

**MOBILE AND WEB BASED APPLICATIONS FOR SUPPORTING
LOCATING OF HOSPITAL SERVICES: A CASE OF MICRO-HEALTH
INITIATIVE ORGANIZATION**

Mbonimpaye Hamis John

**A Project Report Submitted in Partial Fulfillment of the Requirements of the Award
the Degree of Master of Science in Embedded and Mobile Systems of the Nelson
Mandela African Institution of Science and Technology**

Arusha, Tanzania

July, 2022

ABSTRACT

Tanzania has various health policies and strategic plans including the digital health strategy 2019 - 2024". However, these policies mainly address systematic issues to ensure better availability and delivery of health services. The adoption of technology on the health sectors in Tanzania is growing rapidly. Other factors such as income and health insurance status also affect utilization of health services, and are not as widely captured. This study aimed at improving health services seeking behavior through the development of mobile applications and web applications that help patients identify health facilities near their locations, the services available at these facilities and the cost of services. The study employed quantitative research method where data were collected from community and health workers using questionnaires and observations. The data were analyzed using Jupiter python. The results indicated that both mobile and web applications improved accessibility of patients get to know nearby hospitals, services the hospital provides, prices of the services on different hospital. Therefore, it is easy for patient to decide depending on the money he or she have. The other key finding is that patients to be able to book the appointment depending on the hospital services chosen. Hence, provides easiness to the community for patients or anyone who need hospital services.

DECLARATION

I, Mbonimpaye Hamis John, do hereby declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this project report is my original work and that it has neither been submitted nor being concurrently submitted for a degree award in any other institution.

Mbonimpaye Hamis John



19.07.2022

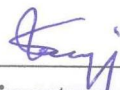
Name of Candidate

Signature

Date

The above declaration is confirmed by:

Dr. Edith Luhanga



3/8/2022

Name of Supervisor 1

Signature

Date

Dr. Anael Sam



26/07/2022

Name of Supervisor 2

Signature

Date

COPYRIGHT

This project report is copyright material protected under the Berne Convention, the Copyright Act of 1999 and other international and national enactments, in that behalf, on intellectual property. It must not be produced by any means, in full or in part, except for shorts extracts in fair dealing, for researcher private study, critical scholarly review or discourse with an acknowledgement, without the written permission of the office of Deputy Vice-Chancellor for Academic, Research and Innovation on behalf of the author and the Nelson Mandela African Institution of Science and Technology.

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by The Nelson Mandela African Institution of Science and Technology, a project report titled “**Web and Mobile based application for supporting locating of hospital Services: A Case of Micro-Health Initiative Company Limited**” in partial fulfillment of the requirements for the degree of Master of Science in Embedded and Mobile Systems of the Nelson Mandela African Institution of Science and Technology.

Dr. Edith Luhanga

Name of Supervisor 1



Signature



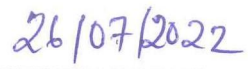
Date

Dr. Anael Sam

Name of Supervisor 2



Signature



Date

ACKNOWLEDGMENTS

I would like to thank God Almighty for his grace and blessings of life which helped to facilitate this work.

I'd like to thank my supervisors, Dr. Anael Sam and Dr. Edith Luhanga, for their willingness to supervise this project, as well as their ongoing encouragement, interest, and guidance during this research. I appreciate my colleagues' invaluable research advice and help during the duration of the project.

I'd also like to show my appreciation to Micro-Health Initiative Company Limited for the internship opportunity and to everyone who took part for their support in this research, especially during the requirement gathering process on the project.

I am grateful to the Centre of Excellence for ICT in East Africa (CENIT@EA) scholarship program for supporting this project, as well as the NM-AIST for providing a supportive atmosphere for me to pursue my academic and professional goals.

DEDICATION

This work is dedicated to my daughter Ruqayyat Mbonimpaye Hamis.

TABLE OF CONTENTS

ABSTRACT.....	I
DECLARATION	II
COPYRIGHT	III
CERTIFICATION	IV
ACKNOWLEDGMENTS	V
DEDICATION	VI
LIST OF TABLES	X
LIST OF FIGURES	XI
LIST OF APPENDICES	XII
LIST OF ABBREVIATIONS	XIII
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background of the Problem	1
1.2 Statement of the Problem.....	3
1.3 Rationale of the Study.....	4
1.4 Objectives	5
1.4.1 Main Objective	5
1.4.2 Specific Objectives.....	5
1.5 Research Questions	5
1.6 Significance of the Study	5
1.7 Delineation of the Study	6
CHAPTER TWO	7
LITTERATURE REVIEW	7
2.1 Factor Affecting Health seeking Behavior	7
2.1.1 Cultural and Social Factor.....	7
2.1.2 Women Freedom	7
2.1.3 Economic Factor	7

2.1.4	Health Facility Location Services	8
2.1.5	Mobile Health Applications	8
2.1.6	Web Technology	9
2.2	Related works.....	9
CHAPTER THREE		12
MATERIALS AND METHODS.....		12
3.1	Area of the Study	12
3.2	Research Methods	12
3.3	Sample Size and Sampling Techniques	12
3.4	Data Collection Methods	13
3.5	Technique for Data Analysis	14
3.6	System Development Methodology.....	15
3.6.1	Extreme Agile Methodology.....	15
3.7	Data Requirements.....	15
3.7.1	Functional Requirements.....	16
3.7.2	Non-Functional Requirements	16
3.8	System Design	16
3.8.1	Architecture.....	16
3.8.2	Conceptual Design	17
3.8.3	Use case diagram.....	18
3.8.4	Data Flow Diagram	20
3.8.5	Database Schema.....	22
3.9	System Implementation	24
3.9.1	Development of Mobile Application.....	24
3.9.2	Development of Mobile Application.....	25
3.10	Web Application System	26
3.10.1	Laravel PHP Framework.....	26
3.10.2	CSS, HTML and JavaScript.....	26
3.10.3	Assumptions and Dependencies on Usability of Web Application	27
3.11	System Testing.....	27
3.11.1	System Validation	27

CHAPTER FOUR.....	28
RESULTS AND DISCUSSION	28
4.1 Research Case Study Area results and Discussion	28
4.1.1 General Awareness of Community Towards health services.....	28
4.1.2 Awareness of Services prices at the Hospitals	28
4.2 Results and Discussion of the System	29
4.2.1 Developed Mobile Application	29
4.2.2 Developed Web Application	32
4.2.3 Super Admin Interface	32
4.2.4 Hospital Admin Interface	33
4.3 System Validation.....	33
4.3.1 Unit Testing.....	34
4.3.2 Integration Testing	34
4.3.3 System Testing	34
4.3.4 User Acceptance Test.....	34
4.3.5 Graphical User Interface	35
CHAPTER FIVE	37
CONCLUSION AND RECOMMENDATIONS	37
5.1 Conclusion	37
5.2 Recommendations.....	38
REFERENCES	39
APPENDICES	44

LIST OF TABLES

Table 1: Use case requirements diagram description	19
Table 2: Result of user acceptance testing	35
Table 3: Menu of the application	36

LIST OF FIGURES

Figure 1:	Community.....	13
Figure 2:	Python Jupiter Notebook.....	14
Figure 3:	System development life cycle.....	15
Figure 4:	General Conceptual Framework.....	18
Figure 5:	Use case diagram.....	20
Figure 6:	Context diagram	21
Figure 7:	Data Flow Diagram	22
Figure 8:	Database Schema.....	23
Figure 9:	PhpMyAdmin display.....	23
Figure 10:	Agile Software development Cycle (Maguire, 2012)	24
Figure 11:	Response from Arusha, Dar es salaam and Kilimanjaro.....	28
Figure 12:	Response on Hospital Price Awareness	29
Figure 13:	Splash Screen and Map screen	30
Figure 14:	Hospital services and sub services screens.....	30
Figure 15:	List of hospitals and list of doctors	31
Figure 16:	Appointment Screen	31
Figure 17:	Login Interface	32
Figure 18:	Super Admin interface.....	33
Figure 19:	Hospital Admin interface	33

LIST OF APPENDICES

Appendix 1: Community Data Collection Questionnaires from Field Surveys	44
Appendix 2: Health Workers Questionnaires from field Surveys	47
Appendix 3: The Mobile App Sample Codes	50
Appendix 4: Poster Presentation	53

LIST OF ABBREVIATIONS

IDE	Integrated Development Environment
JDK	Java Development Kit
JRE	Java Runtime Environment
MVC	Model–view–controller
NBS	National Bureau of Statistics
NGO	Non-Governmental Organization
PPP	Public-Private Partnerships
SDK	Software Development Kit
TCRA	Tanzania Communications Regulatory Authority
UAT	User Acceptance Testing
UI	User Interface
UML	Unified Modeling Language
URL	Uniform Resource Locator
XML	Extensible Markup Language
XP	Extreme Programming

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

A state of full physical, mental, and social well-being, rather than the absence of disease or disability, is described as health (WHO, 2021). According to Oxford, health is defined as a state of being free of illness, disease or injury (Oxford, 2021). Tanzania's economy is the second largest in the East African community. The total population was 54 841 035 on October, 2020, compared to 52 290 795 on July, 2015 (Gupta, 2020) . There were 8497 Medicare institutions in the country, with 62% of them being public, according to the health facilities record, which is managed by health, community development, gender, the elderly, and children. As of 2020, there are new 337 hospitals listed in the register (Health, 2021) . Again, as of 2021 there 9774 operating health facilities in Tanzania (Registry, 2021). As of 2014-2015 supply of health workers were 66 348, percentage of total work force were 100% and the density of health worker per 10 000 population were 14.5. Researchers and governments have made several attempts to address health issues based on patients' access to hospital facilities. For example, according to a 2016 study conducted in Tanzania, the Tanzanian government might build infrastructure in isolated geographical locations to guarantee access to health care. The government can expand health facilities to areas with rapid population growth to guarantee that all Tanzanians get access to health care. Tanzania's government should fund private hospitals through subsidiaries and reduced tax rates so how they can grow to the most impacted areas. Despite the government's current expenditure budget expanding year after year, the Tanzanian government should enhance its health budget to ensure that it can satisfy population demand. The Tanzanian government should also make it easier for young people to enroll in medical school. In order for the Tanzanian government to have enough health workers in the future, more scholarships and financial support should be given (Magaka, 2016).

Tanzania's health industry is one of the most important. Tanzania's health system is decentralized, with the most explicit framework being the National Health Policy. Tanzania's National Health Policy is primarily driven by the need to guarantee that everyone has access to high-quality basic health care (Workforcealliance, 2020). Malaria, respiratory tract infections, diarrhea, intestinal worms, and skin infections were among the most common ailments in all 45 districts studied in 2001. Noncommunicable diseases, hypertension, psychiatric disorders,

neoplasms, and diabetes were also documented in most districts. This study's findings analysis leads to a report on a shortage of health workers, demography, social economic difficulties, dietary challenges, transportation and communication challenges in the districts (Noorali *et al.*, 1999).

Also, it was reported that one of the other sources of health challenges like death of patients are unable to access the hospital services before reaching the specific hospital, hence failing to get services when they reach the hospital, this leads to find other hospital, which in danger the patient health many innocent Tanzanians are continuously losing their lives and some have permanent disability or continuous illness due to failing getting services from the hospitals. Statistics shows that the most risk factors that drive the most death are caused by metabolic risks, environment or occupation risks and behavioral risks. In addition, infectious, maternal, neonatal, and nutritional disorders, noncommunicable diseases, and injuries are the leading causes of death and disability (Team, 2019). In 2020, a study was conducted on the problems of health service delivery in Tanzania under public-private partnerships: stakeholders' perspectives from Dar es Salaam. This partnership (PPP) aims to facilitate collaboration between commercial and government entities to deliver health services. The establishment of this collaboration aims to improve the quality of health services and broaden community access to these services, as well as increase prospects for private sector investment in healthcare and formalize non-profit organizations' participation in healthcare service supply (Sirili *et al.*, 2019; Kamugumya & Olivier, 2016). Regulatory concerns, insufficient resources, a lack of confidence amongst PPP partners, and ineffective monitoring and assessment of PPP activities are all challenges that must be overcome. Inadequate communication and consultation (Said, 2020).

In general, the study on health seeking behavior and under-five mortality in agro-pastoralist villages in Tanzania's Handeni area found that many Tanzanians still rely on or prefer informal health care over professional health facilities. This is due to the prevalence of common knowledge on local and cultural treatment, which also leads to them receiving direction that does not provide them with the services they require due to people relaying information on people who do not have new information about certain services in a specific hospital or clinic, resulting in high mortality rates, a situation that necessitates intervention (Ringo, 2019). Children who are cared for by females are more likely to be taken to health care facilities than children who are cared for by men, according to a study conducted in Tanzania in 2017 on

factors correlated with acceptable healthcare seeking behavior among febrile children. Furthermore, febrile children from high-education communities are more likely to be admitted to the hospital than children from low-education communities (Adinan, 2017). According to research conducted in Tanzania in 2019 on the pathways and associated costs of care in patients with confirmed and presumptive tuberculosis, patients with confirmed TB have more complex pathways and higher costs of care than patients with presumptive TB, but the latter's costs are also significant. Improving access to healthcare and assuring integration of multiple healthcare providers, such as private and public health practitioners, as well as people themselves, could assist reduce the complexity of healthcare seeking and utilization (Gracemahalu, 2019).

