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A framework for robotic process automation (RPA) for the first-line resolution of customer queries: a case study of Safaricom.

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A Framework for Robotic Process Automation (RPA) for the First-line Resolution of Customer Queries: A Case Study of Safaricom

By

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Declaration and Approval

I Kelvin Wachira declare that this research has not been previously submitted to any other University for the award of a Degree in Master of Science in Information Technology.

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Abstract

Customer support is important for every institution, be it profit-making or non-profit making. Better services save money, complains and time. Big companies with millions of customers, strives to provide better customer care support due to the high number of customers. They have always found themselves not achieving the kind of support that their customers want. The biggest challenge that such companies with large customer base face in their customer care department, is having enough workforce to respond to customer queries. Keeping on employing new staff does not solve the problem fully as there is a limit to how many employees the company can be able to sustain beyond which the company running cost will exceed the returns. Therefore, this research proposed to solve this challenge by developing a framework for Robotic Process Automation that would enable the creation of a digital workforce to augment the human workforce available for first-line customer query resolution. The main literature that was supporting this research was previous frameworks on RPA. These frameworks do not address customer query resolution, are specific to a given technology and hence not adaptable to different technology. The existing frameworks are also specific to processes and companies which makes them inapplicable to changes in process or company. This research developed a framework that guides the implementation of RPA for customer care department. The framework is not specific to any technology and hence can be used across the company. Test processes used was customer query response process in Safaricom which is a Telcom company in Kenya. The test results gotten from the test bots was 75% success rate with 100% accuracy rate on the pulled response. There are failures that happened with accounted for 9% due to third-party applications. With this framework and the resultant prototype bot, time taken to given customers their feedback in each shift was reduced from 2 hours to about three minutes. This research enabled streamlining and standardization of the customer care processes as well as automating the reporting part of the customer care process. The results indicated that the value is not only in the bot. This study gives organizations insight on how to successfully implement RPA and what factors to beware of to avoid failure.

Keywords: RPA, First-Line, Software bot, MSISDN, UiPath.

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Abbreviations/Acronyms

BPM - Business Process Management

CRM - Customer Relationship Management

OCR - optical character recognition

ROM - Robotic Operating Model

RPA - Robotic process automation

SMS - short message service

SQL - Structured Query Language

Chapter 1 : Introduction

1.1 Background

Safaricom is a mobile network operator Kenya, which is the largest telecommunications provider in Kenya according to Communication authority of Kenya with 29,570,185 customers as of the 2017 -2018 report published by the Communication Authority of Kenya. The company offers a wide range of services to their customers which includes mobile money transfer, mobile telephony, consumer electronics, e-commerce, cloud computing, data, music streaming, and fibre optic services. With these services, their customers need the best of customer support across the different domains.

Customer support involves the provision of services to customers after acquiring a service or during the process of acquiring a service. Kurtenbach (2000), explains that companies that prioritize customer experience are successful in customer support. The level of satisfaction of the customer is determined by the services that they are provided with although what one customer sees as quality may not be quality to another customer. To provide quality service to customers, customer care department does a lot of tasks that repetitive and mundane such as getting customer profiles and giving feedback to customers.

With these tasks that are mundane and repetitive in customer care department that do not need special expertise to execute, organizations need to develop problem-solving programs that cheaply handle the tasks and at the same time remain competitive or have a competitive edge over their competitors. Robotic process automation enables the automation of tasks that are repetitive and helps in reducing the operation cost (Forrester Research, 2014). The quality of service also improves with speed and with fewer errors due to RPAs ability to execute the same steps several times (Willcocks & Lacity, 2016).

In the past few years, there has been a lot of technological advancement in the field of robotics. Proving that there is a lot of potential in the field of robotics. This has enabled a large proportion of remedial repetitive tasks to be handled by robots. However, technology has slowly shifted from physical robots to more of software robots.

The word Robotic Process Automation (RPA) came into existence for the first time in 2012 and was coined by Blue Prism which is an RPA software company marketing director Patric Geary (Hindle, Lacity, Willcocks, & Khan, 2018). Robotic Process Automation (RPA) has become an emerging topic that has consistently been on the upward trajectory since then (Willcocks & Lacity, 2016). It is expected that from 2018 to 2021 there will be a 94% increase in the market for RPA (Fersht & Snowdan, 2017). There have been several names to describe RPA, which includes botsourcing and software robotics (Vedder & Guynes, 2016; Davenport & Kirby, 2016). They all mean the same thing. This has left humans only to focus on the tasks that need human interactions and more of human brains to execute while leaving the robots to handle tasks that are less demanding of the brainpower and are more repetitive in their workflow.

The idea behind RPA is to collaborate with any software to automate it without changing the actual code of the software as opposed to the traditional way of automation where it involved changing the underlying code of the software to automate the given software. This has resulted in RPA being cheaper and easier to establish and run (Willcocks & Lacity, 2016).

1.2 Problem Statement

According to Gonçalves and Sampaio (2012), to provide good service to the customers' quality is essential. From this, many companies strive to provide quality customer care services to their customers. Organizational survival is highly affected by the satisfaction that customers receive. Customers are unwilling to switch service providers and prefer to stick with a service provider that they feel comfortable and satisfied with, this is highly contributed to by the quality of service they receive (Rosenbaum-Elliott et al, 2011). The more the customers feel that their queries do not get resolved in time and effectively and feedback given in a timely manner, they will find it easy to change to other service providers. With this in mind, there is a need to find a solution that will help in providing quality and effective services to the customers.

Efficiency and effectiveness are key components of the customer care department. When a scustomer sends an SMS or an email, complaining of any service that they are not getting, the system opens a ticket with a unique ticket number that the customer can use to track the progress of his query. A customer service staff logs into the system to see all the open tickets that have not

been closed or resolved and work on them and store the feedback in a customer relationship management system (CRM) as the first line resolution. In case they are not able to resolve the ticket, they refer the problem to Engineers in different departments depending on the kind of issue, which is the second line of resolution. This can take a lot of time before feedback is gotten as once a query is resolved and feedback put into the CRM a customer support agent has to go through all the feedbacks sending them manually to the relevant customers.

According to Goldermier (2016), who heads the contact centre operations department at Safaricom on a daily basis, the average number of tickets that are opened average about 400,000 tickets, with this kind of numbers by the end of the day only an average of 180,000 to 230,000 tickets are successfully closed and feedback given. There has always a big backlog of tickets that have not been responded to, as there are only 700 staff available to close the tickets.

1.3 Aim

The aim of this research is to develop a framework for robotic process automation (RPA) for the first-line resolution of customer queries to handle remedial repetitive tasks. A prototype has been developed for the purpose of proving the effectiveness of the framework. This has created a roadmap that enables implementation of RPA with the most suitable method of implementation describing it in detail and be able to evaluate its benefits to both the customer and Safaricom as an organization.

1.4 Specific Objectives

i. To investigate key characteristics of successful customer service.
ii. To review existing models and approaches for robotic process automation (RPA) implementation.
iii. To develop a prototype bot for customer query resolution.
iv. To test the performance of the developed prototype bot.

1.5 Research Questions

i. What are the key performance indicators of a successful customer care department?

ii. What are the existing robotic process automation (RPA) implementation frameworks?
iii. How can a prototype bot for customer query resolution be developed?
iv. How can the proposed prototype bot be tested?

1.6 Justification

Customer support has been the backbone of every company. Customer satisfaction is therefore crucial to maintaining a good relationship between the customer and the organization. Customers' voice provides the only true direction for any organization. Indeed, in the long run, people do not want services or products from companies that do not go "the extra mile" in looking after their customers (Teh, 2007).

This research makes it easy and faster to handle customer queries and give response. It adds to the workforce that deals with handling customer support. There is, therefore, a need to have a cheap solution that is able to help improve the efficiency and effectiveness of the whole customer care process. This has been driven by the need to survive and remain competitive, hence the pursuit of quality customer services in both private and public organizations (Agus, Barker & Kandampully, 2007).

Reliable and timely closure of customer queries is essential for any company as its key to strengthening customer relationships. It is therefore essential to create an effective first-line customer query resolution. Having a robust RPA framework is key to the attainment of this ensuring that it always responds to questions on time. Improving service delivery to the customer and with minimal human intervention, which is much cheaper to the company as several robots are able to run concurrently.

With the emergence of RPA, it makes it possible to have an all-round working period while ensuring efficiency and good quality work. Therefore, become easy to handle several tickets at the same time being faster than a human being is able to handle. This research creates a roadmap that is beneficial to other departments that would want to replicate the same. In addition, this research gives the following benefits to Safaricom: improved quality as the processes have been standardized, improved productivity as there is extra workers in this case virtual workers that can be scaled quickly and easily, reduced operating cost as there will be no need of hiring extra staff.

Vodafone affiliated companies also benefit from the framework as they have a reference point that will be guiding them in their own implementations avoiding possible failure points.

1.7 Scope and Limitation

In this research, the focus is on robotics, both managed and unmanaged and also the maintenance and monitoring of the robots. The researcher also focusses on the technology involved in creating the robot and go through other supporting technologies that are crucial to the success of the implementation of these robots.

This research uses Safaricom customer care department due to its rich diversity of customer queries and the volume of data available as a case study but also try to compare it to other Vodafone Group-owned telecommunication companies that have made headways with RPA. Safaricom being the biggest company in Kenya provides a good case study as they handle huge volumes of customer queries on a daily basis and hence there is adequate data to test the framework and the prototype. Safaricom has the infrastructure needed for this study which includes a stable network to enable the connection between different systems that are used and the cloud platform. The research is limited by the budget as some of the technologies involved are not freely available and hence is a big hurdle in this research.

Due to the fact that this research is touching on the customer data, stringent rules by communication authority on how customer data is used is also be a limiting factor. To overcome this, sample data of Safaricom employees is used as they form part of the Safaricom customer base having first sought their permission and the permission of the company to use their data.

Chapter 2 : Literature Review

2.1 Introduction

This literature review section is structured in three parts that are the literature review on RPA and customer support giving an overview of what it is all about. Implementation of the project to get to know what is important to look at while implementing projects. The purpose of this part is to identify the different elements that could be used to form a process model for RPA implementation to do customer support. Then the summary of RPA implementation model and the framework.

2.2 Customer Services

A customer is a person who buys goods or services from the service provider. It may also refer to any potential buyer. Customers can be internal to the organization that is providing services such as employees and directors of the organization. They can also be external to the organization that is the general public or even the government of another business (Dei-Tumi, 2005).

Customer service involves provisioning of service to customers, which can be during, before or after acquiring a service. According to Jamier (2002), customer service involves a series of activities that are designed to increase the level of customer satisfaction that is to make a customer feel that their expectations have been met. Quality of service is what a customer perceives, Sureshchander et al. (2002), states that service organizations find it difficult to envision and understand what aspects of service define high quality to a consumer and at what levels they are to be delivered. How satisfied a customer is with the experience they get is what defines satisfaction. For customer satisfaction, the service they get has to meet their expectations.

According to Dean and Terziovski (2002), customer service has strategic importance and companies have to continually enhance customers experience and their satisfaction so as to deliver quality in a market place that is competitive. Customers evaluate service based on five factors according to Leonard Berry (1999) of Texas A & M University:

Reliability – Are they able to provide what they promised dependably and accurately?
Assurance – That is the courtesy that they show their customers, the knowledge and ability to convey trust, confidence, and competence.

Tangibles – that is the equipment they have, their physical facilities and the general appearance.

Empathy – How caring they are and the attention they show to each individual customer.

Responsiveness – how willing are they to help their customers promptly.

2.2.1 Customer Service Triangle

Albrecht and Zemke developed a customer triangle in which at the centre is the customer as shown in Figure 2.1 (Armistead & Clark, 1994).

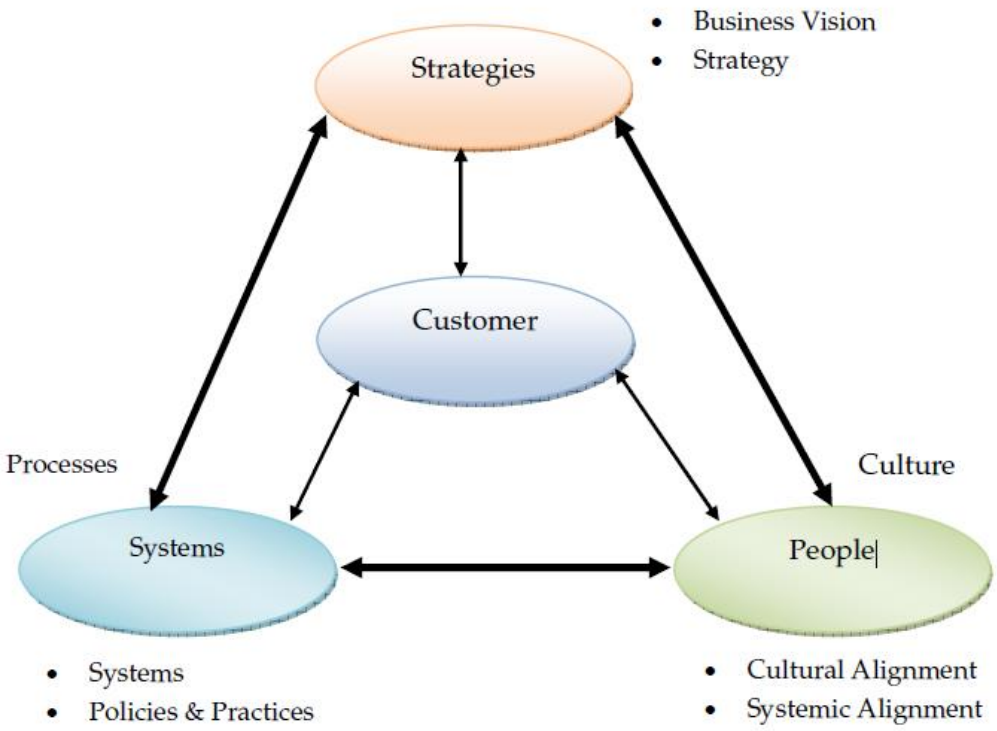

Figure 2.1: Customer Service Triangle (Armistead & Clark 1994, p. 14)

In customer service triangle, every activity must be seen in its impacts on customer satisfaction; understanding how the customer views the organizations' performance rather than accepting internal view. There must be realistic strategies that express the value of service to the customers. The systems employed by the customer service must be reviewed to make sure that they have a significant impact on customer satisfaction. People who deliver the customer service should be

aware of the scope of the task. People will be more effective if they view the systems as a helper rather than viewing them as the ones preventing service.

2.2.2 Characteristics of a Good Customer Service

Good customer service is all about bringing the customers back and sending them away happy. Happy customers give positive feedback to others who may end up trying out the product or service and may become repeat customers. Good customer service has the following characteristics according to Ward (2008):

They do not make promises unless they will keep them – Reliability is a key characteristic of a good relationship. Client appointments and deadlines too need to be taken seriously.
They listen to their customers – A good customer service listens to their customers and makes the appropriate responses like giving customers suggestions on how to solve their problems.
They deal with complaints – They give attention to complaints and by the end of it they may be able to please them.
Take the extra step – They make an extra effort to give customers a good service, for example, telling a customer where a product is located is not enough but taking the extra step of walking with them and showing them the product makes the customer feel appreciated.
Throw something extra to the service – Giving customers coupons, discounts or even additional information. People naturally love getting more than they have bought. This gesture does not need to be large for it to be effective.
They answer customer emails, phone calls or messages – good customer service do not ignore customer emails, phone calls or messages. They answer them promptly and make customers feel appreciated.

2.2.3 Measuring Quality of Customer Service

Most companies measure success by their sales numbers. If they are increasing, then the business is growing, and they use that to measure success, but this does not measure customer service. There are few ideas on how to measure the quality of customer service according to Cook (2002).

Create a survey for the customer to complete – that is to ask customers to rate their past experience. Include questions about particular areas such as the speed of the response, attitude,

how satisfied they were with the solution they were offered, and would they recommend any changes to the services?

Use call monitoring – by this, they are able to measure the type of customer service that they are providing. It may include listening in during a conversation between a service representative and a customer. They may hire consultants to monitor calls and provide training.

Telephone surveys – calling customers to get first-hand feedback on customer experience is also a good way to measure customer satisfaction. It may include calling customers randomly, get their response, and then sample them to get to know their pain areas or areas where they were really well served.

Having a customer service focus group – developing a customer service focus group and allow members of staff and management to gain first-hand feedback from customers. The focus groups can be of two types. Physical focus groups that are having a physical gathering to express their opinions and online focus group that is a discussion held on the web.

Free phone – Providing free customer phones where customers can call toll free any time to express their feedback. For this proper training needs to be provided to staff on how to answer those calls as they can do more harm than good.

Mystery shop – This is hiring people to pose as customers to visit or contact the business. They uncover areas that need improvement and help in identifying skills that the staff needs.

2.2.4 Existing Method of Customer Care Support

Customer care at Safaricom is divided into four stages, that is receiving customer complaints, allocation of tickets, solution, and escalation, and finally response. These four stages take place in a sequential order. At the first stage, customer complaints are received inform of a text message or an email. The complaints are sorted by agents and tickets created which have a unique number to help in tracking the progress of the ticket resolution.

In the allocation stage, the tickets are allocated to different agents who are on duty at a specific time. The third step is the solution and escalation stage where the agents who have been allocated the tickets resolve them. Tickets that the agents cannot resolve are escalated to the engineers who are the second line of resolution. In case the engineers cannot resolve the ticket they also escalate the ticket to the third line support who are the vendors.

The last stage is a response in which the solution is communicated back to the customer who raised the complaint. The response can be in the form of a text message, a call, an email or a combination of all the three modes of communication.

2.3 Robotic Process Automation

Robotic Process Automation (RPA) is a methodology where a computer software is used to complete a specific process that was previously done by a human. Robotic automation software does not replace systems. Instead, it works with the system and performs a particular task in the same way as it has been asked to complete (Sutherland, 2013). RPA interacts with a computer system the same way a human would, but much faster and at a lower cost. Instead of using a salary-paid employee to do a repetitive task on the computer, RPA can be used to do the processes that includes the typing and clicking the same way as a human (Lu, Li, Chen, Kim, & Serikawa, 2017). RPA does not require changing old systems. RPA can be integrated with any software used by humans and it can be implemented in a short period of time for the purpose of carrying out operational procedures (Asatiani & Penttinen, 2016).

