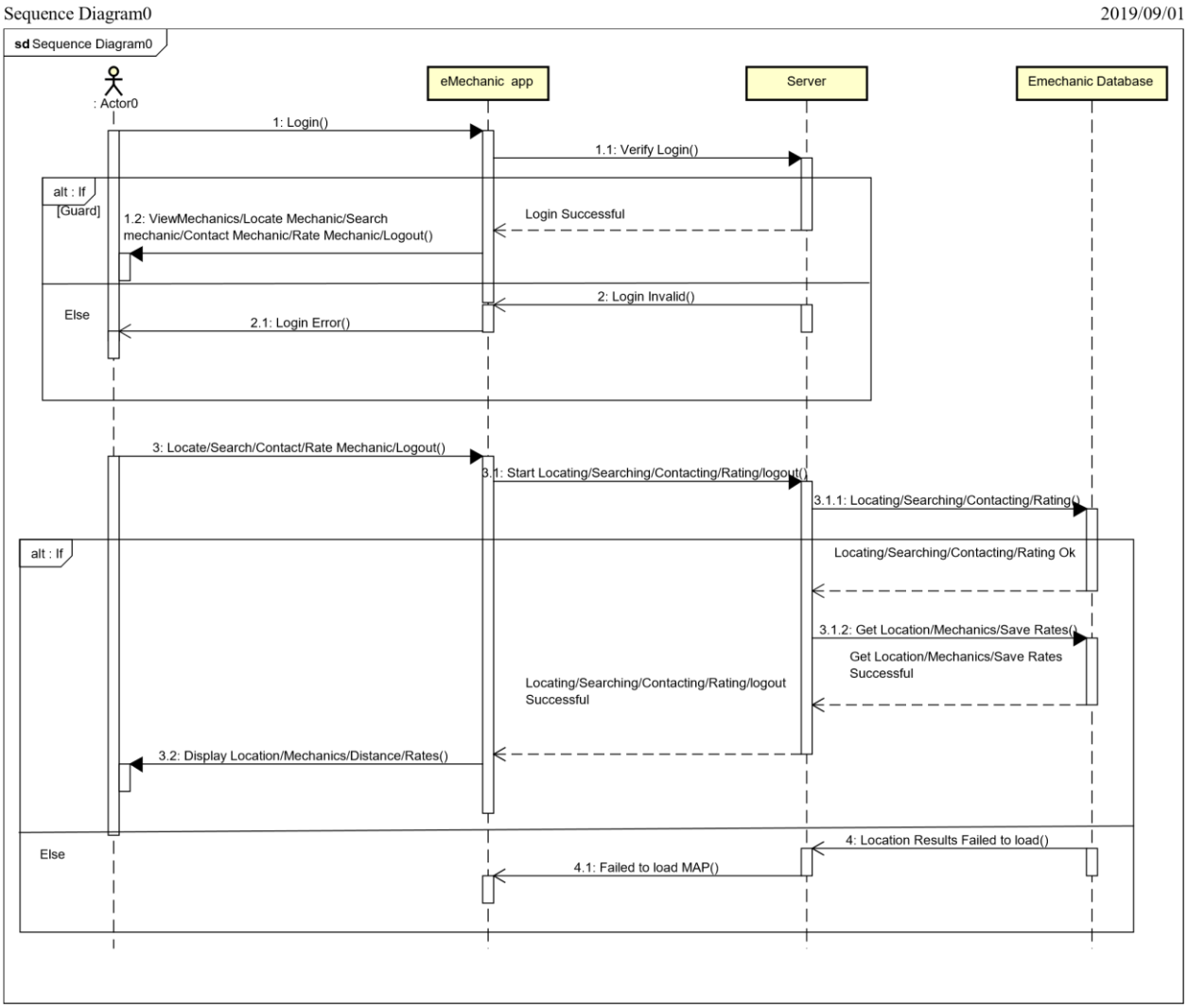
4.4 UML Diagrams

4.4.1 Deployment Diagram

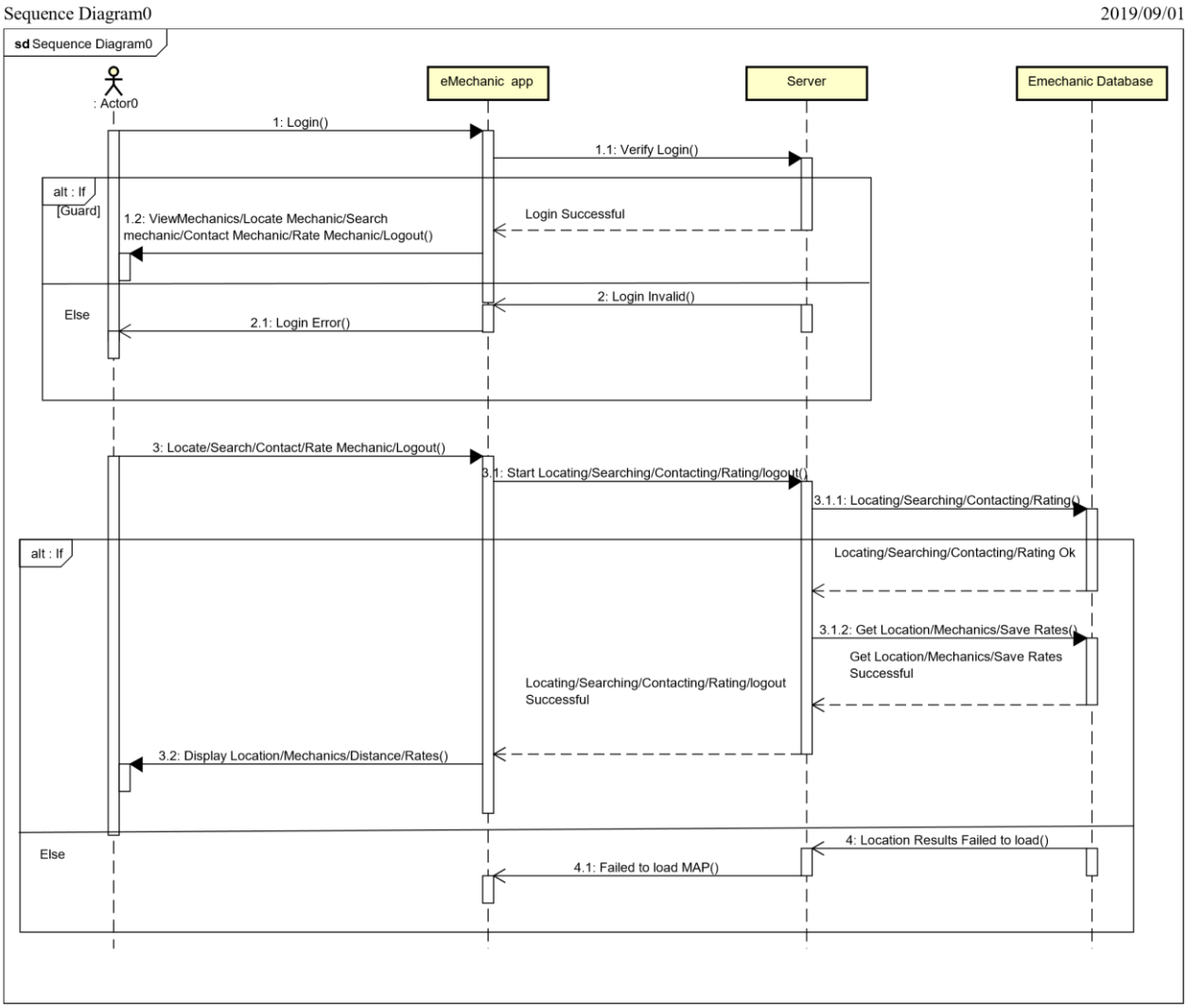


4.4.2 Sequence Diagram

Driver and the system



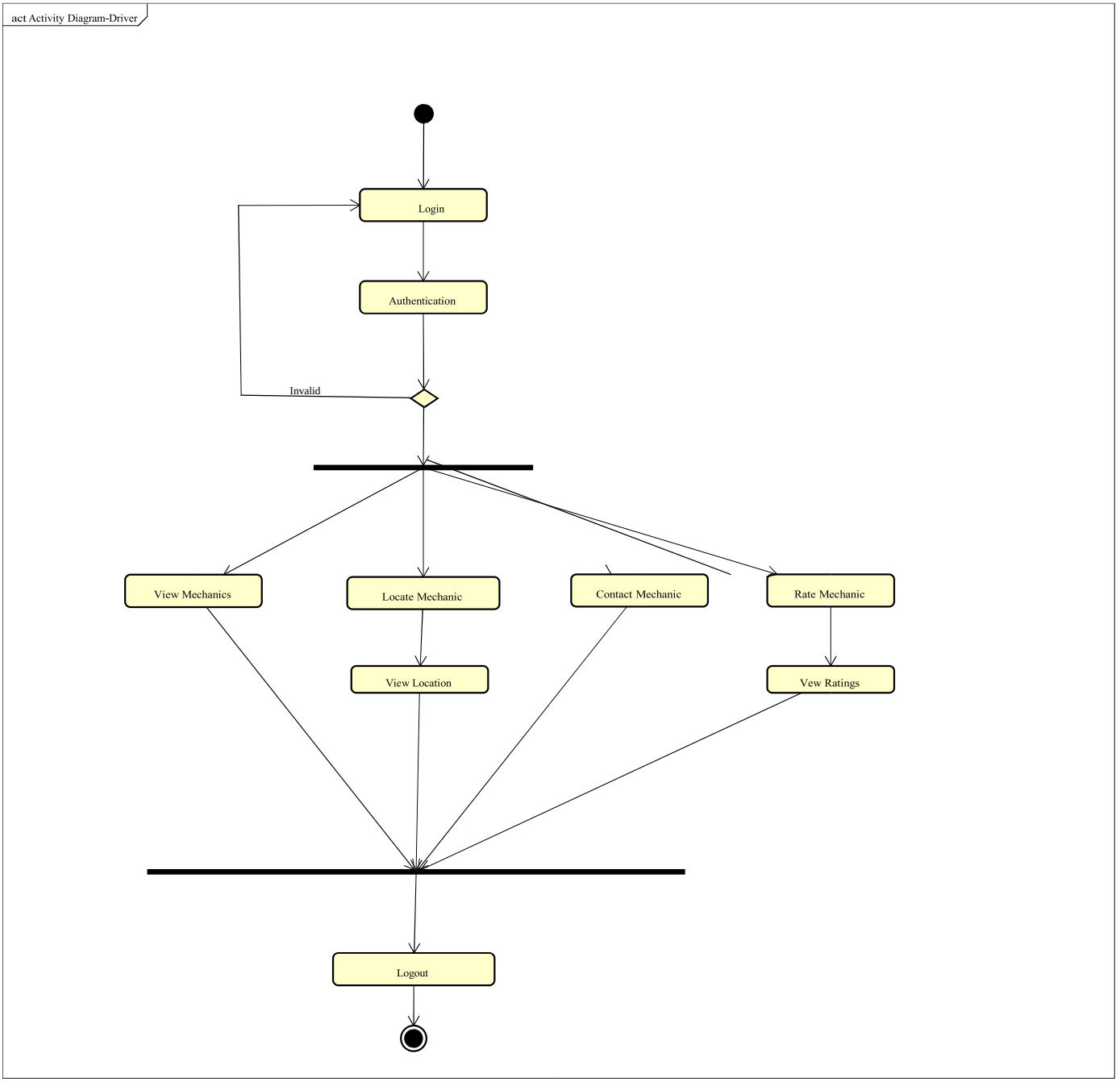
Mechanic and the system



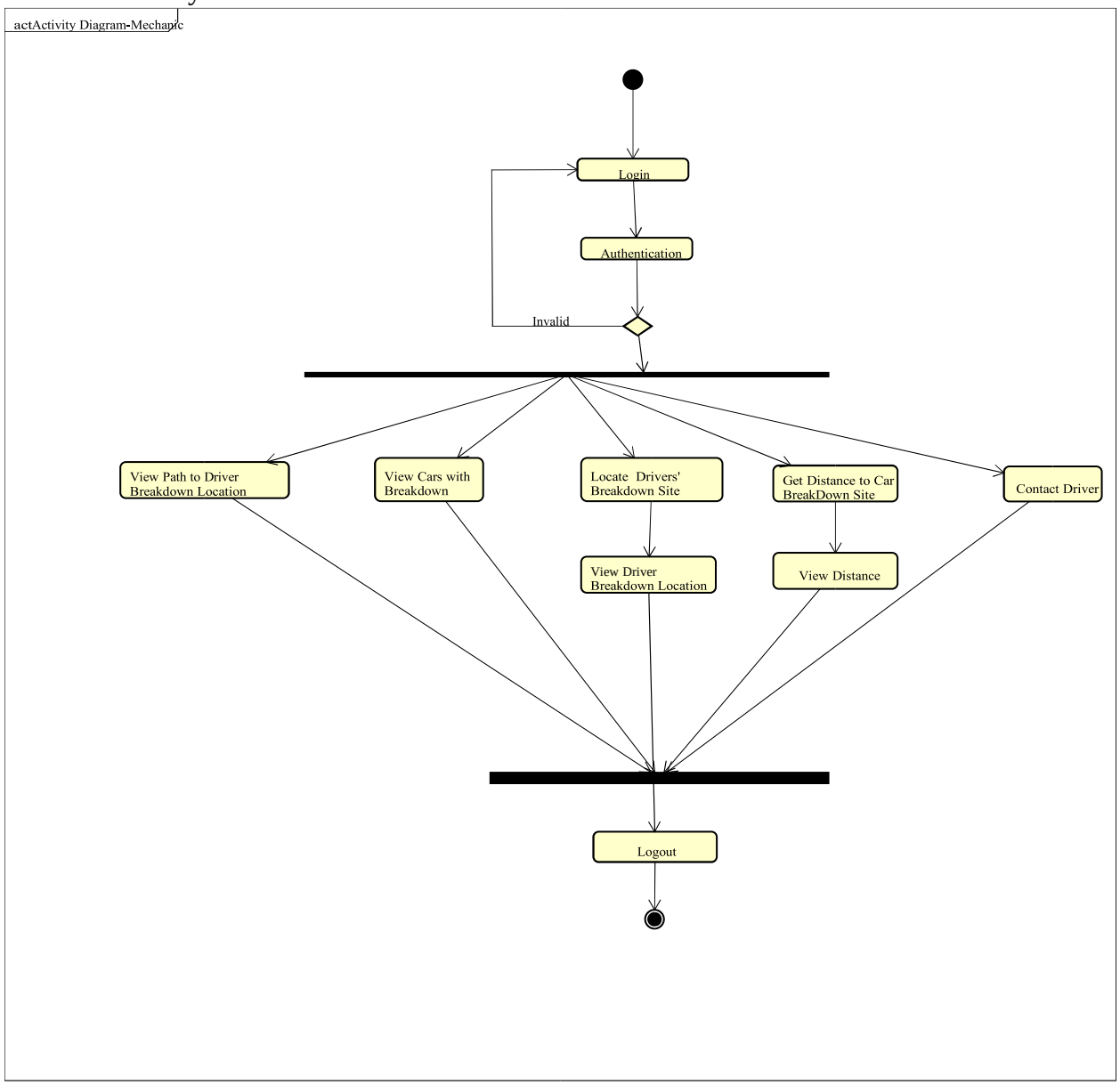
4.4.3 Activity Diagram

Driver and the System

Activity Diagram-Driver 2019/09/02

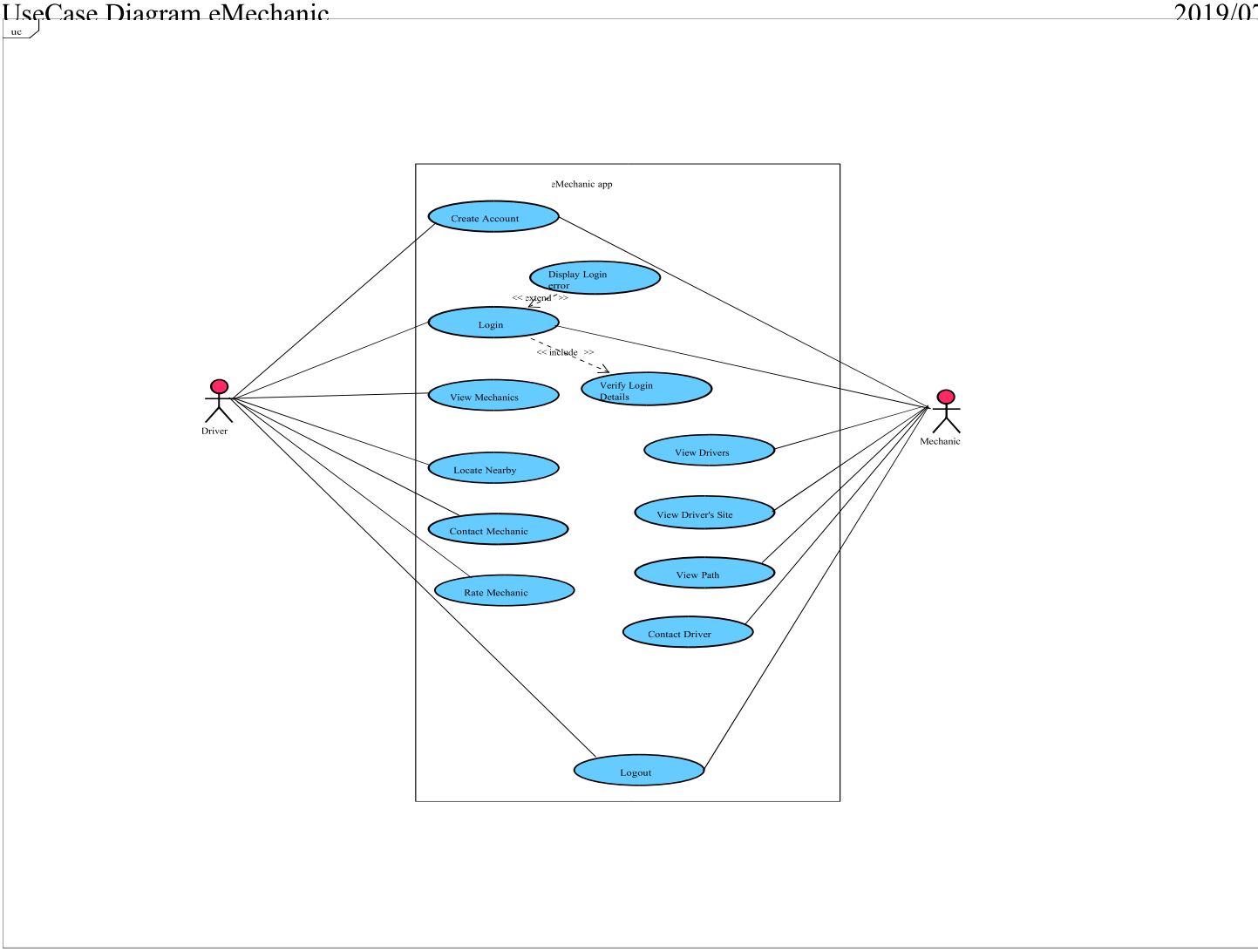


Mechanic and System



4.4.4 Use Diagram

UseCase Diagram eMechanic 2019/07



CHAPTER 6: SYSTEM IMPLEMENTATION AND TESTING

6.1 Introduction