The latest smartphones have made significant advancements in processing power, random access memory, and secondary storage, as well as a variety of supplementary features such as internet connection, allowing for the development of a wide range of applications. Tanzania is undergoing a digital transformation, as seen by the growing use of communication and internet services. This is having a tremendous impact on the country's social, cultural, and economic structures through greater access to critical services and higher productivity and efficiency across economic sectors. In 2018, 42% percent of Tanzanians subscribed to a mobile service, according to GSMA Intelligence on Tanzania Digital Transformation. Since 2010, mobile internet penetration has nearly tripled to 18.5 percent, with over 8 million new members acquired in that time (GSMAintelligence, 2009). The number of cell phone subscribers per 100 people in Tanzania was also recorded between 2000 and 2019. For every 100 persons in 2019, there were 82.21 registered mobile subscriptions (Statista, 2021).

As a result, this study recommends the development of web and mobile applications to assist users in searching for nearby health facilities, hospital services, and associated fees or costs of services on various hospitals. The aim is to facilitate early healthcare seeking behavior by addressing the challenges of people not getting early information about different hospital before attending them, not understanding services and its prices the specific hospital provides.

1.2 Statement of the Problem

Despite the efforts made by the Tanzanian government on health issues, still there are lot of health challenges including absence of enough fund to support health sector, untimely distribution of funds from the central government, lack of communities to participate on health issues like planning (Frumence, 2013). More issues include unequal resource distribution to

secondary and tertiary hospitals compared to primary health care, under funding and inadequate resource allocation, poor stakeholder coordination, and human resource challenges (Magaka, 2016). People prefer informal health services over formal health services, this has resulted into mortality in Tanzanians as people who seems to give information are not professional but rather use their experience. Inappropriate health care seeking behavior contributes in the continuous health challenges among people. These are challenges facing people during health services seeking:

- (i) Traditional and customs challenges. People may decide to opt using elders, traditional healer or nearby shop.
- (ii) Unable to know costs of health services before attending the hospital.
- (iii) Shortage of enough workers among the health centres.
- (iv) Transportation and Geographic challenges
- (v) Loosing time moving from one hospital to another searching for services.

The development of technology including the Internet and smartphone makes people access information online. In 2018 over 95% of 23 million internet user in Tanzania were accessing internet and using smart phone, and the penetration rate was 43% (Statista, 2021). Despite people accessing different information online but in the case of health information there is no proper way for patients or people to access them instead people are using elder people, traditional healer, experience and nearby shops seeking health services (Amuyunzu-Nyamongo, 2016). Therefore, this project aimed at developing technological information tool that will help patients see what health are available near their area and associated costs to help them in early planning before reaching the specific health service area. This web and mobile application will help patients or anyone seeking health service able to see all nearby service and their respectively costs.

1.3 Rationale of the Study

The promise solution is to help people access hospital services in an easy and based on their budget as they will be able to know services cost before reaching the specific hospital. The adoption of technology on the health sectors in Tanzania is growing rapidly. The solution will improve health seeking behaviour as the previous or currently, some societies still practice local was of finding services (Ringo, 2019). Generally, the results indicated that both mobile

and web applications improved accessibility of patients get to know nearby hospitals, services the hospital provides, prices of the services on different hospital. Therefore, it is easy for patient to decide depending on the money he or she have. The other key finding is that patients to be able to book the appointment depending on the hospital services chosen. Hence, provides easiness to the community for patients or anyone who need hospital services.

1.4 Objectives

1.4.1 Main Objective

The main objective of this project is to develop a web and mobile application to support location-based searching of health services and associated costs.

1.4.2 Specific Objectives

- (i) To identify the requirement needed for the development of web and mobile application.
- (ii) To develop the mobile and web application system. To validate and deploy the mobile Application.
- (iii) To validate the developed web and mobile application.

1.5 Research Questions

- (i) What are the strength and weaknesses of an existing application for accessing health services?
- (ii) What is the system requirement for developing web and mobile applications for locating health services?
- (iii) How will the proposed solution be developed to meet end-user expectations?

1.6 Significance of the Study

The study has made a contribution by introducing the realm of a web-based and mobile application to assist people in obtaining health care services from providers in a simple, transparent, and cost-effective manner, also enable timely and conveniently book appointment on the hospital services, again enable people to know nearby hospitals and their services, help people decide to go to any hospital depending on the budget they have and application will

enhance the availability of ambulances services which seem to be challenging in Tanzania hospitals.

1.7 Delineation of the Study

The study was created focusing on customer and hospitals via their hospital admin. The reason for creating android application is developing the system that will be used and based in Tanzania. Due to sensitivity of the health care data and limited financial resources, this study developed and tested the prototype in virtual environments. The android prototype can be implemented by other researchers, developers, and stakeholders in real world environment.

CHAPTER TWO

LITTERATURE REVIEW

2.1 Factor Affecting Health seeking Behavior

Different factors have been identified as the factor affecting the health seeking behavior such as poor social and economic capability, challenge in the accessibility of health services, low literacy of community and the large family size.

2.1.1 Cultural and Social Factor

Cultural practices and beliefs can lead to self-care, home remedies, and consultation with a traditional healer in rural communities (Ik, 2002). Advice from elder women play great role in the society especially on the time of illness (Delgado, 1994). Again, family size, education level and occupation of the head of the family play great role on health seeking behavior, a family with head of family who have education whenever health challenge appear in the family it is very easy to take the patient to the hospital compared to illiteracy family will always find alternative to traditional healer (Geissle, 2000).

2.1.2 Women Freedom

Women play great role in the family but when it comes to health care usually men as head of the family control this role. Men are considered as the decision makers of the family that means he can decide where and at what time his family member to reach the health centre (PY, 2001). In some cultures, women are not allowed to seek health care alone or make financial decisions about health care; instead, everything is controlled by men, which may result in women not receiving health treatment in an emergency (Navaneetham & Dharmalingam, 2002).

2.1.3 Economic Factor

The economic availability within the communities and absence of social security makes poor family in danger in terms of accessibility, affordability and choice of health services provider (Amuyunzu-Nyamongo, 2016). Poor situation not only affect the accessibility of health service but also decision making on health issues (Geissle, 2000). In Tanzania for-example some villages are far away in a such a way that it is very difficult to reach the hospital on time, also health expenditure among people in the societies usually lead them to get out of pocket hence,

once health challenge appear it becomes difficult to reach the health centre alternatives becomes to find traditional healer.

2.1.4 Health Facility Location Services

The right to access a health-care facility is regarded as a basic social right (Nations, 2001). Challenge of reaching the health care area usually leads people to consider health care shop where they are given services based on experience and situation patient has, this will lead to bigger challenges as patient may be seriously in need of health services (S, 2018). Tanzania as one of the developing country the effect of distance on searching or reaching health services is bigger as there is transportation and poor roads, which results into increasing in costs when travelling (Noorali, 1999).

Despite location challenges, by considering currently advancement of technology locating the health services area where people could have prior -information before reaching the health centres this could help the community plan to reach the health area as at least they have information about the health centre it (Adventtech, 2019). Again, by providing location, services and availability of facilities could strengthen initiative to help people know services of specific hospital before reaching it (Calorine, 2017).

2.1.5 Mobile Health Applications

Mobile technology facilitates the delivery of public health programs as well as personal health promotion (Patrick *et al.*, 2008). It allows for the collection and dissemination of information to the general public. Furthermore, it has the ability to aid in disease prevention, recovery, and patient tracking (Qianget, 2011). Communities may get consultation on a specific disease in their geographic area using mobile technology. It may also be used to disseminate knowledge and information to the society (Patrick *et al.*, 2008). Technology used in wireless communication and other similar aspects is known as mobile technology. Mobile technology is rapidly evolving, and the number of subscribers continues to rise. The number of cell phone subscribers reportedly rose from 43.5 million in 2018 to 47.8 million in 2019 (TheCitizen, 2019). Tanzania's internet users have grown from 9 million in 2013 to over 23 million in 2019. Around 2019 and 2020, the number of internet users in Tanzania increased by 3%.

Mobile technology facilitates the delivery of services in society and allows for the collection and dissemination of information to the general public. Mobile technology can be used in

agriculture, health, entertainment, education, the military, and government to provide services to citizens, as well as in the supply chain in industry. Knowledge and information can be transmitted to the community using mobile technology (Hurme, 2005).

In this report, mobile technology will be used to view various health details services that will synchronize and be accessed via mobile application from the web application.

2.1.6 Web Technology

The use of markup language and multimedia packages in web technologies relates to how computers interact with one another (Chawla, 2017). It provides a forum where users can browse content and interact with one another (Manzoor, 2014). Web apps have been utilized to provide online services for persons who are unable to travel to treatment centers owing to their geographic location. Because traditional healthcare facilities are difficult to come by, online apps have been developed to aid in the delivery of therapy and reporting on a variety of health conditions (Chawla, 2017). In healthcare, online technologies have a variety of implications on numerous operations. In the context of this report, the hospital administrator will use online technologies to feed in various hospital resources, including ambulance availability, which will then be displayed on the mobile application.

2.2 Related works

Because of the rapid advancement of technology, the use of technology has expanded, resulting in real-world problems being solved. One of the obstacles is the accessibility of health-related issues, for which many initiatives have been made.

Physical, mental, and social well-being are all components of health. A condition of complete mental and physical well-being is sometimes referred to as health. Healthcare exists to assist people in maintaining their optimal health (Sampson, 2020). Individuals who believe they have a health problem or are sick engage in health seeking behavior (HSB), which is a series of measures they take to obtain the proper medication (Ketis, 2014).

It is suggested that inappropriate health-seeking behavior (HSB) serves as a foundation for ongoing health issues in a given household and community (Hassan, 2016). The frequency of infections and the incidence of death, particularly among under-five children in rural regions, are health issues linked to inadequate HSB (Unicef, 2014). Under-five mortality is common in

underdeveloped nations, including Tanzania. This could be attributed to low health-seeking behavior among households (Arunda, 2016). Furthermore, people in rural areas are unwilling to use formal health services and prefer to use informal health services. This is due to widespread popular knowledge of local and cultural therapy, which leads to high rates of under-five mortality (Ringo, 2019).

The goal of the study was to better understand how people's health-seeking behavior works. It investigates whether people switch health-care providers over time based on their health status (i.e., healed or unwell) following consultation with the preceding physician. Individual preferences for a certain sort of medical care are shifted by previous health outcomes, according to the findings. Patients who recovered after receiving formal (informal) health care are more likely to seek formal (informal) health care in the future; those who stayed sick are more likely to seek an alternate type of practitioner. These assumptions are examined using four years of panel data from a Tanzanian household survey (Cormo, 2014).

In general, Tanzanians are hesitant to use formal health services and prefer to use informal health services. This is due to the prevalence of common knowledge on local and cultural treatment, which also leads to them receiving direction that does not provide them with the services they require due to people relaying information on people who do not have new information about certain services in a specific hospital or clinic, resulting in high mortality rates, a situation that necessitates intervention.

Munir *et al.* (2015) proposed an android-based application for determining a specialized hospital nearest to the patient location, where the patient may see the location of the specialized hospital and how far it is located from the patient location. The disadvantage of this Android application is that it only assists patients in finding a nearby specialty hospital in Pakistan, not all hospitals.

Again, in accordance with the medical device mandate for software, Stephan *et al.* (2012) presented a mobile Android-based application for in-hospital glucose control. The application provides an overview of the creation of a mobile Android-based glucose control system for the treatment of diabetic patients with type 2 diabetes. Because the system provides decision support for insulin dose, it is covered under the updated medical device directive. The limitation of this study focuses on the management of glucose in diabetes type 2 patients only.

Finally, Tebepah (2017) from Nigeria proposed a Health Management App for Android Phones, with the aim of developing a health management system that could be installed in a mobile device running on the Android platform while still being able to communicate with a web server and present a comprehensive research work on the mobile platform. The software works as a plug-in, which means it must be manually installed and run from the mobile device. Users will be able to register with a clinic or hospital, schedule appointments with their primary care physician, and review their medical history using the app. The project is divided into three main aspects in order to achieve the above-mentioned goals: mobile, web, and database. Programming is involved in the mobile and web server aspects, so the required APIs, libraries, and compilers were installed and configured. During the implementation of a program, it is continuously reviewed, and the final testing is carried out using a test plan based on the specified requirement (Tebepah, 2017). The study's drawback is that it only focuses on allowing users to register, schedule an appointment, and review their medical history.

However, Tanzania has not yet been an effective way of solving these health challenges using technology. Generally, the situation requires an intervention which is coming up with the technology that will help people get truly information's like knowing all services of the specific hospital before going to the hospital, know prices of all services of different hospitals, know if the hospital is nearby or not and able to book an appointment so that to avoid delaying while waiting for services in hospitals.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Area of the Study

Understanding and addressing research questions is an important aspect of the study's first goal such as what are the strengths and weaknesses of current structures was chosen as a case study field. What can this analysis teach you that you can't understand from the current literature? Is the built application meeting the needs of the end users? The findings of the case study were instrumental in determining the criteria for developing a prototype approach to aid in the accessibility of health services.