The concept of RPA often leads people to imagine physical robots doing tasks that normally would be done by human beings the same way that human beings would be doing them (Lacity & Willcocks, 2015B; Lacity et al., 2015). Instead, the concept of RPA means configuring software robots to perform tasks that previously were being done by human beings. These software robots interact with different systems such as Enterprise resource planning (ERP) or calendars to perform tasks or share information between them (Lacity & Willcocks, 2015; Lacity et al., 2015). RPA provides a platform for automated mature processes that are rule-based, logical and processes that involve well defined and data that is well structured with a definite set out outputs (Lacity & Willcocks, 2016). The tasks are often mundane, repetitive and they do not require specialized skills to do by hand (Lacity & Willcocks, 2016).

Assisting humans is the main goal of using robots in these processes and in some cases to replace humans entirely (Lacity et al., 2015). The human aspect is still required to monitor robots as most of the work done by robots happens behind the scene and only the inputs and outputs are visible to humans.

Since RPA does not involve physical robots that we can count to quantify how many they are, there is a need to have a defined way of quantifying the robots. Therefore, in RPA terms one software robot is equal to one software license (Willcocks et al., 2015B). Contrary to what many think that to configure robots to do the tasks requires one to have extensive knowledge in programming, it is configured like a logical flowchart (Willcocks et al., 2015B). RPA does away with the syntaxes of programming language and focuses more on the core logic (Willcocks et al., 2015B; Lacity & Willcocks, 2015). Generally, RPA does require a lot of skills to set and deploy and hence can be quickly set up.

In the designing of RPA, it is referred to as "lightweight" due to the magnitude of couplings between different systems (Willcocks et al., 2015B; Lacity & Willcocks, 2015; Slaby, 2012). That is RPA interacts with the system at the presentation layer as shown in Figure 2.2 does not disturb underlying computer systems. RPA is able to access the system on the interface the same way a human being will be able to access the system. The difference between traditional automation and RPA is traditional automation directly manipulates the data in the database while RPA manipulates data at the presentation level.

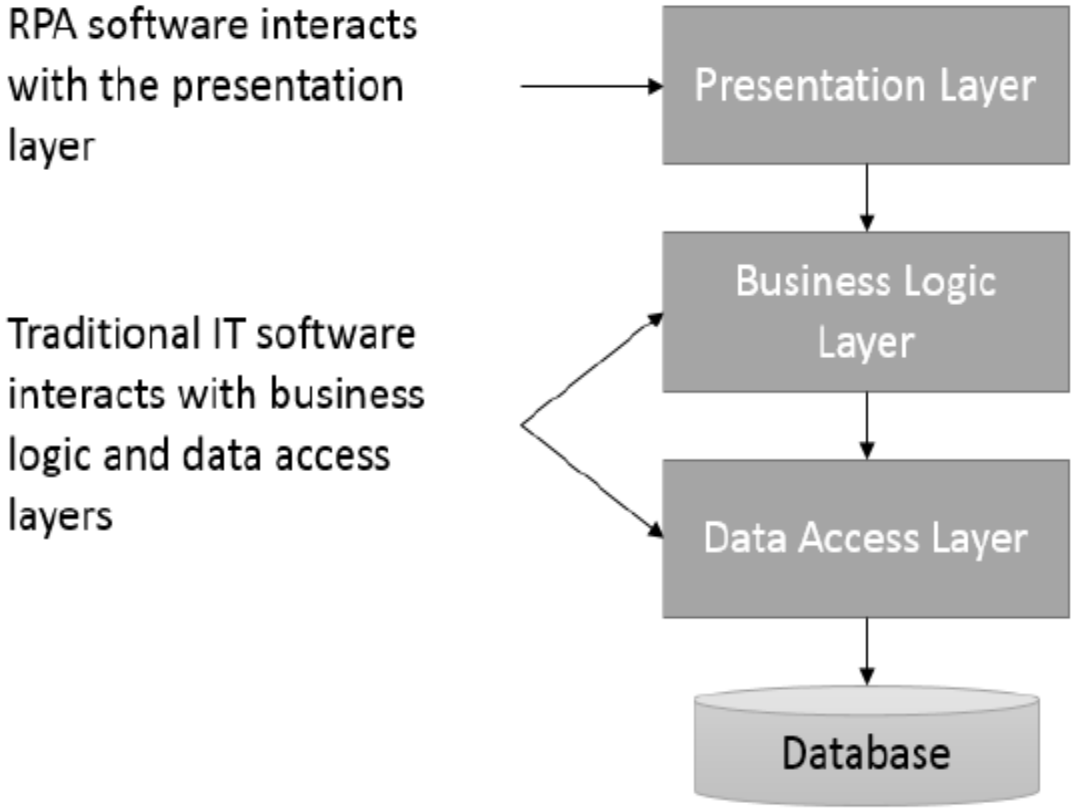

Figure 2.2: The Layers of Software (Willcocks et al., 2015B)

2.3.1 Limitations of RPA

Every technology has its own limitations and that includes RPA. RPA cannot learn from experience as it is not cognitive meaning that it has a shelf life. As processes change and use other technologies there is a need to change the bots to accommodate the change in technology or process. RPA is also limited to the efficiency of the process. RPA is not a Business Process Management (BPM) process and therefore the bots will not fix an inefficient process.

RPA is limited to the infrastructure that is existing. An outdated infrastructure will not be sorted out by RPA. Before applying RPA, technology inefficiency needs to be sorted first before the

implementation of RPA so as to reap maximum benefits. RPA is also limited by the kind of data it can read, unstructured inputs which are non-electric will not be read. Paper letters for instances will not be useful as an RPA input unless scanned and other technologies such as optical character recognition (OCR) used to convert the paper inputs to electronic inputs that RPA can use. Although bots can be trained to read exceptions in the inputs, the inputs need to be of the same format. Different formats will need different bots to handle that hence input format is a limitation for the RPA. This requires the inputs to be of the same format for the robot to handle (UiPath, 2019).

2.3.2 Categories of Queries Solved by Bots

Robotic process automation (RPA) is an exciting technology that helps ease the burden of recruitment as companies grow their customer base. Each technology has its own limitations on what it can achieve and so is RPA. Not all tasks can be handled with RPA as some will be done by a human being better than a bot, so it is important to identify processes that will work best with RPA and those that will not work with RPA. In the landmark 2013 report "Framing a Constitution for Robotistan", analyst Sutherland (2013) identified several key characteristics of processes that would be well-suited for RPA.

Processes that require to access multiple systems, with the ability to access multiple systems through the presentation layer. With the customer care call centre, giving customer response is well suited as for a successful response there are two systems that need to be accessed that is the CRM and Email systems. Processes that do not need special knowledge to execute are a good candidate for RPA. This process follows a predefined flow that does not change and has predefined rules for any decision to be made. The processes are broken into unambiguous rules (Sutherland, 2013).

Processes that are highly repetitive and needs to be undertaken continuously. Processes that do not have a predefined flow are not well suited for RPA as each instance will have its own flow and decisions to be made hence will not be executed by RPA. These are processes that are ambiguous such that one cannot predetermine the next step to take and hence require human intervention (UiPath, 2019). This categories are summarized by figure

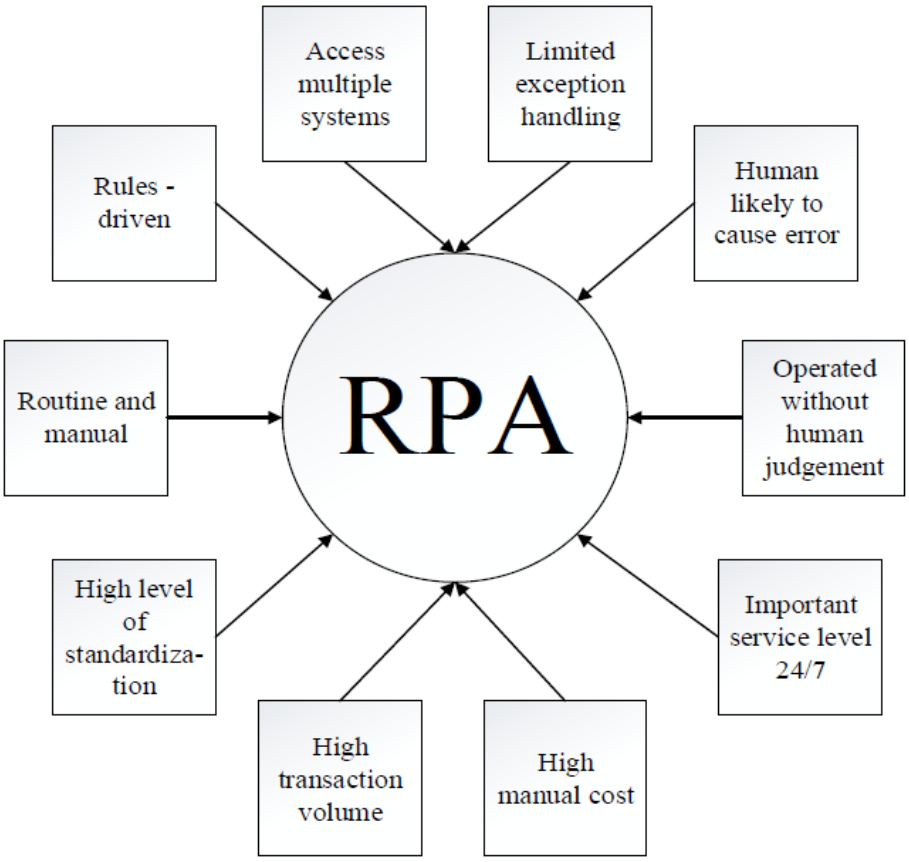

Figure 2.3: Categories of Queries Solved by Bots

2.3.3 Bots Architecture

The key to making a quick transition from a process which is done by a human to an efficient automated process is to choose the right automation software (Mohapatra, 2013). When organizations have decided to implement RPA they have to find out what RPA tool and architecture is best suited for the business. According to Hindle (2018), there were over 45 tools that were marketed as RPA tools. They include Blueprism, UiPath, Automation Anywhere, Workfusion, and Advanced System concept.

Even though RPA does not have self-learning capabilities, it can be used for the further process of the structured output from AI (Burgess, 2016). This is one of many examples of how RPA can be used as an extension to other tools.

RPA software is sometimes confused with screen scraping tools. Screen scrapers only understand a window located in a specific location, so it relies on X and Y coordinates. Recognizing a window defined by a location will no longer work if the window is moved to another screen (Willcocks & Lacity, 2016). Tools like BluePrism and UiPath is an RPA tool, not a screen scraping tool; it interacts with data through Java, Html, Access Bridge and Surface Automation (Willcocks & Lacity, 2016). The architecture of the bots is a composition of several tools that work in tandem to form one complete tool as shown in Figure 2.4.

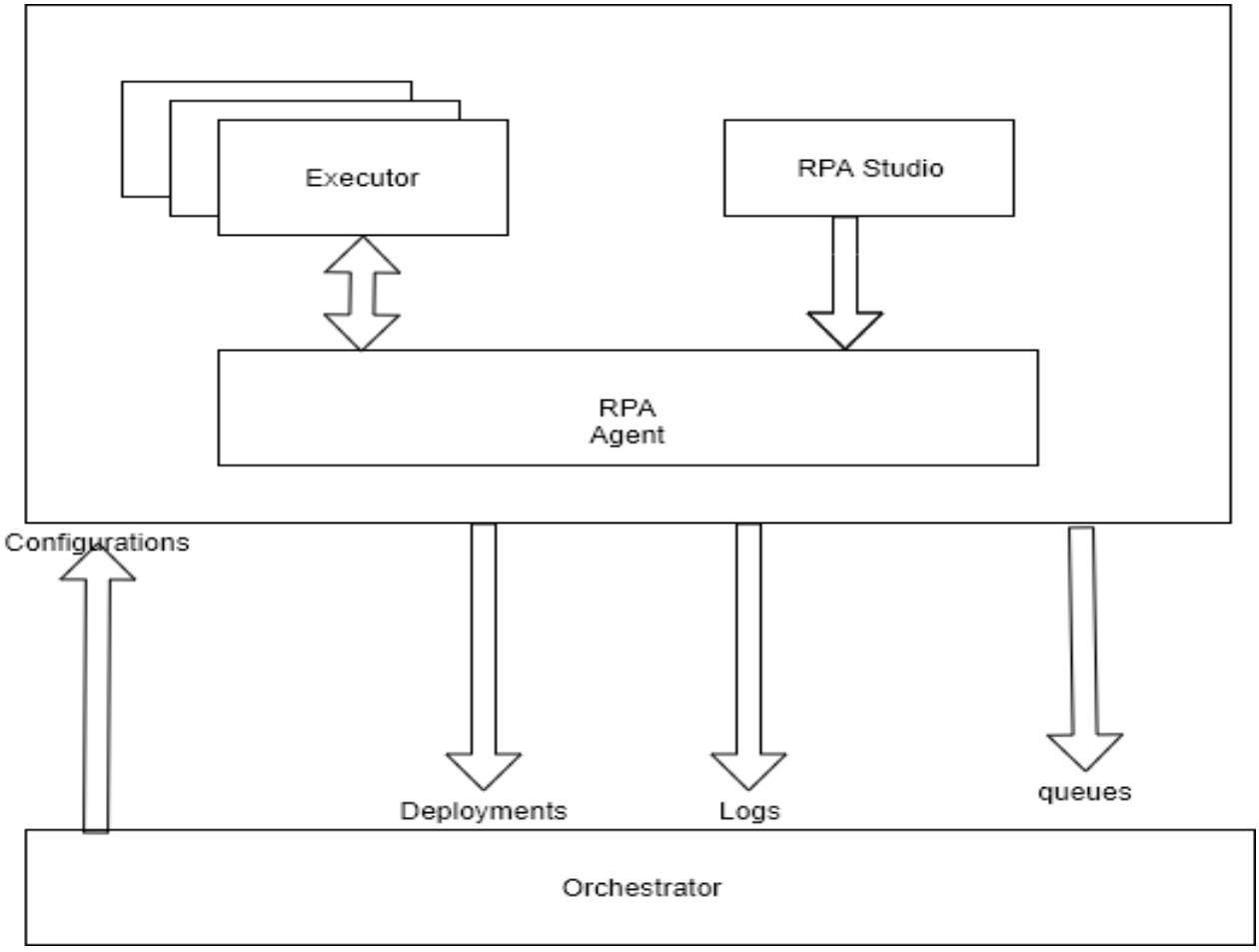

Figure 2.4: Bots Architecture (Wipro, 2019)

RPA Studio: This is used to develop software robots for automation of applications on the desktop. It is an easy-to-use drag and drop development client**.** It comprises of packages such as web recording, optical character recognition (OCR), Citrix environment and screen scrapping. It has Exception handling packages that can be downloaded into the environment and has the ability to write to or from various data sources and to build reusable components. One Studio is required

per developer for development and access to all required target business applications (UiPath, 2019).

Executor: The executor hosts the virtual or physical machines which are controlled based on a pattern. These machines are able to scale up or down in parallel to achieve the automation (UiPath, 2019).

RPA Agent: RPA agent works as a link between the orchestrator and the bots created in the RPA Studio and the executor. RPA agent makes sure that commands from the bots in RPA Studio reach their intended target and if they do not pass, then log errors to the orchestrator for audit trails. RPA agent sits at the client-side of the architecture (UiPath, 2019).

Orchestrator: Orchestrator is used for scheduling and monitoring the processes, authenticate users, encrypt data, and marshal database connections for logging. It also does version controls for the different bots published. It is a centralized control for all robots and assets and audit trails. User configurations are passed in the orchestrator, this includes commands on when the bots are scheduled to run and stop (UiPath, 2019).

2.3.4 Deployment Architecture

According to Wipro (2019), deployment architecture for the bots is in three layers the first layer being the interactive client layer, a middle layer which is the runtime resources layer and the third layer being the application server layer as shown in Figure 2.5.

The interactive client layer contains the development environment and the control and monitoring environment. These two environments can be virtual and such the developer can connect to them using another machine. The development environment is where the actual development of the bots takes place. In this environment is where the RPA Studio is installed for development. Control and monitor environments are for monitoring the bots that are already in production and controlling the bots. This is for displaying statistics and audit trails gotten from the orchestrator. Developer controller machine is a physical device with remote connectivity to interactive clients and optionally to run time resources (Wipro, 2019).

The runtime resource layer has two environments that are: development and testing environment and production environment. This is a standard user desktop image with business applications and

also has an RPA tool installed. Development environment is for hosting the bots during development and testing phase and once done moved to production environment. This layer must be appropriately resourced so as to be able to automate all the required target applications (Wipro, 2019).

Application servers' layer has two environments that are development environment and a production environment. Development environment hosts the target applications during the development and testing phase so as to avoid messing up with data that is already in production. Once the bots are tested and the customer satisfied with the output then the production environment is rolled out and the bots redirected to use the applications stored in the production environment. A database server is used to store the process definitions and audit information to ensure that there is accountability in the whole process. The database is centralized and hence has both trails for the development environment and production environment (Wipro, 2019).

