



Electronic Theses and Dissertations

2021

A Web based Zakat collection and distribution system using K-Nearest Neighbors.

Samatar, Fatuma Abdullahi
School of Computing and Engineering Sciences
Strathmore University

Recommended Citation

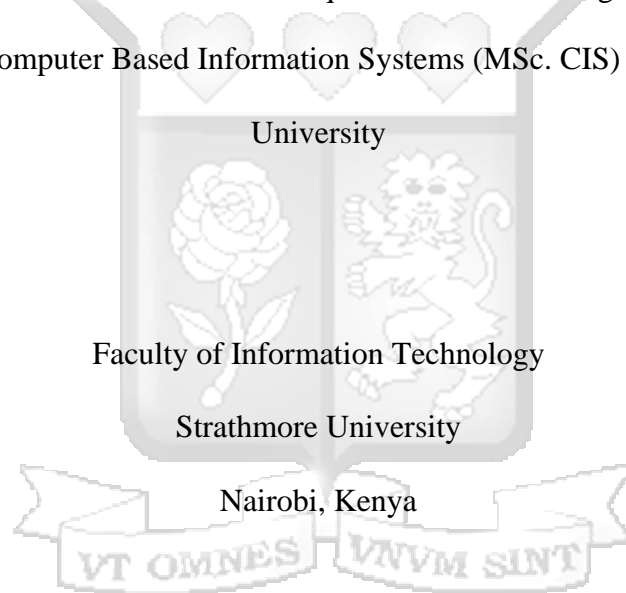
Samatar, F. A. (2021). *A Web based Zakat collection and distribution system using K-Nearest Neighbors* [Thesis, Strathmore University]. <http://hdl.handle.net/11071/12941>

Follow this and additional works at: <http://hdl.handle.net/11071/12941>

**A Web Based Zakat Collection and Distribution System Using K-Nearest
Neighbors**

Samatar, Fatuma Abdullahi

Submitted in partial fulfillment of the requirements for the Degree of Masters of
Science in Computer Based Information Systems (MSc. CIS) at Strathmore



September, 2021

Declaration

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge this thesis contains no part previously published or written by another person except were referenced in the said thesis.

© No part of this thesis may be reproduced without permission of the author and Strathmore University.

Samatar, Fatuma Abdullahi



Sept 09, 2021

Approval

The thesis of Samatar, Fatuma Abdullahi was reviewed and approved by the following:

Dr. Henry Muchiri,

Academic Director, Undergraduate Programmes,

Strathmore University

Dr. Julius Butime,

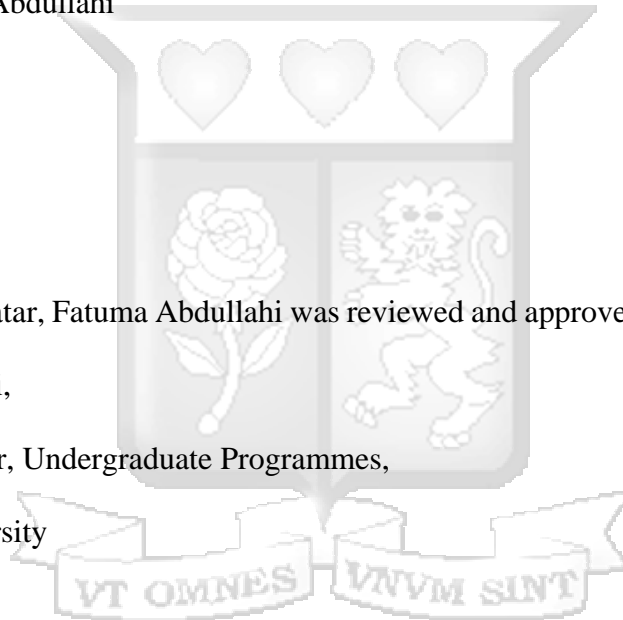
Dean, School of Computing and Engineering Sciences,

Strathmore University

Dr. Bernard Shibwabo,

Director of Graduate Studies,

Strathmore University



Abstract

This research focusses on Zakat and how inefficiency in the process of Zakat collection and distribution impacts poverty. This research studies how the problem of Zakat management is handled in various parts of the world as well as takes a deep look into previous research and proposed solutions in order to come up with a system that attempts to improve efficiency and transparency of the process while building on previous research in the area. The researcher utilized the Agile methodology using a scrum approach to develop the system. The system included a front-facing rule-based calculator to improve the zakat collection process and a machine learning API, built using the K-Nearest Neighbors algorithm, to improve the efficiency of zakat distribution. As such, the model was built using the K- Nearest Neighbors algorithm as it outperformed the other common classification algorithm such as Decision Trees, Naïve Bayes and Support Vector Machine. This process leveraged existing libraries and tools in both the Python and the JavaScript ecosystem. This research concludes that inefficiency in the zakat process could be improved by systemizing the whole process and suggests the developed system as a starting point.

Keywords: Zakat, Zakat Management System, Zakat distribution, Zakat calculator, Machine learning, Algorithms.

Table of Contents

Table of Contents

Declaration	ii
Abstract	iii
List of Tables	vii
List of Figures	viii
List of Abbreviations/Acronyms.....	ix
Definition of Terms	x
Chapter One: Introduction	1
1.1 Background of the Study	1
1.2 Problem Statement	2
1.3. Objectives.....	3
1.3.1 General objective.....	3
1.3.2 Specific objectives	3
1.4. Research Questions.....	3
1.5. Justification.....	4
1.6. Scope.....	4
Chapter 2: Literature Review	5
2.1. Overview	5
2.2. Theoretical Framework.....	5
2.2.1. A brief history of zakat	6
2.2.2. Zakat and Poverty	6
2.2.3. Covid-19 and world poverty.....	7
2.3 A review of existing Zakat Management Systems	8
2.3.3.1. Malaysia	8
2.3.3.2. Kingdom of Saudi Arabia.....	8
2.3.3.3. Bahrain.....	8
2.3.3.4. Kuwait.....	9
2.4. Literature on Zakat Collection	9
2.5. Literature on Zakat Distribution.....	10
2.6. Gaps in the reviewed literature	13
2.7. Conceptual Framework.....	15
2.8. Proposed Solution.....	15
Chapter 3: Methodology	17
3.1. Overview	17

3.2. Research Design.....	17
3.3. System Development Methodology	17
3.3.1. Requirement Elicitation	18
3.3.2. System Design Phase.....	19
3.3.3. System Development.....	19
3.3.4. Testing Phase.....	19
3.4. Target Population and Sampling	20
3.5. Research Quality	21
3.5.1 Key Influences.....	21
3.5.2 Research quality dimensions	22
3.6. Ethical Considerations	23
Chapter 4: System Analysis, Design and Architecture	26
4.1. Overview	26
4.2. System Analysis.....	26
4.2.1. Requirement Gathering.....	26
4.2.2. Functional Requirements.....	26
4.2.3. Non-Functional Requirements.....	27
4.3. System Architecture.....	27
4.4. System Design.....	28
4.4.1. Use Case Diagram	28
4.4.2. Sequence Diagram.....	29
4.4.3. Class Diagram	30
4.4.5. Data Flow Diagram	31
4.4.6. Entity Relationship Diagram.....	32
4.4.7. Wireframes	33
Chapter 5: System Implementation and Testing.....	35
5.1. Overview	35
5.2. System Implementation.....	35
5.3. System Testing	40
5.4. System Deployment/Validation.....	41
Chapter 6: Results and Discussions	42
6.1. Overview	42
6.2. Model Precision Results.....	42
Chapter 7: Conclusion and Recommendation	44
7.1. Conclusions	44
7.2. Recommendations	45

7.3. Future Work 45
References 46
Appendix A: Zakat Application Form 50
Appendix B: Turn It in Report Screenshot..... 53
Appendix C: Ethical Certificate 54



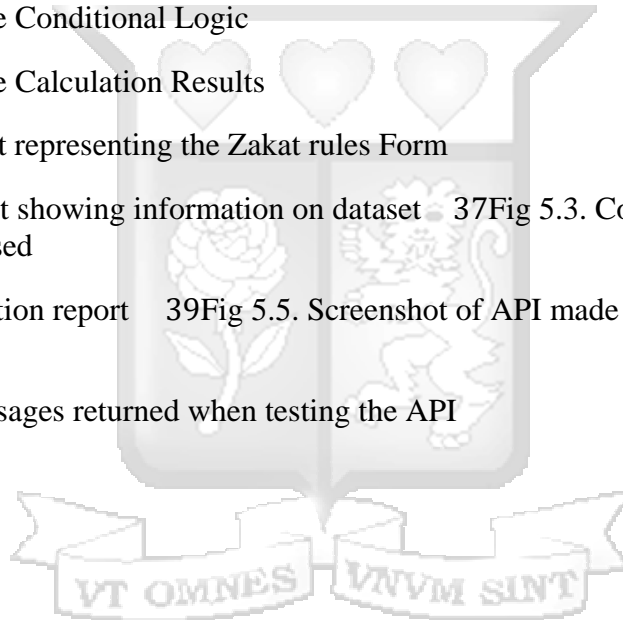
List of Tables

Table 2.1. A tabular representation of the reviewed literature	20
Table 5.1. Results from various Machine Learning Algorithms	41



List of Figures

Fig 2.1. Conceptual Framework	17
Fig 3.1. Insights to agile Methodologies for Software Development (P, n.d.)	18
Fig 4.1. System Architecture	28
Fig 4.2. Use Case Diagram	30
Fig 4.3. Sequence Diagram	29
Fig 4.4. Class Diagram	31
Fig 4.5. Data Flow Diagram	31
Fig 4.6. Entity Relationship Diagram	32
Fig 4.7. Wireframe First Page	34
Fig 4.8. Wireframe Conditional Logic	34
Fig 4.9. Wireframe Calculation Results	34
Fig 5.1. Flow chart representing the Zakat rules Form	36
Fig 5.2. Screenshot showing information on dataset to the algorithm used	37
Fig 5.3. Code snippet relating to the algorithm used	39
Fig 5.4. Classification report	39
Fig 5.5. Screenshot of API made from the generated model	41
Fig 5.6. Error messages returned when testing the API	40



List of Abbreviations/Acronyms

API – Application Programming Interface

FN – False Negative

FP – False Positive

KNN - K- Nearest Neighbors

TN – True Negative

TP – True Positive



Definition of Terms

Zakat - Third pillar of the Islamic faith and refers to an obligation upon specific forms of wealth given to predefined recipients within a strict time frame.



Chapter One: Introduction

1.1 Background of the Study

Zakat is an Islamic term that refers to the obligation upon all Muslims to give a percentage of their wealth to the less fortunate. It is believed to purify wealth and to act as an economic equalizer as well as a stimulus to the economy to encourage trade and self-sufficiency among the poorer Muslims (Lubis, Lubis, & Almaarif, 2019).

Zakat becomes due after a predefined threshold is met and maintained for a full year. The threshold (*nisab*) changes according to the type of earnings. Zakat is applicable on two types of wealth: monetary and non-monetary. Monetary zakat refers to income saved, rental income and profits made over a year that exceed the minimum threshold of 85 grams of gold, and it is calculated as 2.5% of the income/profit. Non-monetary zakat includes crop yields, animals owned and gold.

Zakat should be distributed among eight groups of people who are deemed to be eligible for zakat as specified in the Holy Qur'an surah 9 verse 60). These include:

The poor, the needy, the indebted, the traveler/wayfarer with little/no means, the enslaved, the new converts, in the causes of ALLAH (s.w.t) and the zakat collectors (Yahaya & Ahmad, 2018).

Zakat should not be confused with *Sadaqat*. *Sadaqat* refers to voluntary acts of charity and is not clearly defined. That is, it is not governed by particular rules.

While the majority of the Muslim population complies with the zakat obligation, most of them do so in a decentralized manner. This greatly undermines the potential zakat has in alleviating poverty and stimulating the economy (Shaikh & Ismail, 2017).