The research was carried out in Tanzania's Kilimanjaro, Dar es Salaam, and Arusha regions. Dar es Salaam, Tanzania's major economic city, is located on the Indian Ocean coast and has a population of over 7 million people as of 2021. Dar es Salaam spans 1393 km². According to the Tanzania Bureau of Statistics, Dar es Salaam has a population of roughly 4.3 million people (NBS, 2017).

Arusha one of Tanzania's largest cities, has a population of about 1.6 million people (NBS, 2017). Different national parks, Conservation Area and Lake Manyara National Park are all located in the Arusha district, which covers 34 526 km².

The expected owner of the system, the Micro Health Initiative organization, is based in Moshi, Kilimanjaro. To ensure their full engagement in the design, development and validation of the system, the Kilimanjaro region was also included.

3.2 Research Methods

The procedures or strategies used to find, select, process, and analyze data about a topic are referred to as research methodology. Questionnaires and observations were used to gather data from community and health personnel for the study.

3.3 Sample Size and Sampling Techniques

Members of the population from all three regions took part in the research. where Dar es salaam 70 (44%), Arusha 104 (49%) and Kilimanjaro 13 (7%) of 187 residents in both regions and 31 health workers where, 90% respondents were from Dar es Salaam and the rest other

regions (Fig. 1).

The probability sampling techniques were used during collections of data. This sampling technique allows researchers to set a few parameters and randomly pick members of a population, ensuring that all members have an equal chance of being included in the survey (Sampling, 2021).

The targeted population who is expected to use this app will be hospital health workers and community as whole.

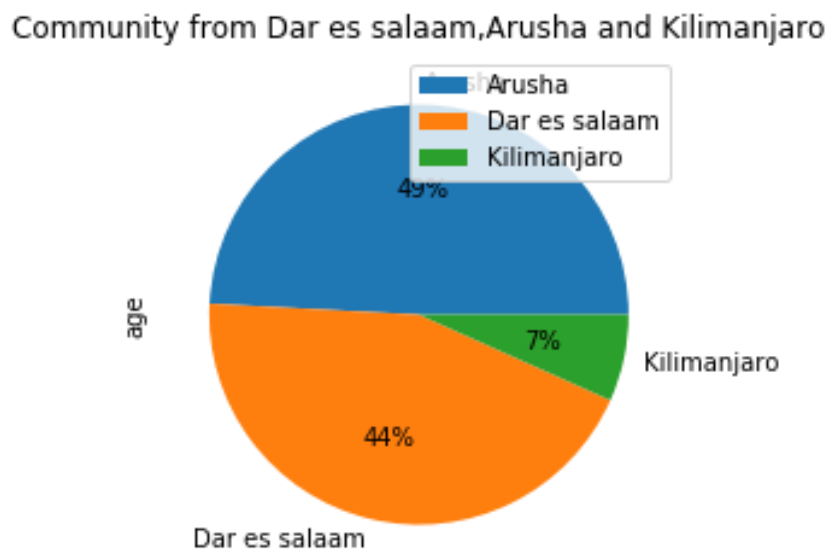


Figure 1: Community

The study focuses only on patients (all class people), the administrator who will be the Micro health initiative, and hospitals (hospital services, doctors, hospital administrator). Besides, the study will target people (patients) with smart phones for installing and accessing a mobile application.

3.4 Data Collection Methods

The main goal was to find out how much awareness the group had about health issues. Data was collected over a two-month period in January and February 2021 for the analysis. Questionnaires, interviews, and observations were used to collect data for this report, as mentioned below.

Questionnaire: People in the group were given self-administered questionnaires. After receiving the google sheet with questions from us, the responses were processed via their smartphone. Closed ended (multiple choice) questions were used to collect data, such as yes (awareness) and no (avoidance) (not aware). The closed ended method was chosen because it takes less time to complete.

The multiple choice and open-ended survey question (respondent were required to type answers and don't provide preset answers) was used, the purpose of these question was to obtain opinions from respondent, then getting overall measures that will support this project development.

3.5 Technique for Data Analysis

During the research, data was collected using interviews, questionnaires, and observations. The results were interpreted using descriptive statistics (frequency). The data was then processed in python using Jupiter Notebook software (Fig. 2), which includes management and administrative features for high performance and data processing. The bar chart and pie chart were created using Jupiter Notebook software.

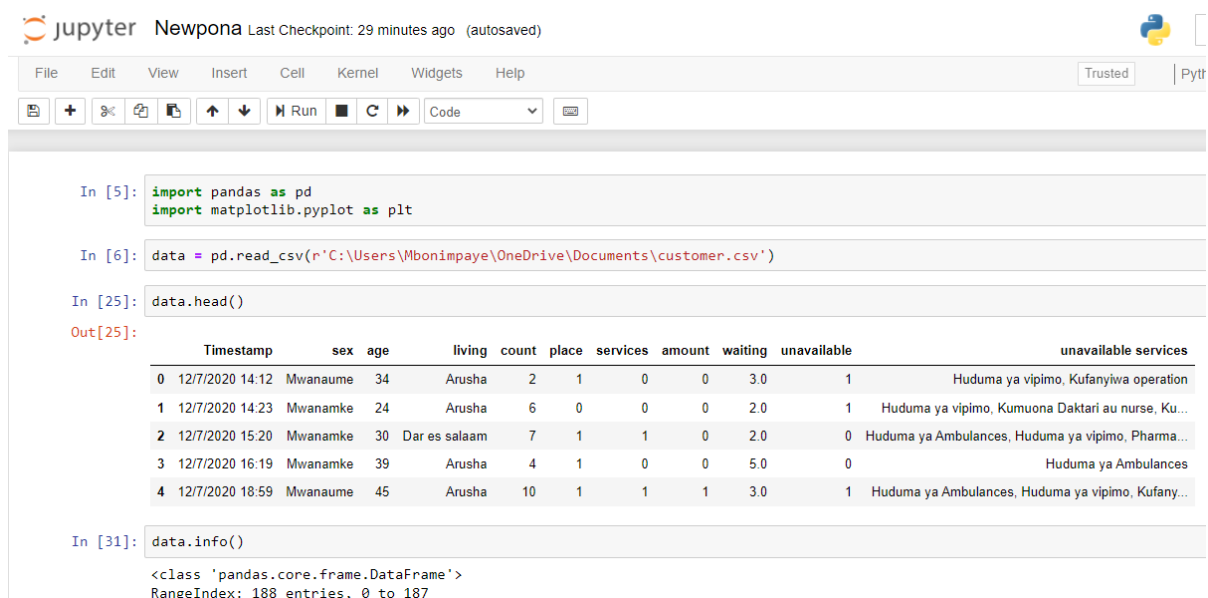


Figure 2: Python Jupiter Notebook

3.6 System Development Methodology

A set of procedures must be accomplished in order to convert user specifications into a software platform during the development process. The system development life cycle (SDLC) was used as a reference in the creation of the suggested system solution to complete the full development process (Fig. 3).

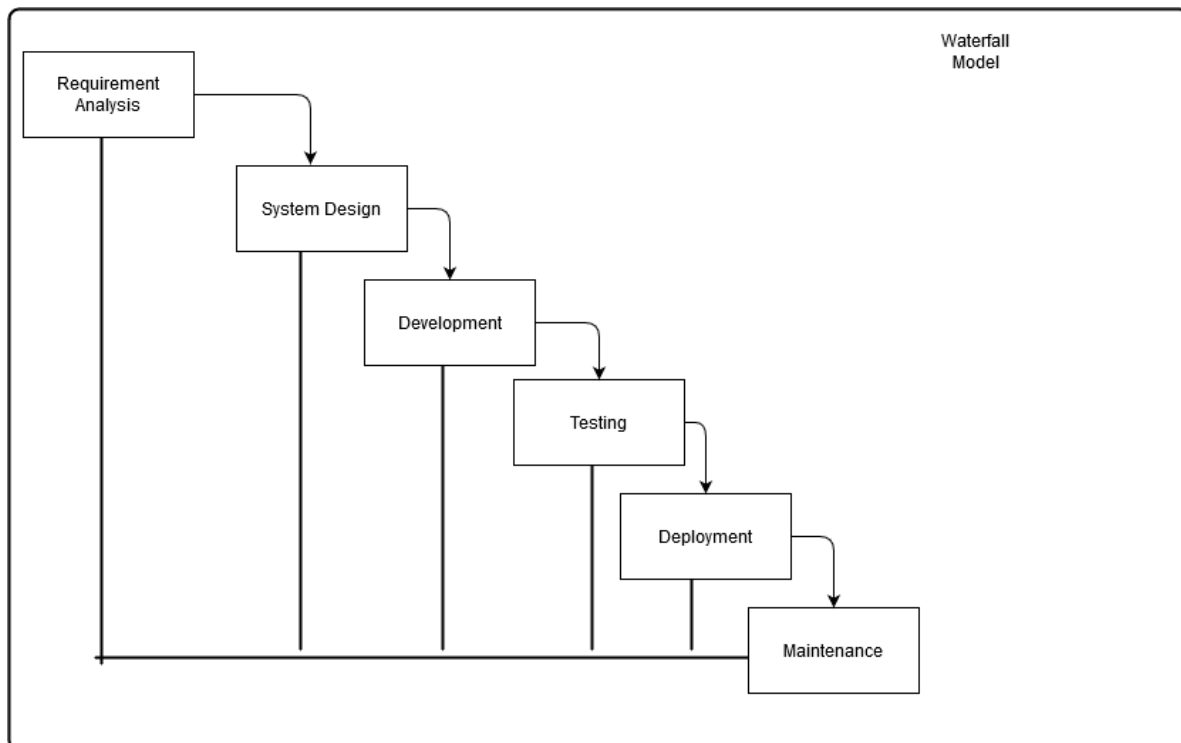


Figure 3: System development life cycle

3.6.1 Extreme Agile Methodology

Agile Application Creation, which falls under the extreme programming category, was used to increase software quality and responsiveness to evolving customer requirements (Miller, 2006). Agile methodology is a software development methodology that can reduce development time by speeding up the development of a system. Agile methodologies, which rely on iterative development and prototyping, are widely used in a variety of industries as a lightweight development method that can adapt to evolving requirements.

3.7 Data Requirements

Requirements analysis is a method of evaluating a new or altered product for a customer (Maguire, 2012). This project study's criteria analysis covers both functional and nonfunctional

requirements. The observation done and according to our interviews we conducted we found out a lot of individual struggles to get hospitals information as early as possible. It was also observed that most people struggle to have access to prices the hospital charges so that they may decide to go to that hospital or finding an alternative.

3.7.1 Functional Requirements

The activity and operations that a system must conduct are captured in functional specifications (Malan, 2001). In the context of our project, functional specifications include:

- (i) The super admin must complete the hospital's registration.
- (ii) Users must be able to use their mobile devices to access hospital facilities.
- (iii) Hospital admin must be able to add and update services.
- (iv) Admission and all process of user coming to the hospital must be done via Mobile.
- (v) Before visiting a particular hospital, users must be able to gather knowledge about it.
- (vi) Hospital admin must be authenticated by the super admin.

3.7.2 Non-Functional Requirements

There are the specifications for how the device should operate (Chung, 2000). They often have activities that aren't explicitly related to the user. These include:

- (i) Usability of the application: how our system can easily be used.
- (ii) Reliability, availability, how often does our system experience failure.
- (iii) Compatibility, how our application can be integrated in different android version.
- (iv) Appropriate response time for our application.
- (v) The suggested solution must be able to be maintained.

3.8 System Design

3.8.1 Architecture

The research study area, data collection methods, and data analysis software were all discussed in greater depth in the previous section. In this section, the use case diagram, data flow diagram, and database schema are used to dig deeper into the essence of the proposed solution.

3.8.2 Conceptual Design

The system's configuration is depicted in the conceptual design. Several issues have been identified as a result of the study's results on accessing hospital services were identified ,some of the problems are inability to know hospital services ,inability to know the hospital services prices, people staying in ques waiting for services for long time ,challenge of knowing the location of the hospitals .As a result, in order to address the issues, the study created a mobile-based application that allows people to access health care in an easy, accessible, and convenient manner.

- (i) Mobile application, the mobile application is used to show various hospitals' facilities and sub-services, as well as local hospital locations, the ability to make appointments with hospital doctors, and to provide complete knowledge about the hospital before arriving. Furthermore, patient information is entered into the Web application by the hospital administrator, which is then synchronized to the database and accessed through the mobile application (Fig. 4).
- (ii) Web Application, A web application offers an interface that allows the super admin, who is in charge of the whole system, and the hospital admin, who is in charge of adding data and services about the hospitals, to access information. Moreover, the solution allows users to decide the kinds of the hospital they wish to go to base on location, prices, and choice they like. Furthermore, the designed solution makes it simple for people to obtain complete information about hospitals and nearby hospitals, allowing them to choose which hospital to visit. The designed architecture (Fig. 1) shows how the full accessibility of hospital services from super admin, hospital admin up to the users.