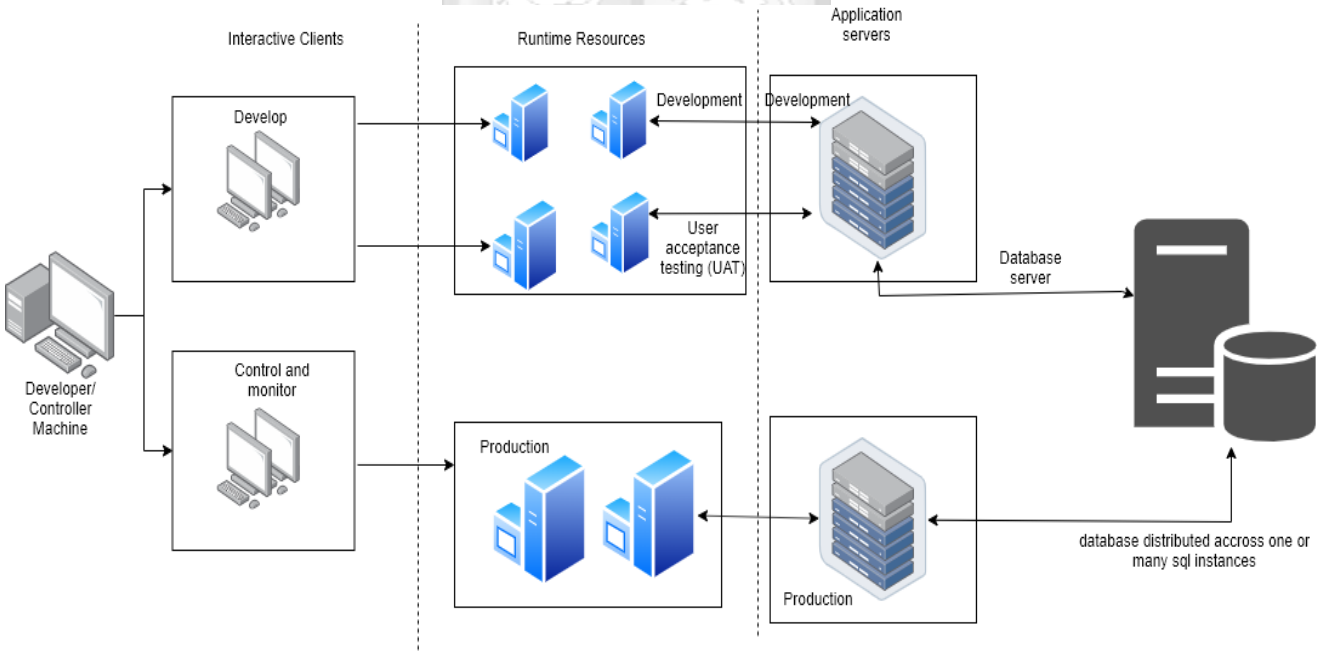

Figure 2.5: Deployment Architecture (Wipro, 2019)

The various layers that make the whole architecture are summarized in Table 2.1

Table 2.1: Deployment Architecture Summary (Wipro, 2019)

Layers	**Description**	**Hardware**	**Software**
Interactive client layer	Contains the development environment and the control and monitoring environment.	Processor - x64 Based CPU with 8 Cores RAM - 8 GB Disk Space - 500 GB	Operating System – Windows 10 .NET Framework - Microsoft .Net 4.6.1 Java Framework - JRE 1.8
Runtime resources layer	Development and testing environment and production environment RPA tool installed	Processor - x64 Server Based CPU with 16 Cores RAM – 16 GB Disk Space - 1 TB	Operating System - Microsoft Windows Server 2016 Data Management System - Microsoft SQL Server 2016 Standard/Enterprise
Applications layer	For database and service applications installation	Processor – Intel Core i7 2.6 GHz RAM - 16 GB Disk Space – 1 TB	Operating System – Windows 10/Windows Server 2016 Web Server/IIS - Internet Information Services 7.5 onward .NET Framework - Microsoft .Net 4.6.1 Data Management System - Microsoft SQL Server 2014 Service Pack 1 (SP1) Express

			Java Framework - JRE 1.8

2.3.5 Frameworks and Approaches for RPA Implementation

Blue Prism Framework

Blue prism developed a framework for implementing RPA using their tool which they named Blue Prism's Robotic Operating Model (ROM®). The framework has been broken down into four steps. That is identify, quantify and prioritize processes for automation then operations team configuring their own processes using software development discipline, introduce processes to production early in the delivery lifecycle and finally continual evolution. The weakness of this framework is that it is skewed to a specific technology that is only offered by Blue Prism (blueprism.com, 2019). This research improves Blue Prism framework by being cross technology that is the framework is adaptable to different technologies and the architecture used is able to work with any technology available. This research also recommends centre of excellence which Blue Prism does not offer, which makes it easier for the implementing company to be able to manage their bots and support the bots from a centralized platform.

Tata Communications Framework

Tata communication developed a framework that guided the development and maintenance of RPA projects. The framework is set up into for stages that is design, configure, deploy and manage. The design phase includes designing the workflow for the bot configuration and setting up the environment. Configure phase includes the training of the bot by the work modules and integrates all the work modules. Deploy phase includes testing and deploying the bot while the manage phase includes proactively monitoring the bot, logging, tracking, and closure of issues. Its strength is that it capitalizes on COE which is easy to manage as everything is centralized. It also has its weakness being that it focusses on the technology part of telecommunication leaving out other departments that are critical in telecommunication (Tata Communications, 2019).

This research creates an architecture that is generic to any process. That means the architecture recommended by this research will be able to support any kind of process. The research also uses a test processes that is not technological in which the framework is able to support the process workflows.

2.4 Change Management

There has been a lot of headlines in the media that speak of human beings losing their jobs to robots. This is because RPA is replacing humans in performing tasks that are repetitive in nature this is the reason why human beings are getting anxious and scared (Slaby, 2012; Lacity & Willcocks, 2016). However, this is not true as robots are only replacing human beings in tasks that a mundane, repetitive and tedious only and human beings can be directed to other tasks that robots cannot handle (Lacity & Willcocks, 2015).

Introducing RPA has meant a shift in the content of work. Robots augment human strengths providing that extra hand meaning that humans will be left to do those tasks that are unstructured and require human interaction and thinking to successfully complete them for example data that needs extraction beyond rudimentary logic, something that only a human being can do (Lacity & Willcocks, 2016). As a new technology with a lot of impacts on the life of employees, it is bound to encounter a lot of resistance from the organization. It is therefore important for the organization to see the mismatches that exist in the culture of the organization and the organizations structure.

Organization culture is one of the barriers that need to be overcome. An organization with a culture that promotes transformation capabilities will have an advantage and will most likely succeed in the implementation of RPA (Willcocks et al., 2015A), with proper management and support from the top management these barriers for other organizations can be lowered significantly (Willcocks et al., 2015B). It is not enough to develop strategies only management needs to enable the execution of the strategies. It is therefore important to have a project champion who will push around and sell the idea of RPA and try to battle the obstacles to lower the barriers that threaten the progress (Lacity & Willcocks, 2016; Willcocks et al., 2015A).

2.5 Skillset

It is easy to develop and model processes using RPA which is a notable aspect. Developers do not need programming skills to be able to implement a robot, rather what they need is to be familiar with the business processes that they are trying to automate (Lacity & Willcocks, 2015). There is no programming that is needed to come up with the robot, it only requires the business logic that the robot will follow to complete the task. The business logic includes the rules and instructions on the keys to press and how to handle certain exceptional cases (Willcocks et al., 2015B).

2.6 Scalability

Scalability is one of the important aspects of RPA. It is more scalable than traditional business process model (BPM) tools, it is also easy to develop and has the ability to define processes and reuse them. To enable scalability, it has to be included in the implementation and the development strategy (Willcocks et al., 2015B). There is a need to have multi-skilled robots to get the maximum out of the robots (Willcocks et al., 2015A). There is a need to make sure that the internal infrastructure grows in pace with automation to keep up with the demand for resources, and the internal technical architecture must make this possible (Lacity et al., 2015; Willcocks et al., 2015B). With this, the robot can easily be scaled to meet changes in workload (Lacity & Willcocks, 2016).

2.7 Project Lifecycle

There are four stages that the project work follows (Pinto & Slevin, 1988; Hartman & Ashrafi, 2002; Artto et al., 2006): Conceptualization, Planning, Execution, and Termination, as shown in Figure 2.6 specification of the project happens at the conceptualization stage. The major question is why the project is needed, its goals and the objectives of the project. Scheduling of all the activities that are required in the project happens in the planning phase. It outlines the timeframe for the project and setting the resources needed for the project. The execution phase is where the actual work takes place. It is the stage that is visible to the user as the deliverables are visible to the user. The last phase, which is termination, involves closing the project and handing it over to the users. It also involves the documentation of the project and transferring the knowledge to the users and owners of the project.

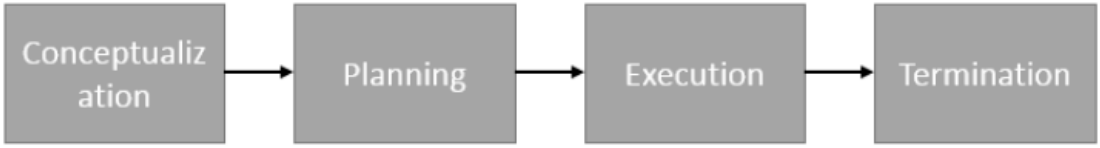

Figure 2.6: Implementation Phases of a Project (Willcocks & Lacity, 2015B)

2.8 Conceptual Framework

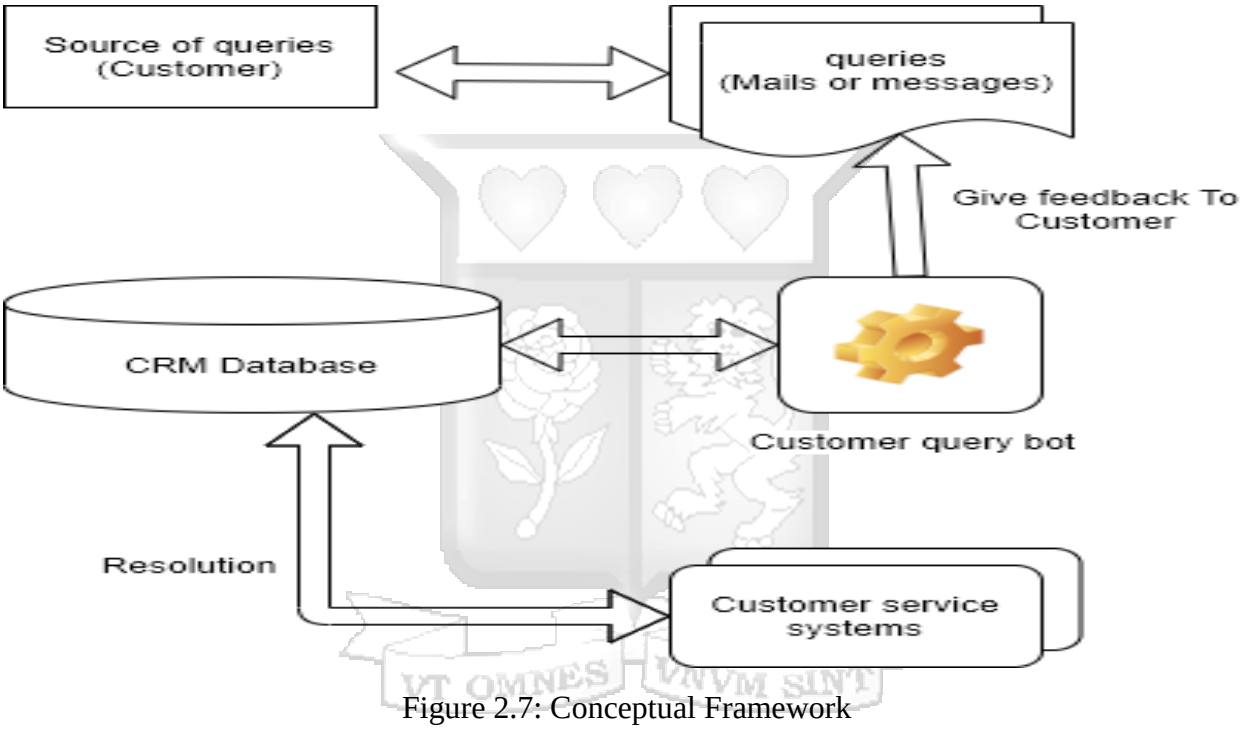

Figure 2.7: Conceptual Framework

The conceptual framework describes how the various input variables are manipulated to get an output and in this case the output being a response to the customer in regard to what he or she posted. Customer posts his query to the system which is in the form of an email or a text message as the input. The queries are stored in the system as they wait actioning. A customer support personnel log into the system to check for new requests, resolve the query and store the feedback in a CRM. In case the customer care personnel are not able to resolve the query he or she escalates the query to an engineer who will work on the query and store the feedback in the CRM. Customer query bot then logs into the CRM checks what feedback needs to be sent to the customer and pick the email address of the customer and the MSISDN and send the feedback to the customer.

2.9 Summary

This model emphasizes on the crucial aspects and steps that need to be considered so as to maximize on the chances of success for RPA solution for customer care support. From the literature, there has been a lot of insight on how to go about RPA process and how to manage the whole project to minimize the chances of failure.

Chapter 3 : Research Methodology

3.1 Introduction

The Research Methodology chapter explores the research design, data collection, population of study and the development of the robotic process automation model for first-line customer support. Additionally, the chapter covers the methodology that has be used in system development and the proposed RPA system architecture. Finally, the chapter has made a statement on the research quality and the ethical considerations for the research.

The main goal of this research was to design and develop a framework for Robotic Process automation that can be used for the first-line resolution of customer queries to give feedback to the customer after their queries have been resolved. The customer care department at Safaricom uses the framework to give feedback to customer queries. The framework outlines the necessary steps to follow for successful implementation of RPA in customer care department.

3.2 Research Design

The proposed research is an applied research as its aims was solving a real-world problem facing customer support department: A case study of Safaricom. Its utility has been limited to be the first-line customer query resolution. The research proposed to build a software robot based on C# programming language and running on windows operating system that would take feedback from CRM database that the customer support staff or the engineer has given in regard to a customer query and then respond to the user through an email.

3.3 System Development Methodology

A system development methodology are the steps that are used in the process of developing a system, they form the plan for the development of an information system. In this research, the researcher developed the solution using Agile methodology.

Agile methodology promotes continuous iteration of development and testing throughout the software development lifecycle. Unlike the waterfall methodology, both testing and development

are concurrent which speeds up the lifecycle of a project (Tobin & Akhilesh, 2011). Agile methodology as shown in Figure 3.1 is used to design software that allows for frequent alteration in the development of the project.

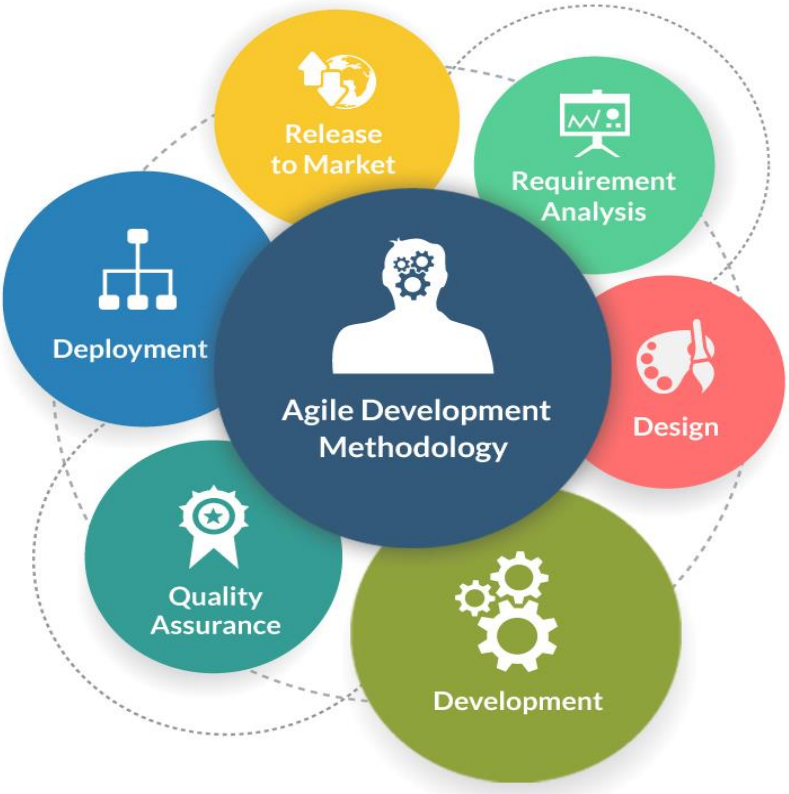

Figure 3.1: Agile Methodology Lifecycle (BrainHub, 2018)

According to Tobin and Akhilesh (2011), Agile methodology is a conceptual framework that is used for developing various software projects. With Agile methodology there is minimal risk as the software is broken down into short time boxes which are called “sprints” that last for a duration of one week to one month. Each sprint can be considered as a miniature project that has its own backlog, design, development, testing, and development as shown in Figure 3.2.

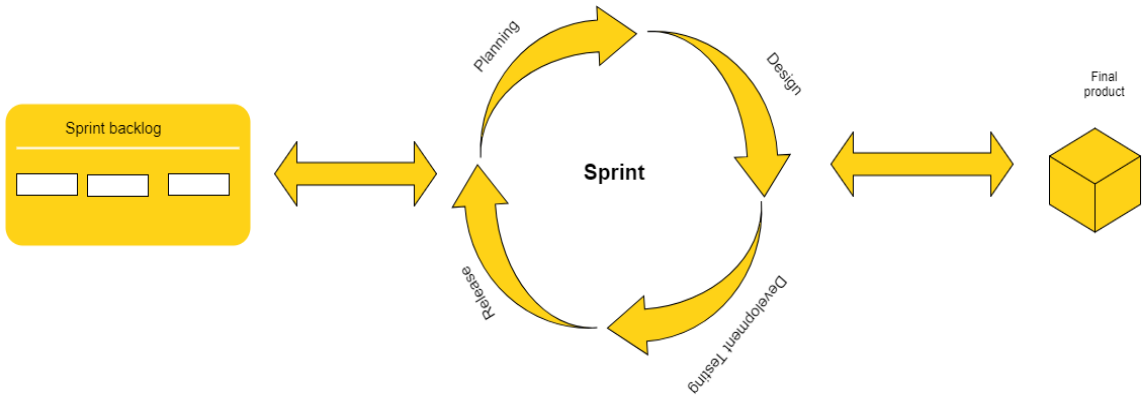

Figure 3.2: Sprint Development Cycle (BrainHub, 2018)

Due to the limitations of time and resources, having a separate development phase and testing phase would not be possible and hence why agile methodology was suitable as it combines the two and does them concurrently. With Agile being adaptive, it is able to respond to the changing requirements of the client. This research used Scrum method for sprint reviews, sprint planning, and the backlog.

3.3.1 Scrum

This research used Scrum as a method of Agile methodology. Scrum begins with the requirements or a story explaining the features, functionality and how they would be tested. Once that is understood the team goes through the sprints to have the product quickly. Requirements for the next sprint are discussed in advance hence able to prioritize and make changes easily if required. Scrum relies on a team that is cross-functional and that is self-organizing. There is no overall team leader to decide who will do what task or even how a problem is to be solved. There are two roles in a scrum team as shown in Figure 3.3, the ScrumMaster and the product owner. In this case, the product owner was the customer care department who represents the business, customer or users to make sure that the right product is produced.