A system is defined as detailed methods or procedures that work together to achieve a particular outcome or goal (Merriam-Webster, n.d.). The use of systems can be used to

bring order to the collection of zakat in Kenya. This can improve the efficiency of the process and hence increase the impact of zakat among the Muslim community (Ariyani, 2016).

Such systems exist in some parts of the Muslim world, most notably in Indonesia (Hafidhuddin & Beik, 2019) but they are not complete systems that handle zakat from the calculation to distribution. It is the intention of this research to design and develop a robust Zakat Management System that will facilitate collaborative and transparent collection and distribution of zakat in Kenya.

1.2 Problem Statement

In Kenya, there are no official or large organizations that deal with the collection and distribution of zakat. If an individual wishes to pay zakat, they can pay it directly to the people in their community they perceive to meet the criteria of receiving the zakat or they can send the zakat to local organizations available in some mosques and trust that the zakat will then reach the people most deserving of it (Weiss, 2020).

This method of zakat collection and distribution is plagued by lack of transparency and no clear definition of whom among the population actually meets the criteria to receive zakat. It discourages the population from fully participating in the remission of zakat in time.

This inhibits the people deserving of zakat from zakat especially for some categories of zakat receivers who are not usually top of mind of zakat givers as most givers think of the *Maskeeen* (poor) and *Fuqara* (destitute/needy). This excludes other categories such as the unlawfully detained and the new Muslims.

Furthermore, this process for lack of proper controls and centralization undermines the ability of zakat to alleviate poverty and to stimulate the economy (Ayuniyyah, Pramanik, Saad, & Ariffin, 2018).

Turning this informal process into a system that is able to streamline the process of paying zakat for givers as well as simplifying the process of zakat distribution for the relevant authorities increases the inefficiencies that marr the process, thereby giving it a better chance of meeting its objective of reducing poverty.

1.3. Objectives

1.3.1 General objective

The aim of this research is to design and develop a Zakat Management System that will coordinate the process of Zakat collection and distribution.

1.3.2 Specific objectives

The specific objectives of this research are as follows:

- I. To evaluate the role-played by Zakat in poverty alleviation.
- II. To analyze the current methods used in Zakat collection and distribution among Muslim populations in the world.
- III. To design and develop a zakat management system that would automate the process of collecting and distributing zakat.
- IV. To validate the aforementioned zakat management system through extensive testing.

1.4. Research Questions

Through this research we will be seeking answers to the following questions:

- I. What role does Zakat play in poverty alleviation?
- II. How is Zakat currently being collected and distributed among Muslim populations across the world?
- III. How can a functional Zakat Management system be designed and developed?
- IV. What is the performance of the developed Zakat Management System?

1.5. Justification

The outcome of this research will result in a system that centralizes and organizes zakat collection and distribution. The system will enable mainstream Muslim organizations like SUPKEM to better play their role of dispensing of zakat within the community, thus moving closer to the goal of poverty eradication.

Furthermore, the creation of a Zakat management system means that the very poor and disadvantaged in the community will be able to reliably access Zakat thereby improving their lives and preserving their human dignity.

Zakat is also closely tied into the Sustainable Development Goals (SDGs) as of the 17 goals included. Specifically, goal one which is stated as “To end poverty in all its forms everywhere”,

goal two of zero poverty which is stated as “End hunger, achieve food security, improved nutrition and promote sustainable agriculture”, goal eight of decent work and economic growth, goal ten of reduced inequalities and goal eleven of sustainable cities and communities can all be helped if zakat management is fully leveraged (UNDP).

This research will impact social security policy at the governmental level if the proposed system is adopted successfully and is impactful.

The academic contribution of this research is how to counter economic disparity among populations.

1.6. Scope

This research focuses on a system that will centralize and organize zakat collection and distribution among Kenyan Muslims.

This research will be using systems for organizing Zakat and its management that are already in existence as a start off point for the proposed Zakat Management System.

Chapter 2: Literature Review

2.1. Overview

This chapter provides a review of literature relevant to achieve the aforementioned objectives. This includes analyzing the role zakat plays in poverty alleviation and evaluating the current methods used in Zakat Management Systems.

In addition, this chapter provides a description of the theoretical framework that forms the basis of the research.

2.2. Theoretical Framework

General Systems Theory proposed in 1936 by Ludwig Von Bertalanffy suggests that systems are open and in interaction with their environment and that viewing all the parts together as a single whole makes systems more effective (Cody, Adams, & Beling, 2020).

This view is what the researcher integrates into the proposed system, by unifying the different parts of the zakat management process into one proposed system that handles the givers, the process of distribution and the distribution of zakat.

Furthermore, automation refers to making processes operate in an automatic manner and Robotic Automation refers to applying technology using a computer in order to complete tasks and processes in the manner that a human would (Lerner, 2004).

The implementation of automation increases efficiency and saves time. This increases the general efficiency of a system enabling it to more easily meet its goals.

Having zakat management carried out minus the proper use of systems and automation results in a process that is inefficient. Data on the zakat process becomes difficult to gather and the process suffers from the lack of proper insights provided by data. Use of non-automated processes makes it hard to distribute the zakat and to decide how to

carry out the distribution. It also becomes difficult to measure the impact and progress that zakat has on the community over time.

It is based on this that the researcher seeks to design and develop the proposed system that will unify the various aspects of zakat and incorporate automation where applicable.

2.2.1. A brief history of zakat

Zakat was first collected by the prophet Muhammed (pbuh) upon the establishment of Islam in present day Medina. It was collected and treated separately from the other sources of state funds and it was distributed to the poor among the community. After the Prophet's death, zakat was enforced by his successors and maintained the same format wherein it was separated from other funds and distributed to the poor.

It was during the golden age of Islam that this centralized zakat system started experiencing growing pains of management at a time of no technological help (Aisyah & Ismail, 2019). Thus, decentralization of zakat as a way of enhancing management was born. In this new method, the state still enforced it but localized institutions were mandated to collect and distribute it within their localities. This is the method primarily in use today wherein Muslim majority countries have national zakat bodies along with private bodies that deal with zakat management, while Muslims in other parts of the world have far more informal systems to help them disburse their zakat obligation to the poor.

2.2.2. Zakat and Poverty

Seeing as zakat has a main goal of eventually eliminating extreme poverty and a number of zakat receivers are broadly classified as living in poverty, it is paramount that the term poverty be defined clearly.

Poverty is generally defined as not being able to meet the bare minimum of needs required to survive over time. World Bank (2020) defines poverty as living below \$1.90 a day with half of the worlds' poorest nations being in Africa.

Zakat helps to alleviate poverty by its design which forces wealth from the few and distributes it to the many. Also, setting up the zakat system involves creation of jobs for the zakat collectors who are entitled to the zakat. This goes into reducing poverty and making people more economically independent. Zakat could also be distributed in non-monetary forms such as giving tools of trade to skilled people. This encourages the poor to work and make themselves independent of the zakat eventually (Mian & Muhammad, 2014).

The use of zakat to encourage business engagement in the society is also one way in which poverty is controlled in a society. This is because a lack of sufficient business activity and entrepreneurial initiatives greatly contribute to poverty and restrict the flow of money in a society (Hoque, Khan, & Mohammad, 2015). By these applications, zakat is able to stimulate the economy and combat poverty in a sustained manner and should be utilized in an effective fashion.

2.2.3. Covid-19 and world poverty

The ongoing Covid-19 pandemic is expected to negatively affect economies across the world. According to the World Bank June 2020 report, poverty rates across the world are expected to rise for the first time since 1990 as a direct effect of the pandemic. The report further states that countries already struggling with high levels of poverty will be disproportionately affected by this increase.

Global GDP is projected to decline by 5.2%, with developing countries at particular risk. This report demonstrates clearly that there is a need, perhaps now more than ever, for societies to protect their vulnerable. Systemizing zakat collection and distributing

the collected funds equitably among those who need cushioning and assistance in this environment can help societies and economies reach this goal.

2.3 A review of existing Zakat Management Systems

There are several Zakat Management Systems that are in use across the world. They vary according to the particular countries that have adapted them and thus have different approaches to the problem of zakat collection and distribution. This research will be focusing on the management patterns of systems adopted in Malaysia, Kingdom of Saudi Arabia, Bahrain and Kuwait. The comparison will be on the following metrics: centralized or decentralized, governmentally controlled or left to the community, funds distributed locally or internationally (Muhammad, 2019).

2.3.3.1. Malaysia

In Malaysia, the government through provinces takes up zakat known as states that have the right to collect and distribute zakat. The main state collects zakat from organizations as well as from individuals.

2.3.3.2. Kingdom of Saudi Arabia

Kingdom of Saudi Arabia has a Muslim population of 97% and collects zakat through the state. KSA mandates zakat on businesses and requires that said entities keep records of the zakat paid along with the compliance certificate issued. This is to increase transparency and to make auditing easier for the government. Although KSA imposes zakat, it has no clear consequence/punishment in the case of violation or evasion of zakat payment on the parts of organizations that meet the threshold of paying zakat.

2.3.3.3. Bahrain

Bahrain is a country in Asia and is one of the richest Muslim majority countries in the world. It has a high population of Muslims that is over 70% of the total population are

Muslim. In Bahrain Zakat is managed by the government through their ministry of Justice and Islamic Affairs. This is further subjected to external auditing. Bahrain mixes zakat funds with *Sadaqat* and only imposes zakat on gold and on savings to the exclusion of all other types of wealth that are subject to zakat.

Bahrain uses a mobile application that is government endorsed to support their zakat management efforts. This application allows the giver to calculate zakat owed and also accepts online payments.

2.3.3.4. Kuwait

Kuwait is similar to Bahrain in location and population of Muslims (over 70% Muslim). Kuwait also manages zakat at the governmental level with three ministries overseeing and administrating the funds. The Kuwaiti government, through Kuwait Zakat House, collects and distributes zakat, including gold, silver, shares and cash.

Their system allows for online payments and also allows the giver to choose who to donate to and what type of project to be affiliated with.

Problems: zakat is distributed mostly externally

2.4. Literature on Zakat Collection

The process of zakat starts with a Muslim seeking to know whether they are eligible to pay zakat. They usually approach a scholar for clarity or turn to online zakat calculators.

The problem with the latter is their simplistic nature that leave out other assets that might be liable for zakat and the limitation of the later is according to scholars (Mamouni, Marzak, & Al Haddad, 2016), like any resource, are scarce and cannot answer all queries at all times. Hence (Aljabr, Almousa, Bhutta, Alesmael, & Ilyas, An Expert System for Calculating Zakat in Islam, 2018) suggest the use of an expert system to help potential zakat payers get clarity on exactly what they should pay. They developed the expert system shell ES-Builder and had a knowledge base as the

backbone. The researchers heavily involved Islamic scholars when building out their knowledge base, frequently going back to the scholars whenever an anomaly of the zakat rules was found. They also used materials suggested to them by the scholars in order to fully understand the problem domain. Using an iterative process, they built the system in the ES-Builder using rules in the form of “if-else-then” type of statements. The system was tested and the results it gave matched the scholars’ response 100% of the time. The main limitation of this system is that it is based on the Hanbali Madhhab and does not cater to other major Sunni ideologies (Aljabr, Almousa, Bhutta, Alesmael, & Ilyas, An Expert System for Calculating Zakat in Islam, 2018).

(Rachman & Salam, 2018) point out that zakat management in general can benefit greatly from leveraging financial technology. The researchers state that user trust in the system is influenced by accountability and transparency, and that financial technology offers reporting capabilities making the process more transparent. Thus, increasing the amount of voluntary zakat collected.

2.5. Literature on Zakat Distribution

Zakat distribution is the bigger challenge in zakat management as it involves distributing funds in an equitable manner to a large non-homogeneous group of people with varying levels of need and urgency.

To tackle this problem, researchers have suggested and tested several solutions that are discussed below.