In this chapter, testing, implementation and deployment activities for the system are highlighted. System design involves the determination of how to build the system and its overall architecture to serve as a technical system blueprint. Deployment then refers to activities that make the hardware and software available for use. Software Testing on the other hand is a strategy that integrates test case design methods into a well-planned series of steps that result in the successful construction of software.

6.2 Test Plan

This is a process which involved a series of different kinds of tests performed on the system and its components.

6.2.1 Unit testing

Involved testing minimal software components and subcomponents or modules such as the registration, selling products, searching products, purchasing products among other modules. Each module was tested individually to verify that they function correctly as per the content. For instance, a module like for locating the mechanic was tested to see whether it carried out the full process correctly.

Test	**Test Area**	**Expected Results**	**Expected Results**
Unit Testing	Testing individual modules of the system	Every module having the capability of running independently and give the expected output	The modules worked appropriately and were able to give the correct output

Table 2 Unit testing table

6.2.2 Integration testing

In this stage, different modules of the system were combined together and tested as a whole. In this process, it verified that the individual components integrated were able to work together and interact well without any conflicts. It was tested that the integrated modules were able to meet the stated user needs.

Test	Test Area	Expected Results	Actual Results
Integration Test	Modules Relationships	Different modules in the system working together in the expected way	The modules were able to work together and produce the expected results

Table 3: integration testing table

6.2.3 Acceptance testing

In this stage of testing, activities involved taking the final system to the real users of the system to test the system for themselves. After the testing it was found that the system had good usability and could be easily understood even by people with little computing knowledge.

Test	Test Area	Expected Results	Actual Results
Acceptance Testing	System's acceptability and usability	Mechanics and Drivers being able to navigate through the site with minimal effort.	Mechanics and Drivers with the lowest level of education were able to use the system with no assistance.

Table 4 :Acceptance testing table

6.3 Test Cases

A test case is a set of conditions or variables under which a tester will determine whether a system under test satisfies requirements or works correctly. This is a process which involved a series of different kinds of tests performed on the system and its components. The process of developing test cases can also help find problems in the requirements or design of an application.

6.3.1 Registration and Login Test Case

This verifies that the user's login form is working correctly. For it to work, one must have a valid phone number and password which is acquired during registration.

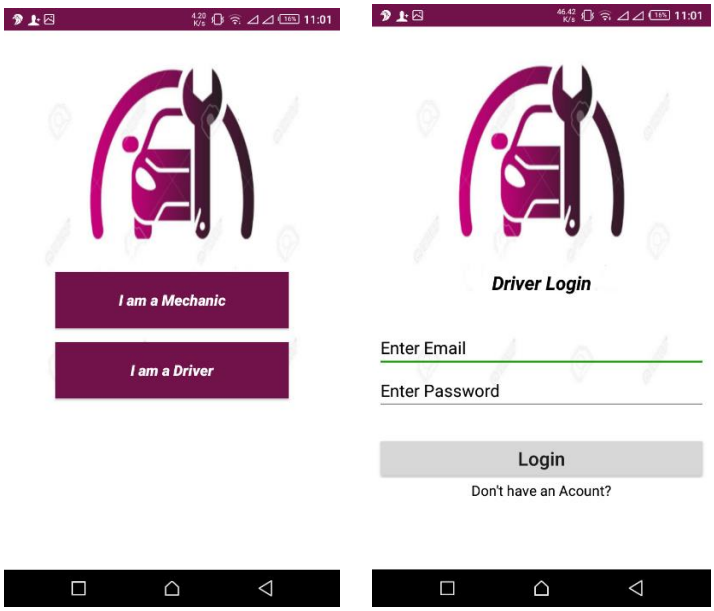


Figure 1 : Registration and Login Test Case

i. Test procedure - Enter the email and password then click the login button.

ii. Test data - email, password.

iii. iii. Expected results - The user logs in on entering correct email and password.

iv. Actual results - If the user details are correct, the user logs in, otherwise he/she is denied access to the system during login.

6.3.2 Manage User Accounts Test Case

Verifies that the system allows users to manage their own accounts.

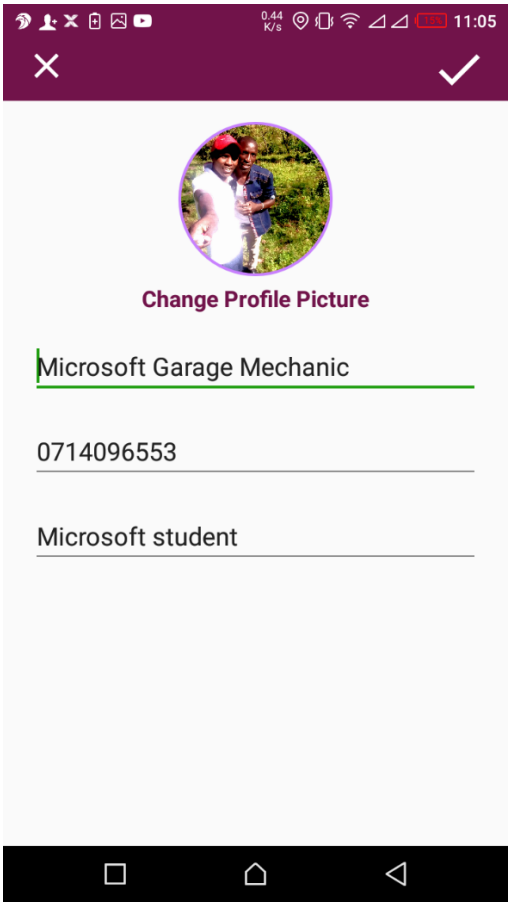


Figure 2 : Manage User Accounts Test Case

i. Test procedure - Click on the Accounts Setting button presented on the user interface to perform the action shown.

ii. Test data - Account details and buttons functionality in response to performing CRUD operations.

iii. Expected results - User able to view and edit their accounts.

iv. Actual results - Successful reading and updates of user accounts.

6.3.3 Locating Nearest Mechanics Test Case

Once the driver is logged in successfully, he or show is able to locate the nearest mechanic

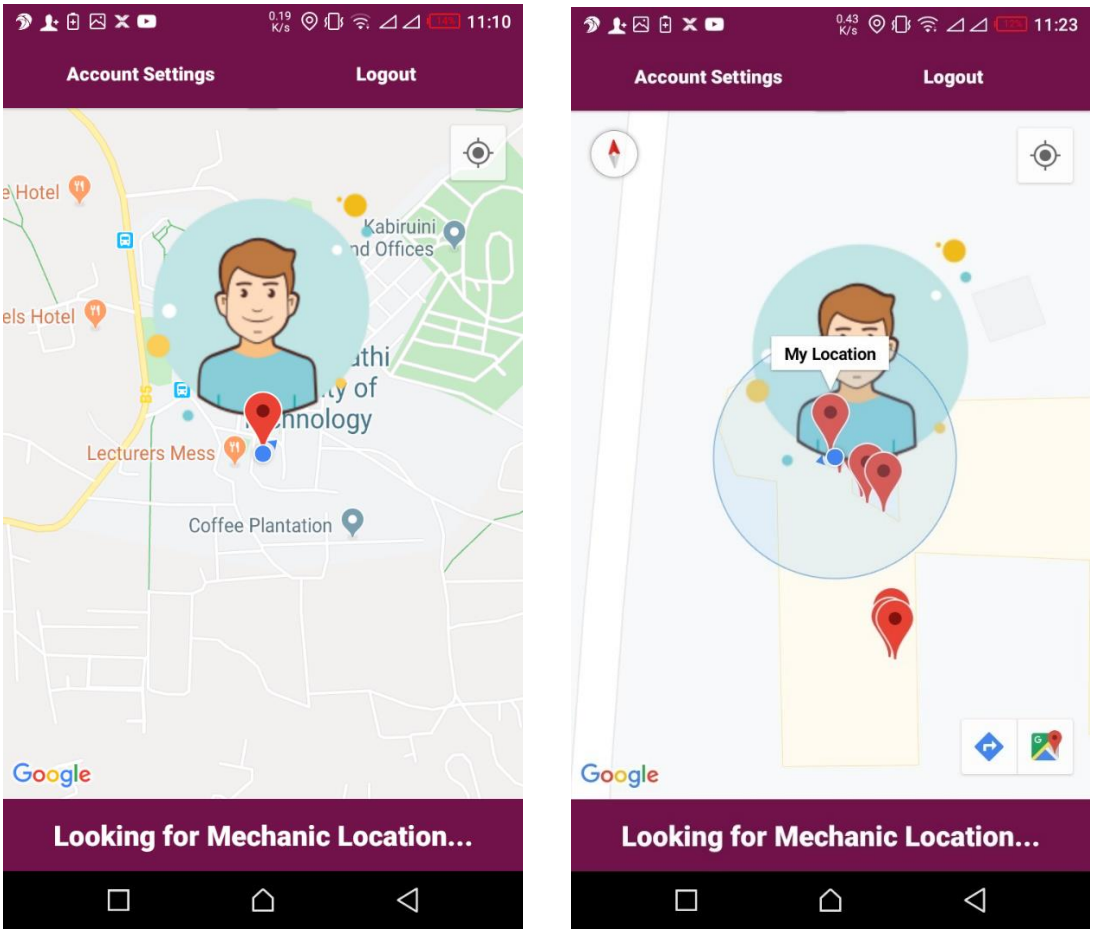


Figure 3: Nearest Mechanics Test Case

The driver can call the nearest mechanic and request for the service

6.3.4 Mechanic's Receive Driver Request Test Case

Once the driver finds the nearest mechanic, he/she can request for the service. The assigned mechanic can view the location to the driver assigned and his/her contact information.

Figure 4:Driver Request Test Case

6.4 Implementation

Front End implementation - It was implemented using Java and XML for the android part. Back End implementation - The Back-End database was developed using Firebase Database.

Implementation Strategy-I used the phased changeover strategy which took place in stages, where implementation of a part of the system was done and ensured that it is probably working before going to the next. The tools which were used for development included android studio for developing the android application, Firebase, visual paradigm for designing the UML diagrams.