The ScrumMaster is the coach for the team to help the team use the scrum process. There are several steps of a scrum method that were followed in this research. The first step was Product backlog creation where the whole monolithic project was broken down into manageable sprints.

This involved the product owner who in this research was the customer care department. After getting the whole project overview and breaking it down into sprints the next step was sprint planning meeting where the team which comprised the developer and representative of the customer care department. They prioritized which sprint should be completed first and within what duration and document the meeting to avoid scenarios where there is a change of priority.

The next step was sprint backlog where the developer arranged the sprints on a board depending on their priority and how the sprints followed each other. Then the actual implementation of the sprints took place. Each day there was a ten minutes scrum meeting to bring to speed the product owner and the scrum master the progress of the sprint. The last step of the scrum was a sprint review where a review of the sprint took place and closed it to move to the next sprint until the whole project was done.

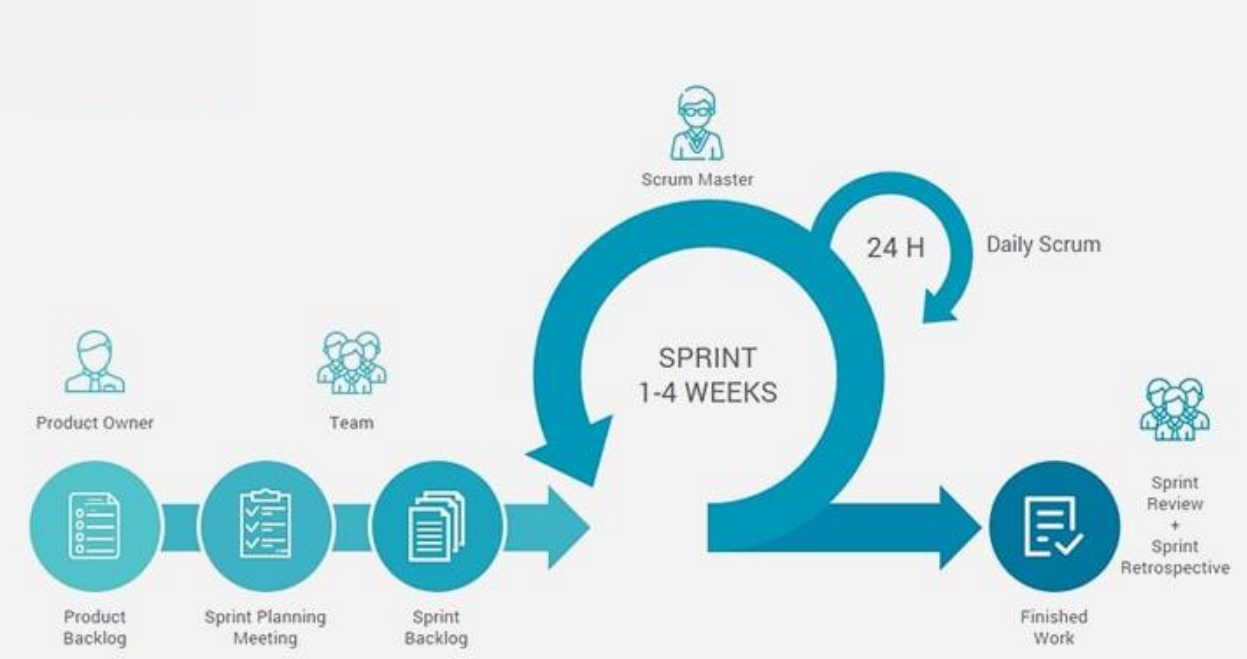

Figure 3.3: Scrum Approach (BrinHub, 2018)

3.3.2 Hardware Analysis

The systems required a lot of processing power to be able to respond to all the queries in a timely and accurate manner. The main motive for this phase was to analyze different hardware available

to determine the most optimal and cost-efficient for this project. For it to be effective, it required optimized server machines that would be both cloud-based and physical server machines to offer backup and load balancing and to stage the robot.

3.3.3 Software Analysis

In this phase, different RPA software were analyzed to determine the one that was best suited to develop customer support robots. Operating system software too were analyzed to determine the one that would comfortably run different robots and that was easy to support. For development and testing, windows operating system was used. For robotics development, there were different software that were analyzed, especially those that are free. Java libraries and C# libraries were installed on the test server to enable development of the robot and enable interaction between the robot and desktop applications. SQL database that is stored in a central location was used for the CRM system to store feedback from the engineers and customer care staff and also to store the logs for the bot.

3.3.4 System Design

In this phase, there was designing of the prototype, how the whole system would operate and modelling interactions between different modules. The network infrastructure that the prototype would use, and the security measures taken. How different users wound interact with the prototype. System specification were the output of this phase which included the system architecture design, the database design for the logs, and email formats for the customer to understand the feedback.

3.3.5 System Implementation

System implementation for customer care support robot took place in three phases that are the development, installation, and support. In development, the researcher installed UiPath software that would be used to develop the robot and UiPath plugins to enable the robots to interact with the browsers. Silverlight extensions and java extensions were also installed to enable the robot to automate Silverlight based applications. In the installation, the system was deployed on a cloud-based server with a minimum Random-Access Memory of 16 GB to process the inputs and an i7 processor or an equivalent processing power. For support, there were reviews after installing to

review how the robot operated and do any major or minor changes that might have been needed depending on how it operated, and the output produced. After implementation, the prototype was presented to the customer care department and to the panel.

3.4 Location of the Study

The proposed research took place in Kenya specifically at Safaricom headquarters, which is located at Nairobi on Waiyaki way, Westlands.

3.5 Target Population

According to Kothari (2004), the target population is the particular population in which the researcher has an interest in and intends to extract the research sample from. The target population for this research was Safaricom employees both permanent and those on contracts. It involved field engineers situated in different locations to help with the feel of a normal Safaricom customer and also to determine the best target process to use that would provide diverse issues faced by the general customers.

3.6 Sampling Techniques

A random sampling procedure was used for selecting the participants in this research. This was used to ensure that there was a fair representation of the variables in the research. The stratification was based on age to represent different age brackets of the customers, contract type as different contract types have different tariffs in Safaricom hence their queries may not necessarily be the same and place of work that is regions or headquarters of the staff in Information Technology department: convergence service operations section.

Safaricom network is segmented into five regions this is to avoid duplication of queries in case a certain region is having a major issue there will be a large number of similar customer queries from the region, hence segmenting the customers will make it easier to isolate, solve them and give feedback to the customers. Selection of staff in each section was done through a simple random sampling to get an accurate representation of the staff. This would be achieved by getting a list of all the employees who fall under the categories and sending them a request randomly to

participate in the research. The sampling technique was employed to select staff members to participate in the research. To get the sample size to use the research used the formula for sample size calculation as provided in Figure 3.4.

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1+\left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

Figure 3.4: Formula for Calculating a Sample Size (Smith, 2013)

Where N represents the population size, z-score is represented by *z*, *e* represents to the margin of error and *p* represents standard deviation. The population distribution based on contract type, place of work that is the regions or headquarters and the age are as shown in Table 3.1

Table 3.1: Employee Distribution Table

CONTRACT TYPE	Age < =35	Age > 35
Permanent working in the regions	15	5
Contractor working in the regions	10	5
PLACE OF WORK		
Permanent working in Headquarters	20	6
Contractor working in headquarters	15	5

This formed the target population of this study. Using the formula for calculating sample size for each category, a confidence level of 95% and a margin of error of 5%, the appropriate sample size for those who are permanent and working in the regions aged 35 was 15 while those aged above 35 was 5. Contractors aged below 35 years and working in the regions was 10 and the ones above the age of 35 was 5. For the permanent employees working in headquarters and aged 35 and below

the population was 20, using the formula the appropriate sample size was 20, for those aged above 35 the population was 6, and hence the appropriate sample size was 6. For the contractors that are in headquarters aged 35 years and below the population size was 15 and hence the appropriate sample size was 15, for those above 35 their population was 5 and hence the appropriate sample size was 5. Therefore, the sample size for this research was 81.

3.7 Data Collection Procedure

Data collection for this study was done through observation and by personal interview. Observation was to get a feel and understand how customer care goes about their routines and the systems they access and how they do it. This ensured that the routine rule-based tasks which would be done by the bots are well understood and implemented. For better understanding, personal interviews were inevitable to get clarifications from the customer care personnel to understand all the business rules. In addition, to understand the risk factors that arose from handling customer data.

3.8 Research Quality

3.8.1 Reliability

Reliability of this research was improved by presenting its findings to experts in the field of robotics to get their expert views on the subject. This was to ensure that the findings were relevant and reliable. The supervisor also reviewed the research to make sure that the objectives were met.

3.8.2 Validity

To ensure the validity of the research, a follow up were done with the respondents to review their responses for accuracy and to see if there is anything they would have liked to add. This was to confirm that the responses were accurate and that they are based on evidence.

3.9 Ethical Consideration

Customer data is confidential and un-authorized access is illegal and punishable by law. To access it the researcher had to seek consent from the customer and from the company to be able to use the data as this research included human subjects. Voluntary participation was applied. Anonymity

and confidentiality were applied to all the subjects used. Data to be used was treated with utmost confidentiality to ensure that it does not land in the wrong hands. Lastly, ethical standards prevented and protected the research from plagiarism, copyright infringement and fabrication of data. This research also gave credit to other research works that it used. Ethical approval was sought for this study and duly granted for the researcher to proceed with this research.

Chapter 4 : System Analysis and Design

4.1 Overview

This chapter presents the overall architecture and detailed design and analysis of the proposed system by incorporating the various requirements. Faisandier (2012) defines system analysis and design as a process of defining the description of the system components, interface, architecture, and modules so as to match the specific user requirements. System analysis encompasses the collection and analysis of user requirements and translating them into conceptual and logical models while system design is the process of defining the modules, data, interface and the architecture to meet specified requirements (Daniel, Barbara & Allen, 2001).

This chapter further analyzes both functional and non-functional requirements, the design of the proposed system incorporates UML diagrams to describe the overall architecture of the system and give a detailed description of the various components of the system. Use case diagrams with detailed use case descriptions, sequence diagrams, context diagrams, and data flow diagrams.

4.2 Data Analysis and Findings

Requirements and user stories were gathered mainly through observations of different contact people in the customer care department. To clearly understand their requirements the researcher observed as the respondents went about their daily tasks of resolving customer queries. Where the requirements were not clear, the researcher did a follow-up interview so that the respondent could elaborate further and demonstrate how they go about the situation.

4.3 Requirements for the Proposed System

Through the interviews conducted and observations, the research was able to establish the customer care department needed a system with the following specific requirements.

i. A system that would give feedback to customers 24 hours a day.
ii. A system that would be able to collect feedback from CRM systems and send feedback to the customer.
iii. A secure system that would be able to maintain confidentiality and integrity.
iv. A system that would enable data-driven decision making which is accurate.

v. A system that would generate reports weekly or on-demand.
vi. A system that generate logs on what it has done
vii. A robust system that would not keep on failing every now and then
viii. A user-friendly system that the customer care department would interact with to prioritize certain customers and issues.
ix. Access to the UiPath user interface and orchestrator.

The researcher further classified those requirements into functional and non-functional requirements. Functional requirements essentially specify the behaviour or the functioning of the system while non-functional requirements cover the logic and the constraints of the system (Daniel, Barbara & Allen, 2001).

4.3.1 Functional Requirements

i. A system that would generate a weekly report.
ii. A system that would keep logs of its operations.
iii. A system that would be able to log into other systems to collect and correlate data to give a feedback to the customer.
iv. A system that would be able to send emails or messages.

4.3.2 Non-Functional Requirements

These were constraints the system had to work within; hence the following constraints had to be taken into consideration.

i. The system had to be resilient and robust - The system had to be able to recover from failures and remain functional to the customer. The bot also had to be resistant to failure and complete the task.
ii. The system had to be reliable and efficient - The system should not only complete the task but also do it within the shortest time possible and also provide accurate results.
iii. The system had to be scalable - Any increase in the number of customer queries had to be accommodated by the system. In the future, the systems had to be able to handle queries in other departments.

iv. The system had to be secure - The system had to ensure user passwords are encrypted, to restrict unauthorized access, accidental or unintended usage and provide access only to legitimate users.

v. Usability - The system was intended for use by customer care team and they had to be trained so that they could understand their interaction with the bots, but actually the system was intended to eliminate remedial repetitive tasks, hence did not require highly skilled staff to operate and support it.

4.3.3 System Requirements

The proposed system had the following system requirements for its operation.

a) Relational Database

A central database was used as a storage for the feedback from the customer care staff and also the engineer, and also store the logs for the bot. The system used MS SQL as it is robust, portable and its interoperability.

b) System Security

To ensure that the team maintains integrity and confidentiality, security mechanisms was embedded. The system used windows credential manager to manage all the passwords that were used.

c) Hardware Requirements

The major hardware requirements were servers and efficient network systems, a dedicated UiPath server and MS SQL server in a production environment. The serves in the network had to be above 2.6 GHz Core i7 and a minimum of 16 GB RAM as the hosts operates virtual machines.

d) Software Requirements

The main software requirement was a Windows 64-bit operating system. The system needed an installation of the .NET frameworks, MS SQL Server, Outlook and UiPath platform installation.

4.4 System Architecture

Architecture of the proposed system as shown in Figure 4.1 outlines the general layout of the RPA system. The major steps that took place in the bot system were as follows:

i. Customer sends his or her query where they are stored in a centralized mailbox or a message box depending on the mode that the customer used. Customers who used mails their queries were stored in a centralized mailbox while those who opted to use text messages were stored in a message box.

ii. A customer support staff access the centralized email box or message box and gets the queries that have not been actioned upon.

iii. The staff actions on the query and posts the feedback into the CRM which is stored into the database as it awaits dispatch (sending the feedback to the customer).

iv. If the staff is not able to resolve the query, they post the query as an escalation in a system called Remedy where the engineer picks it up actions on it and posts the feedback on CRM awaiting dispatch.

v. The bot then accesses the CRM database to get feedback that has not yet been dispatched.

vi. The bot repeats the cycle until all the responses have been dispatched to the relevant customers.

vii. The bot then keeps a log of what it has done in a database for accountability.

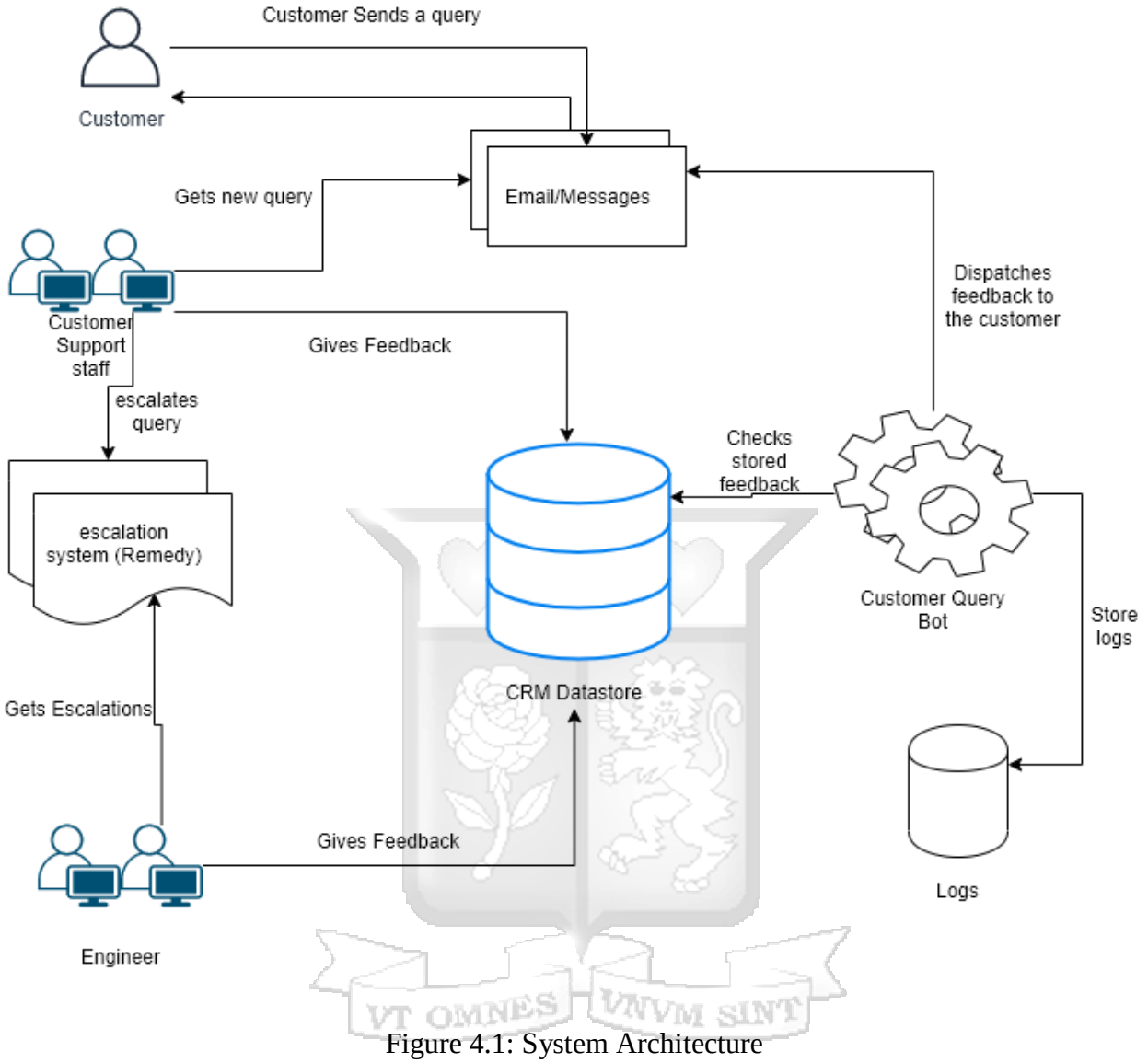

Figure 4.1: System Architecture

4.5 System Process Modelling

System process model is the abstract representation and design of a software process (IEEE, 1995). System process modelling is an abstract representation of the design and function of the software in a standardized format so as to enable planning, organizing and implementation of a software development project. Software objects use case interactions of the system and the sequence of activities and events composes the process of software modelling.

4.5.1 Use Case Diagram

Use case diagram shows the interaction between various actors and the system. Figure 4.2 illustrates interactions between the various actors and the bot. It also depicts the functionality that the proposed system has.