(Akbarizan, et al., 2018) suggest the use of Artificial Intelligence in the determination of zakat receivers. They state that the Bayesian Network method is most appropriate to determine eligibility of a person who asks for zakat assistance. The researchers carried out their study in Indonesia and observed that the zakat committee members manually

assess each application and that inevitably such assessments are subjective and time consuming.

The researchers first establish that Artificial Intelligence can be used to solve similar problems highlighting its use in the aforementioned zakat calculator and its use in creating expert systems for Hajj pilgrims, generally demonstrating that it can be used to solve somewhat complicated problems.

The researchers picked on Bayesian Network as it is both a probability and a graph theory. They used data mining as a method and pre-processed the data through data cleaning techniques in order to clarify the data. They used 1000 counts with 14 attributes and used the Bayesian network as classification. The researchers used a dataset split factor for modeling and they used the following parameters to determine performance: Accuracy, Precision, Recall and False Measure.

The research showed an accuracy rate of 93.24%. This is an impressive result that informs their suggestion that the Bayesian Network be adapted to solve the problem of zakat distribution.

Another solution to zakat distribution is suggested by (Maulana, Shofi, Rozy, & Agustin, 2017) is the use of Weight Product method as a Decision Support System. The researchers set weighting criteria using a subjective method in which the decision maker is the one to decide on the priority. The researchers then divided the criteria into two broad categories. The first category was on income and valuable belongings like home and car ownership. The second category was on dependents and whether or not the applicant was in charge of the dependents. The second category also paid attention to whether or not the applicant had actually filed out their application correctly and completely. The researchers proved that the Weight Product method actually gave out

a list of zakat receivers in order of urgency and thus proving that the system was capable of assisting the decision makers decide on who to give the zakat to.

Another matter that is deserving is the question of how to actually ensure the funds end up with the zakat receivers. (Yahaya & Ahmad, 2018) suggest the use of Mobile Banking as a solution to the aforementioned problem. They use a qualitative approach and state that there are currently, in Malaysia, three main ways of distributing zakat. These are: Cash, Bankers' Cheque and Internet Banking.

The researchers state that Mobile Banking solves the problem of zakat receivers needing to verify that they received help from the zakat funds when applying for financial assistance and that it also solves the problem of emergency. That is, when a zakat receiver requires urgent help the use of Mobile Banking can make it easier and simpler for them to get the assistance they need. The researchers say that Mobile Banking can be facilitated through the use of an application and through the use of notification SMS. The researchers argue that the use of Mobile Banking in this manner is a way to financially include the poor and that financial inclusion is a factor in eliminating poverty and opening up opportunities for the less fortunate.

An issue that is also relevant is the matter of finding the zakat receivers in the first place. (Sukmana, Lestiani, Anggraeni, & Soetarno, 2017) suggest the use of Social Society Approach to solve that problem. They state that the society should be involved in identifying members who are deserving of zakat as they are usually well aware of each other. This reduces the burden on the people in charge of sourcing for zakat receivers and of vetting them as well. It also reduces instances of fraud among the zakat receivers in which they attempt to deceive the system in some way.

The researchers also create a way for multiple zakat systems to communicate with each

other using a proxy database. They also employ Geographic Information System wherein they map the location of verified zakat receivers after accepting suggestions from the society. The researchers use the Citizen-to-Citizen (C2C) approach to help populate their database in real-time with validated information on the zakat receivers.

The researchers developed a system that was unique in that it allowed the zakat givers to directly choose who would receive the zakat while still managing to streamline the entire process of zakat management.

2.6. Gaps in the reviewed literature

The literature reviewed above offers the following solutions:

Table 1 Table 2.1. A tabular representation of the reviewed literature

SOLUTION	DOMAIN	PROBLEM IT TARGETS	LIMITATION
Expert system for zakat calculation	Zakat collection	Makes zakat answers accessible	Only focuses on the Hanafi madhab as explained above. (Aljabr, Almousa, Bhutta. Alesmael & Ilyas, 2018)
Financial Technology	Zakat management	Increase transparency in the process	Is not specific (Rachman & Salam, 2018)

Bayesian Network	Zakat distribution	Equitable distribution of zakat funds	A very specific setting was used (Akbarizan, et al., 2018)
Weight Product Method	Zakat distribution	Equitable distribution of zakat funds	Still relies on human factor (acts as a DSS) (Maulana, Shofi, Rozy, & Agustin, 2017)
Mobile Banking	Zakat distribution	Getting the funds to the zakat receivers	Requires zakat receivers to have a bank account
Social Society Approach	Zakat distribution	Gathering and vetting zakat receivers	Relies heavily on the societal input at the initial stage (Sukmana, Lestiani, Anggraeni, & Soetarno, 2017)

Source: (Lubis, Lubis, & Almaarif, 2019)

2.7. Conceptual Framework

The Zakat System will have an expert system calculator that the potential Zakat giver will interact with due to the complex nature of the zakat rules as seen above. It will accept input of potential zakat receivers from the society-to-society approach and allow registration of said receivers. It will then process this input and output a list of approved receivers.

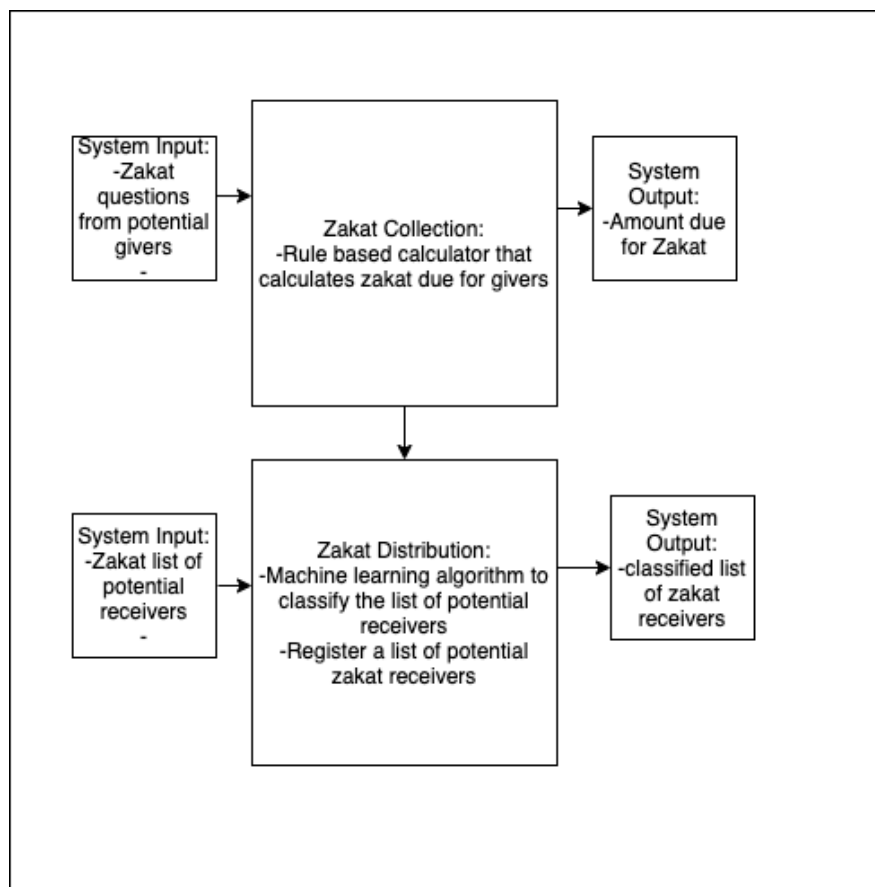


Fig 2.1. Conceptual Framework

2.8. Proposed Solution

The proposed solution intends to build on what is available by adding onto the available solutions and adapting to a Kenyan setting. The proposed solution will include the expert zakat calculator based on the Shafi'i Madhab which is the main one in East Africa. It will also use a machine learning algorithm to classify the zakat applicants into

two groups. In which one group is given the Zakat and the other eligible group will be placed in a waiting list



Chapter 3: Methodology

3.1. Overview

This chapter focuses on three main issues. The first, being the Software Development Methodology that was used to design and develop the proposed complete Zakat Management System collection system.

The second is a discussion of the research methodology that was employed to answer the research questions mentioned and discussed in the previous chapters.

The third part of this chapter will focus on research quality and ethical considerations of the research.

3.2. Research Design

The research used an exploratory research design in order to find important insights into the zakat collection and distribution processes that are already in use. This was so as to get a richer understanding of the technologies used in typical zakat management systems as well as the limitations associated with them. The core features found helped form a basis that can be extended for the proposed system to be developed.

3.3. System Development Methodology

The system was developed using agile development methodology specifically scrum based development. Agile methodology refers to a lean, lightweight and extremely iterative approach to developing software (Al-Zewairi, Biltawi, Etaiwi, & Shaout, 2017). The researcher used this methodology because it is best suited for systems that may experience a change in requirements over time and during development (Fustik, 2017). An Agile approach also allowed the proposed system to be extendable and reusable.

The Agile approach to software development involves six steps: Planning, Analysis, Design, Implementation, Testing and Maintenance. These steps occur in a highly iterative process and are not completely dependent on each other. This concept is illustrated in figure 3.1:



Fig 3.1. Insights to agile Methodologies for Software Development (P, n.d.)

3.3.1. Requirement Elicitation

This phase requires an understanding of the problems the proposed system seeks to solve by focusing on both the functional and non-functional requirements. These requirements have been solicited from the stakeholders. In this case, the stakeholders are broadly classified as zakat givers, zakat receivers and Zakat Kenya. Zakat Kenya will be representing the givers, receivers as well as play the role of religious organization. Interviews with major players in Zakat Kenya, including their council of scholars, and their partner organizations have been conducted to gather requirements.

Further, the researcher went through the existing zakat management systems in a critical manner seeking to understand how they work and their associated limitations. This was documented and used to identify any other requirements for the proposed system.

3.3.2. System Design Phase

Object Oriented Analysis and Design has been used as the system design technique because it boards well with the object-oriented approach that the researcher used. It also allows for faster development, reusable code and is easy to extend later on (Mukherjee, 2016).

The researcher used an object-oriented approach as fore mentioned to identify and to model all the parts of the proposed systems. Use cases of the system were used to understand how different actors interact with the system and the various relationships that come up. This will make clear any other flows and interactions. Further, a class diagram was used to illustrate the attributes and methods associated with each class of the proposed system and as well as relationships between the classes.

3.3.3. System Development

This researcher came up with a zakat management system that is web based and optimized for mobile in order to increase ease of use.

The researcher used the JavaScript programming language for the core system with JavaScript Object Notation (JSON) as the format for data transfer between the two platforms.

The researcher used a NoSQL database for management and storage of data.

3.3.4. Testing Phase

The system was tested to see if it meets the requirements gathered in the initial stage. The system was tested after each module was completed and after all the modules were completed. It was tested against the following standards:

3.3.4.1 Compatibility

The system was checked against different web browsers and across mobile operating systems. This was to ensure that the system works and that it offered a consistent User Experience across all platforms.

3.3.4.2 Load Testing

The system was checked and tested for time taken. It was tested to see how it fares under a large number of requests. Available tools were used to facilitate this test.

3.3.4.3 Unit Test

The system was checked as separate units to ensure that they work correctly at that level. The system was also tested after the modules were put together to confirm that it worked seamlessly together.

3.3.4.4 Validation

The system was tested against the researcher's intention of automating zakat collection and distribution. The researcher checked to see whether the system solves the problem intended without adding a layer of complexity. That is, the system was checked for ease of use in terms of user interface and user experience.

The researcher gathered feedback from the early adopters of the system to get insights on areas of improvement and on how effective the system truly is.

3.4. Target Population and Sampling

The target population for this research is the Muslim population in Kenya that qualifies to be zakat receivers and zakat givers as defined previously in this paper. The target includes the Muslim organizations that were identified as stakeholders in the proposed system. Data was collected from Zakat Kenya which translated to 149 records of zakat

applicants of which 71 were Approved and the rest were Not Approved.