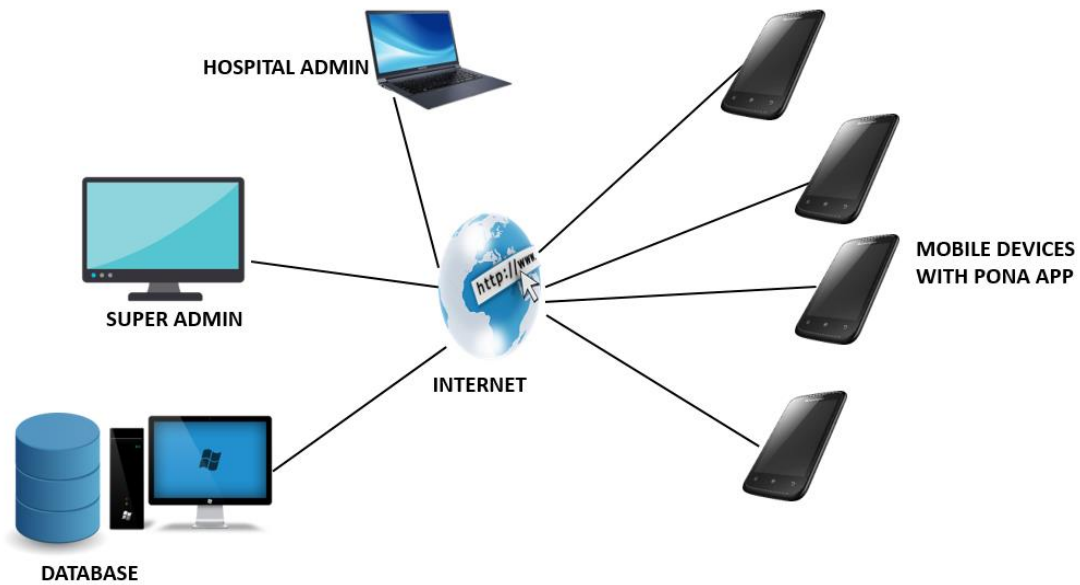


Figure 4: General Conceptual Framework

3.8.3 Use case diagram

The Unified Modelling Language was used to build the various diagrams of the proposed structure in this paper (UML). The Unified Modelling Language (UML) is a design and visualization standard for electronic devices (Bell, 2003). The use case diagram is one of several UML diagrams that depict the system's functional specifications. One of the UML diagrams that represent the system's functional requirements is the use case diagram. It shows how the system's expected activity interacts with external actors. It is explained in such a way that any customer will understand it (Fig. 5).

Actors and their underlying functions make up the structure. The tasks that should be completed in the system are described by roles. Actors are device users who represent the interests of different stakeholder groups in the digital scanner application. The user of the program, the system administrator, and the hospital administrator are the three participants in the system.

Actors and their underlying functions make up the structure. Roles define the tasks that must be completed within the method. Actors are device users that serve different classes of the system's usability. The key players in the entire system are listed in the Table 1.

Table 1: Use case requirements diagram description

Use case	Requirements description
View Services	Users shall be able to view all the hospital service via mobile.
Nearby Location	User shall be to see all nearby hospitals based on the location.
Login & Register	User shall be able to login and register after selecting the specific services they wish to get in the hospital.
Make Appointment	User shall be able to make appointment to the doctors via Mobile App.
Update services	Hospital Admin should be able to update services of the hospital timely. Whenever changes happen the admin will be able to adjust.
Register Doctor	Hospital Admin should be able to register the doctor.
Register Doctor Routine	Hospital Admin should be able to update doctor daily routines.
Register Hospital	Super admin should be able to register new hospital
View Hospital	Super admin should be able to view all registered hospitals in the system.
Approve Hospital	Super Admin should be able to approve or disapprove the hospital based on the system terms between the two (Pona system owner and the hospitals).
Register Hospital Admin	Super Admin should be able to register hospital admin. This is done by sending link via email then the hospital admin will be able to register on his or her own.
View App users	Super admin should be able to view all the users who are using the application.

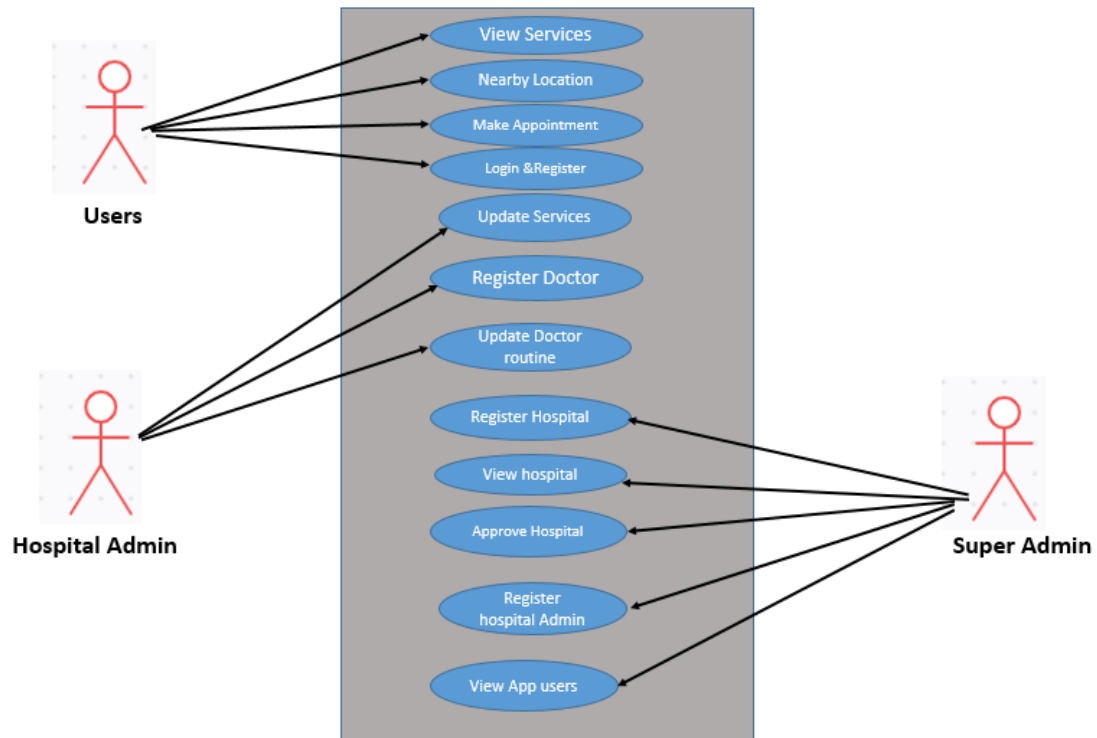


Figure 5: Use case diagram

3.8.4 Data Flow Diagram

It's a data flow graph that shows how information flows through a system and between different operations. It shows how the system handles data input and output. The data flow diagram represents the external object, data store, operation, and data flow. In a data flow diagram, there are several levels, including level 0, level 1, and level 2. At levels 1 and 0, this study reveals the flow of knowledge (context diagram).

(i) Context Diagram (Level 0)

This diagram depicts a system overview. Level 0 is another name for it. The system's interaction with its external elements is depicted in the context diagram (Ibrahim, 2010). The system developer, analyst, and system stakeholder have a thorough grasp of the level 0 diagram. The system's level 0 schematic is shown in Fig. 6.

(ii) Context Diagram (Level 1)

The system's modules are divided into sub-modules in the Level 1 diagram. The Data Flow Level 1 diagram breaks down the system's processes into sub-processes (Ibrahim, 2010).

The diagram additionally includes data stores and data flow (arrows) to connect the process parts. A data flow diagram is similar to a context diagram in that it provides a broad picture but delves further into the subject. In a level 1 data flow diagram, the single process node from the backdrop diagram is divided down into sub processes.

When these processes are introduced to the diagram, additional data flows and data stores will be necessary (Lucid, 2021). The graphic helps system stakeholders understand the system's processes as well as the data flow. Level 1 data flow flowchart is shown in Fig. 7.

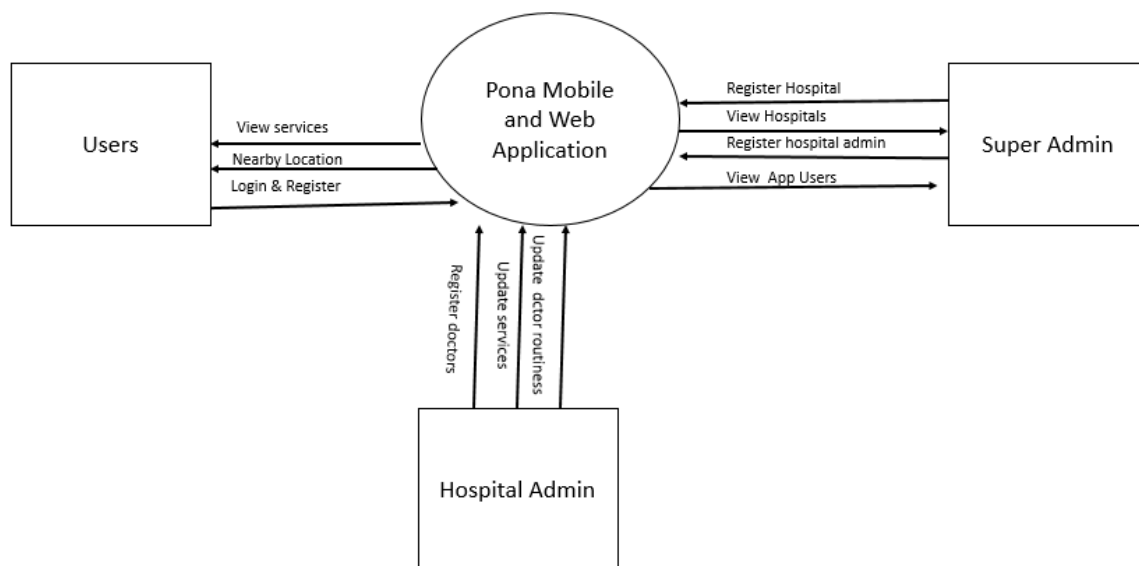


Figure 6: Context diagram



Figure 7: Data Flow Diagram

3.8.5 Database Schema

Database schema is considered as the representation of database in logical way, it is normally created by database management system. Database schema displays the database architecture structure in graphical way. It displays structure that have tables, attributes and tables that has relationship (Wikipedia, 2021). Figure 8 presents the database schema of the system and PhpMyAdmin showing all the tables created on the Database (Fig. 9).

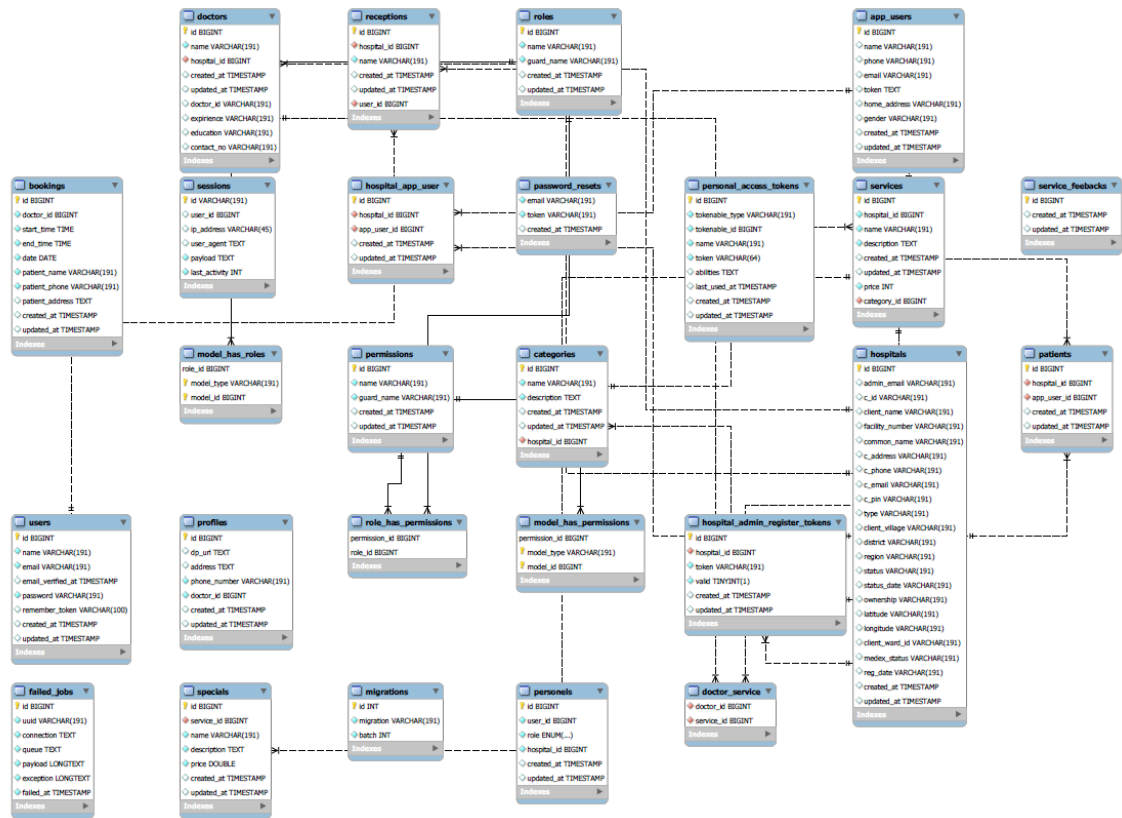


Figure 8: Database Schema

The screenshot shows the PhpMyAdmin interface for the 'advamhwe_pona' database. The 'categories' table is selected, and the 'Structure' tab is active. The table contains 10 rows of data:

	id	name	description	created_at	updated_at	hospital_id
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	3	Bones Disease	Measure Bone Density	2021-02-09 10:42:43	2021-02-09 10:42:43	2
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	4	Children Clinic	Child Clinic Part 2	2021-02-09 10:42:49	2021-02-09 10:42:49	2
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	5	Ambulance Services	Get Ambulance	2021-02-10 11:37:25	2021-02-10 11:37:25	2
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	6	Radiology	Radiology	2021-02-11 06:19:53	2021-02-11 06:19:53	5
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	7	GP	GP	2021-02-11 06:21:41	2021-02-11 06:21:41	5
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	8	MarryBrown	Measure Bone Density	2021-03-08 19:04:29	2021-03-08 19:04:29	1
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	9	Bones Challenge	Measure Bones	2021-04-13 04:19:31	2021-04-13 04:19:31	9
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	10	Covid	covid related	2021-04-13 06:28:47	2021-04-13 06:28:47	9

Figure 9: PhpMyAdmin display

3.9 System Implementation

3.9.1 Development of Mobile Application

A set of procedures must be accomplished in order to convert user specifications into a software platform during the development process. The device development life cycle (SDLC) was used as a guide to complete the whole development process for the suggested solution. Since of the development cycle's time constraints, the Agile Application Design strategy was chosen under the extreme programming category because it has the potential to speed up the system's development and so reduce development time. Agile methodology, which incorporates iterative development and prototyping, is widely utilized in a variety of business initiatives as a lightweight development process that can adapt to changing requirements. Since of the development cycle's time limits, the Agile Application Design approach was chosen under the extreme programming category because it has the potential to accelerate system development and hence reduce development time. Agile approach, which includes iterative development and prototyping, is widely employed in a variety of enterprise projects as a flexible development procedure (Maguire, 2012) (Fig. 10).

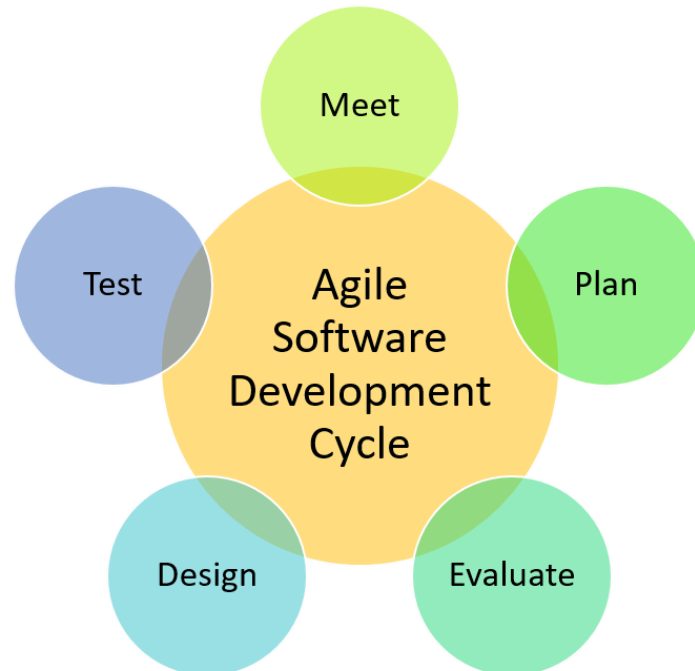


Figure 10: Agile Software development Cycle (Maguire, 2012)

3.9.2 Development of Mobile Application

(i) Mobile Application System

Customers (Community) and health workers could use the mobile app to get hospital services. The mobile application was created using the tools and techniques mentioned below.

(ii) Android Studio

Google's Android Studio is an Integrated Development Environment (IDE) for developing Android apps. The Android Studio production environment was used to create the mobile application. An Android Software Development Kit (SDK) and an editing environment are included in Android Studio.

The software was created with Android Studio. As a result, programming was done in Java and XML, and Android Studio is a free open-source platform with pre-installed libraries that make creating mobile apps a breeze. Android studio includes the Java Run-time Environment (JRE) and Java Development Kit (JDK) components, allowing for quick development. The study makes use of Android 4.4 API level 30.

(iii) Java and XML

The Extensible Markup Language (XML) is a markup language that both humans and computers can understand. To make the user experience smoother, it was used to build a simple graphical user interface. It defines the document's layout, color, string, arrays, font, and form. In the research, XML was used to build the user interface architecture of the mobile application. JAVA is used to building functionalities and advanced user interface for the mobile application.

(iv) Assumptions and Dependencies on Usability of Mobile

- (a) The smartphone application is available to all users.
- (b) All will be able to afford their own smartphone.
- (c) The internet connection is adequate for users to communicate with the device.
- (d) There is enough internet access for hospital administrators to communicate with the system.
- (e) All hospitals will have hospital admin who has knowledge of computer.
- (f) All hospitals have Computer which will be used by hospital Admin.

3.10 Web Application System

Web innovation refers to how computers communicate with one another using markup language and interactive media packages (Chawla, 2017). It provides a platform for clients to view the substance and connect with one another via the provided stage (Manzoor, 2014). Web applications have a variety of effects in the healthcare industry. They increase the availability of data and massive information, improve data sharing across healthcare facilities, and stimulate data capacity and detailing (Ortiz, 2003). This technology will be utilized in the context of this study to allow patients to get information from hospitals, hospital administrators to communicate with the system, and the system's owner, the super admin, to interact with both customers and hospital administrators. The mobile application was created using the tools and techniques mentioned below.

3.10.1 Laravel PHP Framework

Taylor Otwell created Laravel, a free, open-source PHP web framework based on Symphony. It's designed to help you make web apps that follow the model–view–controller (MVC) architectural pattern. Laravel's source code is available on GitHub and is licensed under the MIT License. It is one of the powerful frameworks that take out the pain of development by simplifying common tasks that used to be challenging during the development of web projects like authentication, routing, and caching. The study uses Laravel Framework because it ensures clarity between logic and presentation and also it helps in improving the performance. allows better documentation and has multiple built-in functionalities, offers security to the framework, also easy to do database migration between development machine, lastly Laravel has a feature called artisan which allow the developer to perform the majority of the repetitive and tedious programming tasks.

3.10.2 CSS, HTML and JavaScript

HTML stands for Hypertext markup Language which is used for creating web pages. The Cascading style sheet is the style that is used to describe the presentation of document written in HTML. Also, the JavaScript is used as language that adds interactive behavior to the web pages. JavaScript can be used to create web pages and mobile apps and also developing server applications.

3.10.3 Assumptions and Dependencies on Usability of Web Application

- (i) The internet connection is adequate for users to communicate with the device.
- (ii) There is enough internet access for hospital administrators to communicate with the system.
- (iii) All hospitals will have hospital admin who has knowledge of computer.
- (iv) All hospitals have Computer which will be used by hospital Admin.

3.11 System Testing

System testing consisted of a series of tests performed during the development and integration of modules, including unit testing, integration testing, and system testing, intending to exercise the entire system. Unit testing ensured every unit (module) performed as anticipated, while integration testing examined the relationship between various units to ensure that they communicated properly. Finally, system testing was performed on all of the modules to ensure that they operated properly together. In Chapter 4, the results of application testing were discussed.

3.11.1 System Validation

The affirmation of the user specifications to the framework is referred to as software validation (Lumleyet, 2002). The architecture has gone through various stages of validation testing to ensure product consistency, including unit testing, integration testing, application testing, and user acceptance testing.

A random sample of each user's group, including health workers and customer representatives, was selected at random to test the system. Following that, a survey was performed to determine the system's perceived utility, perceived ease-of-use, and attitude toward use. The data for the assessment was gathered by the use of a questionnaire. In Chapter 4, the findings of system validation were discussed.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Research Case Study Area results and Discussion

4.1.1 General Awareness of Community Towards health services

The aim of the study was to determine if there was a general understanding of how to communicate about health care. The places that responded is Dar es salaam, Arusha and Kilimanjaro. It was found the population from all three regions took part in the research. where Dar es salaam 70(44%), Arusha 104(49%) and Kilimanjaro 13(7%) of 187 residents in both regions and 31 health workers where, 90% respondents were from Dar es Salaam and the rest other regions. Figure 11 shows the regions that responded to this study.

Regions responded to this study

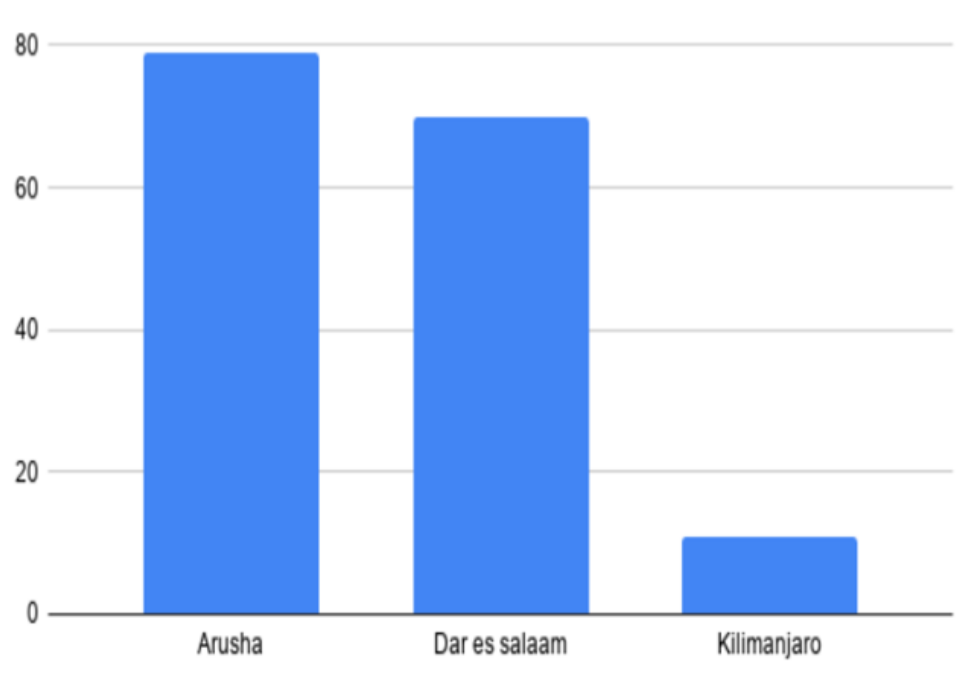


Figure 11: Responses from Arusha, Dar es salaam and Kilimanjaro

4.1.2 Awareness of Services prices at the Hospitals

The study sought to find the general clarity awareness of the hospital services prices. The places that responded is Dar es salaam, Arusha and Kilimanjaro. It was found that 42 (22.5%) responded they knows prices of services while 145 (77.5%) responded they don't know prices

of services at hospital. Figure 12 shows the awareness of community toward health issues like prices of services. From the responses it shows that the community does not know prices and services of different hospitals have. Figure 12 shows response on hospital price awareness.

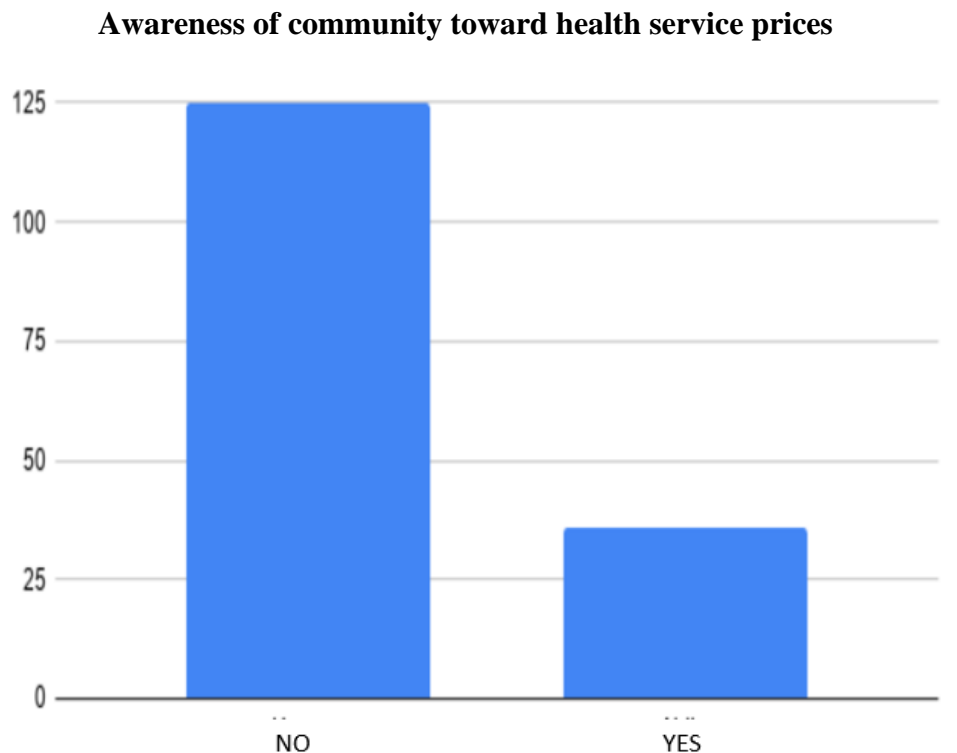


Figure 12: Response on hospital price awareness

4.2 Results and Discussion of the System

4.2.1 Developed Mobile Application

Mobile application which facilitates location-based searching of health facilities and or health services along with their associated costs. The application consists of 6 screens: Splash screen, Map activity, list of services, list of sub-services, list of doctors according to the chosen services, and the appointment screen.

(i) Splash Screen and Map Activity

The splash screen presents the graphical control element that has window which may contain logo or image and version of the application while the Map screen show nearby hospitals (Fig. 13).

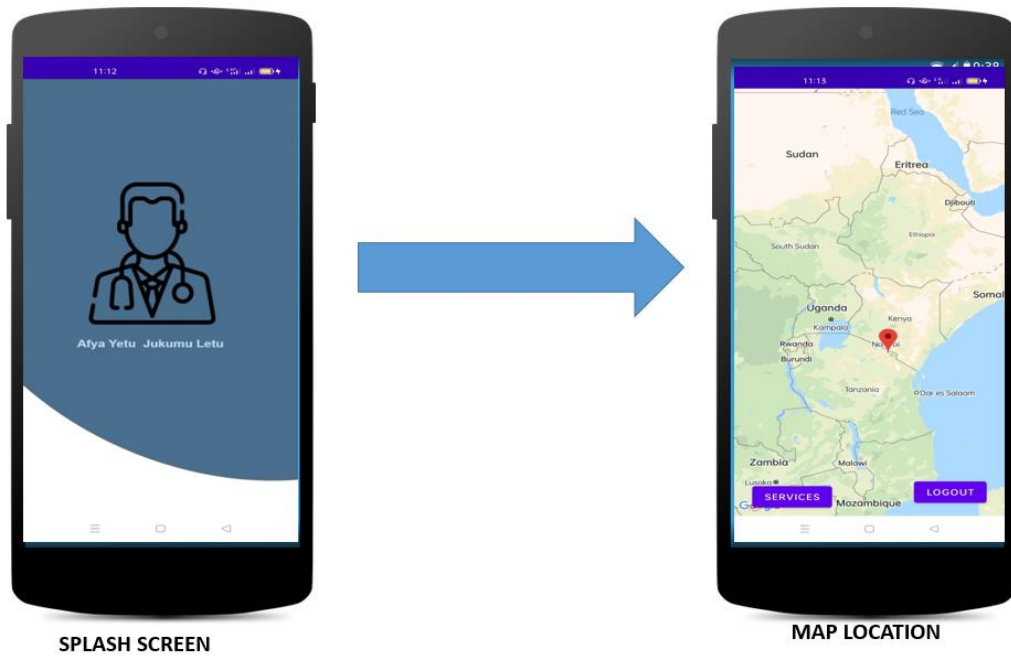


Figure 13: Splash screen and map screen

(ii) Hospital Services and Sub services.

This shows the hospital services and its sub-services. It presents the list of services the hospital provides where the user can select any services (Fig. 14).

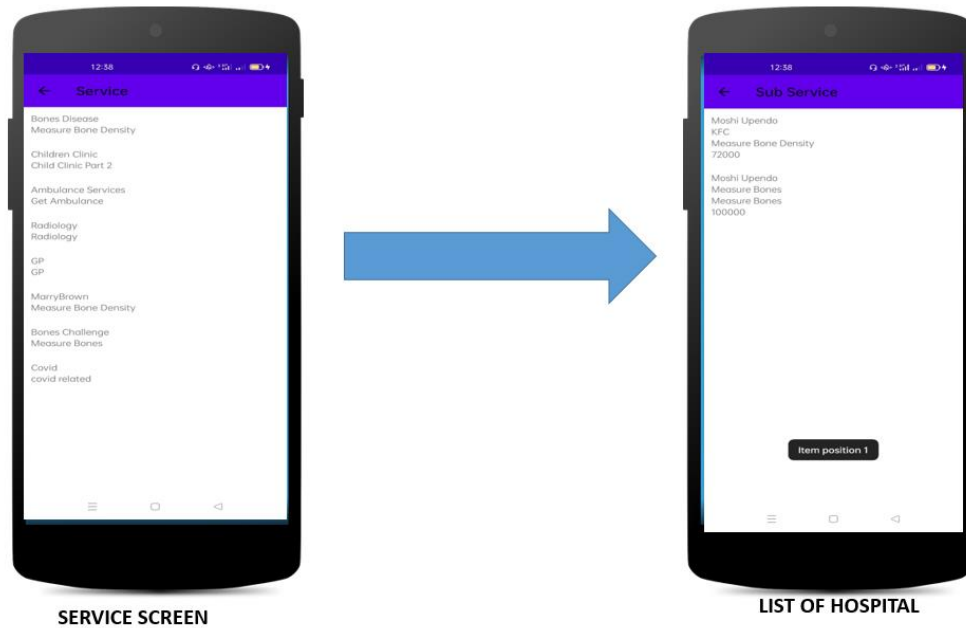


Figure 14: Hospital services and sub services screens

(iii) List of hospitals and list of doctors

This shows the list of hospital and its doctors on the specific diseases chosen by user. It presents the list of doctors the hospital provides has on the specific services (Fig. 15).

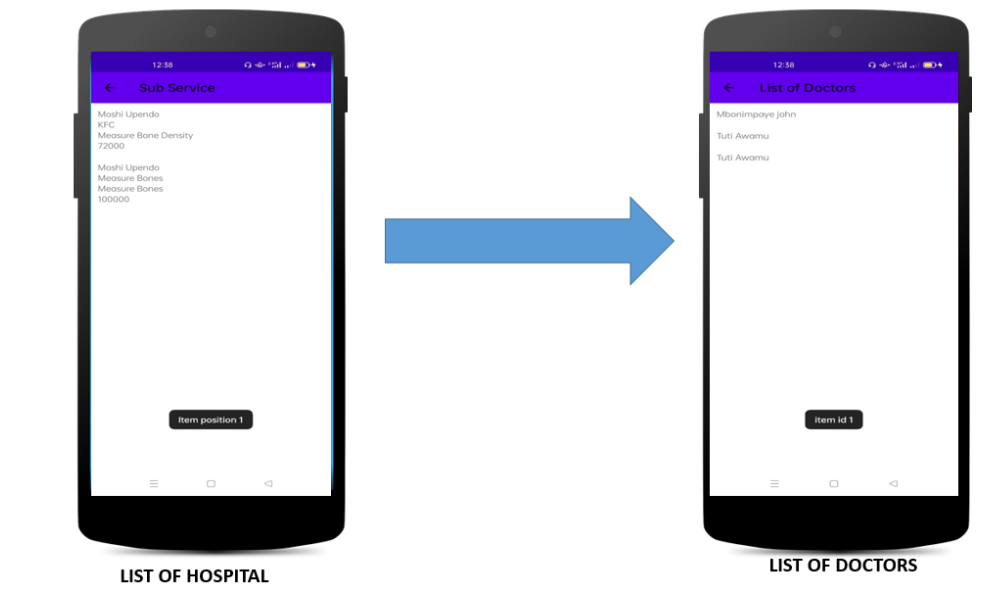


Figure 15: List of hospitals and list of doctors

(iv) Appointment Activity

This shows the appointment activity which allow user to make an appointment before reaching the hospital (Fig. 16).

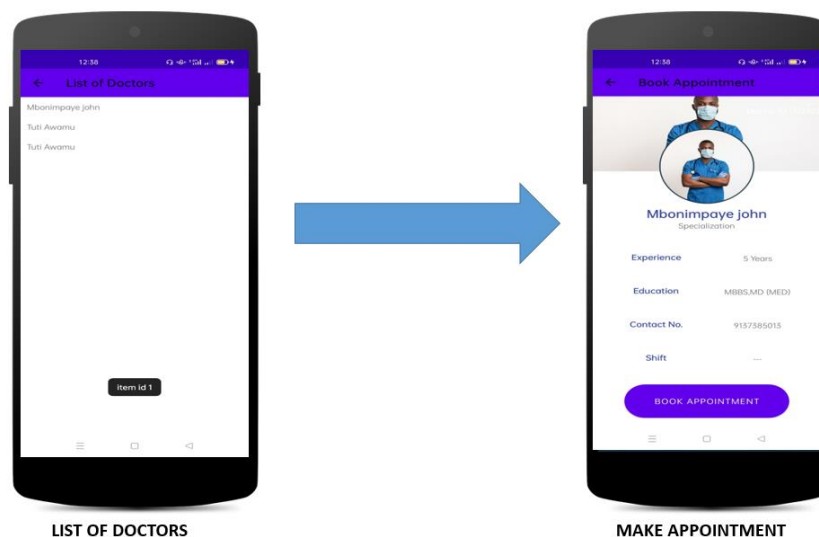


Figure 16: Appointment Screen

4.2.2 Developed Web Application

The Web Management System has many functionalities to improve the usability of hospital facilities, including accessing the hospital's location and providing users with necessary details before visiting the hospital. The system starts with a home page with the Login screen where the Super admin and hospital admin can log in. It allows the super admin to add a specific doctor account by sending him a link, then the hospital admin can create his password (Fig. 17).

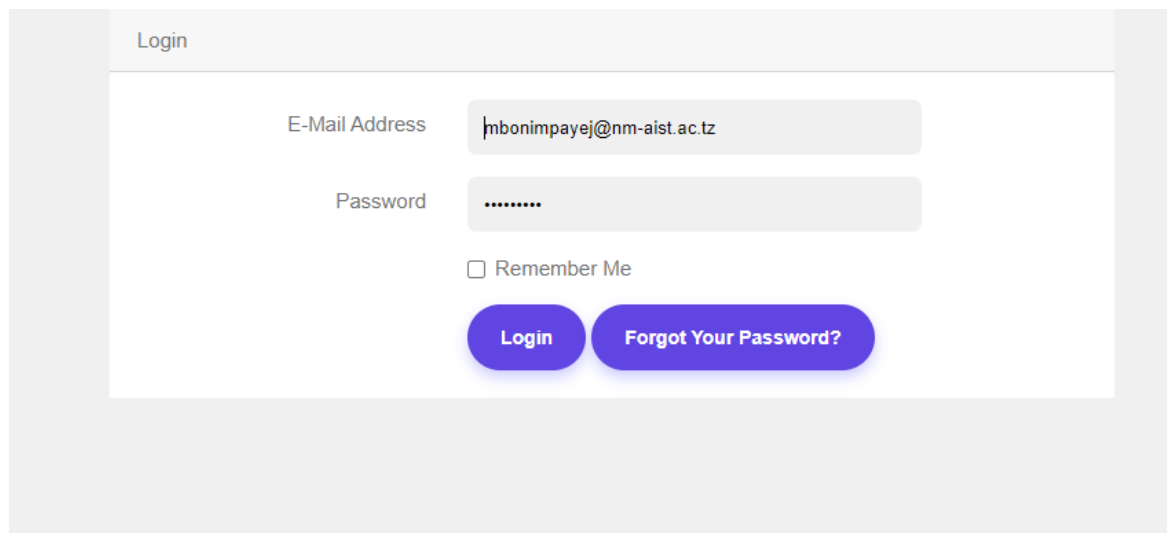
A screenshot of a web application's login interface. The interface is titled "Login" in a light gray header. Below the header, there are two input fields: "E-Mail Address" and "Password". The "E-Mail Address" field contains the text "mbonimpayej@nm-aist.ac.tz". The "Password" field contains a series of dots. Below the password field, there is a checkbox labeled "Remember Me". At the bottom of the form, there are two buttons: a blue "Login" button and a blue "Forgot Your Password?" button. The entire form is set against a light gray background.

Figure 17: Login Interface

4.2.3 Super Admin Interface

The super admin has ability to add new hospital from API (Micro-Health Initiative API) which has all list of served hospitals by the organization. Super admin can register a hospital admin by link from the system to the admin email, once the hospital admin receives the link, he or she can create his or her own account and have full control of the system on hospital part (Fig. 18).



Figure 18: Super Admin interface

4.2.4 Hospital Admin Interface

The hospital admin has ability to add, update and delete services the hospital provides include name of the services and price to acquire those services, adding schedules of the doctors daily to the system. The hospital services added by admin is synchronizing with app so that users can see each hospital with their services based on location (Fig. 19).



Figure 19: Hospital Admin interface

4.3 System Validation

The affirmation of the user specifications to the framework is referred to as software validation (Lumleyet, 2002). The architecture has gone through various stages of validation testing to ensure product consistency, including unit testing, integration testing, application testing, and user acceptance testing.

4.3.1 Unit Testing

The first stage of software testing is concerned with verifying the functionality of each module of the established program (Olan, 2003). At this step of software testing, individual software units are assessed. The goal is to guarantee that each program component functions properly. The tiniest bit of software that can be tested is called a gadget. It usually contains only one or a few inputs and outputs. In procedural programming, a unit can be a single program, function, or process, among other things. A function, which might be from a base/super class, abstract class, or derived/child class, is the smallest unit in object-oriented programming. Some people regard the module of an application to be a single unit. This is not a smart idea because that module will most likely contain a large number of distinct units.

4.3.2 Integration Testing

Individual units are grouped and tested as a group in this form of software testing. Integration testing was carried out to ensure that all of the components worked as anticipated. The aim is to find weaknesses in the interdependence of integrated units.

4.3.3 System Testing

This is a form of testing in which the whole program is examined to see whether it functions properly (Olademeji, 2007). The document digitization application was tested to see whether all functionalities are working correctly. The purpose of performing this kind of testing is to evaluate the system compliance to specified requirements.