In this stage, the agile model proved its importance due to its ability of allowing addition of new requirements as they were recognized at every stage of development. The model also helped reduce inherent project risks by breaking a project into smaller segments and providing more ease-of-change during the development process. I involved the users as well as my supervisor throughout the process which helped increase the likelihood of user acceptance of the final implementation product.

6.5 Deployment

Below are the overall operations that were performed during the deployment of the system.

1. Release - During the course of development, the system prototypes were and shall continue to be released for user testing and reviews. The database was hosted on the on firebase server where the system had access.
2. Installation - Involves both hardware and software installation for the use. I acquired and installed the required hardware for instance mobile phone and configured the new system on them.
3. User Training and Orientation - This involved introducing the users willing to use or learn more about the system, training them on how to get the android application and use it comfortably.
4. Security - For security purposes, the following were implemented:
    a. Password and Email Security
        - Used passwords and email for authentication.

5. Installed System - After the finalized Installation of the System, it was checked to ensure that the new installed system was in the appropriate working server and environment.
6. Maintenance - I was involved in the monitoring and reviewing of the new system's performance and problems. The results of the new system were compared with existing system to assess performance difference.
7. Evaluation - Upon comparison of the performance and reliability of both existing and new system, an analysis was conducted to evaluate their differences and similarities and the service delivery efficiency.

Post Implementation Review Summary - Finally, I wrote a report which identified any techniques and practices used during the development of the project that worked extremely well, and which would benefit current and future projects

7.0 CHAPTER 7: CONCLUSION AND RECOMMENDATION

7.1 Discussion

In this project a system to link Drivers with the Mechanics has been developed. The system can handle as may users as possible. For mechanics, they can upload their service information as one of the objectives and the system is able to capture the location based on the address of their locations. Drivers can view the location of the mechanics on the google map and get the get the nearest mechanic and after getting satisfied they can directly contact the mechanic whereby they pay some small fee. In either of the cases the mechanic can view the pickup locations for the driver.

7.2 Limitations

i. Challenge on obtaining information - During fact finding, not everyone was willing to disclose some crucial information and even some were not confident enough while giving their responses.

ii. High memory requirement for machine while running android studio development environment.

iii. Only Android devices are supported - The mobile application is only capable of running on Android devices and not capable of running on IOS or Windows devices.

7.3 Recommendation

The future requirements for this system are as follows:

i. Incorporate Mpesa Payment module.

ii. Having a chat area for the driver and mechanic where drivers can interact with mechanic on one to one basis.

7.4 Conclusion

Emechanic System was expected to help drivers locate the nearest mechanic in the case of car breakdown. It was also expected to allow the mechanic view the driver's location and the path to the driver's car breakdown site This was well achieved and was the project was a success.

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8.1 APPENDICES

8.1.1 Resources

To realize the performance of the system, several resources and tools are required. The following is a list of the required resources. They include;

8.1.1.1 Hardware resources

Resource	Size	Price Ksh
Computer	Laptop	40000
Hard Disk	500GB	7000
External hard disk (backup)	150 GB	1000
Memory	4GB(RAM)	2500

Table 2: Hardware Resources

8.1.1.2 Software resources

Resource	Size	Price
Operating System	Windows 10/Ubuntu	3000
DMBS	MYSQL/Firebase	4500
IDE	Android Studio	2000
Server		4500

Table 3 Software Resources

8.1.2 Gantt chart

TASK NAME	DURATION IN WEEKS																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PROJECT IDENTIFICATION																				
PROPOSAL WRITING																				
PROPOSAL PRESENTATION																				
DATA COLLECTION																				
DATA ANALYSIS																				
PROJECT DESIGN																				
IMPLEMENTATION																				
PROJECT TESTING																				
DOCUMENTATION																				

PROJECT PRESENTATION																		

Table 4 Gantt chart

8.1.3 Budget

The following is the budget schedule for the proposed system:

ITEM	UNIT	PRICE PER UNIT(KSH)	COST (KSH)
Laptop	1	40000	40000
External hard disk		1000	1000
MSQL server	1	2000	2000
Proposal printing	3	200	600
Internet for Research	8	1000	8000
Transport	1	1000	1000
Documentation printing	3	500	1500
Total cost			54100

Table 5: Budget