3.5. Research Quality

Measuring the quality of research can take many forms and can be trans disciplinary. In this instance the researcher chooses to use the RQ+ framework as proposed and defined (Ofir, Schwandt, Duggan, & McLean, 2016) to measure the quality of this research. The RQ+ framework is based on the understanding that a quality assessment of research requires that elements/variables beyond research outputs be included along with the manner in which said research has been conducted. Details of this framework along with how it was used to measure this research quality are as discussed below:

3.5.1 Key Influences

Five influences are measured on a scale of 1 to 3, 1 being weak and 3 strong. The identified influences by the RQ+ framework are as follows:

3.5.1.1 Maturity of the research field

This refers to how established the area of this research is. The researcher rates this influence at 2 for emerging fields. This is because the field of Islamic finance and zakat management is still young, and the integration with technology is even younger.

3.5.1.2 Research capacity strengthening

This refers to the extent that research strengthens research capacities through support in overcoming challenges. The researcher rates this at 1 for low focus, as external support will be a low priority.

3.5.1.3. Risk in the research environment

This is in reference to the level of moral support offered to the researcher by the

organization within which the researcher operates. The researcher rates this at 2, that is, the research environment is supportive but not very established.

3.5.1.4. Risk in political environment

This refers to external risk associated with political factors. In this regard, the researcher considers the political environment to be somewhat stable and not likely to interfere with the research, and gives it a rating of 1 for low risk.

3.5.1.5 Risk in the data environment

This refers to the extent that data is available and agreed upon. The researcher found that data collection was problematic as the information and metrics were too top-level. Hence, the data environment was considered data poor.

3.5.2 Research quality dimensions

The RQ+ framework has identified four main quality dimensions that are interrelated and may be used to measure the quality of research. They are as discussed below:

3.5.2.1 Research Integrity

This refers to the technical quality and thoroughness of the research in light of acceptable standards. This also includes peer review.

The researcher conducted research that was technically sound and adhered to scientific and empirical standards. The researcher also ensured that the research establishes a clear relationship between evidence used and conclusions reached.

3.5.2.2. Research legitimacy

This refers to a process that considers all stakeholders in the research hence making the research a valid one whose conclusions are acceptable.

The researcher carried out legitimate research that is considerate of local customs and that incorporates knowledge of the research domain.

3.5.2.3. Research importance

This refers to the relevance of research and research contributions. This research seeks to address a relevant and important matter of poverty reduction through leveraging and systemizing zakat collection and distribution among the Muslim community.

3.5.2.4. Positions for use

This refers to the extent that research can be used, be influencing and be more impactful. This can be helped through managing the research process and careful use of variables and outputs. This quality dimension suggests the involvement of end users in the research process itself in order to increase chances of the research being used at a micro level.

The researcher involved the relevant community and their leaders in the research process as part of gathering requirements and prototyping of the proposed system.

3.6. Ethical Considerations

Ethics and ethical considerations are an important part of software development as software developed without a sense of ethics could be potentially harmful (Karim, Al Ammar, & Aziz, 2017).

The researcher followed the following principles (ACM/IEEE-CS Joint Task Force) in order to operate within an ethical framework:

3.6.1 Public Interest

This principle states that software development should be done with the public interest in mind. The researcher did that.

3.6.2. Client and Employer

This principle states that all software development should be carried out with the clients' and employers' best interests in mind. This should not be in contradiction to principle one above. The researcher created a body of work that has the clients', in this case the society, best interests at heart.

3.6.3. Product

This principle holds that products developed should meet the highest standards. The researcher thoroughly tested the proposed system to ensure that it meets the expected standards.

3.6.4. Judgment

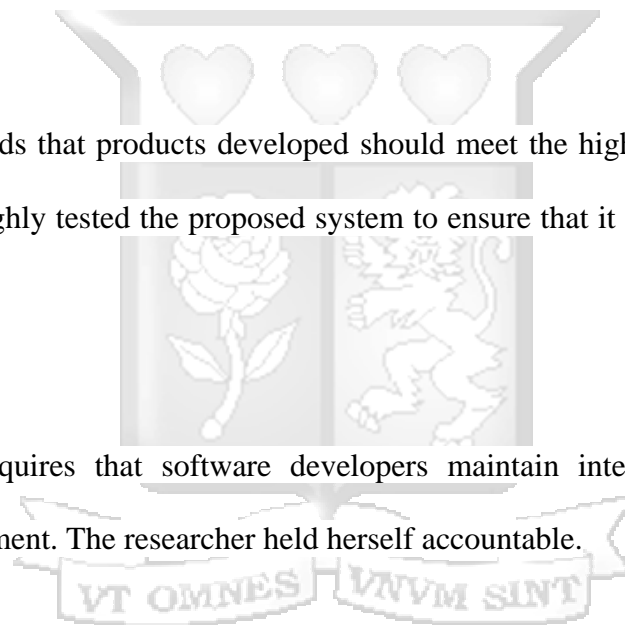
This principle requires that software developers maintain integrity and practice professional judgment. The researcher held herself accountable.

3.6.5. Management

That software developer should approach the development process from an ethical standpoint and should weave this into the management process. This is an approach that the researcher incorporated.

3.6.6. Profession

That software developers consider that they are agents in the reputation of the development field and should carry themselves as such. This should be consistent with public interest



3.6.7 Colleagues

That software developers should be just, fair and supportive to each other. The researcher was fair and supportive to all the entities that took part in the research.

3.6.8 Self

That software developers should engage in continuous learning in order to improve on the products they develop and to improve their knowledge in this domain. The researcher was very intentional about taking advantage of all learning opportunities that may arise during this research.



Chapter 4: System Analysis, Design and Architecture

4.1. Overview

This chapter deals with the analysis, design and general architecture of the proposed system. The details are discussed including the technologies used and simplified wireframes of the proposed system are included.

4.2. System Analysis

System analysis is the process of examining the as-is system in order to understand the problem domain and to find ways to better it. System analysis was important for this research because it enables the researcher to gain a deeper understanding of existing Zakat systems and to identify ways to better them.

4.2.1. Requirement Gathering

The requirements for the proposed system come from the literature review and from studying the zakat process. This was supplemented with interviews with subject matter experts at Zakat Kenya and their associated partner organizations.

4.2.2. Functional Requirements

The system should have the following key functionalities:

- I. It should allow zakat givers to calculate Zakat
- II. It should allow the administrator to register a list of potential Zakat receivers.
- III. It should sort and output a list of Zakat receivers.
- IV. It should support the Swahili language.
- V. It should be API ready.

4.2.3. Non-Functional Requirements

Non-functional requirements refer to extras that the system should do but that are not critical to the system. That is, the system can work with or without them.

The proposed system is projected to have the following non-functional requirements:

- I. Security: The system should allow only authenticated and authorized users to access protected resources.
- II. Reliability: The system should perform its function as expected at all times.
- III. Performance: The system should be fast and should work under heavy load.
- IV. Usability: The system should be easy to use and to navigate.
- V. Extensible: The system should allow integration with third-party systems and APIs.

4.3. System Architecture

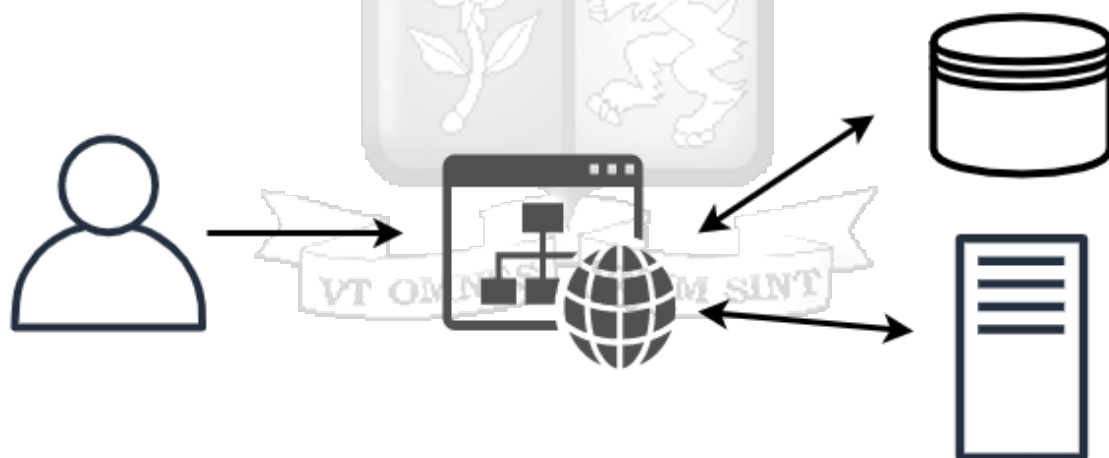


Fig 4.1. System Architecture

The user interacts with a web-based client which, in turn, interacts with the database and the backend server.

4.4. System Design

System Design is the process of defining parts of a system that make up the whole such as the architecture, components, related modules and how they interface with each other.

This research used the Object-Oriented System Analysis and Design (OOSAD) as discussed in chapter three above.

4.4.1. Use Case Diagram

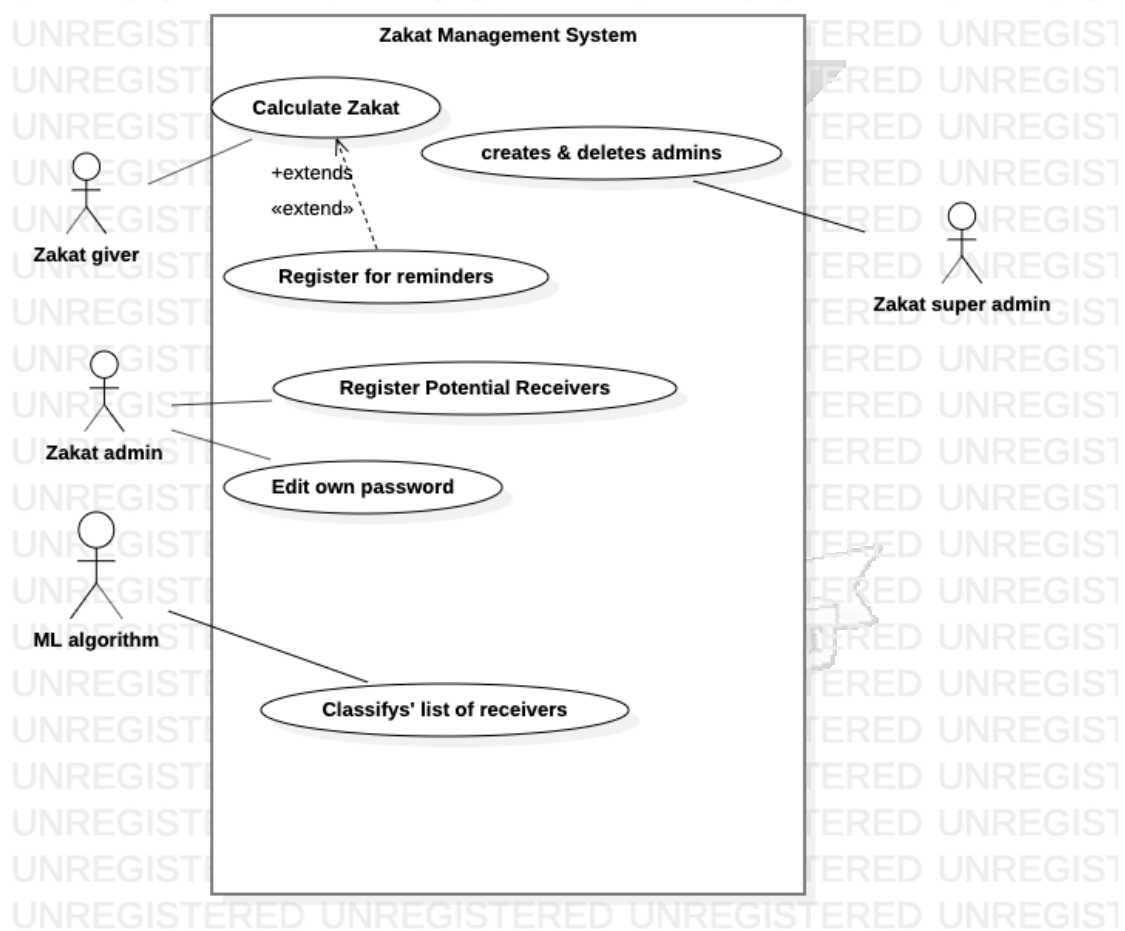


Fig 4.2. Use Case Diagram

4.4.2. Sequence Diagram

Fig. 4.3 below shows the interaction of the identified actors with the system in a sequential manner.

