

**DEVELOPING A TRADITIONAL MEDICINAL HERBS SYSTEM USED BY
KIKUYU COMMUNITY IN KIAMBU COUNTY, KENYA**

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Project submitted in partial fulfilment of the requirements for the award of a Bachelor of Science degree, in Library and Information Studies, the Department of Information and Knowledge Management, School of Information and Social Studies the Technical University of Kenya.

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DECLARATION

This thesis is my original work and has not been presented for a degree or any other award in any other institution.

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DEDICATION

I would like to dedicate this work to my father Mr. Mungai Hinga, my mother Felecia Kahara, my sister Morna Mungai and my brother Adrian Mungai.

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I thank God for giving me strength during the course of this study.

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ABBREVIATIONS AND ACRONYMS

API -	Application Programming Interface
KEMRI -	Kenya Medical Research Institute.
KENRIK -	Kenya Resource Centre for Indigenous Knowledge.
Ticah -	Trust for Indigenous Culture and Health.
WHO -	World Health Organisation.

DEFINITION OF KEY TERMS

Bioethics:	The ethics concerning medical and biological research.
Contemporary medicine:	Standard treatments which are based on the results of scientific research and are currently accepted and widely used.
Deployment:	Process of delivering system, modules and updates from developers to users.
Ethnobotany:	The study of indigenous or traditional knowledge of plants.
Explicit knowledge:	Documented knowledge for future purposes.
System:	An interdependent group of items in this case subsystems which regularly interact and form a unified system which has a specific function.
System design:	The modules are included in the system to satisfy the system user requirement.
System user requirements:	What must be delivered by the system that will satisfy the customer needs and expectations of the system.
Tacit knowledge:	The know-how of something which includes the conception and interpretation of information and is knowledge stored in the mind and difficult to document.
Traditional medicine:	The total of the knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not. It's used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness (World Health Organisation, 2014).

ABSTRACT

Traditional medicinal herbs are used all over the world; People are benefiting from the lucrative industry across the world. However, Africans have been left behind since they were burdened by the colonialists' negative perception of traditional medicinal herbs. They were convinced that Christianity and traditional medicinal practices would not go hand in hand and the latter had to pave the way. This led to the Kikuyu community in Kiambu County overlook the traditional medicinal herbs, which led to the tacit traditional medicinal herbs knowledge not being passed on to the next generation. Some people from the Kikuyu community do not hold this knowledge. This study aims to document traditional medicinal herbs still existing in the Kikuyu community in Kiambu County. The objectives of this study were to: establish the existing traditional medicinal herbs from the area; identify the challenges concerning the traditional medicinal herbs the people go through and identify system user requirement which can be used to design and develop the traditional medicinal herbs system for the Kikuyu community in Kiambu County. This study utilised the qualitative approach to collect qualitative data through in-depth interviews from 35 respondents who are above the age of 65. Analysis of the qualitative data was through thematic grouping. Findings suggested that there are numerous existing traditional medicinal herbs which need to be documented for future generations. This study contributes to Kenya's Vision 2030, to improve the health of Kenyans and the third Sustainable Development Goal of good health and well-being. Additionally, using a traditional medicinal herbs system helps make the information accessible without being hindered by geographical boundaries and language barriers.

Keywords:

Kenya, Kiambu County, Kikuyu community, Tacit knowledge, Traditional medicinal herbs,

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Traditional medicine is the total of the knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not. This is the case in African communities and specifically for this study the Kikuyu community. The knowledge is local, therefore, specific to the area the herbs are found, making them easily accessible. Traditional herbal knowledge is tacit knowledge which was communicated orally to the next generation of traditional herbalists in the community. This ensures the transmission of this knowledge from generation to generation (World Health Organisation, 2014).

According to World Health Organisation (2014) and Gathara (2018), traditional medicinal herbs are still presently being used in Africa and due to its accessibility and affordability. Additionally, people are becoming more conscious about their health and are preferring to utilise the traditional medicinal herbs since traditional medicinal herbs is a natural product therefore safe for consumption (World Health Organisation, 2014 & Appiah et al., 2018). Therefore, creating the need for identifying the traditional medicinal herbs from the various Kenyan community to make the retrieval of indigenous traditional medicinal herbs easier.

This study aims to develop a traditional medicinal herbs system using the existing traditional medicinal herbs. It is envisaged that the traditional medicinal herbs system will ease the process of accessing traditional medicinal herbs as language and geographical barriers will be removed. The process of identifying the existing traditional medicinal herbs is necessary as mostly the traditional medicinal herbs knowledge held by a community is transmitted orally (Shamala & Busula, 2022). Therefore, documenting the existing traditional medicinal herbs knowledge through a system is necessary as this knowledge will not be dependent on the holder of the knowledge to be shared. Also, this will enable and ease the usage of the traditional medicinal herbs knowledge making the knowledge useful as stated in Ranganathan's Five laws of Library Science (Illangarathne & Yingming, 2015).

1.2 Background of the Study

According to Yuan et al. (2016), traditional medicine in history was used to treat and prevent illnesses and they were derived from natural products. Countries like China have focused on traditional medicinal herbs and how they have been able to successfully discover new drugs derived from traditional herbs and are now benefitting. The traditional medicinal herbs industry is lucrative as stated by Fortune Business Insights (2022) to be at \$151.91 as of 2021 in the global market. This is a motivating factor to document traditional medicinal herbs and by doing so enable access to the traditional medicinal herbs' knowledge to more people. Fortune Business Insights (2022), did market research and discovered the utilisation of traditional medicinal herbs was increased during the COVID-19 pandemic as the pharmaceutical industry did not have answers. Therefore, people turned to traditional medicinal herbs to help them protect themselves from the virus by raising their immunity. Thus, showing the importance traditional medicinal herbs are gaining around the world and why Kenya should join.

The tacit nature of the traditional medicinal herbs knowledge, creates a gap, its loss and distortion. Thus, creating a need for this knowledge to be documented. Tacit knowledge only resides in the mind and this project seeks to bring it out to a form where it can be stored and preserved for other people to use other than the originator or holder of knowledge. Therefore, benefitting other people in the process. A study by Kipkore et al. (2014), has shown that databases and systems, in general, can be used to document tacit knowledge digitally where more people can access it and utilise it as information is of value when being utilised.

According to Anggraini (2018), explicit knowledge is documented knowledge and referencing the Socialisation, Externalisation, Combination and Internalisation (SECI) model conversion of tacit knowledge to explicit knowledge is externalisation. The externalisation phase is where the explicit knowledge which is the written knowledge is formed from tacit knowledge. This helps promote the accessibility and availability of the traditional medicinal herbs' knowledge, as it is written down therefore it can be shared to multiple users and they use it simultaneously without restrictions (Anggraini, 2018). Externalisation is the main aim of this study, where the tacit traditional medicinal herbs knowledge is converted to an explicit form of knowledge in the digital aspect using a system.

The benefits of traditional medicine are being rediscovered and importance is set on them. (World Health Organisation, 2014) came up with the Traditional Medicine Strategy of 2014-2023, which aims to show the contribution of traditional medicine to the goal of every person having access to health care. This is because it is near their homes, making it accessible and affordable. Additionally, the use of traditional herbs is also a contributing factor to the Sustainable Development Goals (SDGs). WHO came up with the Traditional Medicine Strategy to contribute to its mission of saving lives and improving health. The strategy aims to integrate traditional medicine and contemporary medicine into the delivery of healthcare systems by developing national policies that promote universal healthcare.

Additionally, understanding the role of both traditional and contemporary medicine which helps bring awareness to people in need to continue the uptake and belief in traditional herbs. Finally, the WHO strategy is to contribute to the knowledge base, helping in saving lives and improving health. This is a role this study claims to contribute to using traditional herbs knowledge from the Kikuyu community (World Health Organisation, 2014).

1.3 Context of Study

Conventionally, people used traditional herbs to cure illnesses and prevent them and are still in use by a larger part of the world population. The traditional herbs were from natural products and contributed to the survival of humankind in their way, thus proving they had an impact on the health and wellness of people (Yuan et al., 2016). The African communities included had their way of curing ailments and surviving. The Kikuyu community in Kenya proximity to Nairobi, the capital of Kenya, Christianity, colonisation and Westernisation in the form of formal education. This led to traditional herbal knowledge being eroded and replaced with pharmaceutical medicine. Since the white man believed that Christianity and indigenous practices were contradictory and counter each other, the latter had to pave the way (Kamau et al., 2016).

In the precolonial era, the Kikuyu community had herbal medicine and beliefs that went together, leading to ethnic-religious, where they would consult seers, diviners and Kikuyu medicine men. They had their ways intertwined with the ethnobotanical and religious sides. The Kikuyu community believed that bad spirits led to some of the sicknesses and to cure them, they had to include traditional herbs and the purification of people to lead to complete curing (Sindiga et al., 1995).

1.4 Statement of the Problem

Ranganathan's five laws of library science state that books are for use and the time of the reader should be saved. This spills into today's world where information is not only extracted from physical books but also e-books, therefore, even here the same rules should be followed (Illangarathne & Yingming, 2015). It is evident that it's complex to research homemade medicines on search engines, so it would be advantageous to have a system to be used to extract information directly to avoid retrieving articles about Western homemade medicines. Since most of the time, the ingredients being used are not available here in Kenya because the system databases are mostly populated with Western data. Currently, the Kikuyu community in Kiambu County rely on pharmaceutical medicine to treat illnesses even though there are traditional herbs which have been proven to work and are easily acceptable and at a cheaper cost. Therefore, populating a system database with information on medicinal herbs from Kenya would lead to people utilising that information as the herbs are available and easily accessible.

According to Tolo (2013), some people in Kenya are not able to access healthcare facilities and services due to financial-related problems caused by widespread poverty. The population growth has also led to hospitals being inadequately staffed to handle the population. In addition, Kenya's poor economic performance and political instability have led to unequal distribution of healthcare. This leads the Kikuyu community in Kiambu County resorting to and relying on traditional herbs as contemporary medicine is inaccessible. This has proven that traditional herbs can be used in public health and can contribute to the accessibility and availability of healthcare. This notion has motivated the documentation of the traditional herbal knowledge to ensure its presence over time and independent of oral communication or a person.

The system assists in the increase of knowledge availability therefore people can use it as they are informed of herbs' purpose. The database part of the system can be used for future research and has the potential of being used in the development of new drugs before the knowledge is lost (Kipkore et.al, 2017). The system was populated with the tacit knowledge held by the older population of the Kikuyu community in Kiambu County to ensure the knowledge is not lost and continues to be of use to the younger generation and generations to come. The system also helps the community to save time and cost since people do not have to ask their older relatives for traditional medicinal herbs. Instead, contribute to people

conserving their environment as they know the use of the plants around them and not see them as weeds and uproot them.

According to Arjona-García et al. (2021), urbanisation can lead to a loss of knowledge and social and cultural patterns change over short periods. This leads to the loss of traditional medicinal herbs knowledge since people change their lifestyles and perception which may directly affect land use. Therefore, the land used in the planting of traditional herbs is used for other purposes and thus, the plants and the knowledge are lost. This is the case with the Kikuyu community in Kiambu County, where Westernisation, Christianity and colonisation brought about change in the people's perception and lifestyle. The loss of traditional herbal knowledge was among the first to go as it was attributed to witchcraft due to the religious part of the process (Kamau et al., 2016).

Cultural knowledge, which includes knowledge of traditional medicinal herbs and general herbal knowledge for other purposes such as food, is lost due to urbanisation, migration and integration of communities. This leads to a lack of faith in the traditional herbs and a loss of knowledge on how to recognise herbs, and use and manage the traditional knowledge of medicinal plants (Arjona-García et al., 2021). However, in recent times the return to traditional herbal medicine has risen, and government bodies such as KEMRI have contributed to that stating that even with urbanisation, there is still a large part of the Kenyan population using traditional medicine and they would like to integrate both the traditional and contemporary medicine to close the gap between supply and demand (Tolo, 2013).

1.5 Aim of the Study

This study aims to design and develop a system for traditional medicinal herbs used by the Kikuyu community in Kiambu County. So as to document the identified existing traditional medicinal herbs knowledge from the Kikuyu community, in Kiambu County.

1.6 Research Objectives

- i. To establish existing traditional medicinal herbs among the Kikuyu community in Kiambu County.
- ii. To identify the challenges of identifying traditional medicinal herbs by the Kikuyu community in Kiambu County.

- iii. To identify the system user requirements for designing and development of a traditional medicinal herbs system.
- iv. To design and develop a traditional medicinal herbs system that can be used for the Kikuyu community, in Kiambu County.

1.7 Research Questions

- i. What are the existing traditional medicinal herbs among the Kikuyu community in Kiambu County?
- ii. What are the challenges undergone when identifying traditional medicinal herbs and herbalists by the Kikuyu community in Kiambu County?
- iii. What are the system user requirements required in designing and development of a traditional medicinal herbs system?
- iv. How is a traditional medicinal herbs system designed and developed?

1.8 Scope of Study

The study is focused on the traditional medicinal herbs in Kiambaa constituency in Kiambu County, Kihara ward from the elderly people from the Kikuyu community.

1.9 Justification of Study

This study helps spread the traditional medicinal herbs tacit knowledge to people who are not part of the Kikuyu community, especially the younger generation. Since there is no other traditional herbal system that focuses on the traditional herbal medicine from the Kikuyu community. The traditional medicinal herbs' tacit knowledge in the Kikuyu community, Kiambu community is documented into explicit knowledge which ensures this tacit knowledge is not lost for the next generations. It is necessary to identify the traditional medicinal herbs and document the practice as different factors are fastening the loss of the traditional medicinal herbs knowledge and also the plants used in herbal medicine. This may be caused by: the massive destruction of forests which causes an impact on the traditional health-care system. Unregulated land use by people who do not understand traditions and lack information on the benefits of traditional herbs and the importance of maintaining their habitat. Modernization also leads to the traditional medicinal herbs knowledge not moving from generation to generation as people are not in touch with their traditions which leads to this indigenous knowledge being susceptible to extinction. Therefore, proving how important

it is to establish the existing traditional herbs knowledge as early as possible to avoid loss of this knowledge (Gakuya et al., 2020).

1.10 Significance of the Study

This study benefits the Kikuyu community and other communities in Kenya as they have access to available traditional medicinal herbal remedies, which are easier to utilise other than borrowing from other countries. Also, remove language and geographical barriers from the local Kenyan communities accessing the existing traditional medicinal herbs from the Kikuyu community. Increasing the utilisation of tacit knowledge reduces the costs of treating illnesses and preventive measures using traditional herbal medicine. Additionally, the younger generation will be able to utilise the traditional medicinal herbs knowledge as they do not have any experience with traditional medicinal herbs which will be a first for them and ease their usage for them.

1.11 Assumption of Study

This study assumes that traditional medicinal herbs can be used in contemporary medicine as the basis to unearth new medicine. Additionally, the aged members of the community and herbalists who have interacted with the herbs and was able to easily identify some of the traditional medicinal herbs due to their experiences using them.

1.12 Limitations of Study

The study was subject to the identified traditional medicinal herbs found in Kiambu County, which may not be all the traditional medicinal herbs in the area and therefore provide an opportunity for further research in the area. With limited time and resources, it may not be possible to capture all the traditional medicinal herbs. Additionally, since Kenya has an approval procedure for medicine, which is a long process therefore this study is hosted locally to avoid legal issues. Additionally, getting people, such as traditional herbalists, to provide information which they use as their source of income may pose to be difficult and impossible hindering the amount of information that can be collected. Therefore, the aged people can help with that as they were present during the older times, they hold that traditional medicinal herbs tacit knowledge.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the literature review which is directed by the objectives stated below and the conceptual framework that supports this study. The objectives of this study are: to establish the existing traditional herbal medicine for the Kikuyu community, in Kiambu County. To identify the system user requirements for a traditional medicinal herbs system, to identify the challenges of identifying traditional medicinal herbs and herbalists and to design and develop a traditional medicinal herbs system for the Kikuyu community, in Kiambu County.

According to Ivins (2006), tacit knowledge is the know-how of something which includes the conception and interpretation of information. Tacit knowledge enables one to understand concepts better as the understanding is done in a personal way that one can easily remember. Especially since tacit knowledge can be easily distorted and lost, elicitation of the knowledge is necessary. The knowledge is extracted from the originator or holder of the knowledge and documented. Therefore, the benefits from the knowledge are shared with those in contact with the documented work and the probability of loss or distortion reduces (Dampney et al., 2002).

Traditional herbs have been around for a long time and have led to the sustenance of many communities all around the world, Kenya included. According to Tolo (2013), most Kenyans can manage their healthcare by using traditional herbs. There is no doubt about the efficacy of traditional herbs since the rural and urban poor only have this as their method of healthcare and it works for them. Additionally, factors such as the distance to the hospitals affect access and also people now want fast ways to be treated as traditional medicinal herbs take time therefore, preferring hospitals has led to problems when using traditional medicinal herbs (Arjona-García et al., 2021). Therefore, Jamshidi-Kia et al. (2017), state that the standardisation of the traditional medicinal herbs is necessary to ensure the safety, efficacy and dosage for the people is known and therefore safe to use the traditional medicinal herbs. The standardisation promotes the use of traditional herbs as a safe, affordable and effective method of health care. Finally, the impact of traditional medicinal herbs cannot be ignored or

washed away but it can be researched and packaged to ensure the safety of Kenyan citizens (Tolo, 2013).

According to Tolo (2013), an acceptable medicinal drug is only a drug when it's converted to one through the pharmaceutical process. The standardisation of this process ensures safety and efficacy, and that the plant is identified as a medicinal herb. Appiah et al. (2018), study of integration of biomedical and herbal medicine in Ghana's hospitals, also states that scientific research is to be done to integrate the traditional medicinal herbs know-how and practices with medicine to prepare a herbal product. The research help understand traditional medicinal herbs, their safety, and efficacy and ensure the traditional medicinal knowledge being held is not lost when people who hold it die.

2.2 Existing traditional herbal medicine among the Kikuyu community in Kiambu County.

Traditional medicinal herbs are all around us and come in different forms just as all plants do. In the different species and genres, the identification of the herbs to know which one in specific is safe for consumption comes from years of trial and error and observation of the occurrences. The older generation in a community is trusted to know which herbs are medicinal, their efficacy, dosage, the part of the plant to use, and if any toxins are present. Since this knowledge was passed from the old generation to the young generation through oral communication, observation and practice (Shamala & Busula, 2022).

According to Jamshidi-Kia et al. (2017), establishing the existing traditional medicinal herbs helps in the discovery of new therapeutic benefits and the production of nature-based products. Especially with rising concerns about the effects of synthetic drugs, people are starting to use traditional medicinal herbs. For this to happen the raw material which is the plants, have to be identified. Therefore, traditional medicinal herbs knowledge needs to be preserved to ensure the benefits of the known herbs are documented, thus, creating a basis for further research on the benefits that can be provided by the plant (Jamshidi-Kia et al., 2017). Ari (2016) averred that sustainable cultivation methods need to be investigated, to ensure the existing traditional medicinal herbs are preserved. This ensures their contribution to healthcare and reduction in use of synthetic drugs is possible.

The Ministry of Health (2014), states that Kenya's Vision 2030, aims to improve the overall status of health for all Kenyans. Traditional and complementary service providers are to be

included as private contributors to the policy objectives in ensuring universal health coverage. Also, the communities are to be included as stakeholders in the health service delivery, where the traditional medicinal herbs are recognised for the role, they play in the delivery of healthcare services and are encouraged to continue. This is a motivating factor for the Kikuyu community to establish their existing traditional medicinal herbs. Therefore, contributing to the goal of providing essential healthcare to Kenyans and thus improving the overall health status of Kenyans.

According to Eddouks et al. (2012), the use of traditional medicinal herbs is increasing even in developed countries, thus, the identification of these traditional medicinal herbs is necessary to ensure the correct herbs are being used. Identification is important since traditional medicinal herbs can confuse one, particularly when it comes to identification, efficacy, and toxicity (Eddouks et al., 2012). According to Githinji (2015), In a study in Kiambu County, Githunguri Division, the results showed the different traditional medicinal herbs the people utilise. 57.5% of the respondents used traditional medicinal herbs alone and 63% did so only when the diseases were chronic. This indicates that people in the Kikuyu community utilise traditional medicinal herbs to a great extent. 42.5% used traditional medicinal herbs with a combination of conventional medicine. Additionally, Githinji (2015) states that “*Warbugia ugandensis*” locally known as “muthiga” is used to cure allergies, pneumonia and malaria. These are diseases treated in hospitals and take money to do so when there are traditional medicinal herbs which can help do the same thing at an affordable price and are accessible (Tolo, 2013).

The National Museums of Kenya (NMK) is one of the government institutions that have come up to help in the identification of traditional herbs. NMK hosts the Trust for Indigenous Culture and Health (TICAH Gardens), which displays medicinal plants from different communities in Kenya and the parts to be used to cure specific diseases. The local dialects’ names, help people easily identify and recognise them. According to (Hardison-Moody, 2015), it was stated that the TICAH Gardens aims to provide a space where traditional medicinal herbs can be shared and preserved and leading to knowledge transfer to the younger generation who are not connected to their traditional culture. The Kikuyu community is one of the communities whose traditional medicinal herbs are showcased at TICAH Gardens based at NMK. TICAH Gardens is a depiction of how the identification of

the existing traditional medicinal herbs can be done as it is free to all and one can see the distinguishing features the plants have and therefore hard to forget (Hardison-Moody, 2015).

2.3 Challenges of identifying traditional medicinal herbs and herbalists by Kikuyu communities in Kiambu County.

Social factors such as the negative perception the community has of traditional medicinal herbs have affected the use of traditional medicinal herbs. This negative perception started with colonialists changing Kenya's health-care system to become like theirs (Kamau et al., 2016). Ari (2016), states this negative perception was also supported by the government, in 1969. The late Mzee Jomo Kenyatta, the 1st president of Kenya, claimed that "herbalists were cheats and they lived on the sweat of others". This was a representation of the people's views, especially people who were in support of the missionary and believed Christianity could not coexist with traditional practices and only believed the educated doctors (Kamau et al., 2016 & Ari, 2016). This has caused challenges in identifying traditional medicinal herbs since people have overlooked this knowledge, accessing it becomes a challenge as people who hold it are few (Ari, 2016).

According to Ari (2016) and Fortune Business Insights (2022) traditional medicinal herbs are a lucrative industry as the herbs can be exported to other countries for the country's revenue, however, there have been cases of wild harvesting. Where people over-harvest the traditional medicinal herbs which drives up the price due to lack of supply and making the herbs scarce. This introduces a vicious cycle since there is no manageable use and management of the resource where it is harvested and cultivated sustainably (Ari, 2016). Additionally, the destruction of the habitats has caused the herbs to have nowhere to grow due to overpopulation which has led to buildings being erected everywhere and therefore, the traditional medicinal herbs having to be uprooted for that (Gakuya et al., 2020). This causes challenges in identifying traditional medicinal herbs since they are not being sustainably managed, therefore, people may forget how they look as time passes by and they have not interacted with the herbs as much.

Herbalists have had challenges with intellectual property rights when dealing with researchers and scientists. Some researchers and scientists steal traditional medicinal herbs' knowledge, adopt and even patent the knowledge they collect from them and get credit from

it without including the traditional herbalists (Gakuya et al., 2020). This causes a dissonance between the parties and therefore makes it difficult for traditional herbalists to provide traditional medicinal knowledge and to help identifying the traditional medicinal herbs proves difficult. Gakuya et al. (2020) state that to curb this, the traditional herbalists need to be given royalties and compensation for their contribution and also the recognition to the community provided.

2.4 The system user requirements for the designing and development of a traditional medicinal herbs system.

System user requirements are what must be delivered by the system that will satisfy the customer needs and expectations of the system and is written in a document (Bevan et al., 2018). Salve et al. (2018), state that the system user requirements should be defined before the designing or coding of the system starts as it guides the process. Understanding users' needs and requirements drive the success of a system and knowing where to place focus ensures acceptance of a system. Since time and resources have been put into the design and development of the system, it is crucial to ensure resources are satisfying user needs. It is also important to recognise that the user's opinion may vary in requirements and every user's requirement should be considered. This may pose a challenge and priority and constant negotiation of user requirements is required to strike a balance and ensure that the system satisfies the customer's needs (Bevan et al., 2018).

In Tanzania, Beebwa et al. (2019), carried out a study on the requirements for digitising traditional medical knowledge by using an application. They were able to acquire user requirements for the application using the survey and the ones which were mostly voted for were: the information about herbs to be uploaded. Additionally, Beebwa et al. (2019) stated that the application should indicate the relevant traditional knowledge and allow users to search for information about a medical plant. The tool should be accessible through different devices, the herbal practitioners should be able to register onto the system and share their knowledge and the information should be in English and Swahili. Additionally, there are non-functional requirements such as accessibility, through different devices. Usability for a friendly user interface and scalability, where the system can handle the extension of features as the system requirements change. These are a few of the functional and non-functional requirements that Beebwa et al. (2019) were able to acquire. This applies to the system user

requirements to guide the user requirements to be incorporated into the traditional herbal system for the Kikuyu community.

User requirements involve information gathering as it is the way to know what the users want to satisfy their needs. This helps to get a deeper understanding of why people would want certain system requirements and information-gathering techniques such as interviews, surveys or focus groups can be used to determine what user requirements users want. The user requirements may not be decided from the start as the users may not fully know what they may want from a future system (Maguire & Bevan, 2002). The study by Beebwa et al. (2019), depicts how the functional and non-functional requirements are acquired through surveys and the users had the same requirement but worded them differently as they suited their needs. Therefore, showing that the user requirements have to be analysed to get to understand what are the system user requirements.

2.5 Designed and developed traditional medicinal herbs system

According to (Bhargavi, 2018), a system is an interdependent group of items in this case sub-systems which regularly interact and form a unified system which has a specific function. For a system to be developed there are steps in place to facilitate the process. The popular Software Development Life Cycle (SDLC) is used in guiding the system development and ensuring the development is timely and quality is achieved (Gurung et al., 2020). The SDLC is all about planning, the solution to a problem, building it and then maintaining it. This has to be done in stages to ensure completion and in the various SDLC models discussed the designing and development of the system are part of the building to bring forth the system (Gurung et al., 2020).

System design is the definition of the modules included in the system to satisfy the system user requirement. The modules to be included are visualised to assist in identifying the changes to be made. The user interface and database have to be well designed to ensure the users can be able to interact with the system and benefit from it and that their information needs are being met with accurate and complete information (Bhargavi, 2018).

Kigen et al (2017) recommends using a database to preserve the identified existing traditional medicinal herbs from the Marakwet community for the next generation as it is independent, accessible and available to all. According to Shamala and Busula (2022), a database presents a centralised position for the traditional medicinal herbs and their literature which can be used

in drug discovery which fasten the process as the researchers do not have to go into the field again, they can syphon the benefits of the work already done which saves time and makes this work much easier to do and few resources are required (Fabricant & Farnsworth, 2001).

Currently, pharmaceutical drugs are not working as people are gaining resistance towards them due to the overuse of antibiotics, and the need for traditional herbs continues to grow (Shamala and Busula, 2022). The traditional medicinal herbs knowledge present can be used to overcome this even with the fear of over-exploitation of the wild traditional herbs; a few can be preserved to save the benefits for the future (Ari, 2016). This is only possible once people in general and institutions understand the benefit of every specific herb and evaluate it and see if it is worth saving for the future when the people who last used it are not be present but the benefits will still be needed by people (Shamala & Busula, 2022). Systems can help in the preservation of this traditional medicinal herbs knowledge and ensure its presence in future as there is no fear of the one holding it will die or forget.

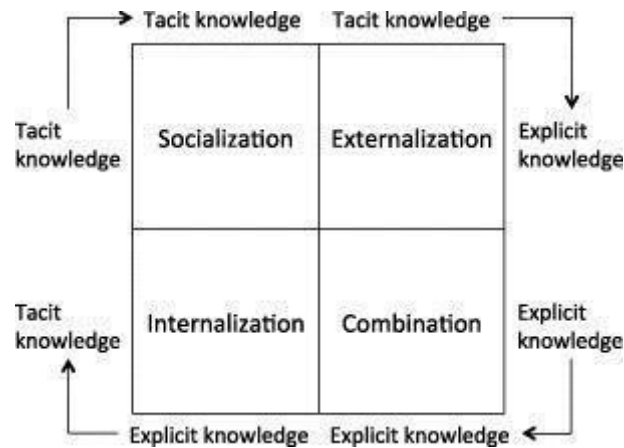
Systems such as databases can be used to preserve traditional medicinal herbs enabling access to information without having to go out and ask people, making it efficient and convenient (Kigen et al., 2017). The World Health Organization (2014), came up with the traditional Medicine Strategy which focuses on shining light on the importance of traditional herbs. It can be seen that a database can be used to contribute to the strengthening and broadening of the knowledge base used for traditional herbal medicine. Which can then be used by the common people as a point of reference in their own lives. Traditional herbal medicine usage is an important contribution to society as it ensures every person has access to quality health care in an accessible manner and at an affordable rate (World Health Organization, 2014).

2.6 Conceptual Framework

The conceptual framework supporting this study in explaining knowledge sharing and conversion is the Socialisation, Externalisation, Combination and Internalisation (SECI) model (Anggraini, 2018). According to Anggraini (2018) and Hugo-Burrows, (2022), socialisation is where knowledge is converted from tacit to tacit mostly when people are conversing orally, externalisation is when knowledge is converted from tacit to explicit, where the tacit knowledge is documented whether digitally or on paper. Combination on the other hand is when different explicit knowledge is combined, the different explicit knowledge is merged. Finally, internalisation from explicit to tacit where explicit knowledge is converted

to tacit knowledge, and the explicit knowledge is understood from the perspective of the person.

Below is a diagram of the SECI model.



Source: Nonaka and Takeuchi (1995)

Figure 1 Conceptual framework of the study

According to Nonaka and Takeuchi's (1995) model, tacit knowledge was shared among the people in the Kikuyu community orally as they socialised. Documentation of the traditional medicinal herbs was not done therefore in the olden day there was no explicit knowledge of traditional medicinal herbs (Sindiga et al., 1995). The SECI model was implemented in this study since the traditional medicinal herbs' knowledge being shared is tacit knowledge that the respondents hold. They have been able to gain this knowledge orally through generations and its conversion to explicit knowledge is the main aim of this study. Externalisation occurred, where the traditional medicinal herbs tacit knowledge is converted to explicit knowledge as it is documented through the traditional medicinal herbs system this study aims to design and develop. The documentation helped to ensure the knowledge is available and accessible since explicit knowledge ensures the recorded tacit knowledge can be shared and is communicable, where the knowledge can be documented (Anggraini, 2018). This makes it easier to specify details which when being orally communicated may be lost or distorted and additionally recorded in a neutral language which everyone can understand and benefit from the traditional medicinal herbs knowledge (Hugo-Burrows, 2022).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter focused on the research and system design, the population of the study, sampling techniques, and sample size of the study. Additionally, the data collection techniques and tools, data analysis techniques and tools, data presentation, reliability and validity and ethical considerations of the study were discussed in this chapter.

3.2 Research Design

According to Kothari (2004), research design is the outline for the collection, measurement and analysis of data. This research implemented the qualitative research design that makes it possible to do one on one and in-depth questioning of the respondents which is required in the collection of tacit knowledge. This research design assisted in the identification and collection of traditional medicinal herbs, understanding the user requirements that people want and therefore making it straightforward in developing the traditional medicinal herbs system and populating the database. The qualitative research design enabled the collection of detailed information especially since it's an open-ended process making it the best option for the collection of traditional medicinal herbs tacit knowledge.

3.3 Systems Design and Development Methodology

According to Wasson (2005), the waterfall development strategy is where the system design and development activities are done phase by phase. The waterfall method phases do not overlap and ensure the previous phase has ended before another one starts since the output from one phase is input for the next phase. According to Senarath (2021), when using the waterfall methodology, the requirements are well defined early in the project and therefore allowing for the goal of the project to be well defined. This makes the development process smooth as the technology to be used is defined early, therefore ensuring one is ready to complete the design and development. Therefore, making the system design and development process stable and faster.

3.3.1 Requirements Analysis

Requirement analysis is done through finding the user requirements of a system and the user requirements are what should be delivered by the system to satisfy the customer (Bevan et al., 2018). For this project, the user needs were determined, which is usually the goal of the system design and development process. The user needs are: designing and developing the traditional medicinal herbs system for the Kikuyu community which is also the goal of this study. After the system requirements were determined most of the requirements used were referred from the determined system requirements by (Beebwa et al. 2019). Since the respondents of the study are above 65 years and are mostly not conversant with system requirements.

3.3.1 Design Phase

In this phase, the design is done to satisfy the user needs by defining all the modules which are required and this helps when discerning whether the system development continues since the skills to develop the modules have to be present (Bhargavi, 2018). This system was designed using different diagrams such as the use case modelling technique, data flow diagram and flowchart diagram. This was used to design the system architecture, how data within the system is flowing and the different permissions and rights users have within the system.

3.3.1 Coding Phase

The system development is done to ensure the system meets the user needs and the project. Loading errors are fixed here to ensure testing is done in an error-free environment (Senarath, 2021). For this study the system used JavaScript programming language specifically React JavaScript for the client side and express, node js framework for the server side and PostgreSQL for the relational database management system of the project. The coding was guided by the design which was made and ensured the design is well implemented.

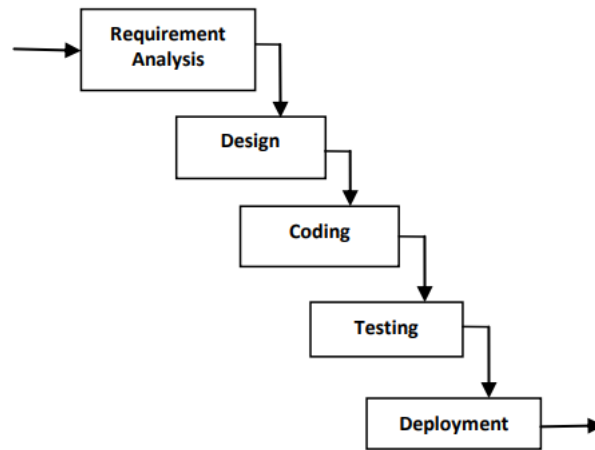
3.3.1 Testing Phase

Here the system is tested and if there are any errors present, they are fixed. This prepares the system to be used by the end users and therefore the user needs to be met and the system

working well (Senarath, 2021). The system was tested using postman to ensure the Application Programming Interface (API) endpoints are working as expected and the client and server side can communicate and ensure the system is working well. Additionally, system testing was done to ensure the system is working well for the end user.

3.3.1 Deployment Phase

Deployment is the transition of the system into the real world where the system is delivered to the end-users and system maintenance and support are done there (Senarath, 2021). Finally, deployment of this system was done using the Vercel platform where the end users were able to get access to the system and also the system maintenance was made possible.



Source: Salve et al. (2018)

Figure 2 The waterfall development process

3.4 Population of Study

Kiambu County has a population of 2.4million people and the constituency of focus was Kiambaa constituency in the specific Kihara area. In the Census of 2019, the Kihara area had a population of 13,190 (Kenya National Bureau of Statistics, 2019). According to World Population Dashboard-Kenya (2022), the aged are usually 3% of the population therefore the population of the study was 395.

3.5 Sampling techniques

Sampling is the process of selecting respondents to collect data from during a study (Kothari, 2004). The non-probability sampling technique was used in this study where a combination

of purposive sampling is due to the small population who are aged above 65 years of age and hold traditional medicinal herbs knowledge (Kothari, 2004 p. 84). Respondents above the age of 65 is the main factor to be considered when selecting the respondents and the respondents were accessed in the church where they have seniors meeting every Wednesday. Additionally, snowballing sampling is where current respondents are used to find new respondents, especially in professions where respondents should have a specific trait. Snowball sampling was used for the herbalist respondents; the respondents were able to provide detailed information about traditional herbs and have experience using them in different situations.

3.5.1 Sample Size

Kothari (2004), describes sample size as the derived group from the population of the study for research. Kothari (2004, p.180), formula is used to calculate the sample size of the study:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N - 1) + z^2 \cdot p \cdot q}$$

$$1.44 * 1.44 * 0.5 * (1 - 0.5) * 395 = 204.768$$

$$(0.1 * 0.1 * (395 - 1) + 1.44 * 1.44 * 0.5 * (1 - 0.5)) = 4.4584$$

$$204.768 / 4.4584 = 45.92$$

Therefore, the sample size was 46.

3.6 Data collection techniques and tools

Data collection is the process of gathering information from the selected sample of the study (Mugenda & Mugenda, 2003). The data collection tools and techniques used are discussed below

3.6.1 Data collection techniques

The data collection technique used in this study was the interview technique where the personal interview technique was done for the respondents. The respondents were asked in-depth questions, which are aimed at collecting traditional medicinal herbs knowledge. The information, about the usage of traditional medicinal herbs, how to prepare them and what diseases they cure. This was hand-written and pictures of the plants were taken. The interview questions were open-ended to get the respondents to share more and explain in detail information about the traditional medicinal herbs.

3.6.2 Data collection tools

Kothari (2004), states the scheduled method is the collection of data where the researcher fills in the questions. The interview schedule tool was used to collect the traditional medicinal herbs qualitative data from the Kikuyu community respondents. The interview schedule tool allowed for the data to be collected in time as the data collection is filled by the researcher and also provides personal contact which is necessary due to the nature of qualitative data collected and also ensures the collected data was more accurate (Kothari, 2004 p.122). Additionally, since the study's respondents are above 65 years, they were not able to write on their own, the interview schedule tool supported for the researcher to assist by filling out the prepared questions for them (Kothari, 2004 p.122). Since the interview method was used to collect data, it required the researcher to take note of the responses of the respondents.

3.7 Data analysis techniques and tools

Data analysis is the process of organising and manipulating data to get meaning from the data collected from the study (Kothari, 2004). This section looks at the data analysis techniques and tools that were used in this research.

3.7.1 Data analysis techniques

The narrative analysis was done, where the interviews were analysed, and the information required was extracted from the interviews. Then thematic grouping was done to the data collected and it was categorised using the traditional medicinal herbs using their Kikuyu dialect name, scientific name, parts to be used and how to do it to form a medicinal product from the traditional medicinal herbs. The thematic grouping technique helped with the

organisation of the respondents' interviews, and all of the information provided such as how the traditional medicinal herbs are prepared for usage, the parts to be used and what it cures.

3.7.2 Data Presentation

Data presentation is displaying collected data from research using visual aids such as tables and graphs (Kothari, 2004 p.367). This study used tables to present, organise and categorise the qualitative data collected which was assisted by the thematic grouping done in data analysis.

3.7.3 Data analysis tools

The QDA Miner Lite tool was used for the analysis of the qualitative data as it analyses textual data from the information collected through the interview technique.

3.8 Reliability and validity

The interview schedule (Appendix I) to be used was presented to the supervisor to ensure the questions to be asked are brief, and to the point, and were able to elicit the traditional medicinal herbs tacit knowledge. This helps with the validity of the instruments used to collect data and the supervisor may have insights on how to phrase the questions to get maximum information. The interview question being valid makes the instruments for data collection, interview in this case, reliable as they can be able to extract information consistently, from all the respondents.

The data collected was hard to verify as it is from people's experiences and may have a different effect on different people when used.

3.9 Ethical Considerations

The respondents' informed consent was sought by ensuring the respondents were kept anonymous since there is no record of their personal information. Also, an introductory letter from the Information and Knowledge Management Department at the Technical University of Kenya was sort.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of this study. The data collected was analysed based on the objectives of the study, which were to: establish the existing traditional medicinal herbs; Identify; the challenges of identifying traditional medicinal herbs and system user requirements for designing and development of traditional medicinal herbs system. Also, designing and developing traditional medicinal herbs system for the Kikuyu community, Kiambu County.

4.2 Response Rate

This study was able to gather 35 respondents, who agreed to participate in this study. The traditional medicinal herbs data were collected from 65 years and above respondents and traditional herbalists.

Therefore, the participation levels were 76%, which is above 70%, which is the required participation level for a study to be effective (Kothari, 2007). The response rate is shown in Table 1.

Table 1: Overall Response Rate n=35

Respondents	Men	Women	Total	Total (%)
Above 65 years	5	27	32	69.5
Herbalists	2	1	3	6.5
Total of respondents	7	28	35	76

This research intended to include respondents above the age of 65 years and herbalists in the data collection. The respondents above 65 years were more at 69.5 %, and the herbalists were at 6.5%, this was because aged respondents were more in number in the area as herbalists

vary in availability. Additionally, women were more at 28 and men were at 7, this study's response rate has a big gap between the genders.

The respondents were interviewed and provided information about the traditional medicinal herbs they use, which disease it cures and the method of administering and preparation. Additionally, information about the challenges of identifying traditional medicinal herbs and herbalists was collected from the respondents.

4.3 Existing traditional medicinal herbs among the Kikuyu community in Kiambu County.

The first objective was to identify the existing traditional medicinal herbs among the Kikuyu community in Kihara Ward, Kiambu County, Kenya. This study was able to identify the existing traditional medicinal herbs from the respondents in the area through interviewing the respondents, and the results are shown in Table 2.

Table 2: The existing traditional medicinal herbs

LOCAL NAME	SCIENTIFIC NAME	PART USED	PREPARATION METHOD	ADMINISTERING METHOD	DISEASE CURED
Gathiriga	Feurstia Africana	Leaves	boil the leaves	Drink	Releases blocked urine
Kererwa	Croton dichogamus	Leaves	boil the leaves	Drink	Throat irritation
Kiruma	Aloe vera	Leaves	ground the leaves	Apply	Cures wounds
Maigoya	Plectranthus barbatus	Leaves	crush the leaves	Apply on tooth	Toothache
Makorobia	Persea americana	Seed	Ground and dry the seed	Mix the ground seed with water	Ulcers
Mikinghi	N/A	Leaves	rub the leaves	Apply on the head	Reduces headache
Muarubaini	Azadirachta indica	Leaves	Boil the leaves	Drink	Malaria
Mubangi	Tagetes minuta	Leaves	boil the leaves	Drink	High blood pressure
Mubera	Psidium guajava	Leaves	boil the leaves	Drink	Diabetes, High blood pressure
Mucatha	Vernonia lasiopus	Roots	wash the roots	chew the roots	Lack of appetite

Mucatha	Vernonia lasiopus	Leaves	boil the leaves	Drink	Skin diseases
Muceege	Bidens Pilosa	Leaves	crush the leaves	apply on eyes	Sore eyes
Mucuthi	Caesalpinia volkensii	Leaves	boil the leaves	Drink	General body pains, Influenza, Malaria
Mugaa	Acacia	Bark	boil the bark with mukungugu	Drink	Diarrhoea
Mugucua	Zanthoxylum usambarense	Bark	wash the bark and remove thorns	Chew the bark	Bleeding gums, Tooth ache, Bad breath
Mugwa-nugu	Aloe kedongensis	Leaves	extract sap out of leaves	Apply on wound	Healing of wound
Mugwa-nugu	Aloe kedongensis	Leaves	extract sap out of leaves	apply on affected skin	Skin conditions
Muiiri	Prunus africana	Bark	Boil	Drink	Food allergy, Urinal problem for men above 40 years.
Mukinduri	Croton megalocarpus	Bark	boil the bark with milk	Drink	Intestinal worms.
Mukoigo	Bridelia micrantha	Bark	boil the bark	Drink	General body pains

Mukungugu	Commoiphora eminii	Bark	boil the bark with mugaa	Drink	Diarrhoea.
Mukura utuku	Malva verticillate	Leaves	squeeze sap out of leaves	Apply on wound	Healing wound.
Munyua mai	Eucalyptus globulus	Leaves	boil the leaves with spring onions	Cover and inhale the steam	Common cold, Asthma.
Mutamaiyu	Olea europaea	Bark	boil the bark	drink after eating allergen	Food allergy.
Muthiga	Warbugia ugandensis	Bark	Boil the bark and add milk	Drink	Common cold, Pneumonia.
Muthuri	Euphorbia candelabrum	Leaves	squeeze sap	apply on eye	Trachoma
Mutongu	Solanum incanum	Leaves	boil the leaves	Drink	Stomach ache
Mutundu	Neoboutonia macrocalyx	Leaves	Squeeze sap from leaves	Apply on wound	Stops bleeding
Mwenderendu	Tredea	Leaves	boil leaves with milk	Drink	Joint pains
Mwenyere	Cussonia spicata	Bark	boil the bark	Drink	Post-natal pains
Nathi	Physalis peruviana	Leaves	wash the leaves	eat the leaves	Stomach ache
Nathi	Physalis peruviana	Leaves	boil the leaves	Drink	Typhoid

Ndimu	Citrus limon	Peel	boil peels	Drink	Common cold
Nduuma (female)	Colocasia antiquorum	Leaves	boil the leaves	Drink	Stomach ulcers
Nduuma (male)	Colocasia antiquorum	Leaves	Boil	Drink	Throat pains
Rosemary	Salvia rosmarinus	Leaves	Boil	Drink	Memory improvement
Thabai	Urtica dioica	Leaves	boil the leaves	Drink	High Blood pressure
Wanjiru wa Rurii	Ajuga remota	Leaves	boil the leaves	Drink	Malaria

The analysed data in Table 2 shows the identified traditional medicinal herbs collected in this study in Kihara Ward, Kiambu County, Kenya. This arrangement of the collected data is shown in the 1st row of Table 2. This information showed that the Kikuyu Community still holds knowledge about traditional medicinal herbs. Most of the traditional medicinal herbs information from the 65 years and above respondents coincided with information from the herbalists showing the transmission of traditional medicinal herbs knowledge is done.

Traditional medicinal herbs used in the Kikuyu community are shared throughout as the region is similar. According to Githinji (2015) study in Githunguri division and Kamau et al. (2016) study in Nyeri County, “*Warbugia ugandensis*” is a common traditional medicinal herb in the Kikuyu community. Where this study was able to identify it as a cure for the common cold and pneumonia, whereas Githinji (2015) found it to be used for malaria, pneumonia and allergies. Kamau et al. (2016) found that the herb was used to cure more than seven diseases, mostly respiratory, such as asthma and the common cold. Traditional medicinal herbs usage is similar in different localities and additional uses may be incorporated such as using it for stomach problems, gout, AIDS, tooth-ache, arthritis and cancer (Kamau et al., 2016).

According to Kamau et al. (2016), other traditional herbs which are commonly used include “*Prunus africana*”, “*Croton megalocarpus*”, “*Kigelia africana*”, “*Cordia abyssinica*” and “*Rotheca myricoides*”. This study was able to identify the “*Prunus africana*” which is used for protein allergies and urinary problems for men above 40 years and “*Croton megalocarpus*” used to cure intestinal worms. Whereas Kamau et al. (2016) were able to find the “*Prunus africana*” cures: for animal protein allergies, STDs, and arthritis and acts as a blood purifier among other diseases and “*Croton megalocarpus*”: amoeba, typhoid, over-bleeding, wounds and family planning method. This shows that the common traditional medicinal herbs in Nyeri County are also present and utilised in Kiambu County for the Kikuyu community.

4.3.1 Additional uses of traditional medicinal herbs

This study intended to identify traditional medicinal herbs; however additional uses other than medicinal benefits were discovered from the same traditional medicinal herbs identified and pictures taken, which are represented in Table 3.

Table 3: Additional uses of traditional medicinal herbs

LOCAL NAME	SCIENTIFIC NAME	PART USED	ADDITIONAL USE
Kererwa	Croton dichogamus	Leaves	Cooking.
Kiruma	Aloe vera	Leaves	Cooking
Makorobia	Persea Americana	Fleshy part	Fruit
Mubariki	Ricinus communis	Leaves	Calcium for cows
Mubera	Psidium guajava	Leaves	Fruit
Muceege	Bidens Pilosa	Leaves	Food
Mugucua	Zanthoxylum usambarense	Bark	Tooth Brush
Muarubaini	Azadirachta indica	Leaves	Mouth wash
Muiiri	Prunus Africana	Leaves	Cooking
Ndimu	Citrus limon	Fleshy part	Tea, Cooking
Nduuma	Colocasia antiquorum	Roots	Food
Rosemary	Salvia Rosmarinus	Leaves	Cooking
Thabai	Urtica dioica	Leaves	Cooking

Table 3 indicates additional uses of the traditional medicinal herbs that people have utilised over time. Therefore, they can re-discover additional uses and this boosts confidence that they have used and can help others understand them.

This is paramount to happen as the usage of traditional medicinal herbs leads to the discovery of other additional uses such as food and mouthwash. These are uses that ensure maximum usage of traditional medicinal herbs other than buying processed and manufactured products.

4.4 To identify the challenges of identifying traditional medicinal herbs and herbalists.

This study sought to identify the challenges the Kikuyu community in Kihara Ward Kiambu County face when identifying traditional medicinal herbs and herbalists.

4.4.1 Challenges of identifying traditional medicinal herbs and herbalists

It was established that negative perception sometimes comes from medical doctors who advise patients to stay away from using traditional medicinal herbs, and therefore it has led to people shunning traditional medicinal herbs. This is what some interviewees had to say:

“My doctor advised me to stay away from traditional medicinal herbs since I have diabetes and that I should focus on one side and not mix the two.”
[Interviewee 7]

“I use traditional medicinal herbs for minor diseases such as now I am having a stomach ache. I used a concoction made by my friend for me. However, I also know that when I use contemporary medicine, I do not use the traditional medicinal herbs, I try to use them both but separately.” [Interviewee 2]

This restricts access to traditional medicinal herbs as people’s interest in accessing traditional medicinal herbs is low. This is because the negative perception leads to the value of traditional medicinal herbs not being realised.

Additionally, some respondents disagreed with the issue of standardisation of traditional medicinal herbs usage and that traditional medicinal herbs require strict dosage and are not mixed with contemporary medicine. One of them said that:

“Traditional medicinal herbs are natural products therefore even when taken whether in excess or not it is not harmful to the body.” [Interviewee 1]

Standardisation of the traditional medicinal herbs is necessary to ensure the traditional medicinal herbs can be integrated into hospitals and be used together with contemporary medicine. The Health Act (2017), states that standardisation will be done for traditional medicinal herbs, this will promote access to traditional medicinal herbs since safety will be ensured by standardisation by regulation bodies.

The traditional medicinal herbs information is not difficult to access as one would think.

“Since I have grown up with the medicinal herbs I know of a few out of my experience and I know most old people have experienced them. Therefore, when we sit together, we can advise on which one to use for what and when the disease is chronic the herbalist may be involved to help know the way forward as they are experts.” [Interviewee 10]

The traditional medicinal herbs system will help improve the access to traditional medicinal herbs without having to access the traditional herbalists which is tiresome as appointments are required. The traditional medicinal herbs system will remove the language and geographical barrier to the traditional medicinal herbs making them more accessible.

Additionally, the differentiation of traditional medicinal herbs is a major challenge which hinders their usage as one is not sure of their identity.

“Herbs look similar so I try to use the herbs I know of and have used regularly. For me to use new herbs I have to get them from the herbalist or anyone who I know is knowledgeable in the herbs area and has used what they are advising.” [Interviewee 16]

However, some of the respondents believe that traditional medicinal herbs were easy to identify as one uses them more and becomes familiar with the look.

“Herbs are similar looking but the difference is seen when you are in constant usage and you get to notice the difference over time. Especially for me as I have taken time to study the traditional medicinal herbs and have understood them. I am constantly looking and go to different areas to do the same which helps in differentiating the traditional medicinal herbs” [Interviewee 31]

Therefore, this restricts access to traditional medicinal herbs as the identification of traditional medicinal herbs is difficult. However, the traditional medicinal herbs system can be used to display the traditional medicinal herbs images, which will help distinguish the different traditional medicinal herbs and help with their identification.

Traditional medicinal herbs also have the challenge of negative harvesting practices which makes them scarce in supply.

“The herbs become scarce when people use them without understanding that they should be used in an orderly manner where others are left for the next people.” [Interviewee 33]

The negative harvesting practices restrict access to traditional medicinal herbs, as this leads to the depletion of the traditional medicinal herbs resources. Therefore, access to traditional medicinal herbs is difficult as the supply of traditional medicinal herbs is low.

According to Ari (2016), the negative perception is not a new challenge for traditional medicinal herbs as it was there since 1963 and it stemmed from the leaders and colonialists.

Therefore, uprooting the beliefs and perceptions is a difficult task which may be unyielding as the bias has been deeply rooted and has been passed down to medical professionals and individuals.

Also, the standardisation of traditional medicinal herbs has been a challenge which in a way restricts the adoption of traditional medicinal herbs as the responsible bodies have to be sure of their safety and efficacy (Tolo, 2013). However, this study was able to uncover that the respondents do not have a reservation about the safety of traditional medicinal herbs due to them being natural products. However, Kamau et al., (2016) stated that there are traditional medicinal herbs which were reported to have toxicity even though rare. Therefore, the claim of toxicity and safety is validated but on specific traditional medicinal herbs which are reported to have rare toxicity.

CHAPTER FIVE

SYSTEM ANALYSIS AND REQUIREMENT MODELLING

This chapter presents the system architecture, flow chart, use case diagram, both functional and non-functional requirements and the specific tools used to develop the traditional medicinal herbs system.

5.1 System Architecture

The system architecture is the model that describes the structure of the sub-systems within a system (GeeksforGeeks, 2022). This includes the client, business layer service, server, and database which are the sub-systems that make up the traditional medicinal herbs system.

Below is the system architecture of the traditional medicinal herbs:

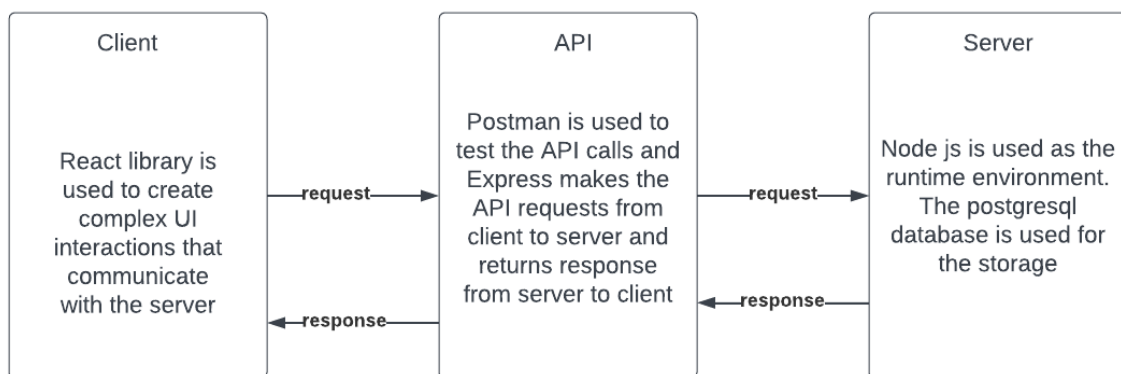


Figure 3 System Architecture of the Traditional Medicinal Herbs System.

The above diagram depicts the system architecture of the traditional medicinal herbs system where the client is the side the user interacts with. The client-side was developed using the React library which enables the traditional medicinal herbs system to be dynamic and create a user interface that can communicate with the server. The Application Programming Interface (API), handles what flows from the server to the client, where it makes requests for data. In the traditional medicinal herbs system, the API receives requests from the client to view the traditional medicinal herbs stored in the PostgreSQL database. Also, the server returns a response to the API and the API returns the response to the client of the traditional medicinal

herbs on the medicine page and also when searching for a specific traditional medicinal herb or disease being cured. The node js is used to create the server-side and it uses the express library to create the APIs which are used to get and post data from and to the PostgreSQL database.

5.2 Flow Chart

A flow chart is a graphical representation of an algorithm that shows how information flows. Figure 4 depicts the traditional medicinal herbs system flow chart, where opening and viewing the traditional medicinal herbs is the start of the system. Where the user views the home page of the traditional medicinal herbs system and can view the tabs that can direct them to other pages. When the user clicks the medicine tab and they are not logged in, the user is requested to log in using their google account to view the traditional medicinal herbs. The user can choose to go to the contact tab where the user can comment about the traditional medicinal herbs system. Also, the user can divert to the search tab, which also requires the user to be logged in using their google account, to be able to search for the traditional medicinal herbs or diseases to be cured.

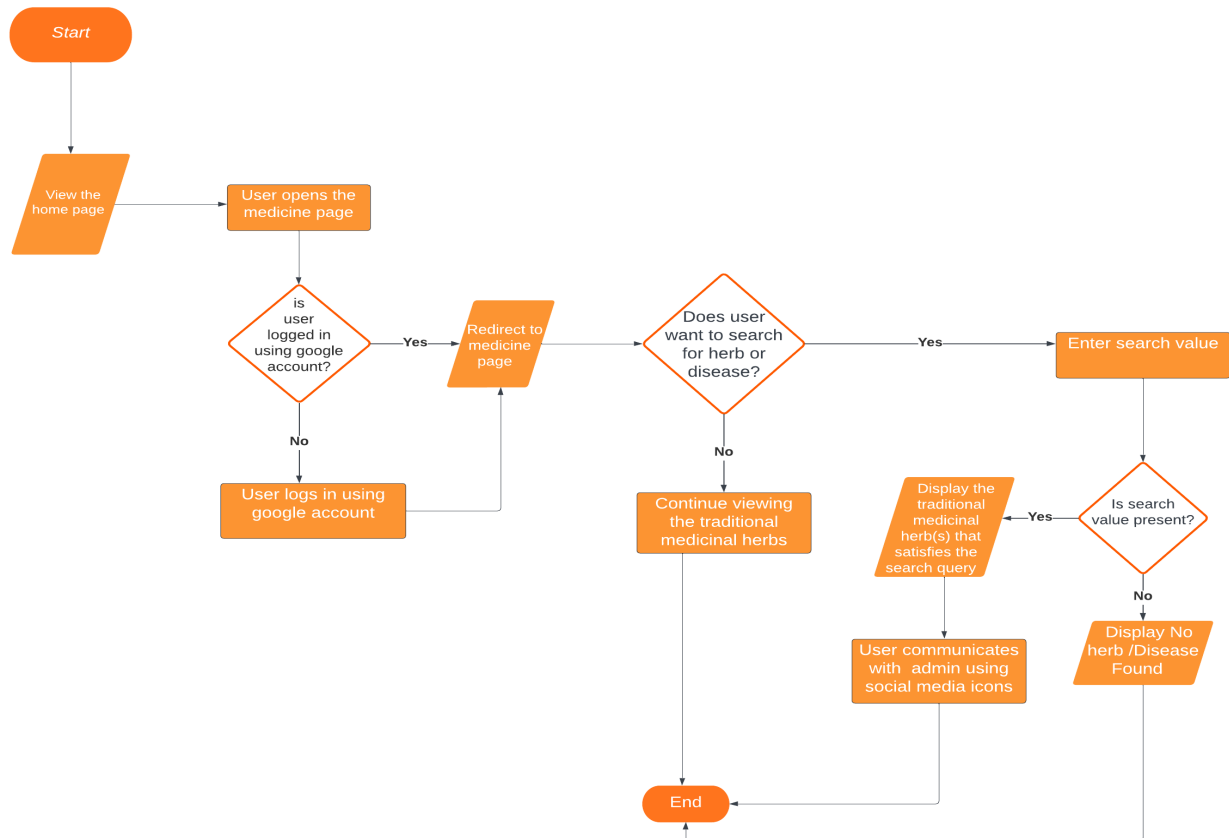


Figure 4 Flow Chart of the Traditional Medicinal Herbs System

5.3 Use Case Diagram

A use case diagram is a unified modelling language which is used to specify the behaviour expected from the system or software from the end-users view point (GeeksforGeeks, 2021). This as shown in figure 5.

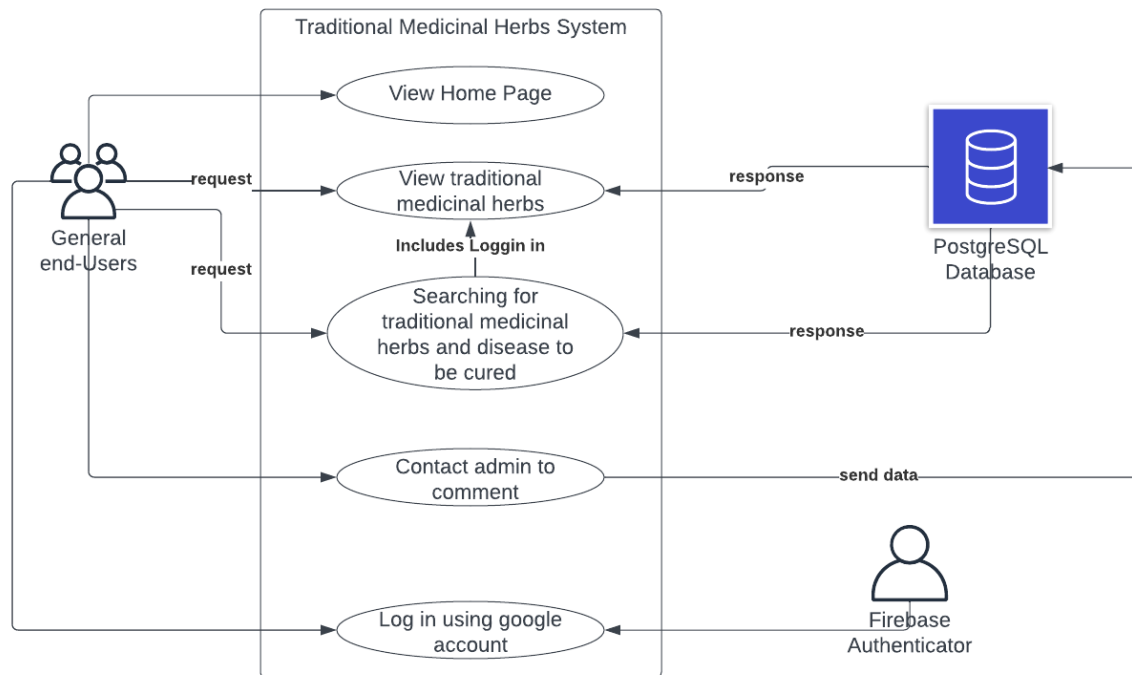


Figure 5 Use Case Diagram for the Traditional Medicinal Herbs System

5.4 Requirements

Requirements specification is the process of outlining the identified requirements in the analysis process of the system design (Martin, 2023). There are different sets of requirements, the functional and the non-functional requirements as discussed below.

5.4.1 Functional Requirements

Functional requirements are the specifics that a system must provide to ensure a system is doing what is expected of it (Geeks, 2023). The traditional medicinal herbs system stores the traditional herbs information, where the landing page provides a short description of the project and the area it was carried out in. Additionally, the medicine tab displays the traditional medicinal herbs and additional details such as the local Kikuyu name, scientific name, picture of the traditional medicinal herb, the disease it cures, how the traditional

medicinal herb is prepared and which specific part of the traditional medicinal herb is used. The plants have a unique number to identify them and this is all stored in a PostgreSQL database.

Additionally, users can log in to the system using their google account to have access to the traditional medicinal herbs. Also, users can search using different categories either the local dialect name or the disease it cures.

5.4.2 Non-Functional Requirements

Non-functional requirements are qualities a system must provide for the users to be able to use the system easily and seamlessly (Leffingwell, 2023). Additionally, Leffingwell, (2023) states the non-functional requirements describe how well the system carries out its intended purpose not its specific functionality therefore ensuring user satisfaction. The non-functional requirements for the traditional medicinal herbs system are as shown below:

i. Reliability

The search results are accurate and this ensures the system is reliable and accurate for the user, especially in matters of health.

ii. Availability

The information is available 24 hours a day every day as long as internet access is present and the user is logged in.

iii. Safety and Security

The system is secure as the users log in to get access to the traditional herbs information using their Google account.

iv. User-friendly

The system is easy to use and understand therefore the user can interact with it without needing assistance.

v. Performance

The user can use the system and not have a long wait time before their request gets a response also multiple users can be able to use the system at the same time and the performance will not change.

5.5. Tools used

The project used Windows 11 64-bit operating system. The hardware of the computer used to develop the system is an HP EliteBook laptop with core i7 and RAM 16GB. Visual Studio Code was used as the source code editor for this project's coding process. The React Library was used to code the front end, Postman Agent was used to test the API calls. The node and express js were used to create the runtime environment and create the API calls to get and post data and the pgAdmin 4 was used to store the PostgreSQL database.

CHAPTER SIX

SYSTEM DOCUMENTATION

This chapter documents the system developed specifically the user interface, the API and the backend connection. The documentation is of display of the traditional medicinal herbs system and the code itself in some instances.

6.1 User Interface

The user interface was implemented using HTML, CSS, and javascript in specifically the React library. Figure 6, displays the Login page for the traditional medicinal herbs system: the login page, where users can be able to login using their Google account and view the traditional medicinal herbs. This ensures security as users have to log in to view the traditional medicinal herbs.

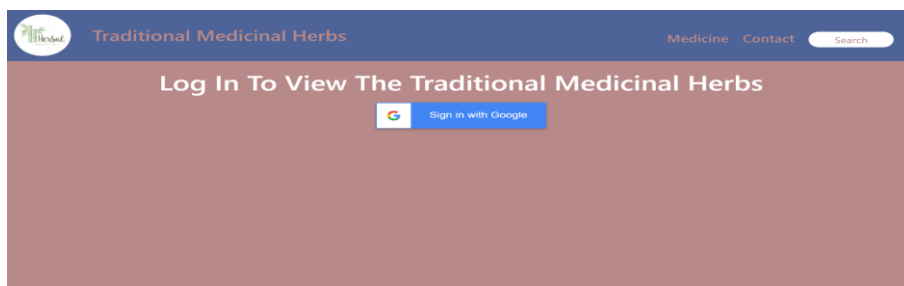


Figure 6 Traditional Medicinal Herbs System Login Page

Also, the contact page as seen in Figure 7, where the users can communicate with the admin by filling out the form or using the social icons to connect to social media for communication.

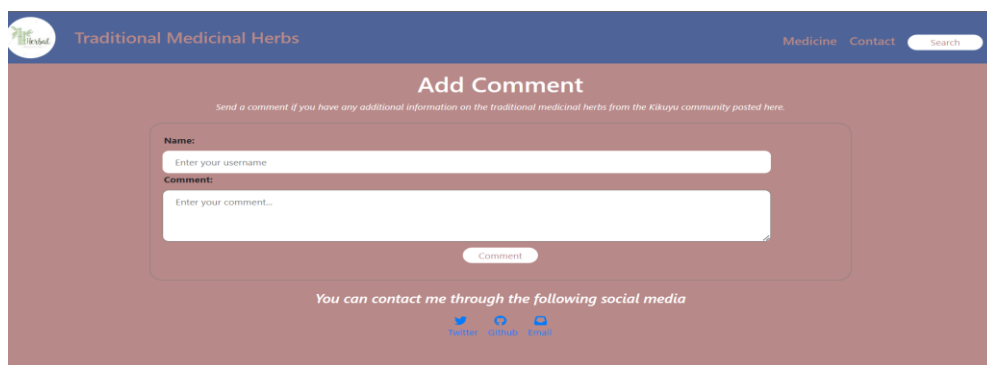


Figure 7 Traditional Medicinal Herbs System Contact Page

6.2 Application Programming Interface

The APIs to be used are as documented, in Figure 8. The get API is used to get the traditional medicinal herbs from the database and display them in the medicine tab.

```
//list all herbs

app.get("/allHerbs", async(req, res) => {
  try {
    const allHerbs = await pool.query("SELECT * FROM medicinalherbs")
    res.json(allHerbs.rows);
  } catch (err) {
    console.error(err.message);
  }
});
```

Figure 8 Traditional Medicinal Herbs System Get Query

From the above get query, Figure 9 is what is to be displayed on the screen for the user, as the data required has been fetched from the database, for logged-in users.

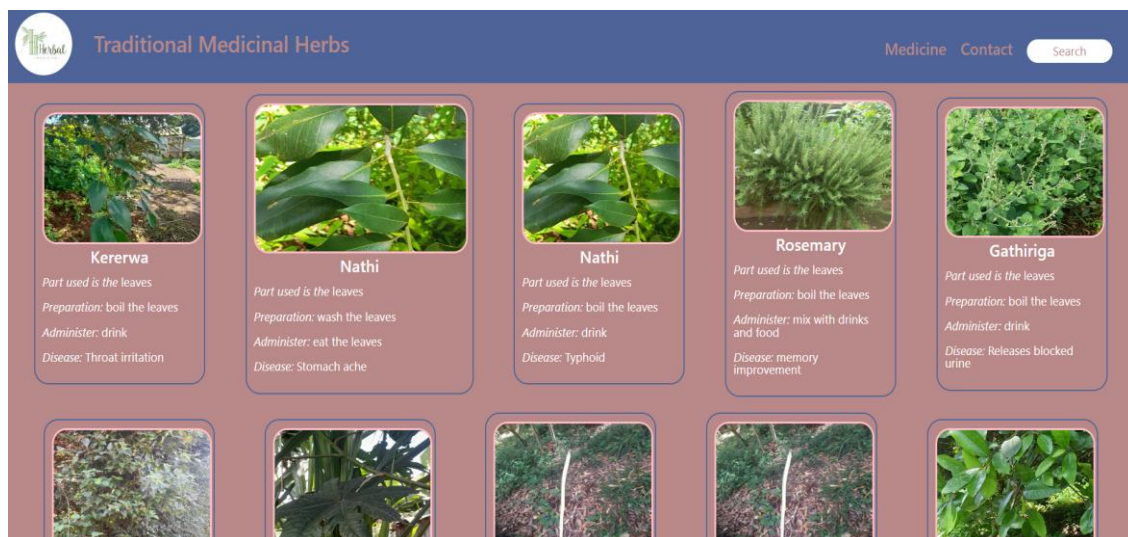


Figure 9 Traditional Medicinal Herbs System Medicine Page

Also, there is the search tab where the user can be able to search using terms such as the traditional medicinal herbs kikuyu name or the disease to be cured. The search API which connects to the traditional medicinal herbs PostgreSQL database is seen in Figure 10. The

search API get request and also makes the connection to the front end possible. The “/herb” path connects to the search input to be able to return the appropriate traditional medicinal herbs that satisfy the search value.

```
//search for specific herb or disease
app.get("/herb", async(req, res) => {
  try {
    const { value } = req.query;

    const specificHerb = await pool.query(
      `SELECT * FROM medicinalherbs WHERE disease || ' ' || kikuyuname ILIKE $1`,
      [`${value}%`]
    );

    res.json(specificHerb.rows);
  } catch (err) {
    console.error(err.message);
  }
});
```

Figure 10 Traditional Medicinal Herbs System Search API

Figure 11 displays, the result when the search value is present within the PostgreSQL database. Using a common name of the traditional medicinal herbs the one in brackets. Additionally, the Kikuyu name or the disease to be cured can be used as the search term.



Figure 11 Traditional Medicinal Herbs System Search Page

6.3 Database

The database schema is shown in Figure 12.

```

Microsoft Windows [Version 6.0.6002.18004] (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\lorna> sqlcmd -S localhost -U lorna -P lorna
sqlcmd (13.11)
WARNING: Console code page (437) differs from Windows code page (1252)
8-bit characters might not work correctly. See sqlcmd reference
page "Notes for Windows users" for details.
Type "help" for help.

sqlcmd> \c herbs
You are now connected to database "herbs" as user "lorna".
herbs> SELECT * FROM medicinalherbs;

```

id	kikuyuname	scientificname	part	preparationmethod	administmethod	disease	imageurl
2	Kererwa	Croton dichogamus	leaves	boil the leaves	drink	Throat irritation	kererwa
24	Nathi	Physalis peruviana	leaves	wash the leaves	eat the leaves	Stomach ache	nathi
25	Nathi	Physalis peruviana	leaves	boil the leaves	drink	Typhoid	nathi
28	Rosemary	Salvia rosmarinus	leaves	boil the leaves	mix with drinks and food	memory improvement	rosemary
1	Kathiriga	Feurstaia africana	leaves	boil the leaves	drink	Releases blocked urine	kathiriga
5	Mikingini	Ricinus communis	leaves	rub the leaves	apply on the head	Reduces headache	mikingini
7	Mubariki	Ricinus communis	leaves	ground the leaves	eat the leaves	Calcium for cows	mubariki
10	Mugucua	Zanthoxylum usambarense	bark	wash the bark and remove thorns	chew the bark	Tooth ache	mugucua
11	Mugucua	Zanthoxylum usambarense	bark	wash the bark and remove thorns	chew the bark	Bleeding gums	mugucua
12	Muiri	Prunus africana	bark	boil the bark	drink	Allergy	muiri
13	Muiri	Prunus africana	bark	boil the bark	drink	Urinal issue for men over 40years	muiri
14	Mukinduri	Croton megalocarpus	bark	boil the bark with milk	drink	Intestinal worms	mukinduri
15	Mukoigo	Bridelia micrantha	bark	boil the bark	drink	General body pains	mukoigo
16	Mukungugu	Commiphora esini	bark	boil the bark	drink	Diarrhoea	mukungugu
17	Mukura utuku	Malva verticillata	leaves	squeeze sap out of leaves	apply on wound	Healing wound	mukura-utuku
8	Mubera (Guava)	Psidium guajava	leaves	boil the leaves	drink	High blood pressure	mubera
9	Mubera (Guava)	Psidium guajava	leaves	boil the leaves	drink	Diabetes	mubera
22	Mutundu	Neoboutonia macrocalyx	leaves	squeeze sap out of leaves	apply on wound	Stops bleeding	mutundu
23	Muenderendu	Tredea	leaves	boil the leaves with milk	drink	Joint pains	muenderendu
19	Munyua mai (white blue gum)	Eucalyptus globulus	leaves	boil the leaves	Cover and inhale the steam	Asthma	white-bluegum
21	Mutongu	Solanum incanum	leaves	boil the leaves	drink	Stomach ache	sodom-apple
3	Kirima (Aloe Vera)	Aloe vera	leaves	ground the leaves	apply	Helps cure wounds	-- More --

Figure 12 Traditional Medicinal Herbs System Database Schema

The PostgreSQL database stores the collected Kikuyu community traditional medicinal herbs which are used in the traditional medicinal herbs system. The first row of the table is used to categorise the data within the database. Where the id, is a serial type which is automatically generated, the Kikuyu name, scientific name, part, administer method, preparation method, disease and image url all have the varchar data type. This allows for the traditional medicinal herbs data to include letters and symbols.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

This chapter is summary of discussions and findings of this project based on the objectives and research questions, and the recommendations drawn from this research's findings.

7.1 Conclusions

This project set out to develop a traditional medicinal herbs system from the Kikuyu community, in Kiambu County in Kenya and it was able to conclude that:

- i. This project identified 34 traditional medicinal herbs from the Kikuyu community as shown in Table 2. The traditional medicinal herbs identified cure both acute diseases such as colds and chronic diseases such as diabetes are healed, showing that the traditional medicinal herbs can be used for primary health care services due to their holistic nature.
- ii. The major challenges established from this project include negative perception contributed to the reduced usage of traditional medicinal herbs, because the Kikuyu community were highly influenced by Westernisation, Christianity and Modernisation therefore leading to a preference for contemporary medicine other than the traditional medicinal herbs.
- iii. This project was able to conclude that users main system user requirement is the ability to retrieve the traditional medicinal herbs or the diseases to be cured. Since this makes the process of retrieving information faster and simple for the user. Therefore, system features that make the traditional medicinal herbs more user friendly are preferred, such as the search functionality that makes access and retrieval of the Kikuyu community traditional medicinal herbs knowledge easier.
- iv. The traditional medicinal system developed promotes access to the Kikuyu community's traditional medicinal herbs. Therefore, making the retrieval process easier, as less time is taken to get results since the traditional medicinal herbs system makes the traditional medicinal herbs easily accessible to the Kikuyu community and the general public since the language and geographical barrier is removed through

traditional medicinal herbs knowledge being documented through the traditional medicinal herbs system.

7.2 Recommendations

From the above conclusions, the following recommendations were made:

- i. Carrying out further research to broaden the traditional medicinal herbs knowledge base from the various Kenyan communities. This will ensure various traditional medicinal herbs resources are being utilised as this will regulate the depletion of the traditional medicinal herbs resources due to various sources being used. Also, it will ensure the accessibility of the traditional medicinal herbs to everyone due to the various sources.
- ii. Developing a national traditional medicinal herbs database that will store the traditional medicinal herbs from this study and traditional medicinal herbs from the various Kenyan communities. To ensure the preservation of this knowledge before the holders of the knowledge die with it.
- iii. Developing a nationwide traditional medicinal herbs system which will integrate the traditional medicinal herbs from other Kenyan communities. This will ease access and make it user-friendly since users can be able to retrieve information from the traditional medicinal herbs system. Therefore, contributing to the Natural Products Industry Initiative by the National Museums of Kenya, by securing and documenting indigenous traditional medicinal herbs knowledge from various Kenyan communities.

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APPENDIX I

INTERVIEW QUESTIONS FOR THE HERBALIST

1. Gender of the herbalist?
2. Age of herbalist?
3. How did you learn about traditional medicinal herbs?
4. How long have you practised making traditional medicinal herbs?
5. Do you sell traditional medicinal herbs?
6. If yes, how do you package it?
7. What is the reason for exploring the traditional medicinal herbs sector?
8. What is the importance of traditional medicinal herbs to the Kikuyu community?
9. Where do you get the traditional medicinal herbs?
10. What are the challenges of identifying traditional medicinal herbs?
11. What are the traditional medicinal herbs used by the Kikuyu community and what disease do they cure?
12. How are the traditional medicinal herbs prepared?
13. What part of the traditional medicinal herb is used?
14. Can pictures of the traditional medicinal herbs be taken?
15. Other than curing disease, what else can the traditional medicinal herbs be used for?

INTERVIEW QUESTIONS FOR THE RESPONDENTS

1. Age of the respondent?
2. Gender of the respondent?
3. Do you use traditional medicinal herbs?
4. If yes, which traditional medicinal herbs do you use and what disease does it cure?
5. What is the method of preparation for the traditional medicinal herbs?
6. What are the challenges you experience when identifying traditional medicinal herbs?
7. Are there any herbalists you visit to help with the usage of traditional medicinal herbs?
8. If yes, how do you access the herbalists?
9. What are the challenges of identifying herbalists?
10. Why do you use traditional medicinal herbs?
11. Are you content with traditional medicinal herbs?
12. Do you use contemporary medicine together with traditional medicinal herbs?
13. If yes, in what situation do you do so?
14. Do you understand what a system is?
15. If yes, do you think the use of a system will help the use of traditional medicinal herbs?
16. If yes, what are the system user requirements you would require as a user?