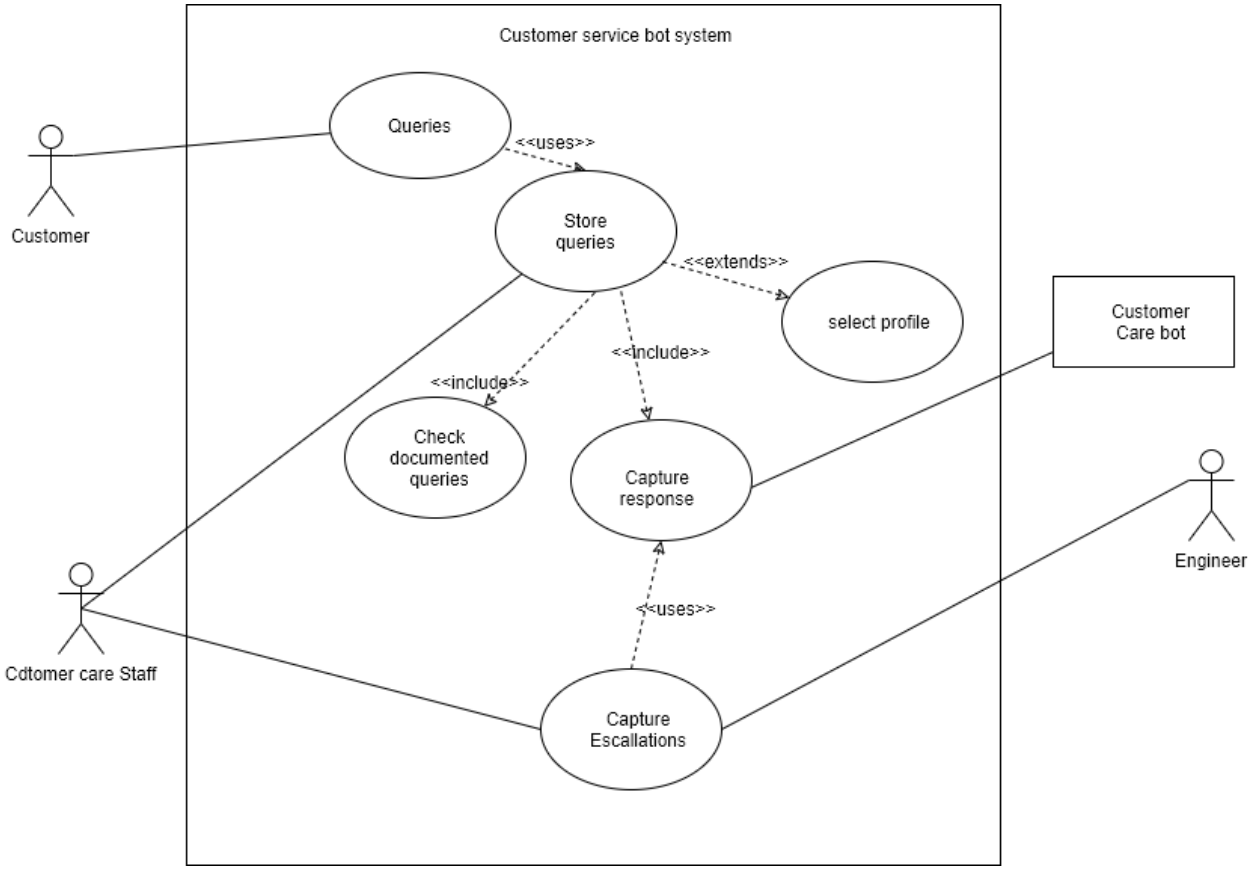

Figure 4.2: Use Case Diagram

A description of the use case

Use Case: Queries staging and loading.

Primary Actor

Customer

Customer care staff

Preconditions

Customer successfully sent his or her query

Post Conditions

Customer queries successfully loaded into the query store.

Success scenarios.

Customer query bot launched and read any new message or mail.

Customer Support staff fetches query, checks customer profile from the User profile system.

Customer support staff raises an escalation to the engineer in case of unsuccessful resolution

Use Case: Solution and feedback.

Primary actors

Engineer

Customer query bot

Preconditions

Successful retrieval of customer profile

Post Conditions

Feedback was sent back to the customer

Main Success Scenarios

Customer query bot successfully checks feedback.

Engineer checks for escalated queries and solves them

Engineer captures the feedback in CRM.

Engineer gives feedback on the escalated cases.

Customer query bot sends the feedback to the customer.

Customer query bot exits the systems.

4.5.2 Sequence Diagram

Figure 4.3 illustrates the relationship between the Customer, engineer, existing systems and the proposed bot as well as the interactions among the various internal components of the systems and the customer query bot. Customer sends his or her query as a message or an email. The messages are stored in repository waiting to be executed. Once the queries are received, the customer support staff goes through them reading the unread ones getting problem from the messages so as to search them in the knowledge base. The problems are extracted and the checked in docqueries() to check if the query exists and userprofile() so as to get the user profile. Customer support staff keeps on accessing the querystore() to check for new customer queries and either solves them or escalates to the engineer through escalations() or give a feedback through feedback(). Engineer checks

escalations() to get new escalations and post the feedback through feedback().The bot checks for new feedback that need to be dispatched and sends it to the customer. This process is repeated over and over again depending on how many customer queries are available and how many feedbacks need to be dispatched.

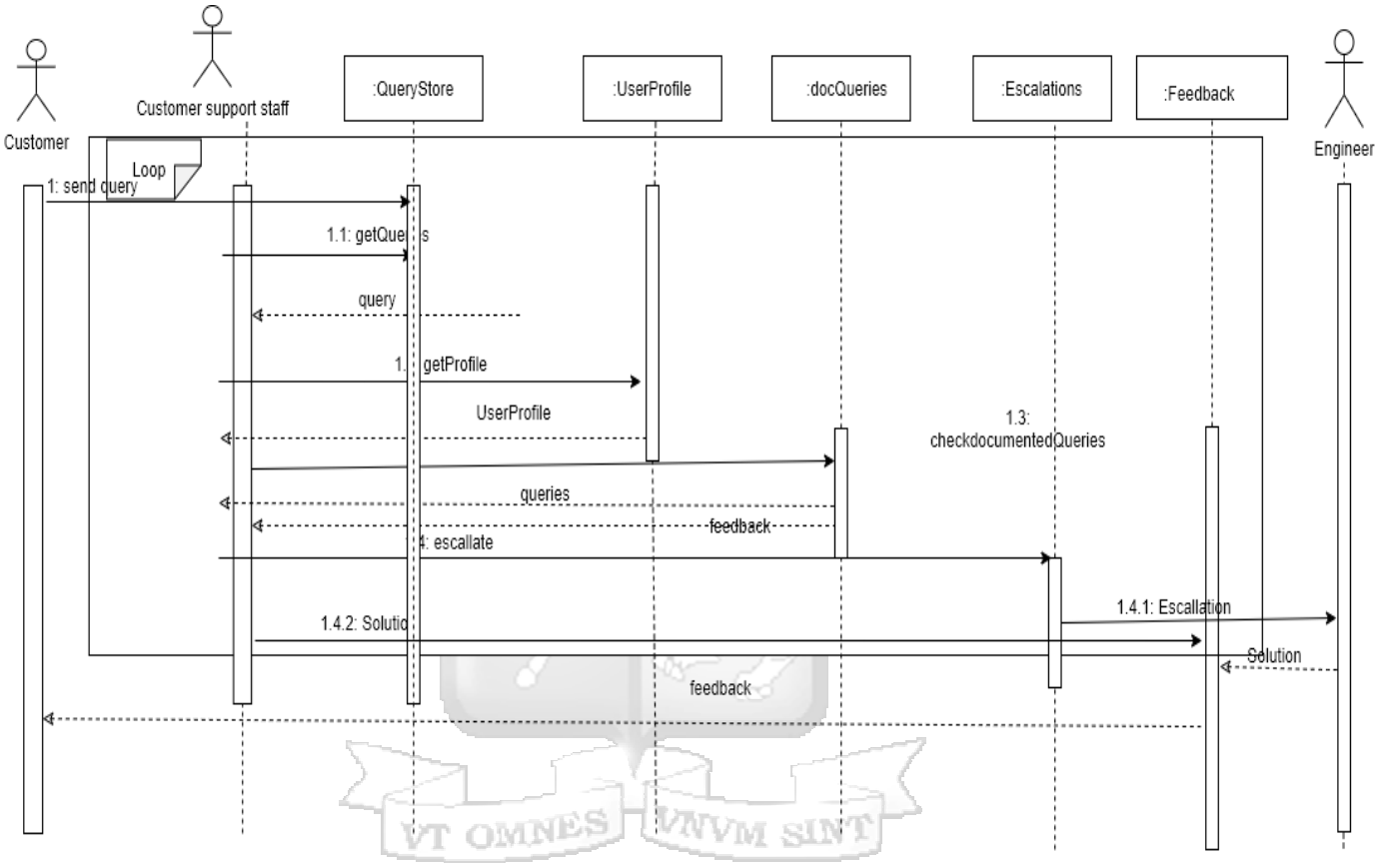

Figure 4.3: Sequence Diagram

4.5.3 Context Diagram

Figure 4.4 depicts the context diagram illustrating the boundary of the prototype bot, the environment and the entities that interact with the bot. In addition, it also shows the various inputs and outputs from the prototype bot to the entities. The main entities interacting with the proposed prototype are the customers, the customer relationship system (CRM) and the Engineer/customer care staff. The customer sends his query which is acted upon by the customer care staff and gives a feedback through the CRM. The bot then checks the CRM to get the feedback and dispatch it to

the customer. If a customer care staff could not solve the query, he or she escalates to the engineer who after resolving gives the feedback which is stored in the CRM for the bot to pick it up and dispatch.

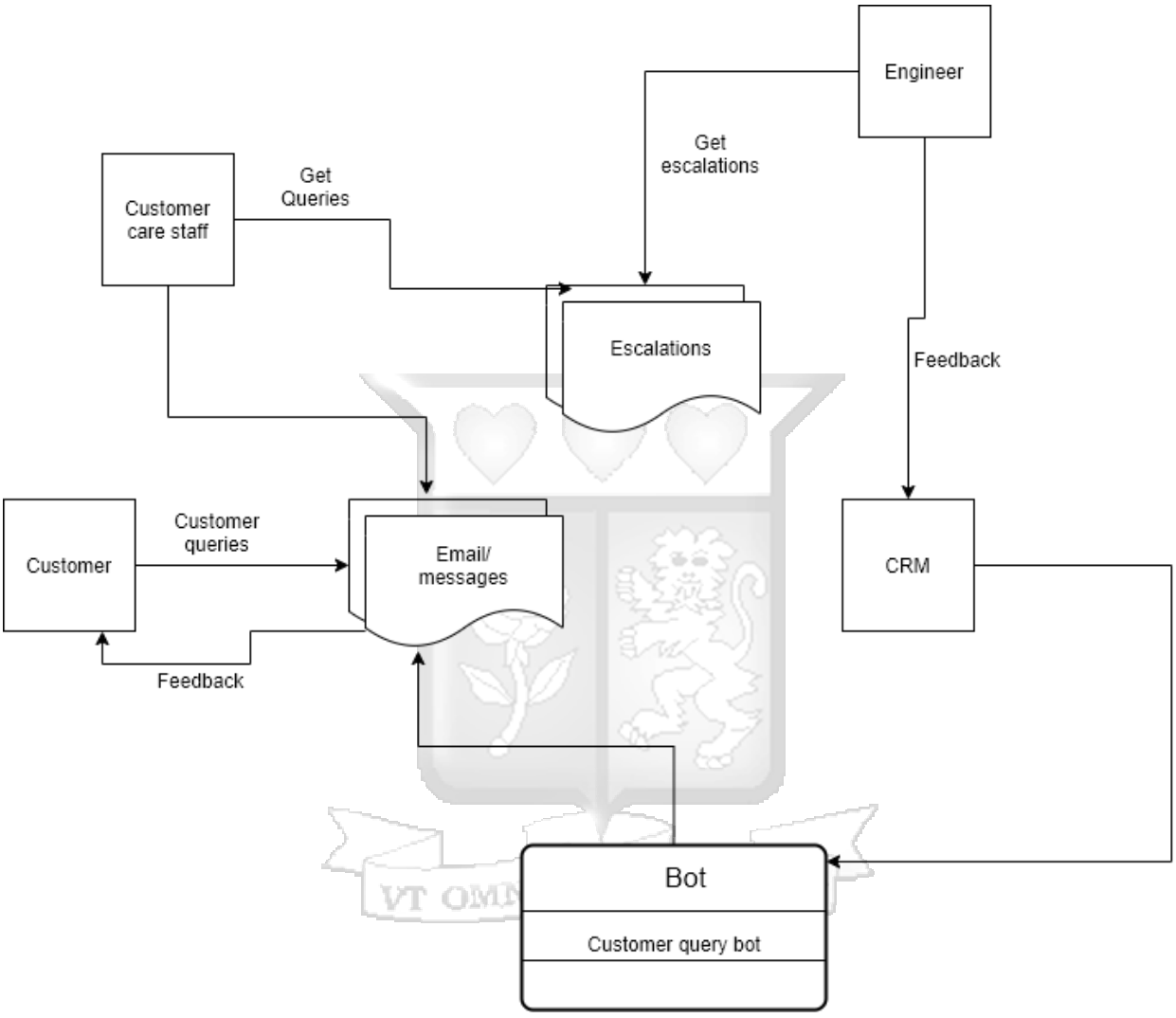

Figure 4.4: Context Diagram

4.5.4 Level 0 Data Flow Diagram

The level 0 data flow diagram shown in Figure 4.5 gives details of the system illustrating the various processes contained in the modules, data stores and entities. The arrows show the direction of the flow of data among various components of the DFD. The first process called mail/messages receives a query from the customer which is stored in a datastore D3 called messages. Process 2 called CRM receives the feedback and stores them as feedback in D4 datastore waiting to be

relayed back to the customer through process 1 by the bot. The feedback comes from the engineer and the customer care staff and the bot gives the response directly through process 1. Process 3 which is Sibel system receives new solutions from the engineer and stores them in D2 datastore known as Knowledge base. Process 5 which is the users stores user profiles in data store D1, this process interacts with the customer care staff who access it to get customer details so as to vet the customer. D1 datastore contains all the information about the subscriber (Customer), any new customer when being registered by the agents, their details are stored in D1.

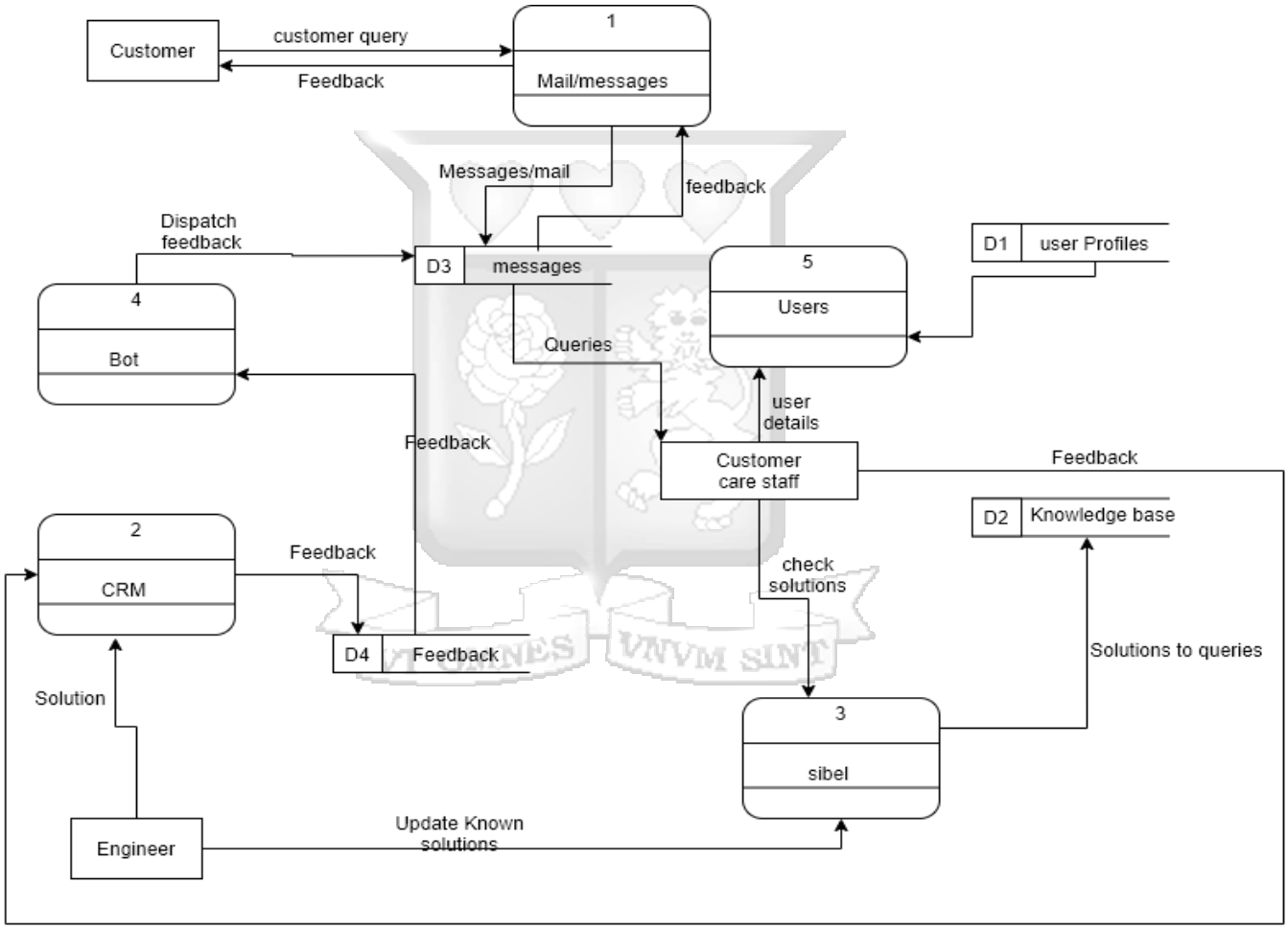

Figure 4.5: Level 0 Data Flow Diagram

Chapter 5 : System Implementation

5.1 Introduction

This chapter describes the implementation and testing of the prototype. The testing of the prototype is also be discussed in order to evaluate whether the bot meets the user requirements and the security requirements and the implementation of the prototype. It also describes the workflow of the system, that describes how the queries are solved. The system being an integration of RPA and Knowledge-based system, describes the workflow and the business processes used in developing the rules and facts implemented in the rule-based Knowledge-based system. In addition to this, the development of the bot through UiPath Studio.