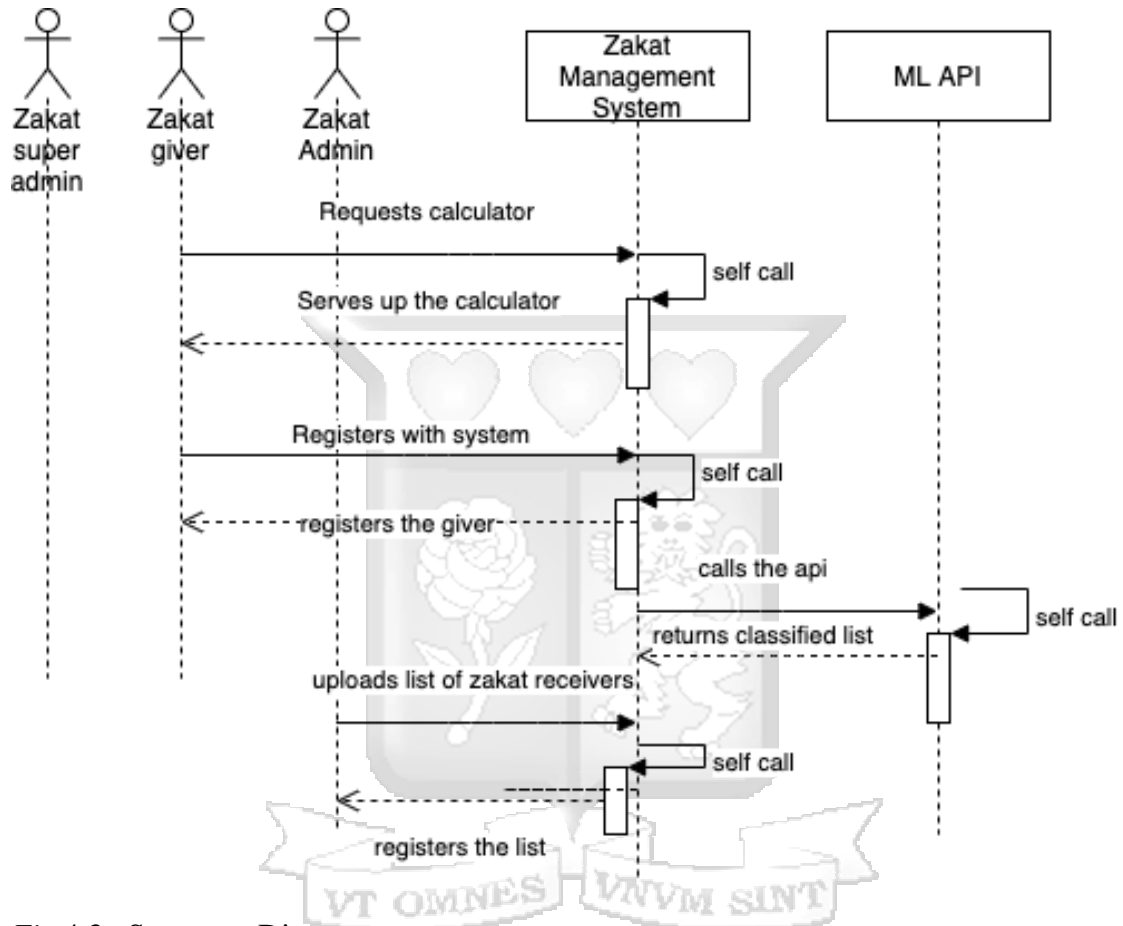


Fig 4.3. Sequence Diagram

4.4.3. Class Diagram

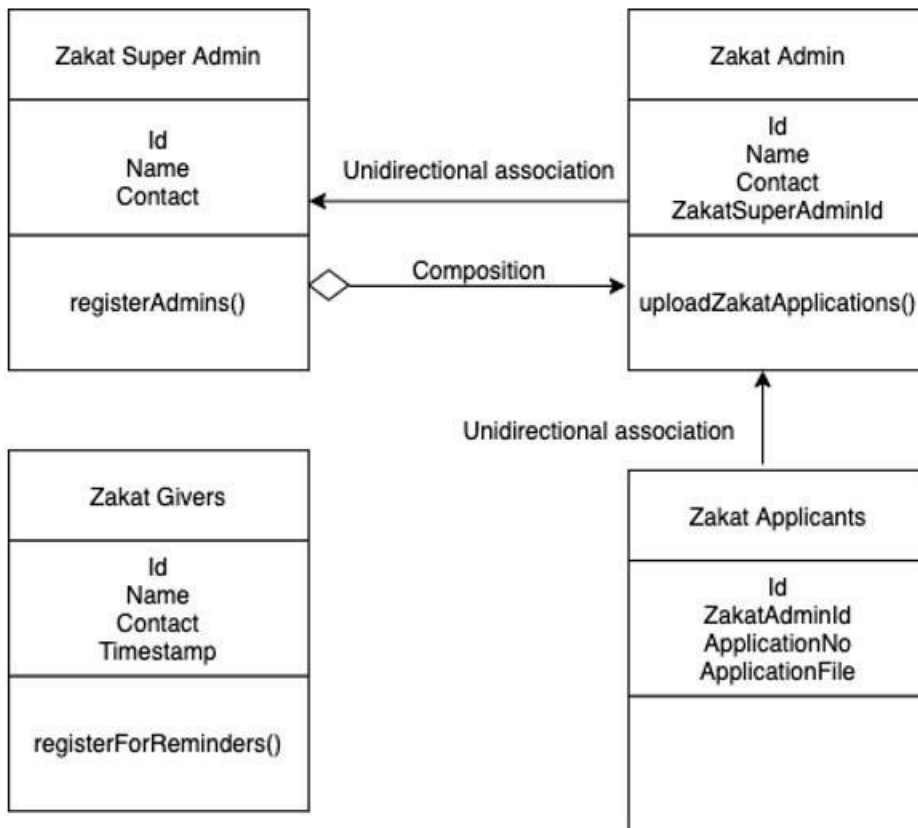


Fig 4.4. Class Diagram



4.4.5. Data Flow Diagram

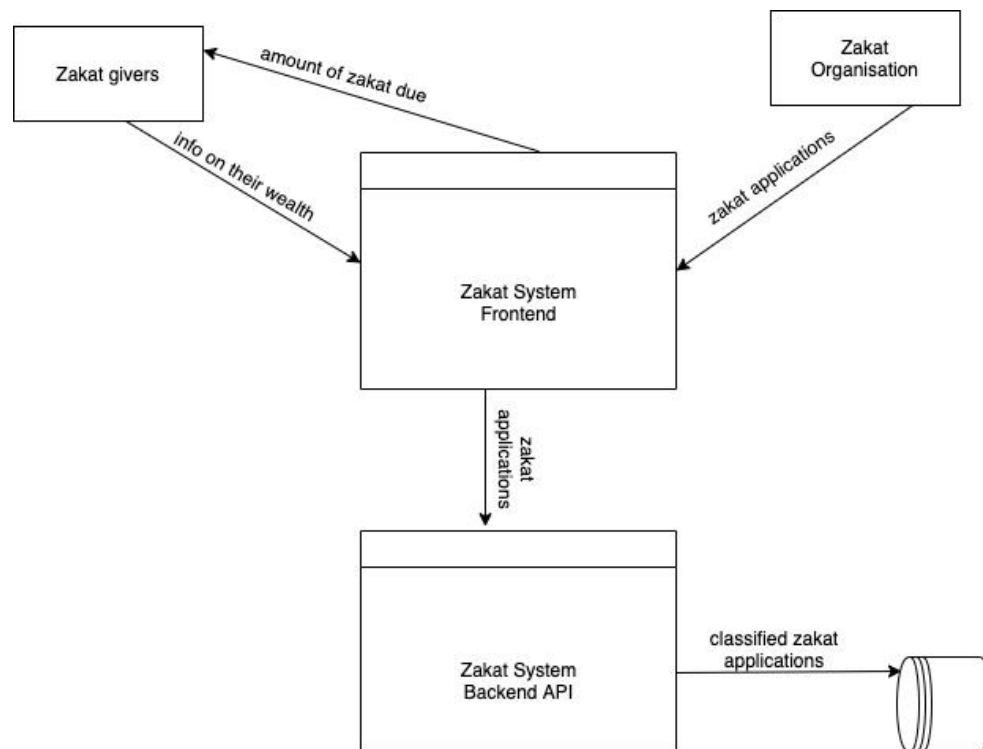


Fig 4.5. Data Flow Diagram



4.4.6. Entity Relationship Diagram

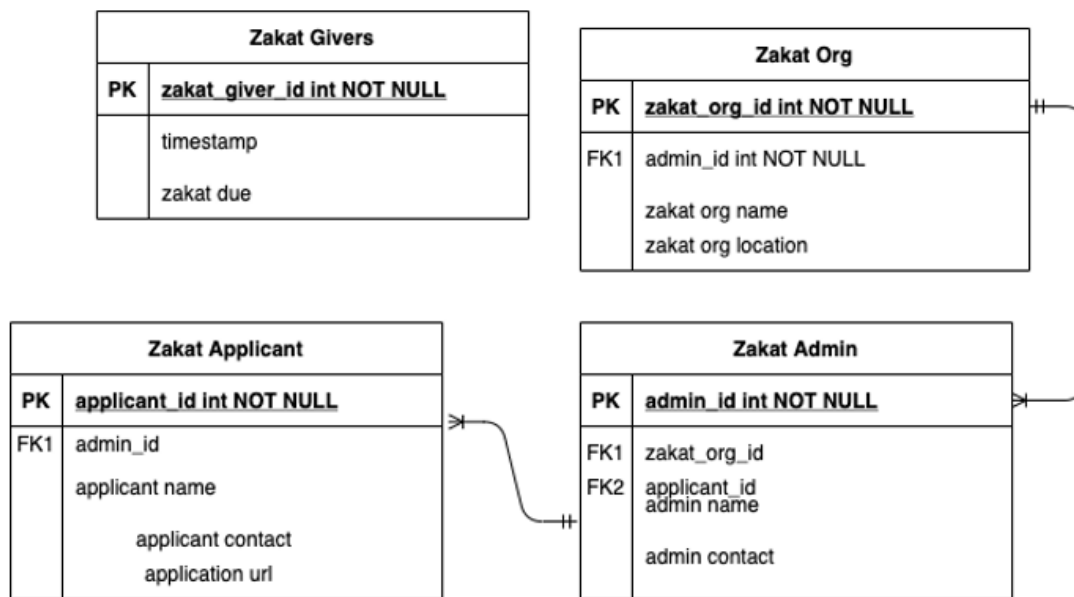
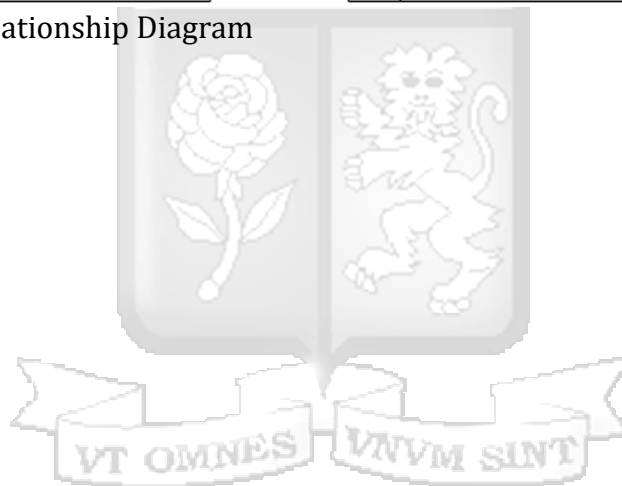