4.3.4 User Acceptance Test

This is the final stage in the software development life cycle, in this stage the actual user of our application is verifying the software if it suits his or her needs. User approval, as well as questionnaires, were developed to learn about the application's perceptions and opinions. The questionnaire was as follows. Table 2 shows the results of acceptance Testing.

Table 2: Result of user acceptance testing

	Strongly Agree (%)	Agree (%)	Disagree (%)	Not sure (%)
I think the web and Mobile application are easy to use	62	36	0	2
I think I will be able to use the web application and Mobile App	68	30	1	1
The web and mobile app will facilitate the accessing of the hospital services easily	78	22	0	0
I think the mobile app will help patient get services easily	72	28	0	0
I think the mobile app reduce the waiting time during meeting the doctors	44	50	2	4
I think ambulance challenge will be saved	50	49	0	1

The majority of users were satisfied with the application's service, strongly agreed with established solutions, and demonstrated willingness to use the application, as seen in the table above.

4.3.5 Graphical User Interface

The Graphical User Interface (GUI) was designed quietly simple and user-friendly. The testing of the app was done on the Micro health initiative workers before taken to the public. Service screen, Map screen, and appointment screen feature workers liked most and they suggested and emphasize fully focus on them because these are the features that people will be interacting regularly on the app. Table 3 listed the main screen and features of this application.

Table 3: Menu of the application

Use case	Requirements description
View Services	Users shall be able to view all the hospital service via mobile.
Nearby Location	User shall be to see all nearby hospitals based on the location.
Login & Register	User shall be able to login and register after selecting the specific services they wish to get in the hospital.
Make Appointment	User shall be able to make appointment to the doctors via Mobile App.
Update services	Hospital Admin should be able to update services of the hospital timely. Whenever changes happen the admin will be able to adjust.
Register Doctor	Hospital Admin should be able to register the doctor.
Register Doctor Routine	Hospital Admin should be able to update doctor daily routines.
Register Hospital	Super admin should be able to register new hospital
View Hospital	Super admin should be able to view all registered hospitals in the system.
Approve Hospital	Super Admin should be able to approve or disapprove the hospital based on the system terms between the two (Pona system owner and the hospitals).
Register Hospital Admin	Super Admin should be able to register hospital admin. This is done by sending link via email then the hospital admin will be able to register on his or her own.
View App users	Super admin should be able to view all the users who are using the application.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The aim of the research was to evaluate the current way people accessing hospital services like ambulance, hospital nearby, knowing if the service is available or not, then develop a web and mobile application that would help people accessing hospital services in an easy way. Through this study there were three questions, explained below:

- (i) What are the strength and weaknesses of an existing application for accessing health services?
- (ii) What is the system requirement for developing web and mobile applications for locating health services?
- (iii) How will the proposed solution be developed to meet end-user expectations?

Considering the first question above, a literature review on the existing methods on how people are currently accessing hospital services and the struggle they are going through. In addition, after the filed a survey, the user and application specifications for the development web and mobile application were captured.

The second research question was successfully answered by developing the web and mobile application using Agile methodology, which is an agile approach. During system implementation, a variety of system modeling approaches, user interface design techniques, and technologies such as use cases, Context diagrams, and DFD were used. The study developed the wen and mobile application the help people accessing hospital services.

Lastly question, the micro health imitative organization representatives tested and validated the developed web and mobile application to find out whether it does what was intended to do as per requirements captured in the foremost research method. They showed high expectation that the developed web and mobile application will help people accessing the hospital services.

5.2 Recommendations

From the study, I recommend creating awareness to the communities about the application by providing education and advertisement. The government could be involved so that to support the idea and making easy for people to recognize the application and use it.

The study can be extended by adding the module for machine learning location detection using techniques called inertial Measurement units (IMU) where it will be able to detect the location and do the location process itself, also it can be extended by adding AI vision where people could look the environment of the hospital via their mobile phone before reaching the hospital area.

REFERENCES

- Adinan, J., Damian, D. J., Mosha, N. R., Mboya, I. B., Mamseri, R., & Msuya, S. E. (2017). Individual and contextual factors associated with appropriate healthcare seeking behavior among febrile children in Tanzania. *PLoS One*, 12(4), e0175446.
- Adventtech. (2019). The rise of real-time location services in healthcare.
- Amuyunzu-Nyamongo, M., & Nyamongo, I. K. (2006). Health seeking behaviour of mothers of under-five-year-old children in the slum communities of Nairobi, Kenya. *Anthropology & Medicine*, 13(1), 25-40.
- Arunda, M. O., Choudhry, V., Ekman, B., & Asamoah, B. O. (2016). Under-five mortality and maternal HIV status in Tanzania: Analysis of trends between 2003 and 2012 using AIDS Indicator Survey data. *Global Health Action*, 9(1), 31676.
- Atkinson, S., Ngwengwe, A., Macwan'gi, M., Ngulube, T. J., Harpham, T., & O'Connell, A. (1999). The referral process and urban health care in sub-Saharan Africa: The case of Lusaka, Zambia. *Social Science & Medicine*, 49(1), 27-38.
- Bell. (2003). Unified Modelling Language.
- Chawla, S., Srivastava, S., & Bedi, P. (2017). Improving the quality of web applications with web specific goal driven requirements engineering. *International Journal of System Assurance Engineering and Management*, 8(1), 65-77.
- Chung, L., Nixon, B. A., Yu, E., & Mylopoulos, J. (2012). Non-functional requirements in software engineering. *Springer Science & Business Media*, 5, 476.
- Corno, L. (2014). Learning (or not) in health-seeking behavior: Evidence from rural Tanzania. *Economic Development and Cultural Change*, 63(1), 27-72.
- Delgado, E., Sorensen, S. C., & Van der Stuyft, P. (1994). Health seeking behaviour and self assessment for common childhood. *Annales de la Societe Belge de Medecine Tropicale*, 1994(74), 161–168.
- Frumence, G., Nyamhanga, T., Mwangi, M., & Hurtig, A. K. (2013). Challenges to the implementation of health sector decentralization in Tanzania: experiences from Kongwa district council. *Global Health Action*, 6(1), 20983.

- Geissler, P. W., Nokes, K., Prince, R. J., Achieng'Odhiambo, R., Aagaard-Hansen, J., & Ouma, J. H. (2000). Children and medicines: Self-treatment of common illnesses among Luo schoolchildren in western Kenya. *Social Science & Medicine*, 50(12), 1771-1783.
- GSMAintelligence. (2009). Tanzania Mobile Communication growth. <https://www.gsma.com/newsroom/press-release/gsma-intelligence-shares-global-mobile-trends-2021/>
- Gupta, V. (2020). A case study on economic development of Tanzania. *Journal of the International Academy for Case Studies*, 26(1), 1-16.
- Hassan, S. R., Sutan, R., & Shamsuddin, K. (2016). Health information seeking behaviour among hypertensive disorder in pregnancy high risks antenatal mothers. *Women's Health and Gynecology*, 2(7), 1-6.
- Health, M. O. (2021). List of hospitals. Best Hospitals in Tanzania (ghealth121.com)
- Hurme. (2005). Mobile Applications for Knowledge Workers and Field Workers. *Mobile Information Systems*, 2005.
- Ibrahim, R. A. (2010). Formalization of the Data Flow Diagram Rules for Consistency Check. *International Journal of Software Engineering and Applications*, 1(4), 95-111
- Kamugumya, D., & Olivier, J. (2016). Health system's barriers hindering implementation of public-private partnership at the district level: A case study of partnership for improved reproductive and child health services provision in Tanzania. *BMC Health Service Research*, 16(1), 1-13.
- Ketis, Z. E., & Kersnik, J. (2014). Health Seeking Behaviour in General Population with Psychological Symptoms. *Journal of Psychiatria Danubina*, 26(2), 181-186.
- Lo, J. Y., Amour, C., Buchner, D., Cross, D., Brenner, J. L., & Matevelo, D. (2017). Mapping health facility characteristics and location in rural Tanzania. *Paediatrics & Child Health*, 22, e18.
- Lucid. (2021). Data flow diagram levels. <https://www.lucidchart.com/pages/data-flow-diagram>
- Lumley. (2002). System Validation.

- Mhalu, G., Hella, J., Mhimbira, F., Said, K., Mosabi, T., Mlacha, Y. P., Schindler, C., Gagneux, S., Reither, K., Kees., Weiss, M. G., Zemp, E., & Fenner, L. (2019). Pathways and associated costs of care in patients with confirmed and presumptive tuberculosis in Tanzania: A cross-sectional study. *BMJ open*, 9(4), e025079.
- Maguire, M., & Bevan, N. (2002). User Requirements Analysis : A Review of Supporting Methods. *IFIP World Computer Congress*, 133-148.
- Malan, R., & Bredemeyer, D. (2001). Functional requirements and use cases. *Bredemeyer Consulting*.
- Manzoor, D. A. (2014). Improving the quality of web applications with web specific goal driven requirements engineering. *International Journal of Advanced Computer Science and Applications*, 5(5), 196–201.
- Miller, K. A. (2006). Extreme Programming Applied: Playing To Win. *Addison-Wesley Longman Publishing Corporation*.
- Munir, M. W., Omair, S. M., & Haque, M. Z. U. (2015). An Android based Application for Determine a Specialized Hospital Nearest to Patient's Location. *International Journal of Computer Applications*, 118(9), 43-46.
- Nations, U. (2001). Elements for a Draft Declaration on Human Rights and Health Practice Geneva.
- Navaneetham, K., & Dharmalingam, A. (2002). Utilization of maternal health care services in Southern India. *Social Science & Medicine*, 55(10), 1849-1869.
- NBS. (2017). Tanzania Total Population by District - Regions-2016-2017. Tanzania Total Population by District - Regions -2016-2017.
- Noorali, R., Luby, S., & Hossein Rahbar, M. (1999). Does use of a government service depend on distance from the health facility? *Health Policy and Planning*, 14(2), 191-197.
- Nuhu, S., Mpambije, C. J., & Ngussa, K. (2020). Challenges in health service delivery under public-private partnership in Tanzania: stakeholders' views from Dar es Salaam region. *BMC Health Services Research*, 20(1), 1-12.

- Nyamongo, I. K. (2002). Health care switching behaviour of malaria patients in a Kenyan rural community. *Social Science & Medicine*, 54(3), 377-386.
- Okyere, A. W. K., Anum, A., Osei-Akoto, I., & Adukonu, A. (1998). Cost recovery in Ghana: are there any changes in health care seeking behaviour? *Health Policy and Planning*, 13(2), 181-188.
- Oladimeji, P., Roggenbach, M., & Schlingloff, H. (2007). Levels of testing. *Advance Topics in Computer Science*.
- Olan, M. (2003). Unit testing: Test early, test often. *Journal of Computing Sciences in Colleges*, 19(2), 319-328.
- Ortiz, E. A. (2003). Use of information technology to improve the quality of health care in the United States. *Health Services Research*, 38(2).
- Oxford. (2021). What is Health. USA: Oxford.
- Patrick, K. G., Griswold, W., Raab, F., & Intille, S. (2008). Health and the mobile phone. *American Journal of Preventive Medicine*, 35(2), 177-181.
- PY, K. (2001). Socio-economic factors responsible for poor utilization of PHC services in rural community in Nigeria. *Nigerian Journal of Medecine: Journal of the National Association of Resident Doctors of Nigeria*, 10(1), 28-29.
- Qiang, C. Z. W., Rossotto, C. M., & Kimura, K. (2009). Economic impacts of broadband. *Information and communications for development 2009: Extending reach and increasing impact*, 3, 35-50.
- Registry, H. F. (2021). Health facilities.
- Ringo, J. J. (2019). Health seeking behaviour and incidence of under-five mortality in agro-pastoralist communities in Handeni district, tanzania. *East African Journal of Social and Applied Sciences*, 1(2), 58-70.
- Sampling. (2021). Types of sampling technique.
- Sampson, S., & Felman, A. (2020). What is good health. *Medical News Today*.

- Sirili, N., Frumence, G., Kiwara, A., Mwangi, M., Goicolea, I., & Hurtig, A. K. (2019). Public private partnership in the training of doctors after the 1990s' health sector reforms: the case of Tanzania. *Human Resources for Health*, 17(1), 1-11.
- Statista. (2021). Number of mobile cellular subscriptions per 100 inhabitants in Tanzania from 2000 to 2019.
- Spat, S., Höll, B., Beck, P., Chiarugi, F., Kontogiannis, V., Spanakis, M., Manousos, D., & Pieber, T. R. (2011). A Mobile Android-based Application for in-hospital Glucose Management in compliance with the Medical Device Directive for Software. *International Conference on Wireless Mobile Communication and Healthcare*, 211-216.
- Swere, K. M. R. (2016). Challenges Hindering the Accessibility of Tanzania's Health Service. *International Journal of Economics and Finance*, 8(8), 242-245.
- Team, H. (2019). Health Data United Republic of Tanzania.
- Tebepah, I. R. (2017). Health Management App for Android Mobile. *Researchgate, Software Engineering*, 6(1): 1-7
- TheCitizen. (2019). Internet penetration increases to 43 per cent. <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi7ifrvj4AhVfwAIHHZihCI0QFnoECAgQAQ&url=https%3A%2F%2Fwww.thecitizen.co.tz%2Ftanzania%2Fnews%2Fbusiness%2Finternet-penetration-increases-to-43-per-cent-2670784&usg=AOvVaw3RubRrrL41uXYOZGAWTwOx>
- Unicef. (2014). Levels and Trends in Child Mortality, Goal No 4, Estimates developed by the Un Inter-agency group for Child Mortality Estimation.
- WHO. (2021). Frequently asked questions - WHO | World Health Organization. America: WHO.
- Wikipedia. (2021). Database schema.
- Workforcealliance. (2020). Tanzania Health.