5.2 The Workflow

The workflow are the specific steps that are followed so as to solve a customer query and to give a feedback to the customer.

The following steps are the steps that are undertaken for a successful customer support.

i. Customer contacts customer care support (Call, SMS, Email).
ii. Customer care staff vets the customer to make sure that the person calling or requesting the service is who he or she says they are. This is done by getting customer profile and asking questions to the customer or comparing what the customer has indicated on their mail to what is in the user database
iii. After successful vetting customer care checks if the customer query is documented and raises a ticket which will be closed after the solution has been dispatched
iv. If the customer care staff cannot resolve the query, they escalate the issue to an engineer who has domain expertise for them to solve. This is done in a system called Sibel together with the ticket raised by the customer care staff for easier follow up.
v. Engineer goes through the escalations and solving them and giving a feedback which is stored in the CRM awaiting a dispatch of the feedback to the customer.

vi. Engineer updates the solution into Sibel to make it easier for the customer care agent to resolve it next time such an issue is raised.

vii. Bot logs into the CRM datastore to get all the feedback that is awaiting dispatching and send the feedback to the customer.

viii. Bot logs out of the system and wait for another dispatch.

The flow can be summarized in a flow chart as shown in Figure 5.1

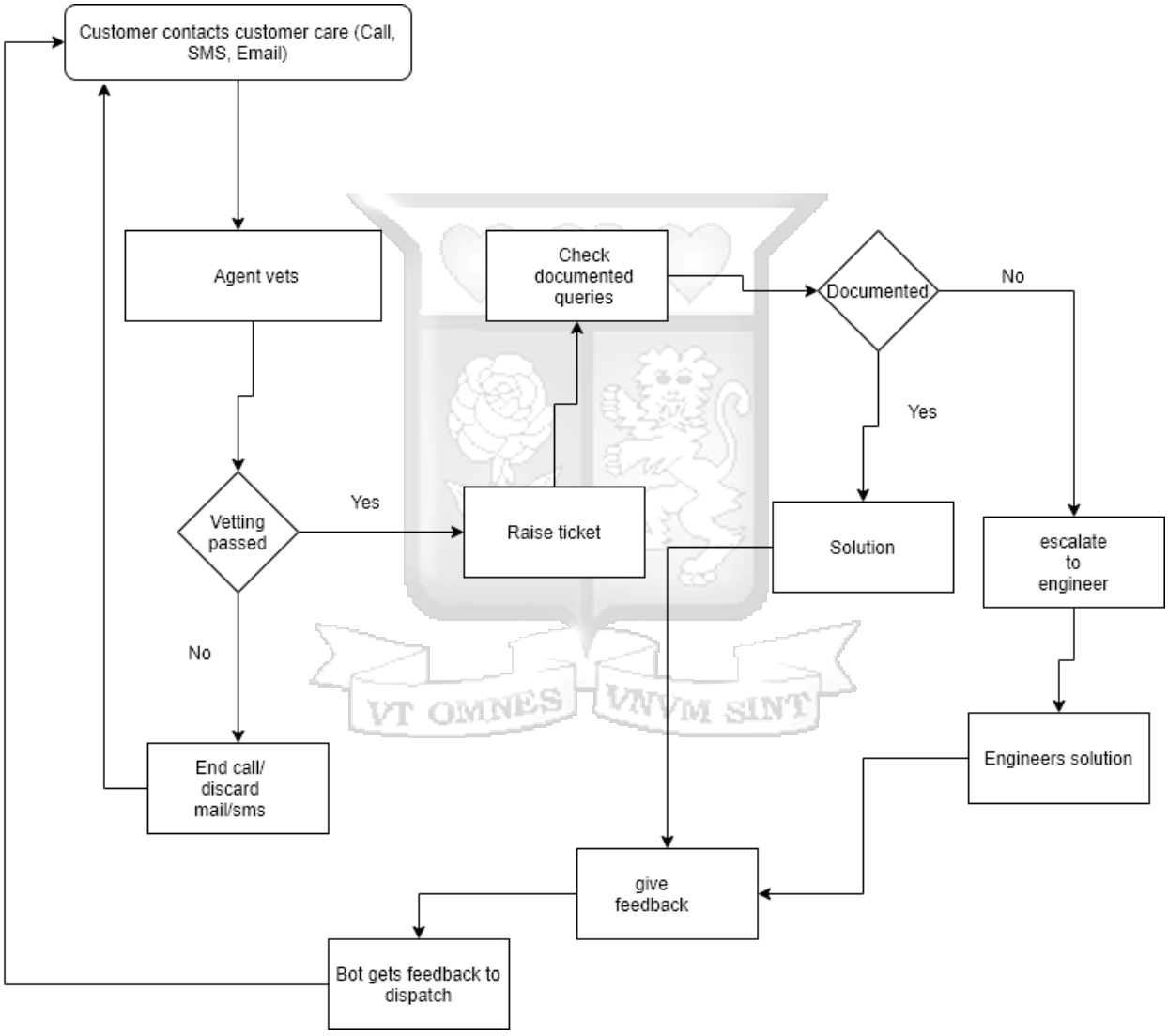

Figure 5.1: Customer Care Flow Chart

5.4 Software Configuration

In order to build the prototype and to test, there are steps that need to be completed in both the developer, test and deployment environments.

i. Installation of UiPath Studio and make sure that the Studio works. To check whether the Studio works, the researcher connected the UiPath to the free version of Orchestrator that is provided by UiPath. Successful connection between the orchestrator and UiPath Studio shows that the Studio is working correctly.

ii. Installation of MS SQL database for storing logs.

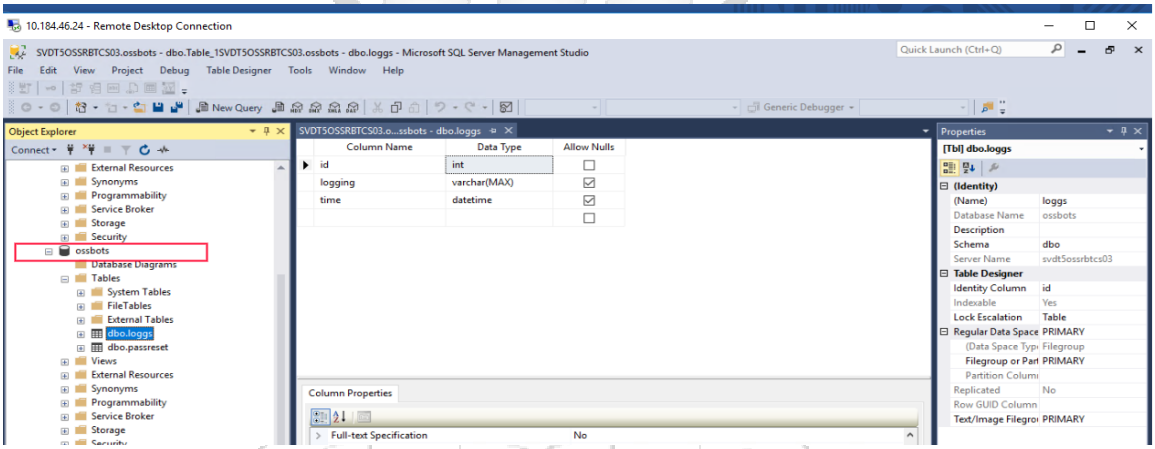

Figure 5.2: Database Setup

iii. Installation of extension in UiPath- that is Chrome extensions, Firefox extensions, Silverlight plugins and Java plugins

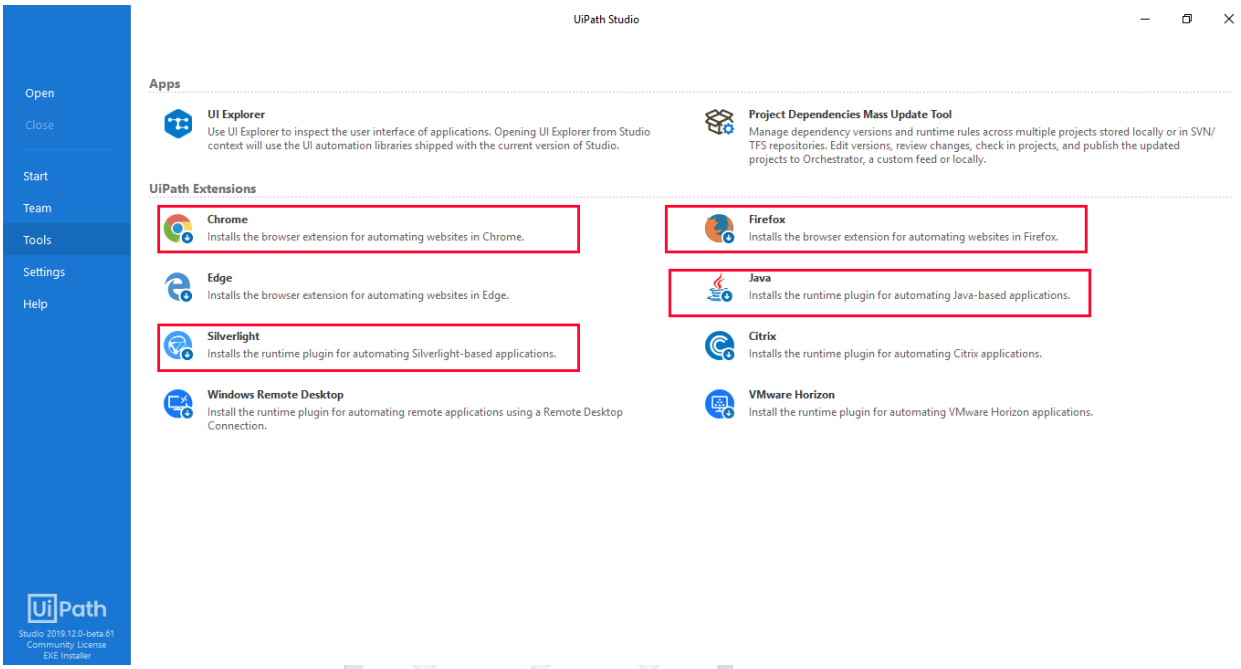

Figure 5.3: Installed Plugins

iv. Connecting UiPath Studio to the orchestrator provided by UiPath that is accessed through https://platform.UiPath.com/ . First the researcher created an account with UiPath and connected the UiPath to the orchestrator at the Machine tab on the orchestrator as shown in Figure 5.4.

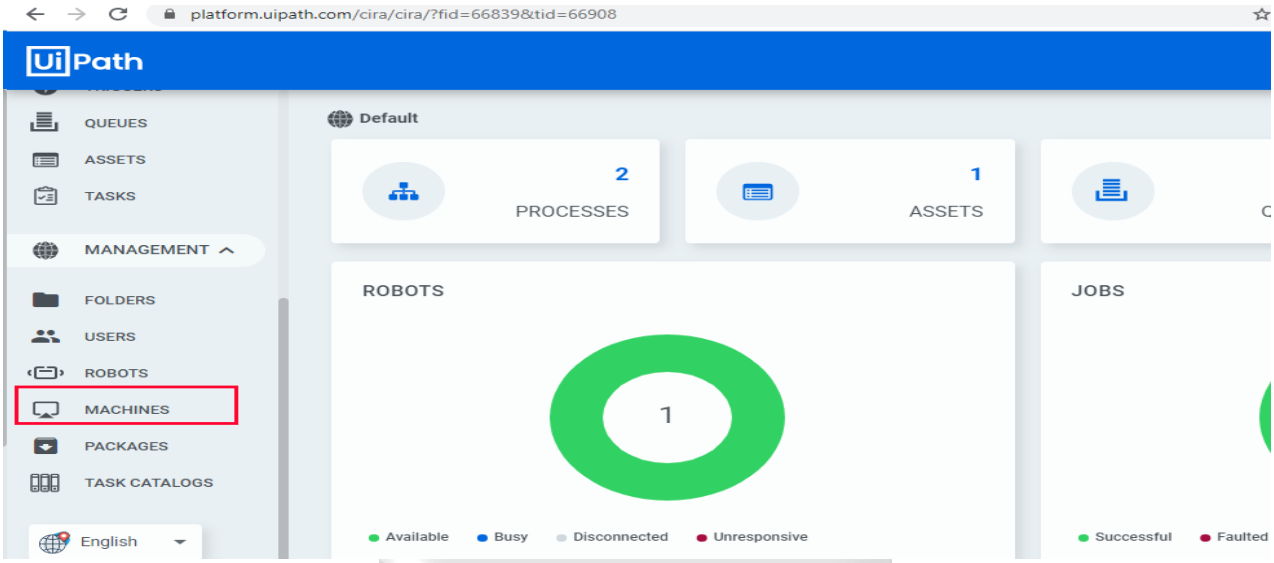

Figure 5.4: Orchestrator Connection

After successful connection on orchestrator, the Studio is visible from the orchestrator and the version installed as shown on Figure 5.5.

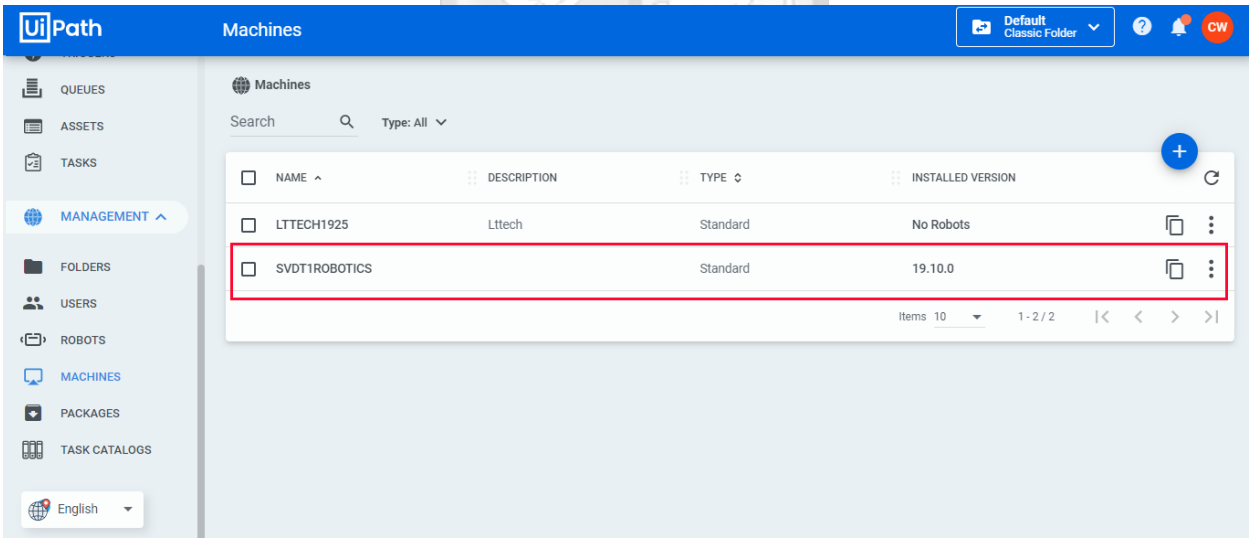

Figure 5.5: Successful Connection

v. All the required passwords were stored in credential manager which is available in Windows operating systems as shown in Figure 5.6

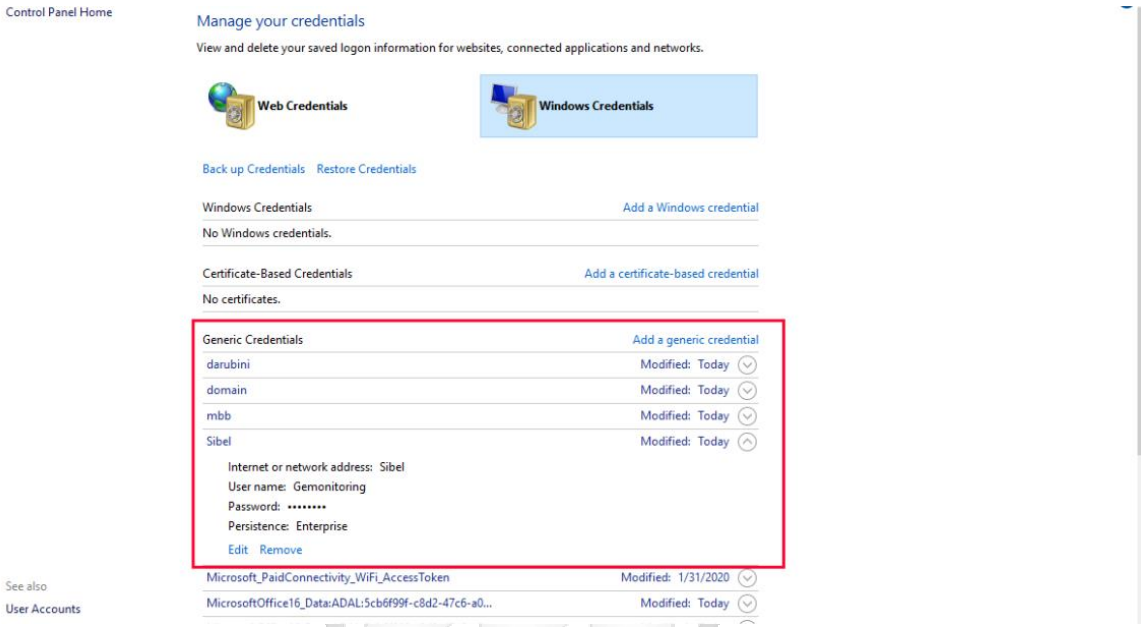

Figure 5.6: Credential Manager

5.5 Bot Implementation

For easier management, troubleshooting and maintenance of the bot, the researcher used REframework that is provided by UiPath. This made it easy to structure the bot in classes and functions which are easier to maintain and troubleshoot. As shown in Figure 5.7, the bot is segmented into three major sequences for easier management and troubleshooting. Sequence 1 contains all the connections to the databases to retrieve all the feedbacks and customer information so as to get their email addresses and phone numbers. The email address is where the feedback will be sent. Sequence 2 creates reports of data fetched from the CRM database. This also is for record keeping to know what was dispatched and what has not yet been dispatched. Sequence 3 dispatches the mails to the customer containing the resolution as gotten from the CRM database.

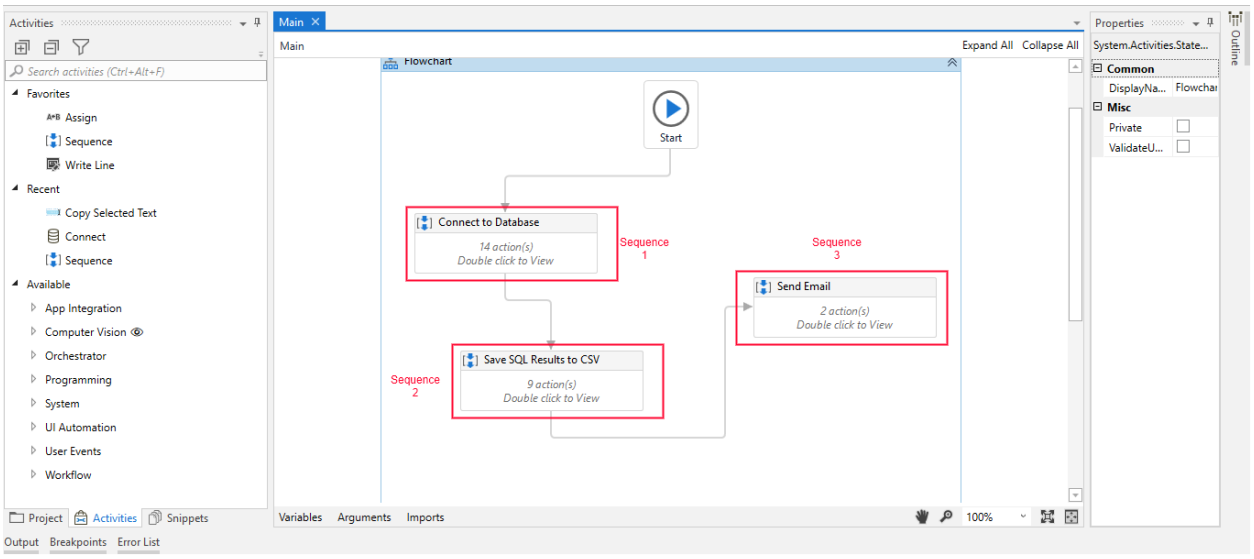

Figure 5.7: Overview Structure

Sequence 1 creates a data table to store has been fetched from the CRM, connect to the database and run a query that fetches all the responses at that given time that have not been actioned upon through execute query function as shown in Figure 5.8.

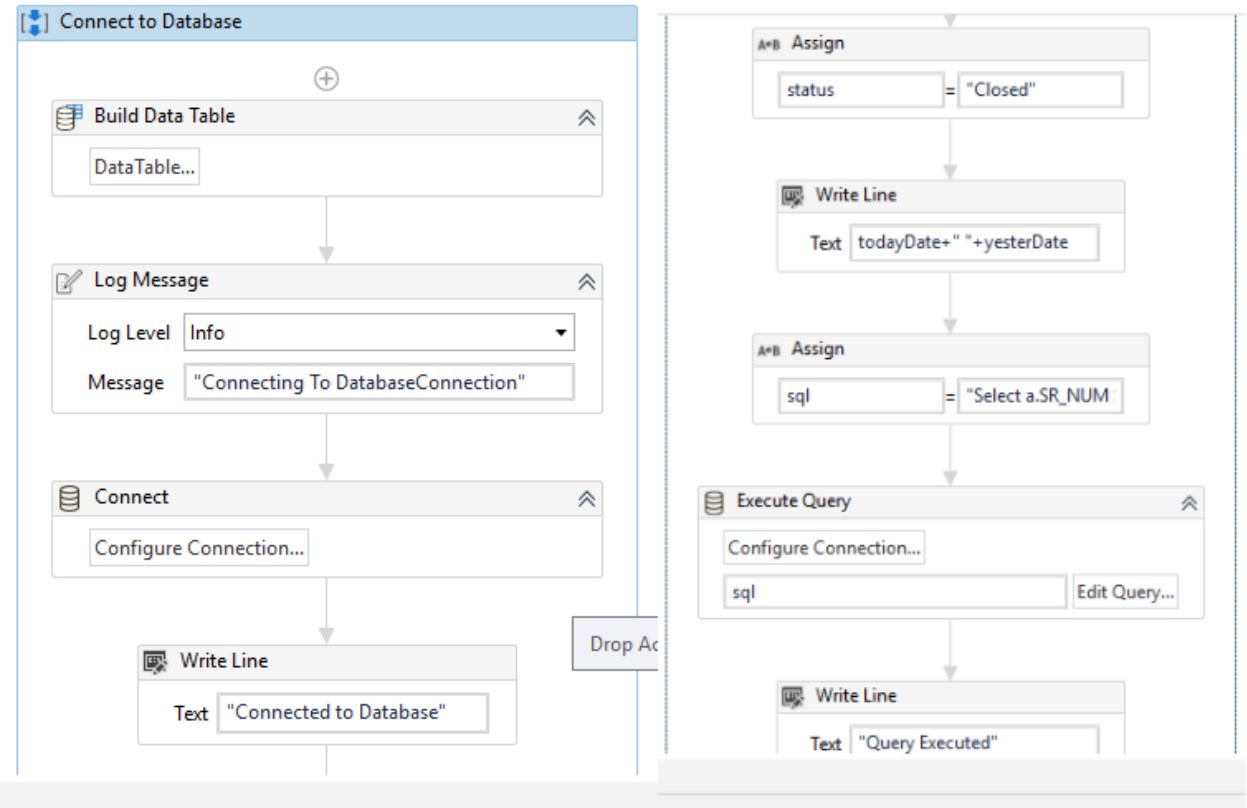

Figure 5.8: Database Connection Overview

Sequence 2 creates the csv document based on the data table that was created in sequence one and saves it with a timestamp to know when it was created as shown in Figure 5.9.

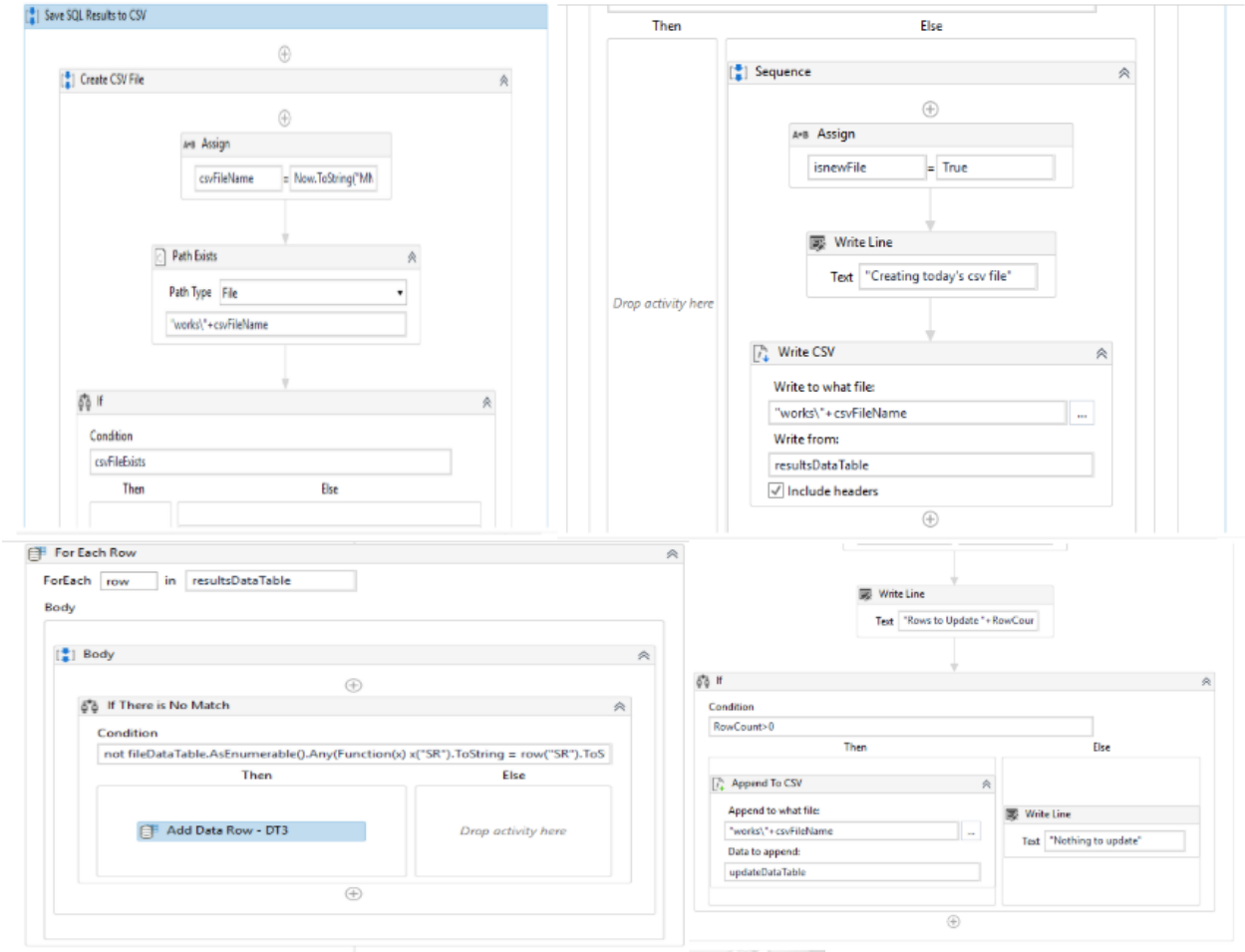

Figure 5.9: Report Sequence

Sequence 3 sends the mail to the customer using the details it got from CRM and structures the mail in a table format as shown in Figure 5.10. The mail contains the date it was reported, date the query was resolved, the person who resolved the query, what the query was about, the resolution that was given and who sent the query mostly MSISDN or an email address depending on the mode the customer used as shown in Figure 5.11.

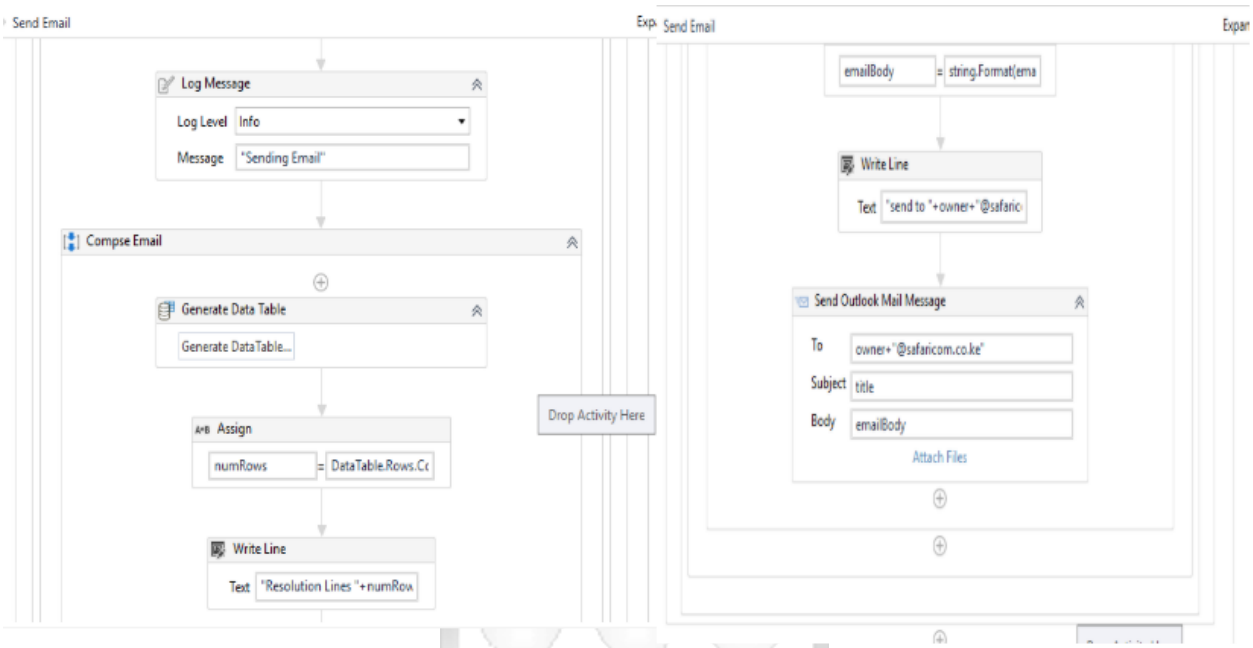

Figure 5.10: Emailing Sequence

Incident Report

Dear Customer,

Your Service Request 1-33IFOO83 has been resolved

C3 - Safaricom Confidential Internal

Date Reported	02/05/2020 16:16:41
Date Resolved	02/05/2020 17:19:09
Closed by	FCHIRCHIR
Reported Incident	Wimax : Intermittent Link Timeout
Resolution	Wimax restored and uptime confirmed==========Client called on 716518189 and confirmed ==========RP/1/RSP0/CPU0:ENT-NBI-SCC-ASR9K1-PE-01#ping vrf carrier 41.139.185.114Wed Feb 5 17:16:21.986 EATType escape sequence to abort.Sending 5!!!!!Success rate is 100 percent (5/5)RP/1/RSP0/CPU0:ENT-NBI-SCC-ASR9K1-PE-01#sharp vrf carrier 41.139.185.114Wed Feb 5 17:16:31.643 EATAddress Age Hardware Addr State Type Interface41.139.185.114 00:00:46 10fe.edff.8f33 Dynamic ARPA Bundle-Ether333.7777
Reported by	0724872093

Figure 5.11: Sample Email Structure

5.5.1 Development Environment

The system was developed in the following hardware and software environment

i. Lenovo ThinkPad TP13 x64-based PC
ii. Intel(R) Core(TM) i5-7200U CPU @ 2.50GHz, 2401 Mhz, 4 Core(s), 4 Logical Processor(s)
iii. 8GB System RAM
iv. 500GB Hard Disk
v. Microsoft Windows 10 Enterprise Operating System
vi. UiPath Studio 2019.12.0 beta 61 community License
vii. MS SQL Server 2017

The bot was tested on the following hardware and software environment

i. x64-based VMW 7.1V
ii. Intel(R) Xeon(R) Gold 6152 CPU @ 2.1GHz, 8401 Mhz, 8 Core(s), 8 physical Processor(s)
iii. 16GB System RAM
iv. 500GB Hard Disk
v. Microsoft Windows Server 2019 64-bit Standard Operating System
vi. UiPath Studio 2019.12.0 beta 61 community License
vii. MS SQL Server 2017

5.6 Testing

Testing the bot was done by the cyber security team to make sure that it does not expose the already existing systems that it interacts with to external threats and expose customer data. It was tested by the customer care user to make sure that it meets the requirements and solves the queries in the expected manner. Quality control also did a test on the bot to make sure that it met the minimum standard for deployment.

Quality control and customer care tested for completeness of the system: - this is that the bot met all the performance specification and provided all the functions that were specified by the customer care.

Correctness: - that the bot performed all the tasks correctly.

Reliability: - that the bot was able to handle normal flow of queries and also peak loads of queries.

Consistency: - that the bot solves all the queries in the same manner each time.

Efficiency: - that the bot solves the queries with minimal resources and within the shortest time.

Integrity: - that only the authorized personnel can run the bot, and when the bot is done with a certain query it logs out of the systems to make sure that no one else uses the sessions opened by the bot for accountability.

5.6.1 Functionality Test

After the users, cyber security and quality control did their tests, functionality tests were carried out by the researcher and the results are as shown on Table 5.1.

Table 5.1: Functionality Test Overview

NO	Functionality	Description	Status
1	Fetch Credentials	Fetch credentials from Credential manager in Windows	OK
2	Login	Use the fetched credentials to login into Sibel	OK
3	Access Mails/SMS	Access mailbox and messages repository to read and send mails/messages	OK
4	Logging	Keep logs in a human readable format for maintenance and troubleshooting	OK
5	Data Aggregation	Get data from different systems, get customer data	OK
6	Reporting	Generate weekly report and store the reports for future reference	OK

5.7 Maintenance of the Bot

Further development of this bot shall be performed from time to time to scale it further to be able to handle different functionalities that go beyond customer care. Patches and updates will also be done to the UiPath Studio to make sure that the bot gets the latest enhancements. Windows server operating system will also be updated and patched every time there is an update to make sure it gets the important security patches to prevent the operating system from being the backdoor to compromise the bot. To match dynamic user requirements from the customer care department regular maintenance of the bot will be carried out to make sure that it matches the requirements.

Chapter 6 : Discussions

6.1 Introduction

This chapter discusses the results of the research according to the objectives set out in chapter one. The objective of this research was to investigate key characteristics of successful customer service, review existing frameworks and approaches, develop a prototype for a customer query resolution and finally test the prototype bot. Business rules were developed and others refined to enable smooth running of the bot and a standard process. The prototype bot was also developed using RPA's UiPath platform due to availability of community version of the same. A number of tests were conducted to validate the performance of the prototype bot and the accuracy in which it operated.

6.2 Experimental Test Results

The manual process of giving customer response after their queries have been sorted took about two hours a customer care staff to get customer details and send them their responses. There had to be a dedicated staff in every shift checking for unsent responses and send them. This meant that there were two staff dedicated every day to send responses to the customers, (Customer Care Department, 2020). The bot has enabled redeployment of those two staff to other tasks such as resolving the queries while the bot now does the responses to the customers. The bot has also brought down the time taken from 2 hours in each shift to about three minutes each cycle 100 customer as it pulls the records in bulk and sends the responses in bulk to all the customers but each customer with his or her custom response. The time taken was measured using UiPath tool as it has the capability to show how long the bot was running.

The bot was tested for eight hours as shown in Figure 6.1, which is equivalent to two shifts in the customer care department. The bot was set to run at an interval of 10 minutes between each run.

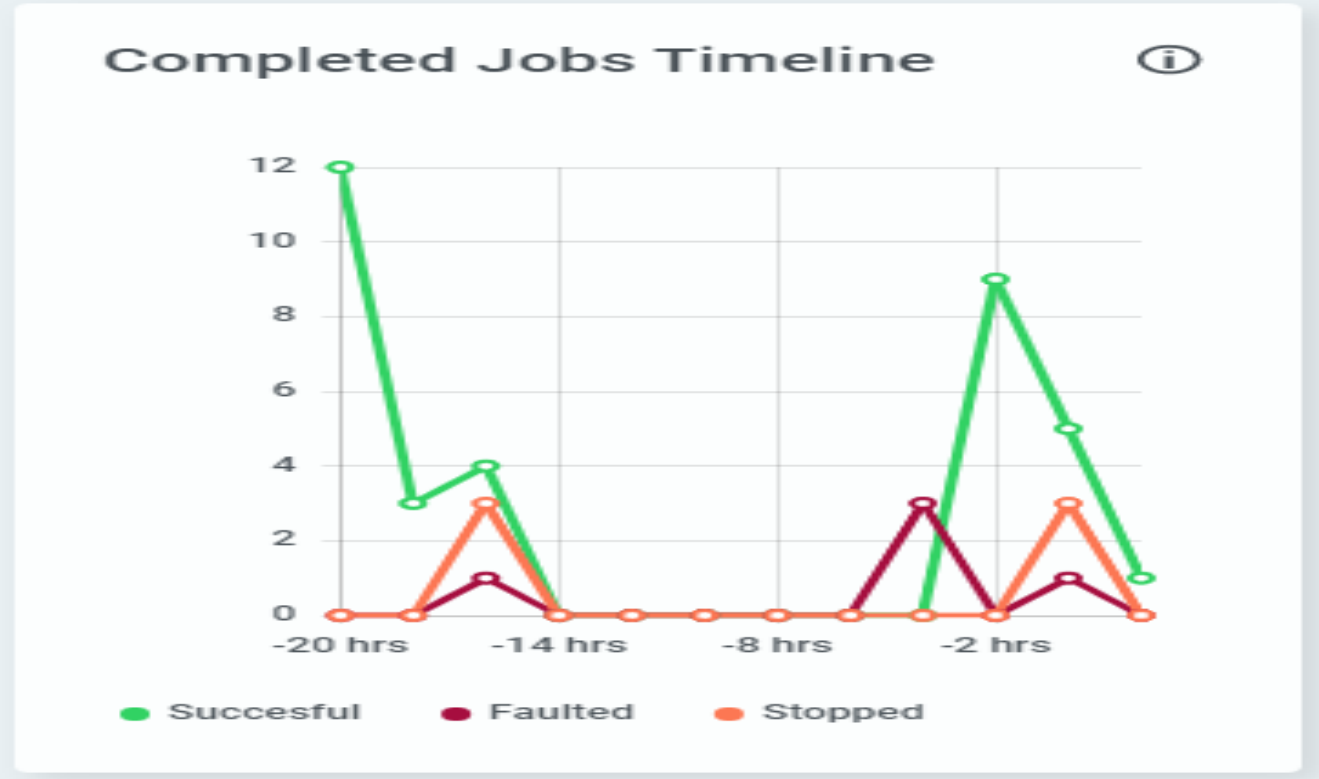

Figure 6.1: Test Timeline

As shown in Figure 6.2 the prototype bot was executed 53 times with 40 successful execution. This translates to 75% success rate. The prototype bot also had 5 failures that occurred due to unresponsive third-party applications like the database. This translates to 9% of the total executions. The Bot was also stopped 8 times by the researcher. The reason for the researcher stopping the bot was trouble shoot some of the failures and also to do changes to the workflow.

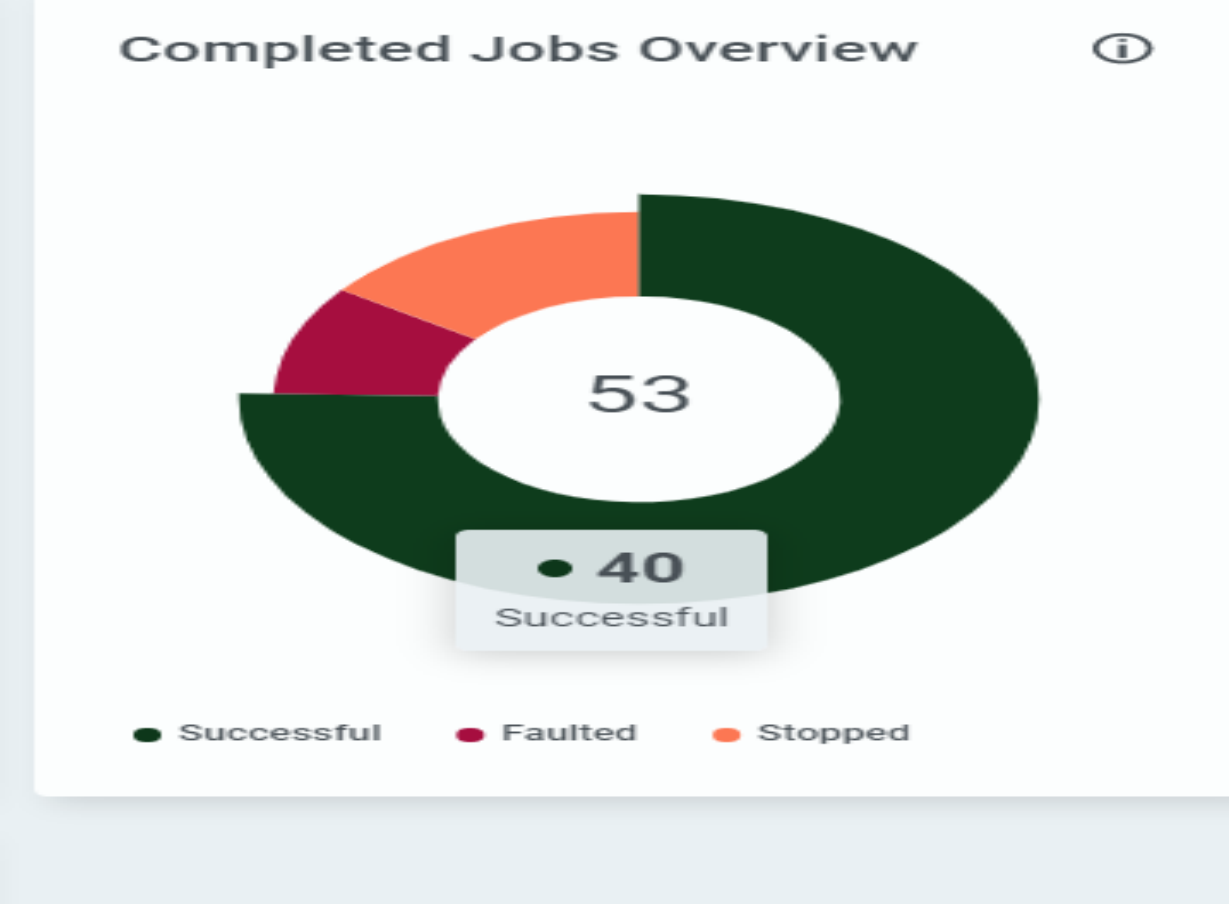

Figure 6.2: Success Overview

6.2.1 Test Phases

The prototype bot was tested based on the various phases of testing. Table 6.1 shows the test phases that were carried out. The testing phases include integration testing, system testing, user testing, security and end-to-end testing.

Table 6.1: Test Phases

Type of Test	Focus
Security Testing	Security testing was done to confirm that the bot did not expose the credentials it was using and that it was getting the credentials from credential manager in an encrypted manner.
User Testing	Users from the customer care department have been incorporated to validate the functional requirement of the bot.
End-to-End Testing	The bot was validated by running it from the start of the process where it gets data from the database to the end where the bot terminated after successfully sending response to the customer.
Integration Testing	Different units of the bot after being tested individually were integrated to form the complete system and so they were tested on how they integrated to form the systems. They were also tested on how they integrated with the existing systems and platforms. Errors were debugged and confirmation done that they were well integrated.
System Testing	During this test, system was tested to make sure that it produced the right results and that it performed as expected.

6.3 Advantages of the Developed Prototype Bot

The framework that governed the creation of the prototype bot and the bot itself had numerous advantages. The framework helped streamline the processes by standardizing the customer care process and guided how the bot was to be developed. The prototype bot ensures that all the responses are shared for all support related queries. Also ensures that all the customers are notified when their cases are marked closed with relevant information on the cause of fault. It Improves customer communication on causes of fault. Bot establishes a single source of truth with customers

and also enforces best practices. The bot also provides custom feedback that is specific to a specific customer. The feedback is simplified and easy to understand making it easy for the customer to know what his or her issue was at a glance. The response also include customer unique identifier which the customer can use to follow up next time the customer has a similar issue which is not included in automatic responses. The bot has also reduced wastage of time by having to close the ticket and share response on separate email.

6.4 Challenges Encountered

It was a challenge getting approvals to use customer data especially using the bot to solve customer queries hence the scope of the study had to be narrowed down. This is the reason as to why the prototype bot was not deployed for an end to end process and was only deployed for a section of the whole process of customer care. Getting staff to appreciate and understand RPA as a technology to augment them and not to get rid of them. This proved to be a challenge as the staff did not fully understand the whole technology. Getting credentials to access the systems more so back end database was a challenge as there were fears on what the bot will be doing on the background as some of the instances of the database did not have test environment hence there are restrictions on what can be done on production databases.

6.5 Achievement of Objectives

This section discusses step by step how the objectives of this research were met. The first objective in section 1.4 was to investigate key characteristics of successful customer service. The study shows that there are several key characteristics of a successful customer care services. These characteristics are explained in detail in section 2.2.2. These characteristics have been cited as indicators of a successful customer care. This research goes ahead and discusses ways to measure the quality of customer service after detailing the characteristics of a successful customer care department. This guides how a company sets up its customer care and how to go about the daily operations of a customer care.

The second objective was to review existing frameworks and approaches for RPA implementation. This research discussed two frameworks that are publicly available. They are discussed in section 2.3.5 highlighting each frameworks strength and weaknesses. Blue prism framework weakness is

that it is skewed towards their technology and tool which makes it hard to use it in a different environment. This research borrowed from the framework on the aspect of the lifecycle especially the development cycle as illustrated by Figure 2.4. Tata framework is another framework that this research analyzed. The framework weakness is that it focusses on the technology part of the network which limits its usability in the telecommunication industry. This research borrowed from Tata framework the aspects of bot architecture as illustrated in Figure 2.3.

The third objective of this research was developing a prototype bot for customer query resolution. The aim of this objective was to prove that by following customer care best practices highlighted in Chapter 2 and the steps highlighted in Chapter 4 for creating a bot, the researcher could develop a bot that would be suited for customer care department. The development process of the prototype bot is discussed extensively on Chapter 5. By mitigating the weaknesses of the reviewed frameworks and borrowing from their strengths the researcher was able to come up with prototype bot that is able to give feedback to the customers for the queries they had raised. The advantages of this prototype bot are discussed in section 6.3.

The fourth objective of this research was to test the prototype bot. This was to make sure that the bot achieved its purposes and that it passed some security measures laid down by the security team. There were several tests that the bot was subject to as discussed in Section 6.2.1. The test results of the bot are discussed in section 6.2. It shows the number of times the bot was tested and the duration as well as the results of the overall test. This includes the number of times the bot was successful and the number of times the bot failed as well as the number of times the researcher stopped the bot due to different reasons. Section 6.2 also shows the time that the bot takes to execute successfully.

Chapter 7 : Conclusion and Recommendations

7.1 Conclusion

Customer support is the backbone of every company, to maintain customers good quality customer care is fundamental. For big companies that have a huge customer base require a large workforce to handle all the customer queries. At the long run it is not sustainable to keep on employing staff to support the customers. So, there is need for innovative ideas on how to employ technology to solve customer queries and maintain a manageable work force.

Robotics is one of the technologies that can be employed to help companies solve their customer service and at the same time remain competitive in the market. A lot of research has been done on robotics in the past on how best to implement RPA. This research has borrowed good practices from them. Those researches and frameworks have presented different approaches on how RPA can be implemented and some of the frameworks and researches have been mentioned in this research.

The aim of this research was to provide a new approach through the application of RPA to solve customer care problems while still borrowing from what has been done. This research minimizes the human aspect to reduce the time taken to respond to a customer as time is of essence in a customer care department while also reducing errors that come with human staff. Reducing the cost of running a customer care department through hiring and training of new staff is also important. The protype bot is meant to help in the process by speeding it up and streamlining the process through following set business rules and standards. Due to the man hours involved in responding to customer queries, the bot has helped as the staff were redeployed to other tasks that required human intelligence and skills to solve.

In this research it was necessary to understand the background of customer care support processes by reviewing relevant literature as well as participant observation of the processes involved. The literature also helped gain an insight on the various errors in the process and failure points. The various rules were extracted from the processes and standards set on how the process should be going forward. The bot was only restricted to giving responses to customers on their queries that have already been resolved by the customer care staff. Finally, several experiments were carried

out to determine the time taken by the bot to accomplish the tasks and compared to the manual process of sending responses to the customers.

7.2 Contributions of the Research

This research has brought about a new way of dealing with customer queries especially the response part. It has addressed the issue of staffing which is a constant problem in customer care. It has also eased the congestion experienced by the number of responses and reduced the time taken for the customer to get a feedback. This research has also helped in streamlining and standardizing the customer care department process especially data formats. The research has helped the company appreciate RPA and understand what RPA is all about and identifying other processes that are candidate for RPA automation. Through this research staff has realized that robots can coexist with human being and they are not here to replace human beings rather to augment them and to make their work easier. Through this research the average time taken to given responses to the customers has been reduced from two ours to an average of three minutes.

7.3 Recommendations and Future Work

This research proposed developing a framework for RPA that could be used in customer care by developing a prototype bot. The prototype bot created by following the framework can be deployed not only in the customer care department but also in other departments. This framework can also be used to create bots for bigger companies than the one used in this research and also in different case scenarios.

This research recommends optimizing the platforms that the third-party applications run on as most of the errors that led to failures in the execution of the bot were as a result of third-party applications not responding on time.

For the purpose of this research the prototype bot was limited to sending responses to customers after their queries have been resolved by a customer care staff. In future the scope can be enlarged to accommodate end to end process from the point at which the customer sends his or her query to the point where he or she receives the response. The whole process to be handled by the bot without human interactions. Future works should also concentrate on having more that one bot working of

the same case and communicating between themselves to share and pass data between themselves. This will further reduce the time a single bot will take to resolve queries and increase efficiency especially in processes that have many business rules.

This research recommends that the prototype bot be extended to other departments of the organization as it will give out a huge return on investments. This research also recommends building capacity in different departments and upskilling the staff that their tasks have been taken by the bot. This will enable staff to maintain the existing bot and also create new bots.

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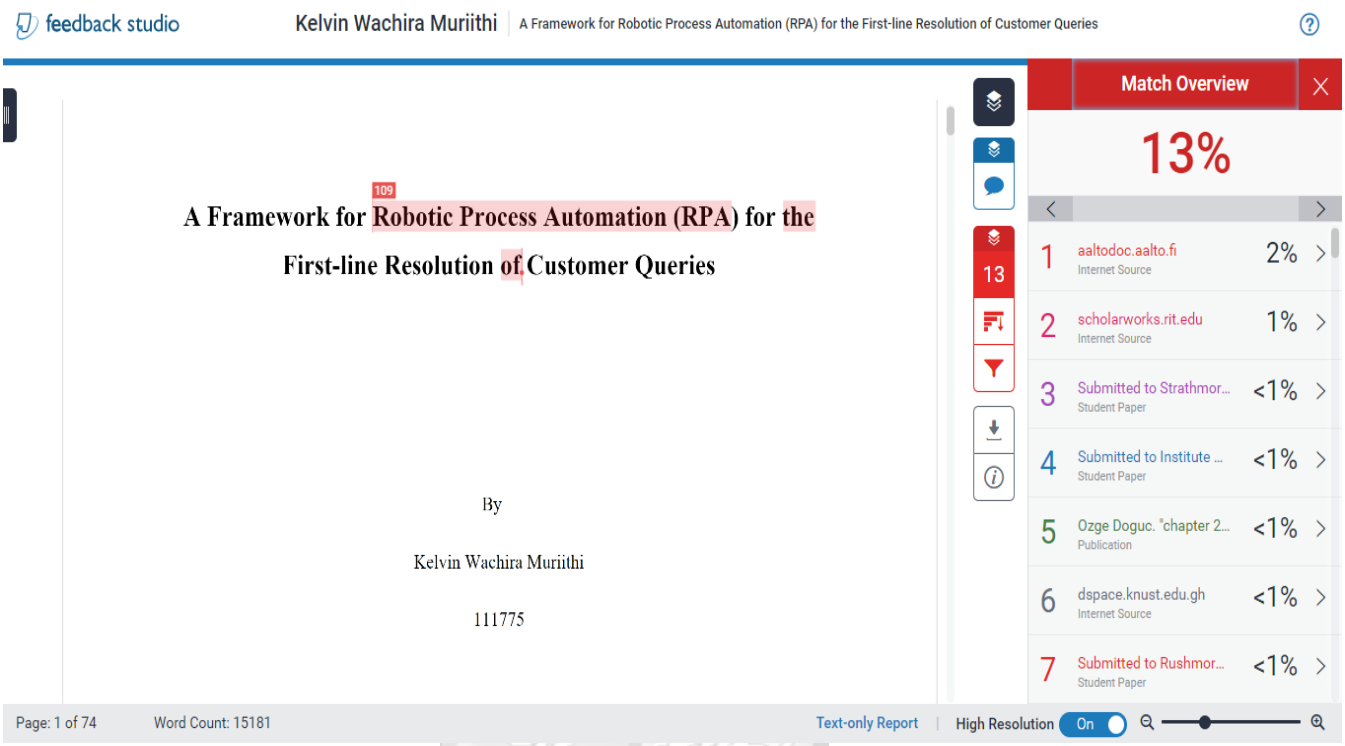
Appendix A: Originality Report



Appendix B: Ethical Approval

Strathmore UNIVERSITY

6th February 2020

Mr Wachira, Kelvin
muriithi.wachira7@gmail.com

Dear Mr Wachira,

RE: A Framework for Robotic Process Automation (RPA) for the First-line Resolution of Customer Queries: A Case of Safaricom

This is to inform you that SU-IERC has reviewed and **approved** your above research proposal. Your application approval number is **SU-IERC0569/19.** The approval period is **6th February, 2020 to 5th February, 2021.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

for. Dr Virginia Gichuru,
Secretary; SU-IERC

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06 FEB 2020
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Cc: Prof Fred Were,
Chairperson; SU-IERC

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