Fig 4.6. Entity Relationship Diagram



4.4.7. Wireframes

HOME SIGNIN SIGNUP ADMIN

Calculate Your Zakat

Choose Your Wealth Category

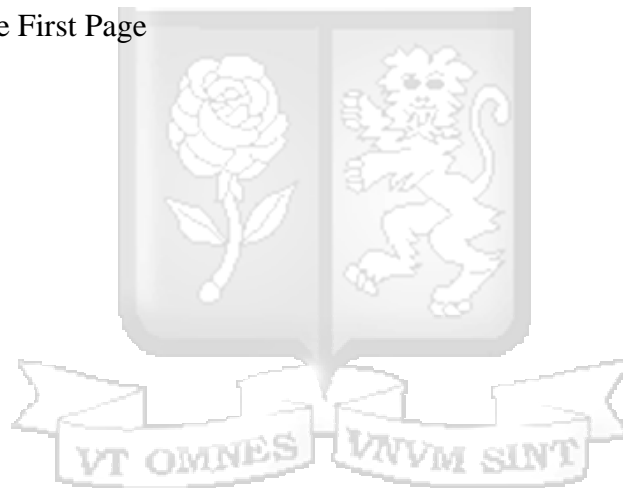
Gold Silver Cash

Livestock Agricultural Produce Grains & Dried Fruits

Sea Wealth Merchandise Goods Business Or Trade

Burried Treasure

Fig 4.7. Wireframe First Page



Calculate Your Zakat

Choose Your Wealth Category

- Gold
- Silver
- Cash
- Livestock
- Agricultural Produce
- Grains & Dried Fruits
- Sea Wealth
- Merchandise Goods
- Business Or Trade
- Burried Treasure

Have you had the gold for a full lunar year?

- Yes
- No

Have you had the cash for a full lunar year?

- Yes
- No

CALCULATE ZAKAT

Fig 4.8. Wireframe Conditional Logic

Zakat Due

Monetary Zakat Due:

144119.87200000003

Fig 4.9. Wireframe Calculation Results

Chapter 5: System Implementation and Testing

5.1. Overview

This chapter deals with the implementation and testing of the proposed system. The details discussed include how the system was actually built, tested and deployed. This section will focus on the machine learning model used to meet the use case of classifying zakat applicants as per chapter 4 above.

5.2. System Implementation

The proposed system contains two main parts, that is the smart zakat calculator that is governed by IF-ELSE statements and the machine learning model used to classify zakat applicants.

The smart calculator was implemented through the use of a user facing form and a series of if-else statements that matched the input received. It then displayed the results to the user.

The zakat calculations were based on codified rules that define exactly what categories of wealth are considered, what the threshold is and what percentage or exact figure are considered Zakat. These rules were interpreted with the help of a book (al-Sadlaan) and with the help of the team at Zakat Kenya.

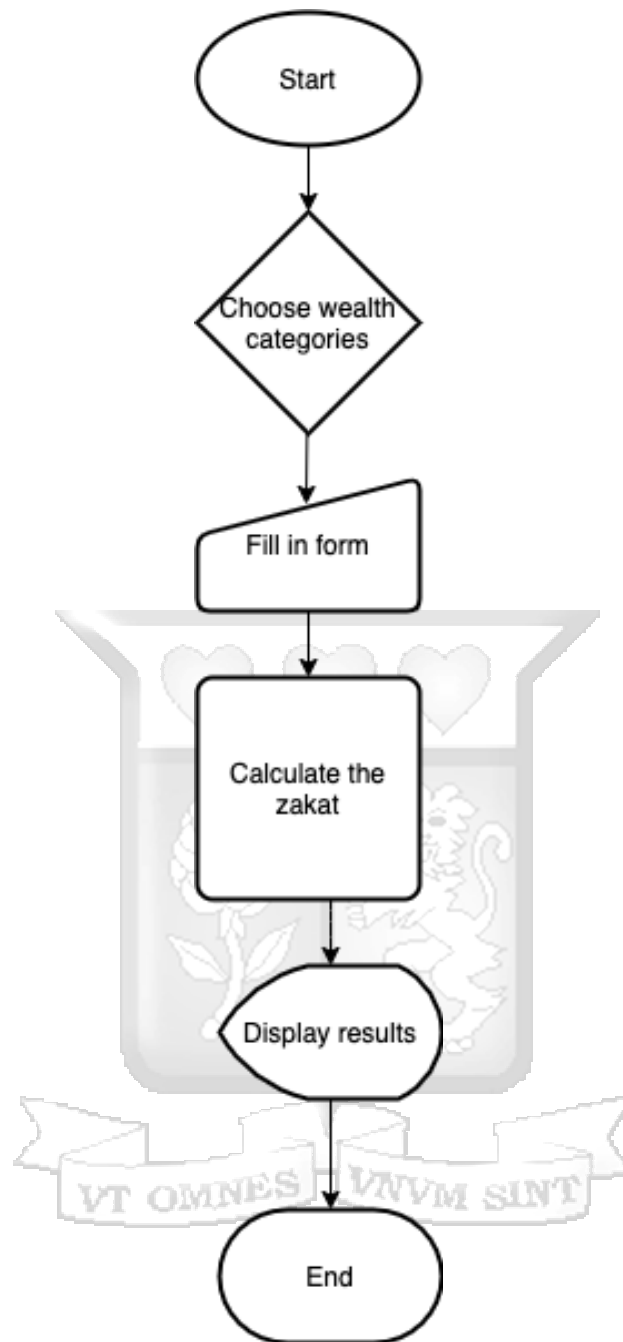


Fig 5.1. Flow chart representing the Zakat rules Form

This was built using ReactJS and included client-side validation as part of the web application that illustrates the entire system flow.

The system also had a /admin URL that was protected and required authorization to access. This allowed an admin to upload files pertaining to zakat applications received.

This was implemented using Google's Firebase Auth service.

For the remaining part that required machine learning, the researcher gathered data from Zakat Kenya (Appendix A) that pertains to records of zakat applicants that indicated which applicant was given the zakat funds and which was put on a waiting list.

The data consisted of 149 Zakat applicants, of which 71 Zakat applicants were approved. The researcher, in collaboration with a Zakat Kenya representative, identified 17 fields from the application form that would be used as features.

The study used Python and corresponding python libraries to conduct exploratory analysis of the said data.

The first step was to import the Pandas library in order to load the data and start preparing it. The code snippet and the corresponding output when checking for null values and general information on the dataset is shown below:

```

Age Religion Marital Status Are you currently employed? ... Are you disabled? Reason for application Is first application? is Approved?
0 40 ISLAM W N ... N BUSINESS Y Y
1 27 ISLAM S N ... N BUSINESS Y Y
2 54 ISLAM W N ... N BILLS Y Y
3 58 ISLAM NaN NaN ... N BUSINESS Y Y
4 35 ISLAM M Y ... N BILLS, HEALTH Y Y
.. ..
122 35 ISLAM M N ... N HEALTH N N
123 32 ISLAM M SELF EMPLOYED ... N EDUCATION N NaN
124 28 ISLAM S N ... N EDUCATION N N
125 49 ISLAM S N ... N EDUCATION N N
126 32 ISLAM M N ... NaN BUSINESS N N

[127 rows x 16 columns]
['Age' 'Religion' 'Marital Status' 'Are you currently employed?'
 'Do you own property?' 'Gold owned' 'Silver Owned' 'Have a bank account?'
 'Cash in hand' 'Money owed' 'Your income' 'Total monthly expenses'
 'Are you disabled?' 'Reason for application' 'Is first application?'
 'is Approved?']

```

Fig 5.2. Screenshot showing information on dataset

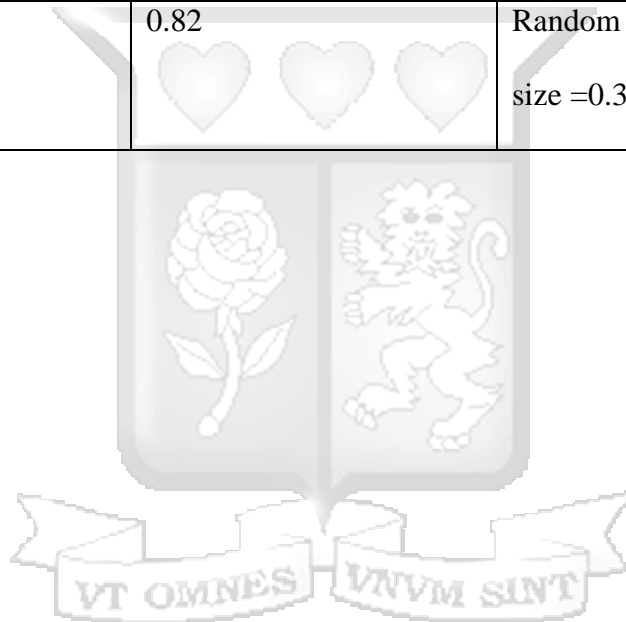
The researcher then had to drop columns that had over 70% null values and convert the categorical features seen above into numerical features.

After preprocessing and cleaning the dataset, the researcher trained several models and the documented results are as below:

Table 5.1. Results from various Machine Learning Algorithms

Algorithm Name	Accuracy Score	Other Comments
Gaussian Naïve Bayes	0.82	Random state of 42

Logistic Regression	0.82	Random state of 42
KNN classifier	0.92	Random state of 0, K=3, test-size = 0.2
Random Forest	0.74	Random state of 42, n_estimators = 100, test- size =0.3
Decision Trees	0.77	Random state of 42, test- size =0.3
SVM	0.82	Random state of 42, test- size =0.3



Code segments are as below:

```

X = df.iloc[:, [0,17]].values
y = df.iloc[:, 18].values

x_train, x_test,y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 0)
# Initialize our classifier
model = KNeighborsClassifier()
score = cross_val_score(model, X, y, cv=10, scoring = 'accuracy')
print(score)
# Train our classifier
model.fit(x_train, y_train)

predictions = model.predict(x_test)
#List Hyperparameters that we want to tune.
leaf_size = list(range(1,50))
n_neighbors = list(range(1,30))
p=[1,2]
#Convert to dictionary
hyperparameters = dict(leaf_size=leaf_size, n_neighbors=n_neighbors, p=p)

#Use GridSearch
clf = GridSearchCV(model, hyperparameters, cv=10)
#Fit the model
best_model = clf.fit(x_train,y_train)

#Print The value of best Hyperparameters
print('Best leaf_size:', best_model.best_estimator_.get_params()['leaf_size'])
print('Best p:', best_model.best_estimator_.get_params()['p'])
print('Best n_neighbors:', best_model.best_estimator_.get_params()['n_neighbors'])
print('Best score:', best_model.best_score_)

# print(preds)
print('The classification report is:\n ', classification_report(y_test, predictions))

```

Fig 5.3. Code snippet relating to the algorithm used

The classification report is as shown below:

```

_warn_print(average, modifier, msg_start, len(result))
The classification report is:

```

	precision	recall	f1-score	support
0	0.92	1.00	0.96	24
1	0.00	0.00	0.00	2
accuracy			0.92	26
macro avg	0.46	0.50	0.48	26
weighted avg	0.85	0.92	0.89	26

Fig 5.4. Classification report

Therefore, the researcher went ahead with K Nearest Neighbors and exported the trained model for easier use in the overall system.

5.3. System Testing

The researcher exported the model and turned it into an Application Programming Interface using the python web framework called Flask. The API was tested using postman and was able to send back predictions.