APPENDICES

Appendix 1: Community Data Collection Questionnaires from Field Surveys

DODOSO YA UELEWA WA JAMII JUU YA HUDUSMA ZA AFYA (CASE STUDY KILIMANJARO, ARUSHA & DAR ES SALAAM)

ENGLISH

I am Mbonimpa John, master's student at The Nelson Mandela Institution of Science and Technology (NM-AIST), currently doing project research titled " PONA: A Mobile Web-based application for helping people get health care services from providers conveniently, transparently at affordable prices under Micro-Health Initiative Organization: A case of Moshi, Arusha and Dar es salaam in Tanzania". The aim of the questionnaire is to understand the knowledge community has on health issues.

SWAHILI:

Naitwa Mbonimpaye John, ni mwanafunzi wa Masters chuo cha Nelson Mandela Arusha. Kwa sasa Nafanya utafiti/project inayoitwa PONA. Ni program ya simu itakayowasaidia watu kupata misaada ya huduma za kiafya kupitia Simu kutoka kwa watoa huduma kwa wepesi na uwazi na kwa gharama zinazoendana na soko chini ya shiraka lisilo la kiserikali la Micro-Health Initiative-Moshi.

Dhumuni/Lengo la Maswali haya ni kujua uelewa wa jamii juu ya huduma za afya. Nipende kukushukuru kwa ushirikiano na muda wako.

Tafadhali jaza alama ya vema (✓) panapositahili.

1. Je, jinsia yako ni ipi?

Mwanamke ☐

Mwanaume ☐

1. Je, una umri gani?

3. Je, Unaishi mkoa gani kati ya hii??

Kilimanjaro ☐

Arusha ☐

Dar es salaam ☐

4. Je, Unazijua hospitali (vituo vya afya hospitali na zahanati) ngapi zinazopatikana mkoa wa uliotaja swali namba 3? (Taja idadi kwa namba mfano: 4)?

5. Je, Unajua huduma zote kwa majina zinazotolewa katika vituo vya afya ?

Ndio ☐

Hapana ☐

6. Je, Unajua gharama zote za huduma zinazotolewa katika vituo vya afya (hospitali na zahanati)?

Ndio ☐

Hapana ☐

7. Je, Unajua gharama zote za huduma zinazotolewa katika vituo vya afya (hospitali na zahanati)?

Ndio ☐

Hapana ☐

8. Kwa uzoefu wako katika vituo vya afya umeshawahi kukaa foleni ukisubiri huduma kwa muda gani? (mfano: masaa 4 n.k)

9.Je,Unajua gharama Kwa uzoefu wako wa kupata huduma katika vituo vya afya umeshawahi kukuta huduma unayotaka haipo na ukaenda kutafuta hospitali nyingine?

Ndio ☐

Hapana ☐

10.Kwa mtazamo wako ni huduma zipi kati ya hizi ni kazi kuzipata kwa haraka?

Huduma ya Ambulances ☐

Huduma ya vipimo ☐

Kumuona Daktari au nurse ☐

Kufanyiwa operation ☐

Huduma ya Kujifungua kwa wajawazito ☐

Appendix 2: Health Workers Questionnaires from field Surveys

DODOSO UELEWA WA JAMII JUU YA HUDUMA ZA AFYA KUPITIA WAHUDUMU WA AFYA.

ENGLISH

I am Mbonimpaye John, master's student at The Nelson Mandela Institution of Science and Technology (NM-AIST), currently doing project research titled " PONA: A Mobile Web-based application for helping people get health care services from providers conveniently, transparently at affordable prices under Micro-Health Initiative Organization: A case of Moshi, Arusha and Dar es salaam in Tanzania". The aim of the questionnaire is to understand the knowledge community has on health issues from hospital attendant side.

SWAHILI:

Naitwa Mbonimpaye John, ni mwanafunzi wa Masters chuo cha Nelson Mandela Arusha. Kwa sasa Nafanya utafiti/project inayoitwa PONA. Ni program ya simu itakayowasaidia watu kupata misaada ya huduma za kiafya kupitia Simu kutoka kwa watoa huduma kwa wepesi na uwazi na kwa gharama zinazoendana na soko chini ya shiraka lisilo la kiserikali la Micro-Health Initiative-Moshi.

Dhumuni/Lengo la Maswali haya ni kujua uelewa wa jamii juu ya huduma za afya kutoka kwa wahudumu wa afya. Nashukuru kwa ushirikiano na muda wako.

Weka alama ya vema (✓) kwenye kisanduku

1. Je, jinsia yako ni ipi?

Mwanamke ☐

Mwanaume ☐

3. Je, Wewe ni muhudumu wa afya mkoa gani kati ya hii?

Kilimanjaro ☐

Arusha ☐

Dar es salaam

☐

4.Unafanya kazi katika vituo au kituo cha afya cha ?

Binafsi(private)

☐

Serikalini (Government)

☐

Binafsi na Serikalini(Private and Government) ☐

5.Je,Wagonjwa wote ambao umewahi au unawadumia huwa wanajua bei za huduma?

Ndio

☐

Hapana

☐

7.Kwa uzoefu wako wagonjwa huwa wanakaa folani wakisubiri huduma kwa muda mrefu?

Ndio

☐

Hapana

☐

8.Kwa uzoefu wako baadhi ya wagonjwa huwa wanashindwa kupata matibabu kutokana na gharama za huduma??

Ndio

☐

Hapana

☐

9.Kwa uzoefu wako huduma ya Ambulance ni rahisi kupatikana hospitali au kituo cha afya unachofanyia kazi?

Ndio

☐

Hapana

☐

10.Unahudumia vituo vingapi vya afya ?(andika idadi mfano: 4

Ndio

☐☐

Hapana

8.Je,ukiwekewa mfumo wa watu kufanya appointment kupitia simu janja(Smartphone)
unahisi itasaidia kuondokana na changamoto ya foleni za wagonjwa kusubiri huduma?

Ndio ☐

Hapana ☐

Appendix 3: The Mobile App Sample Codes

Splash Screen Codes.

```
package com.mbonimpaye.pona;

import androidx.appcompat.app.AppCompatActivity;

import android.content.Intent;
import android.os.Bundle;
import android.view.animation.Animation;
import android.view.animation.AnimationUtils;
import android.widget.ImageView;

public class MainActivity extends AppCompatActivity {
    private ImageView mSplashText;
    private ImageView mSplashLogo;
    private Animation uptodown;
    private Animation downtoup;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        mSplashText = (ImageView) findViewById(R.id.splash_logo1);
        mSplashLogo = (ImageView) findViewById(R.id.splash_logo);
        uptodown = AnimationUtils.loadAnimation(this, R.anim.uptodown);
        downtoup = AnimationUtils.loadAnimation(this, R.anim.downtoup);

        mSplashText.setAnimation(downtoup);
        mSplashLogo.setAnimation(uptodown);

        Thread thread = new Thread(){
            @Override
            public void run() {
                try{
                    sleep(3000);
                }
                catch(Exception e){
                    e.printStackTrace();
                }
                finally
                {
                    Intent main_intent= new Intent(MainActivity.this,
MapLocation.class);
                    startActivity(main_intent);
                }
            }
        };
        thread.start();
    }
    @Override
    protected void onPause() {
        super.onPause();
        finish();
    }
}
```


Android Codes for Doctor List

```
public static class ViewHolder extends RecyclerView.ViewHolder{
    TextView textViewName;
    public ViewHolder(@NonNull View itemView) {
        super(itemView);
        textViewName = itemView.findViewById(R.id.doctor_name);
        itemView.setOnClickListener( v -> {
            int itemPosition = getLayoutPosition();
            itemPosition = itemPosition + 1;
            Intent intent = new Intent(itemView.getContext(),
DoctorAppointment.class);
            intent.putExtra("doctor_id", itemPosition);
            itemView.getContext().startActivity(intent);
        } );
    }
}
```

Android Codes for Appointment Screen

```
package com.mbonimpaye.pona;

import androidx.appcompat.app.AppCompatActivity;

import android.os.Bundle;
import android.widget.TextView;

import com.mbonimpaye.pona.api.interfaces.APIInterface;
import com.mbonimpaye.pona.api.models.Doctor;

import retrofit2.Call;
import retrofit2.Callback;
import retrofit2.Response;
import retrofit2.Retrofit;
import retrofit2.converter.gson.GsonConverterFactory;

import static com.mbonimpaye.pona.api.APIConfig.API_URL;

public class DoctorAppointment extends AppCompatActivity {

    private TextView textViewDoctorName;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_doctor_appointment);
        textViewDoctorName = findViewById(R.id.doctor_name);
    }

    @Override
    protected void onStart() {
        super.onStart();
        int doctor_id = getIntent().getIntExtra("doctor_id", 0);
    }
}
```

```

package com.mbonimpaye.pona;

import android.content.Context;
import android.content.Intent;
import android.view.DisplayCutout;
import android.view.LayoutInflater;
import android.view.View;
import android.view.ViewGroup;
import android.widget.TextView;

import androidx.annotation.NonNull;
import androidx.recyclerview.widget.RecyclerView;

import com.mbonimpaye.pona.api.models.Doctor;

import java.util.List;

public class DoctorListAdapter extends
RecyclerView.Adapter<DoctorListAdapter.ViewHolder> {
    private List<Doctor> listDoctors;
    private Context context;

    public DoctorListAdapter(List<Doctor> _listDoctors, Context _context){
        this.listDoctors = _listDoctors;
        this.context = _context;
    }

    @NonNull
    @Override
    public DoctorListAdapter.ViewHolder onCreateViewHolder(@NonNull ViewGroup parent,
int viewType) {
        View view =
LayoutInflater.from(parent.getContext()).inflate(R.layout.doctor_list_adaptor,
parent, false);
        return new DoctorListAdapter.ViewHolder(view);
    }

    @Override
    public void onBindViewHolder(@NonNull ViewHolder holder, int position) {
        Doctor doctor = listDoctors.get(position);
        holder.textViewName.setText(doctor.getName());
    }

    @Override
    public int getItemCount() {
        return listDoctors.size();
    }
}

```

Appendix 4: Poster Presentation



MOBILE AND WEB BASED APPLICATIONS FOR SUPPORTING LOCATING OF HOSPITAL SERVICES

Mbonimpaye Hamis John¹, Anael Sam², Edith Luhanga³
The Nelson Mandela African Institute of Science and Technology, Arusha-Tanzania,
✉ mbonimpayej@nm-aist.ac.tz



Background

✓ Health is a state of full physical, mental, and social well-being, rather than the absence of disease or disability. Tanzania is undergoing a digital transformation, reflected by the growing number of people connected to communications and internet services. The adoption of technology on the health sectors in Tanzania is growing rapidly.

- 42% of the population subscribed to a mobile service in 2018.
- Mobile internet penetration has nearly quadrupled since 2010 to 18.5%, with more than 8 million new mobile internet subscribers added over that period. (TheCitizenMagazine2019)



✓ The current way of people seeking for health services is very challenging.

Current strategy

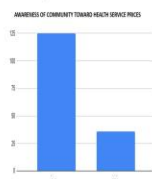
- People access health services through nearby shop
- People use elders and traditional healers
- Shortage of enough workers among the health centers
- Loosing time moving from one hospital to another searching for services.

Above Limited as people struggle to get services in easy way

Therefore a fast health application solution have to be developed.

Why it matters?

The research was carried out in Tanzania's Kilimanjaro, Dar es Salaam, and Arusha regions. It shows that there is high need to come up with solution that will help people accessing health services in easy way.



Showing how people are unaware of hospital services prices.

Solution

- The solution is developing the Web and Mobile Application. The Web and Mobile application will have capability of
- The developed application will enable people to know near by hospitals and their services. The developed application will enable timely and conveniently book appointment on the hospital services
- This study will help people decide to go to any hospital depending on the budget they have.
- The developed application will enhance the availability of ambulances services which seem to be challenging in Tanzania hospitals..



Future work

- The study can be extended by adding the module for machine learning location detection using techniques called inertial Measurement units (IMU).
- Adding AI vision where people could lock the environment of the hospital via their mobile phone before reaching the hospital area.

Reference

- [1] TheCitizenMagazine, "Internet penetration increases to 43 per cent. (Tanzania) [1]" 2019. [Online]. Available: <https://www.thecitizen.co.tz/news/business/internet-penetration-increases-to-43-per-cent/1840414-4962082-21gap9/index.html>
- [2] Aranda, M. O. (2018). Under-five mortality and maternal HIV status in Tanzania: Analysis of trends between 2003 and 2012 using AIDS Indicator Survey data.
- [3] eSentechn (2019). THE RISE OF REAL-TIME LOCATION SERVICES IN HEALTHCARE.
- [4] GSMA Intelligence. (2009) Tanzania Mobile Communication growth Available: <https://www.gsma.com/>
- [5] W. G. Patrick K., Onwiod and F. Raab, "Mobile Technology" 2008.