The following screenshot illustrate this:

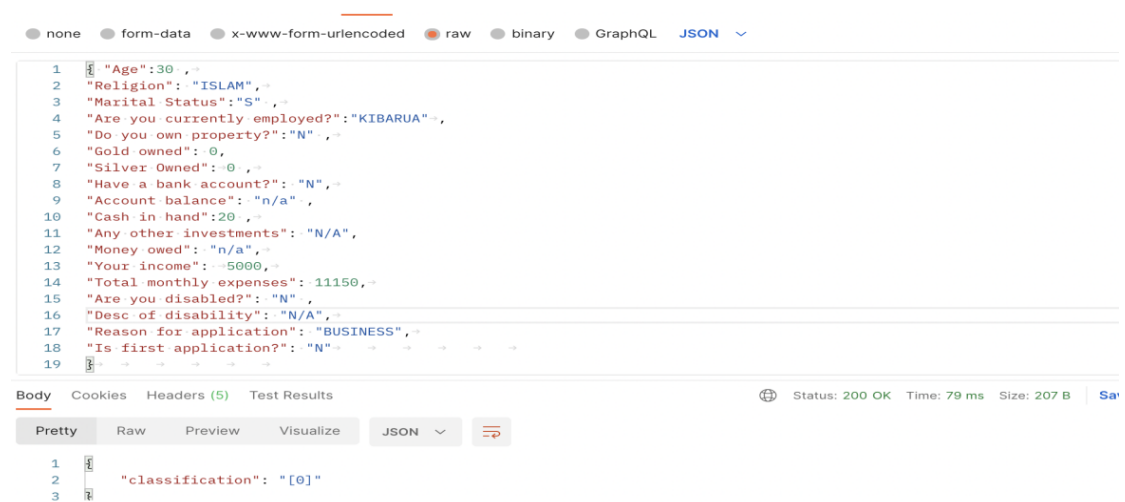


Fig 5.5. Screenshot of API made from the generated model

In the case that the data passed to the API is in the wrong format, the following error is sent back:

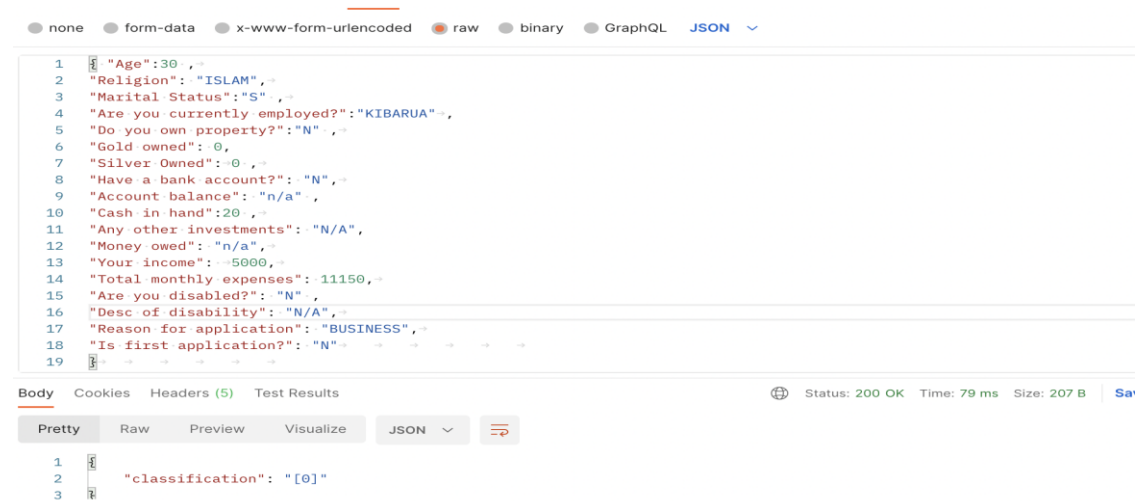


Fig 5.6. Error messages returned when testing the API

5.4. System Deployment/Validation

The Flask based API was deployed to Heroku, which is a platform as a service tool that allows quick deployment and monitoring of web applications, allowing the model to be consumed from any client application.

The API worked as expected as shown below:



```
1 {"Age":30 , ,
2 "Religion": "ISLAM", ,
3 "Marital Status":"S" , ,
4 "Are you currently employed?":"KIBARUA" , ,
5 "Do you own property?":"N" , ,
6 "Gold owned": 0 ,
7 "Silver Owned": 0 , ,
8 "Have a bank account?": "N" , ,
9 "Account balance": "n/a" , ,
10 "Cash in hand":20 , ,
11 "Any other investments": "N/A" ,
12 "Money owed": "n/a" , ,
13 "Your income": -5000 , ,
14 "Total monthly expenses": 11150 , ,
15 "Are you disabled?": "N" , ,
16 "Desc of disability": "N/A" , ,
17 "Reason for application": "BUSINESS" , ,
18 "Is first application?": "N" , ,
19 }
```

Body Cookies Headers (5) Test Results Status: 200 OK Time: 79 ms Size: 207 B Sa

Pretty Raw Preview Visualize JSON

```
1 {"classification": []}
2
3
```

Fig 5.7. Results from the API



Chapter 6: Results and Discussions

6.1. Overview

This chapter discusses, in depth, the results of the model built in chapter 5. It focusses on explaining what the results mean using different metrics and what those metrics mean as well. This chapter also ties together the model built and its performance to what has been found in literature, essentially discussing the models' strengths and areas of further improvement.

6.2. Model Precision Results

The model was trained and tested on a dataset of 149 records containing two classes of Approved and Not Approved. 78 records fell under the later class and 71 records fell under the former class. The dataset was balanced and the K- Nearest Neighbors algorithm was used to train it. This was because the other classification algorithms such as Naïve Bayes performed at an average of 0.82 compared to knns' 0.92 accuracy score as discussed in chapter 5 above.

The recall score is also known as sensitivity refers to the percentage of relevant instances that were retrieved from the dataset. It is calculated by $TP / (TP + FP)$, where TP refers to True Positives and FP refers to False Positives (Carson, Leach, & Murphy, 2018).

The precision score is also known as Positive Predictive Value (PPV) and refers to the percentage of relevant instances among the retrieved instances. It is calculated by $TP / (TP + FN)$, where TP refers to True Positives and FN refers to False Negatives (Carson, Leach, & Murphy, 2018).

The support column in the referenced figure refers to the number of records in each class in the records reserved for testing by Sklearns' `train_test_split()` method.

According to the classification report generated through Sklearn's metrics module as at figure 5.8 above, the model had a recall score of 1.00 on class 0 which corresponds to the Not Approved class and a precision of 0.92 for the Approved class. This means that the model was able to correctly predict class No 100% of the time and class Yes 92% of the time.

The precision score of the model on class Not Approved was at 1.00 and class Approved is at 0.92. This means that out of the 100% correctly predicted class Not Approved, 100% of them were actually in class Not Approved and that out of the 100% correctly predicted class Approved, 92% were actually in class Approved.

Previous research focusing on solving the Zakat distribution problem using machine learning generally has higher accuracy rates and uses larger datasets. For example, this research (Akbarizan, et al., 2018) using Bayesian Network achieved an accuracy score of 95.95%. This research (Maulana, Shofi, Rozy, & Agustin, 2017) using weighted product method was able to correctly rank the applicants by priority.

The trained model the researcher built performs above average with an accuracy of 92% on a small dataset of 149 records compared with 95.95% of the previous researchers. This is promising and means that k – nearest neighbors can be a valid algorithm when applied to solve the given problem. The accuracy of the model can be further improved over time in production as it is trained on a larger dataset overtime.

Chapter 7: Conclusion and Recommendation

7.1. Conclusions

This chapter ties together the research objectives as outlined in chapter one above with what conclusions the researcher came to.

The objectives, in a summarized form, are: evaluation of role-played by Zakat in poverty alleviation, analyzing current methods used in the collection and distribution of Zakat and to design and develop a system that would help automate the entire process.

In the process of carrying out this research and in interactions with key players in Zakat Kenya, the study found that Zakat was more effective in reducing extreme poverty among the population when carried out in a systematic manner that ensured careful follow up with zakat receivers. This was in line with what the literature (Ariyani, 2016) and (Ayuniyyah, Pramanik, Saad, & Ariffin, 2018) revealed.

The research findings match with the literature in that the methods used by the population in paying their Zakat and by Zakat Kenya to distribute zakat involve a mix of the social society approach (Sukmana, Lestiani, Anggraeni, & Soetarno, 2017) and the weighted product method (Maulana, Shofi, Rozy, & Agustin, 2017).

The researcher found that Zakat Kenya was able to increase efficiency and experience better outcomes from utilizing their existing system that was a mix of paper based and digital techniques. Which was in line with the literature that stated that better systems led to better outcomes (Cody, Adams, & Beling, 2020)

The researcher, based on this research, concludes that proper management of Zakat has the potential to alleviate poverty in society.

The researcher also concludes that the current methods being employed to manage Zakat collection and distribution are different across the world, and that the methods

are more effective when Zakat processes are viewed as a whole and managed from that perspective.

7.2. Recommendations

The researchers' recommendations are as below:

- I. That the model generated as part of the system be further exposed and trained.
- II. That the relationship between Zakat and Poverty levels be more closely investigated.
- III. That the methods in use across the world be directly compared and that a unified blueprint be derived from them. This would be beneficial in further enabling the Zakat framework to fully participate in the fight against extreme poverty as per the SDGs.

7.3. Future Work

The researcher proposes that further development of the system be done, most especially to improve the machine learning model in use with it. The researcher also proposes that the smart calculator be decoupled from the current system developed in order to make the calculator more reusable and easier for independent applications and systems to consume it.

References

- Aisyah, S., & Ismail, N. (2019). The distribution of zakat at the time of caliph Umar ibn Khattab. *Al-Iktisab: Journal of Islamic Economic Law*.
- Akbarizan, Kurniawan, R., Nazri, M. Z., Sheikh Abdullah, S. N., Murhayati, S., & Nurcahaya. (2018). "Using Bayesian Network for Determining the Recipient of Zakat in BAZNAS Pekanbaru. *2nd International Conference on Electrical Engineering and Informatics (ICon EEI)*. IEEE.
- al-Sadlaan, D. S. (n.d.). *Fiqh Made Easy*. Riyadh, Saudi Arabia.
- Al-Zewairi, M., Biltawi, M., Etaawi, W., & Shaout, A. (2017). Agile software development methodologies: survey of surveys. *Journal of Computer and Communications*, 74.
- Aljabr, A. K., Almousa, A. M., Bhutta, M. N., Alesmael, M. W., & Ilyas, Q. M. (2018). An Expert System for Calculating Zakat in Islam. *3rd International Conference on Emerging Trends in Engineering, Sciences and Technology (ICEEST)*. IEEE.
- Aljabr, A. K., Almousa, A. M., Bhutta, M. N., Alesmael, M. W., & Ilyas, Q. M. (2018). An Expert System for Calculating Zakat in Islam. *3rd International Conference on Emerging Trends in Engineering, Sciences and Technology (ICEEST)*. IEEE.
- Ariyani, N. (2016). Zakat as a Sustainable and Effective Strategy for Poverty Alleviation: from the Perspective of a Multi-Dimensional Analysis. *International Journal of Zakat*, 88-106.

- Ayuniyyah, Q., Pramanik, A. H., Saad, N. M., & Ariffin, M. I. (2018). Zakat for poverty alleviation and income inequality reduction. *Journal of Islamic Monetary Economics and Finance*, 85-100.
- Carson, N., Leach, L., & Murphy, K. J. (2018). A re-examination of Montreal Cognitive Assessment (MoCA) cutoff scores. *International Journal of Geriatric Psychiatry*, 379 - 388.
- Cody, T., Adams, S., & Beling, P. (2020). Motivating a Systems Theory of AI. *INSIGHT*, 37-40.
- Fustik, V. (2017). The advantages of agile methodologies applied in the ICT development projects. *international Journal on Information Technologies & Security*, 51-62.
- Hafidhuddin, D., & Beik, I. S. (2019). Zakat Development: The Indonesia's Experience. *Al-Infaq: Jurnal Ekonomi Islam*.
- Hoque, N., Khan, M. A., & Mohammad, K. D. (2015). Poverty alleviation by Zakah in a transitional economy: a small business entrepreneurial framework. *Journal of Global Entrepreneurship Research*, 1-20.
- Karim, N. S., Al Ammar, F., & Aziz, R. (2017). Ethical software: Integrating code of ethics into software development life cycle. *international Conference on Computer and Applications (ICCA)*. IEEE.
- Lerner, V. S. (2004). Introduction to information systems theory: concepts, formalism and applications. *International Journal of Systems Science*, 404-424.
- Lubis, M., Lubis, A. R., & Almaarif, A. (2019). Comparison of the Approach in the Zakat Management System. *Journal of Physics: Conference Series*.

- Lubis, M., Lubis, A. R., & Almaarif, A. (2019). Comparison of the Approach in the Zakat Management System. *Journal of Physics: Conference Series. Vol. 1235. No. 1. IOP Publishing.*
- Lubis, M., Lubis, A., & Almaarif, A. (2019). Comparison of the Approach in the Zakat Management System. *Journal of Physics, 1235(1), 012048.*
- Mamouni, A., Marzak, A., & Al Haddad, Z. (2016). ZCMGProcess: ZCM-based process for the Zakat calculation models generation (ZCMGenerator a framework supporting this approach). *11th International Conference on Intelligent Systems: Theories and Applications (SITA). IEEE.*
- Maulana, H. O., Shofi, I., Rozy, N., & Agustin, F. E. (2017). Application for determining mustahiq based on the priority using weight product method (case study: BAZIS DKI Jakarta). *5th International Conference on Cyber and IT Service Management (CITSM). IEEE.*
- Mian, M. A., & Muhammad, A. (2014). Dynamic role of zakat in alleviating poverty: A case study of Pakistan.
- Muhammad, I. (2019). Analysis of Zakat System in High-Income Islamic Countries. *The Journal of Muamalat and Islamic Finance Research, 1-11.*
- Mukherjee, M. (2016). Object-Oriented Analysis and Design. *International Journal of Advanced Engineering and Management, 1-11.*
- Ofir, Z., Schwandt, T., Duggan, C., & McLean, R. (2016). Research Quality Plus (RQ+): a holistic approach to evaluating research.
- P, P. (n.d.). *insights-to-agile-methodologies-for-software-development*. Retrieved from experfy.com: www.experfy.com/blog/insights-to-agile-methodologies-for-software-development

- Rachman, M. A., & Salam, A. N. (2018). The Reinforcement of Zakat Management through Financial Technology Systems. *International Journal of Zakat*.
- Shaikh, S. A., & Ismail, A. (2017). Role of Zakat in Sustainable Development Goals. *International Journal of Zakat*, 1-9.
- Sukmana, H. T., Lestiani, D., Anggraeni, N., & Soetarno, D. (2017). The prototype of Zakat management system in Indonesia by using the social society approach: A case study. *5th International Conference on Cyber and IT Service Management (CITSM)*. IEEE.
- Weiss, H. (2020). Muslim NGOs, Zakat and the Provision of Social Welfare in Sub-Saharan Africa: An Introduction. *Muslim Faith-Based Organizations and Social Welfare in Africa.*, 1-38.
- Yahaya, M. H., & Ahmad, K. (2018). Financial Inclusion through Efficient Zakat Distribution for Poverty Alleviation in Malaysia: Using FinTech & Mobile Banking. *Proceeding of the 5th International Conference on Management and Muamalah*, 15-31.
- (n.d.). Retrieved from Merriam-Webster: <https://www.merriam-webster.com/dictionary/system>

Appendix A: Zakat Application Form

This is the application form filled in by the potential zakat receivers when applying for zakat through Zakat Kenya.



Application form for support

In the name of Allah, the most beneficent, the most merciful

About filling in this form

- Please use black ink to fill in the form.
- If you make a mistake, cross it out and put the right answer next to it.
- Answer 'Yes' or 'No' questions by ticking the relevant box.
- If you are picking an answer from a list of answers, put a tick in the relevant box.
- Please read all the information and notes in the form.
- Please use the checklist on page 10.
- Please provide photocopies – originals will not be returned.
- Your information and proof of documents must be correct and complete.
- Once completed, you can either scan and email or post the form to us; details can be found on page 10.
- Please note sending an incomplete application or omitting supporting documentation is likely to delay the process considerably.
- **PLEASE REMEMBER TO SIGN AND DATE THE DECLARATION.**

Processing the form and decision

If you have provided all the relevant and requested documentation, we may contact you by phone or home visit to request further information or clarification. Please respond to the queries that are sent to you.

What next?

Once we receive your application, you will be assigned a caseworker. You will be contacted by your caseworker for further queries. They will complete a case report that will be submitted to our Zakat panel who will determine eligibility and approve funds if applicable. We will then notify you about our decision.

Please note we DO NOT distribute cash payments to applicants. For example, our support may be in the form of food parcels or direct payments to creditors and/ or landlords where relevant.

**Part 1 – About you and your partner**

	You	Your Partner
Surname		
First name (s)		
I.D / Passport number		
Age		
Date of birth		
Religion		
Marital Status		
Ethnicity/ Tribe		
Area of origin		
How many years have you lived in the area		
Telephone Number (mobile)		
Are you currently employed?		
Do you own property?		
Please describe your type of housing		

**Part 2 – About any children who live with you**

Please provide proof of ID for all children listed below, in the form of a birth certificate or passport copy.

If no children live with you go to Part 3

	First Child	Second Child	Third Child	Fourth Child
Surname				
First name (s)				
Date of birth				
Age				
Gender				
Level of education & name of school				

Part 3 – About family members and /or dependents who live with you

	Person 1	Person 2	Person 3
Surname			
First name (s)			
Date of birth			
Gender			
Relationship to you			
Are you financially responsible for them			
Do they get an income (from employment, benefits etc)? Provide details.			

**Part 4 – Your Assets**

	You	Your Partner
Gold (in grams)		
Silver (in grams)		
Do you have a bank account	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
How many accounts do you have?		
Please provide balance for each account:		
• Bank account		
• Chama		
• Saccos		
Cash in Hand		
Any other investments		
Property (in addition to your home)		
Money owed to you by any third party debtor (if anyone owes you any money please also state when it is due to be paid)		

**Part 5 – Outstanding Debt** (Please provide all relevant documentation as evidence.)

	You	Your Partner
1. Chamas		
Name of chama		
1.		
2.		
3.		
2. Personal Debts		
Name of lender		
1.		
2.		
3.		
3. Other (please describe)		
Name of lender		
1.		
2.		
3.		
Total		



Part 6 – About your income

Application form for support

No income from any sources Tick Box

Please state the amount PER MONTH (figures should reflect reality of last 3 months)

	You	Your Partner
Employment income		
Self-employment income		
Other (please describe)		
TOTAL MONTHLY INCOME		

Part 7 – About your expenses (Please state the amount PER MONTH)

	You	Your Partner
Rent		
Mortgage		
Gas/ Kerosene/ Coal		
Electricity		
Water Rates		
Food		
Medical		
Education		
Loan repayment		
Baby/child related expenses		
Other (please describe)		
TOTAL MONTHLY EXPENSES		
Total Household income		



Part 8 – Have you applied to any other organisations for support?

Application form for support

Name of organisation	Case number & contact person	Amount of funding/ support requested

Part 9 – About any disabilities

	You	Your Partner
Are you disabled	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
Description of disability (please provide evidence)		

Part 10 – Referees (Please note referees cannot be family members. It is preferred if these references are from a professional e.g. your Imam, community leader e.t.c.)

	Referee 1	Referee 2
Name		
Address		
Postcode		
Telephone		
E-mail		
Relationship with applicant		
Number of years known to applicant		



Part 11 – Please explain your situation & how you would like Zakat Group to help you

Application form for support

How did you hear about Zakat Group?

Part 12 – Previous applications

Have you previously applied for support from Zakat? Yes No

If yes, please state the date of your application and your previous application number below.

Date of previous application	
Previous application number	

Please note you may only reapply on the basis of new or exceptional circumstances.



Declaration

I testify in front of Allah (SWT) that the information provided on this form is true and accurate to the best of my knowledge.

I testify that I am not submitting a fraudulent application and that I am genuinely in need of support.

I agree that the information provided in this application form will be utilised in connection with this request for Zakat.

I understand that my personal information will remain private and confidential and that any sharing of information will be limited for the purpose of processing my application. I also give my consent to Zakat to make reasonable enquiries relating to my application.

Should my application be successful then I consent to Zakat receiving and distributing Zakat funds on my behalf in a manner that the organisation sees fit and in line with the needs highlighted in my application.

	You	Your Partner
Name		
Signature		
Date		

MUST SIGN AND DATE APPLICATION OR APPLICATION WILL NOT BE PROCESSED.

Appendix B: Turn It in Report Screenshot

This is a screenshot of the plagiarism report on this document.



Document Information

Analyzed document	A Web Based Zakat Collection and Distribution System Using K-Nearest Neighbors.docx (D109940504)
Submitted	6/30/2021 11:18:00 AM
Submitted by	
Submitter email	Fatuma.Samatar@strathmore.edu
Similarity	8%
Analysis address	library.strath@analysis.orkund.com

Sources included in the report

W	URL: http://web2py.iit.ac.in/research_centres/publications/download/mastersthesi.pdf.8194795ed28cb795.4d535f5468657369735f5369646468617274685f46696e616c2e706466.pdf Fetched: 12/23/2020 12:26:51 PM	2
W	URL: https://su-plus.strathmore.edu/bitstream/handle/11071/6706/An%20Algorithm%20for%20inferring%20consumer-to-consumer%20trust%20on%20twitter.pdf?sequence=3&isAllowed=y Fetched: 4/26/2020 6:45:32 PM	2
W	URL: https://su-plus.strathmore.edu/bitstream/handle/11071/5980/Open%20source%20intelligence%20gathering%20for%20hate%20speech%20in%20Kenya.pdf?sequence=5&isAllowed=y Fetched: 1/17/2021 8:08:33 PM	2
W	URL: https://www.researchgate.net/publication/340375321_Financial_Inclusion_through_Efficient_Zakat_Distribution_for_Poverty_Alleviation_in_Malaysia_Using_FinTech_Mobile_Banking Fetched: 6/30/2021 11:19:00 AM	3
W	URL: http://e-journal.iainpekalongan.ac.id/index.php/IJIBEC/article/view/3067 Fetched: 6/30/2021 11:19:00 AM	3
W	URL: https://www.researchgate.net/publication/327896884_Model_of_receipt_and_distribution_of_zakat_funds_information_system Fetched: 5/25/2020 5:01:04 AM	2
W	URL: http://jimf-bi.org/index.php/JIMF/article/view/1122 Fetched: 6/30/2021 11:19:00 AM	2
W	URL: https://journal.umy.ac.id/index.php/ijief/article/download/9029/5610 Fetched: 6/30/2021 11:19:00 AM	1
W	URL: https://www.revue-isg.com/index.php/home/article/download/500/465/1838 Fetched: 6/30/2021 11:19:00 AM	1
W	URL: https://www.researchgate.net/publication/271843308_Ontology_of_Zakat_Management_System Fetched: 6/30/2021 11:19:00 AM	1

Appendix C: Ethical Certificate



12th October 2021

Ms Samatar Fatuma A,
fatuma.samatar@strathmore.edu

Dear Samatar,

RE: A Web Based Zakat Collection and Distribution System Using Bayesian Networks

This is to inform you that SU-IERC has reviewed and **approved** your above **SU-master's** research proposal. Your application reference number is **SU-IERC0948/20**. The approval period is **12th October 2021 to 11th October 2022**.

This approval is subject to compliance with the following requirements:

- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
- iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 48 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 48 hours
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

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

Yours sincerely,

for: Prof Fred Were,
Chairperson; SU-IERC



Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu