



ASHESI UNIVERSITY

**A CREDIT SCORING SYSTEM FOR MOBILE MONEY USERS:
A CASE STUDY OF BEREKUSO, GHANA**

UNDERGRADUATE THESIS

B.Sc. Computer Science

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UNDERGRADUATE THESIS

Thesis submitted to the Department of Computer Science,
Ashesi University in partial fulfillment of the requirements
for the award of Bachelor of Science degree in Computer
Science

Viola Cheptanui Melly

May 2020

DECLARATION

I hereby declare that this Undergraduate Thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:

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Candidate's Name:

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Date:

.....

I hereby declare that preparation and presentation of this Undergraduate Thesis were supervised in accordance with the guidelines on supervision of Undergraduate Thesis laid down by Ashesi University.

Supervisor's Signature:

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Date:

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Abstract

An estimated five billion people in the world own a mobile phone [11]. Among these people, an estimated four hundred and fifty-six million people are from Africa, with eight million people being from Ghana [11]. The high number of mobile phone owners shows the importance attached to the use of mobile phones. The curiosity and the availability of resources to develop new applications have led developers to come up with new and innovative ways that go beyond the primary intention for which the phone was created: communicating with one another. One such innovation is the development of mobile money services [17]. This research seeks to find out how effective a credit scoring system would be in addressing the non-payment of loans by the customers of service providers. It proposes an online platform that provides users with financially related information and a credit scoring system that can help both lenders and borrowers check the creditworthiness of an individual before they get access to loans.

Table of Contents

DECLARATION.....	i
Acknowledgment.....	ii
Abstract.....	iii
Chapter 1: Introduction and Background.....	1
Chapter 2: Related Literature.....	3
Chapter 3: Methodology.....	6
3.1. Introduction.....	6
3.2 Research Question Definition.....	6
3.3 Research Approach.....	6
3.4 Selection of Samples.....	7
3.5 Data Collection.....	7
3.5.1 Guided interviews.....	7
3.5.2 Questionnaires.....	8
3.6 Data Analysis.....	8
Chapter 4: Implementation and Analysis.....	9
4.0 Introduction.....	9
4.1 Data Collection.....	10
4.2 Findings.....	12
4.2.0 Mobile Phone usage.....	12
4.2.1 Mobile money usage.....	13
4.2.2 Payment of mobile money loans.....	14

4.2.3 Need for a credit scoring system.....	15
4.3 System Implementation.....	16
4.3.1 System architecture.....	16
4.3.2 Implementation Resources.....	18
4.3.3 Implementation.....	18
Chapter 5: Conclusion and Future Work.....	19
5.1 Summary.....	19
5.2 Limitations.....	20
5.3 Suggestions for Future Work.....	21
References.....	22

List of Figures

4.1 Gender of the participants.....	10
4.2 Level of education of the participants.....	10
4.3 Marital status of the participants.....	11
4.4 Service providers used by the interviewees.....	11
4.5 Loans acquired from service providers by participants.....	12
4.6 Phone ownership among the participants.....	13
4.7 Ownership of a mobile wallet by the participants.....	14
4.8 System architecture.....	17

Chapter 1: Introduction and Background

An estimated five billion people in the world own a mobile phone [11]. Among these people, an estimated four hundred and fifty-six million people are from Africa, with eight million people being from Ghana [11]. The high number of mobile phone owners shows the importance attached to the use of mobile phones. This importance has prompted developers and inventors of mobile phone applications to find new and innovative ways in which services can be rendered to the mobile phone users with ease [4]. The curiosity and the availability of resources to develop new applications have led developers to come up with new and innovative ways that go beyond the primary intention for which the phone was created: communicating with one another. One such innovation is the development of mobile money services [17].

Mobile money services involve the process of providing an avenue in which financial transactions can be conducted with ease, using a mobile phone [5]. Mobile money services have revolutionized banking for the unbanked, especially in developing countries[16]. A lot of mobile service providers are continuously finding new ways in which they can be ahead of the competition when it comes to the provision of mobile money services [24]. The use of mobile money has been very successful in African countries, especially within the unbanked as it provides an easy way to transact without the need to have a bank account [16, 2]. An example of such a significant and powerful mobile money service platform is M-pesa, a mobile money service platform in Kenya that is changing the way people transfer goods and services between themselves [25].

Ghana has not been left behind when it comes to the adoption of this technology; it is considered the fastest-growing mobile money market in Africa [22]. It is not surprising as mobile

money brings many benefits to the users that were not there before. Among the many benefits of the emergence of mobile money services is the development of mobile money loans [1]. Mobile money loans are the services of lending money by one individual or institution to another person through the use of mobile phones. The person requesting a loan usually has to create an account mostly referred to as a mobile money wallet in which the money is sent to when the loan is approved and uses the same wallet to pay back the loan [10].

Mobile money loans have been great tools in helping people get easy access to loans; this has been especially very useful to the poor people and the unbanked [2]. Many lenders have come up, and it is effortless for anyone to get a loan sent directly to their phone [16]. Although mobile money loans make it effortless in accessing loans, it has encouraged overborrowing. Overborrowing has also encouraged people to participate in betting activities with the hope of getting more money [2]. It can affect the need to save and have a secure source of money, especially when it comes to dealing with unforeseen circumstances like emergency health payments or the death of a loved one.

The presence of a lot of mobile money loan providers, which makes it easy for people to access loans, has also resulted in situations where customers over-borrow from the loan providers and fail to pay them back as they feel they have more avenues to get loans [2]. It has also led to some Ghanaians using pre-registered and fraudulently registered sim cards to commit mobile money fraud to get money [25]. This occurrence is not only disadvantageous to the lenders as they lose much money in the process, but also to the borrowers, as they get blacklisted and fail to have access to avenues where they can borrow money and make good use of it [26]. This research, therefore, seeks to find out how effective a credit scoring system would be in addressing the non-payment of loans by the customers of service providers.

Chapter 2: Related Literature

Research papers have been written on the emergence of the provision of financial services through the use of mobile phones. One such research paper is by Donovan [12]. The research suggests that the emergence of mobile money services is due to the many benefits accrued from its use and also the reason why many people are now willing to use it. It argues that the many benefits that arise from the use of mobile money services have “led the technology to gather a lot of interest from large institutions who view its emergence as a successful way in which the mobile applications and services can be used to improve economic and human development” [12]. M-pesa, a mobile money platform used in Kenya for financial transactions, is primarily used as an example of a successful way in which mobile money implementation has been done and adopted by the target market [12]. Although the research gives a lot of positive effects of the use of mobile money in detail, its limitation is the failure to explain the adverse effects of mobile money use in detail. The lack of detail does not enable the assessment and comparison of both the positive and adverse effects of mobile money use. It might be beneficial in determining whether the benefits are more than the disadvantages or vice versa.

Among the many benefits of the provision of financial services through mobile money, is helping individuals in Africa build savings to cater for unfavorable circumstances in life. Serge, Rugemintwari, and Sauviat (2018)’s study, finds that the use of mobile money increases the tendency for individuals to save for health emergencies. The results further suggest that the safety and the possibility to transfer money within the

continent, which is associated with mobile money, could be a factor that encourages users to save for health emergencies [14].

Although there are many benefits that users can get from mobile money services, there are still many people who are not willing to adapt to it. Osey-Assibey [8], through a case study, shows the unwillingness by the “*susu*” users in Ghana to adopt the use of mobile money services. The case study makes use of Innovation Diffusion Theory and Technological Frameworks. It also makes use of field survey data and logical regression for analysis to establish the willingness of people in West Africa who use the traditional way of saving to adopt the use of mobile money as their new way of saving. The findings suggest that perceived risk, level of education, the age of the collector are contributing factors to the willingness to adopt the use of mobile money. The paper also points out that the adoption of mobile money by “*susu*” users is slow and suggests financial literacy as a way of improving the adoption rate of mobile money. The limitation of this paper is that it does not give a comprehensive report of the findings. It assumes that the readers understand the reasons behind the statements made.

Many researchers have pointed out the importance of financial literacy as an influencing factor when it comes to savings. Baidoo, Boateng, and Amponsah [20] are among the authors that have contributed to this body of knowledge. The results from their research support their hypothesis that financial literacy is critical in promoting domestic saving in Ghana. The source of data for this paper is primary data, and they use binary probit estimation to analyze their data. The paper discusses an old tradition used in saving money called “*susu*” used by Ghanaians as a platform for saving money. The findings of the paper suggest that financial literacy is essential in determining the motivation for individuals to save in financial institutions rather than the traditional way of saving. These findings correlate with the

findings from research done by Baidoo, Boateng, and Amponsah[20], which emphasizes that the more literate a person is, the higher their motivation to save. Fernandez, Lynch, and Netemeyer [5] are among the researchers to show the relationship between financial literacy and savings. Their research builds on already existing literature on the relationship between financial literacy and financial behaviors. Although the paper presents characteristics of behaviors that might affect the financial behaviors, it fails to explain in detail what those characteristics are and what can be done to encourage people to have positive behavior towards financial activities.

Aside from the educational level of a person, other factors have been explored to determine if they affect the saving culture of Ghanaians. One such factor is religion. Kwaku [19] presents a study that evaluates whether Protestant beliefs lead them to seek for resources (financial knowledge) that eventually lead to firm performance, unlike Catholics. The study also examines the determinants of financial literacy aside culture. The researcher uses data from SMEs in Ghana to conclude the research question. The results of the study refute the hypothesis of the study showing that there is no relationship between religion and financial literacy. It goes ahead to add that gender does not significantly affect financial literacy. Although the paper states that gender does not have a significant effect on financial literacy, it does not give much explanation for the conclusion.

Chapter 3: Methodology

3.1. Introduction

The heart of chapter three is in the methods used in collecting data and the tools used in analyzing the acquired data. The previous chapters were crucial in describing the problem and providing relevant literature that validates the problem topic. According to Kumar [13], this chapter shows the route the researcher takes in the research, the methods of data collection and the methods of data analysis. The following sections provide the stages and activities completed during the research process to ensure the validity of the outcome.

3.2 Research Question Definition

This research seeks to find out how effective a credit scoring system would be in addressing the non-payment of loans by the customers of service providers. It proposes an online platform that provides users with financially related information and a credit scoring system that can help both lenders and borrowers check the creditworthiness of an individual.

3.3 Research Approach

This research adopts a quantitative approach and also implements a proof-of-concept to validate this work. The research involves understanding the financial literacy of the people of Ghana with a focus on the people of Berekuso. It also involves finding out whether telecommunication companies would be willing to use a credit-scoring model/API if they do not already use it. A credit-scoring model would ensure that the telecom companies in Ghana do not have a situation where customers avoid paying back their loans. It would also give their customers a better chance of getting higher loans if they have good credit from their history with mobile money loans. The proof-of-concept involves building a system that tests the research question. The information gathered from the stakeholders is expected to be in quantitative form.

3.4 Selection of Samples

Sampling, as explained by Vanderstoep and Johnston [21], is essential because interviewing or giving the whole population questionnaires is not very practical. The participants in the questionnaires are expected to be adults of ages between eighteen years and seventy-eight years. They are expected to be identified through snowballing. Snowballing is a sampling technique that involves identifying an initial group of people to gather data. This initial group proposes an eligible group of people to participate, then letting that next group identify another group of eligible participants until there is data saturation [21]. A worker in Ashesi who lives in Berekuso is expected to be identified. The worker can then refer a person who can be asked to fill the questionnaire, after which the person selects another person. This process continues until the sample is saturated.

3.5 Data Collection

3.5.1 Guided interviews

The research makes use of guided interviews. Guided interviews follow a set of questions, but not all questions and transitions are developed before the interview [21]. The method is useful because it provides an opportunity for the interviewer to ask follow-up questions that are important to the research [21]. The interviewees from the telecoms in Ghana and the National Communication Authority of Ghana are expected to be identified through the reference of the research supervisor. After the first people have been identified, the other people from the two authorities are expected to be identified through snowball sampling.

3.5.2 Questionnaires

The research makes use of questionnaires that are distributed and filled by the people of Berekuso voluntarily, and that information is used to validate the research question. During the research, the subjects are required to fill a consent form to ensure that they understand what they have to do and give the researcher permission to use the information they provide. The users would be required to fill a questionnaire that is provided in English to aid in the research process.

3.6 Data Analysis

The responses collected are analyzed using R¹. The technology is used because it has powerful graphical abilities that accompany its analytical tools [15,18,3]. R is used to convert information collected into statistical formulations that provide answers to the problem statement [15,18,3]. It is used to generate graphs. The method that is used to analyze the data is trend analysis. It is done by checking if there is a consistent pattern between the variables that are being measured.

¹ R is a software environment for statistical and graphical analysis

Chapter 4: Implementation and Analysis

4.0 Introduction

The heart of chapter three was in the methods used in collecting data and the tools used in analyzing data during the research process. The focal point of chapter four is in the analysis of the data collected through guided interviews and questionnaires. This chapter responds to the research questions outlined in chapter one and the ones that were modified during the process of the research.

The initial research question sought to find out the effects of having easy access to mobile money loans on the saving culture of the unbanked people of Berekuso. The intention of the research was to find out how easy access to mobile money loans from service providers has affected the saving culture of people in Berekuso. As the research progressed and after interacting with the intended audience, the research question changed.

The second intention was to propose an online platform that provides users with financially related information and a credit scoring system that can help both lenders and borrowers check the creditworthiness of an individual before they get access to loans. The site was intended to provide users with information such as how to access loans, how to build up their credit, and how credit scoring is done. The site is also meant to provide functionality for credit scoring.

During the progression of the research, the initial topic of the research, which was; has easy access to mobile money loans affected the saving culture of the people of Ghana? Changed to how efficient will a credit scoring system affect the non-payment

of loans? This data analysis focuses on the data that was collected from the people of Berekuso, the outcome that was gathered from it, and the recommendations obtained from the analysis. The recommendation portion is extensively discussed in chapter five.

4.1 Data Collection

Data used in this research paper was collected from January 2020 to March 2020. Data collection was done through questionnaires. The graphs below give more details about the participants. The graphs are a response to the questions that the participants were asked.

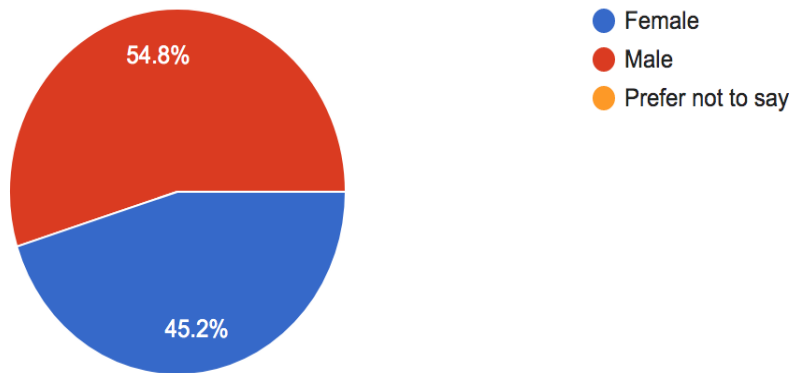


Figure 4.1 Gender of the participants

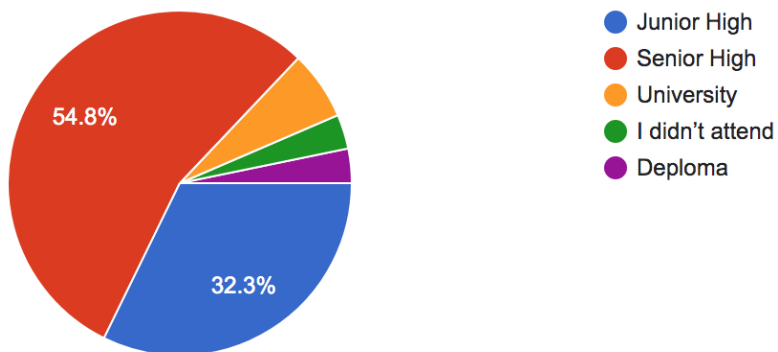


Figure 4.2 Level of education of the participants

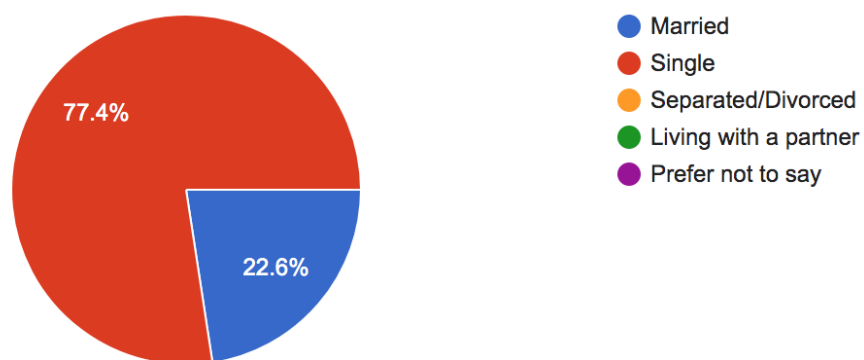


Figure 4.3 Marital Status of the participants

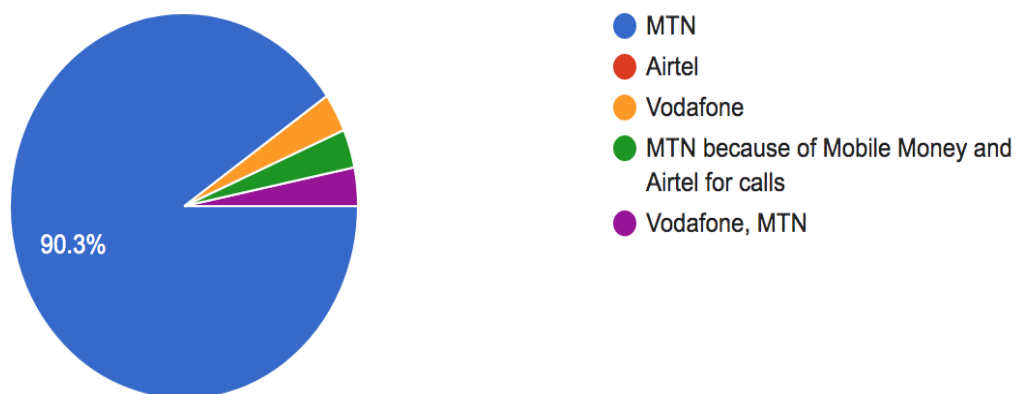


Figure 4.4 Service providers used by the participants

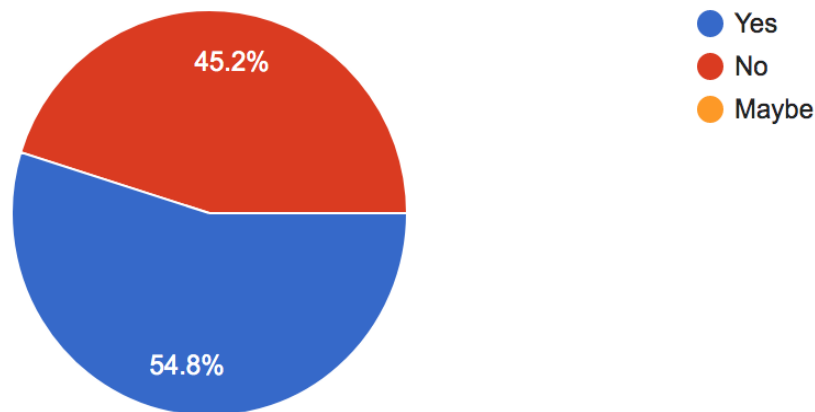


Figure 4.5 Loans acquired by participants from service providers

4.2 Findings

This section outlines the information gathered during the research process from the target audience. This is the section that shows clearly how the research question was answered and other information that was collected or inferred from the data collected. It also shows other alternative discoveries that were encountered during the research

4.2.0 Mobile Phone usage

96.8 percent of the participants own a mobile phone. In this Undergraduate Thesis, ownership refers to the state of having access to a phone and using it as your own, it does not matter if the phone or the sim card used with the phone was registered under the user's name or someone else's as long as the participant had a phone they use at any particular point in time.

The possession of a phone by majority of the stakeholders suggests that a phone is considered a necessity, as majority of the people own at least one. Aside from the fact that the phone is used for communication, the stakeholders used it for more than just communication. Majority of the participants used the phone to make purchases and to send and receive money. A

phone is considered a necessity as it is used for a variety of things. The graph below shows the percentage of mobile phone ownership among the participants.

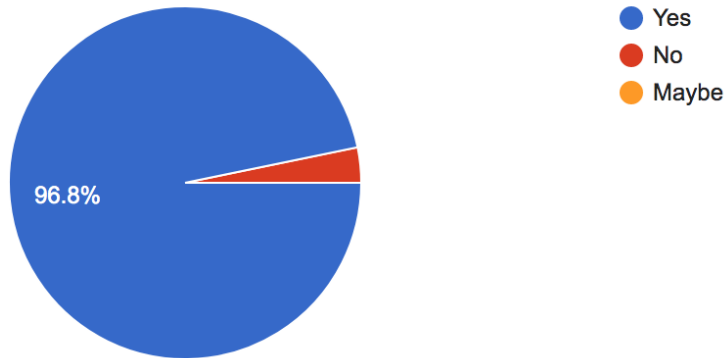


Figure 4.6 Phone ownership among the participants

4.2.1 Mobile money usage

From the data analysis, it was identified that 93.5 percent of the participants have a mobile money wallet. This represents the majority of the population that was part of the research. Possession of mobile money wallets by the majority of the people suggests that there is a market for these services. It suggests that it is a service that is very popular among the interviewees and this is not a surprise as the service providers compete day in and day out to outshine each other and get more customers to their side by providing a variety of services to attract more customers. The research reveals that some participants had more than one mobile money wallet with different service providers.

The possession of more than one mobile money wallet confirms that the users borrow money from different subscribers. The possession of more than one mobile money wallet suggests that there is a possibility that the users of the service might have a hard time paying and if not there

is a possibility that they might delay payment of the loans because the deadline for payment of the loans might be on the same day for all the mobile service providers they use.

See figure 4.7 for the number of people who have a mobile money wallet among the participants.

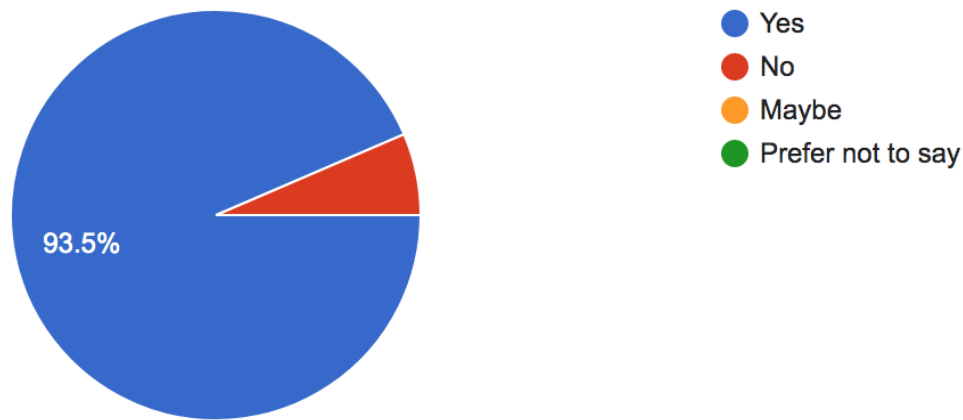


Figure 4.7 Ownership of a mobile wallet by the participants

4.2.2 Payment of mobile money loans

Although a majority of the mobile money users paid back the loans they got on time, some of them admitted to not paying back the money on time or not paying back at all. Some of the reasons they gave for not paying back the loan include; Lack of money to pay back the loans at the moment. They suggested that although they knew they had a debt they needed to pay, they could not pay it because they genuinely did not have money to pay back. The money they had, had been planned for something else. Some of them suggested that although they had money at the moment, the money had been planned for something else and therefore could not pay back the loan.

The findings suggest that although it is easy for them to get these loans, it is hard for them to pay back. Some participants suggested that their income is irregular and therefore sometimes when the loan is due they do not have the salary they could use to repay it. This, therefore, puts them in the category of the non-payers even though they do not want to be there. This state of events makes it hard to get more loans even when they want to because their credit history suggests that they are not trustworthy.

Although some customers had genuine reasons for not paying back the loans, it was clear that some of them chose not to pay back regardless of whether they had money or not. This is the reason why some service providers end up experiencing losses and become skeptical about extending credit to some customers with genuine reasons for needing a loan.

4.2.3 Need for a credit scoring system

Although it was clear that some customers are genuinely willing to pay back their loans and others are not, one thing that stood out is the need to have a system that would enable customers to plan for their money and pay back the loans on time and also enable the lenders to lend money without risking loss. One running theme in the research is the need for the participants to improve their credit. They suggested that although they were able to pay back the loans, they could not borrow a large amount of money because the lenders would not give them a large amount of money because they thought they could not pay back the loans.

Sometimes in an unfortunate turn of events, they end up losing their sim card and when that happens, all the information they had with the lenders is disregarded. Therefore they have to start building up more information from the beginning, this, therefore, does not encourage them to be consistent and keep paying back loans on time because they do not see the benefit of being

consistent yet when they need it, it does not help them. The participants would also like to know if they are eligible for a loan at any given point in time. This is because they have encountered situations where they would like to get a certain amount of money as a loan but they were not eligible but this information was presented to them after going through the process of asking for a credit.

It would be beneficial to them to have a system where they can check if they are eligible for a loan before they go ahead and ask for it. This will save them a lot of time they could have used in doing something beneficial other than going through a list of amounts without any success. This system would also be beneficial to lenders because they will have information about the eligibility of their customers while rendering them transparent to their users. The users would know how the system works and what part of their information is used so that they can protect their privacy by preventing service providers from asking for more information than is needed for developing the system.

4.3 System Implementation

4.3.1 System architecture

The system has two different components, an API that is used to calculate the credit score and a website that is used to render the information calculated to the users. Figure 4.8 shows the system architecture presented in the Model View Controller pattern.

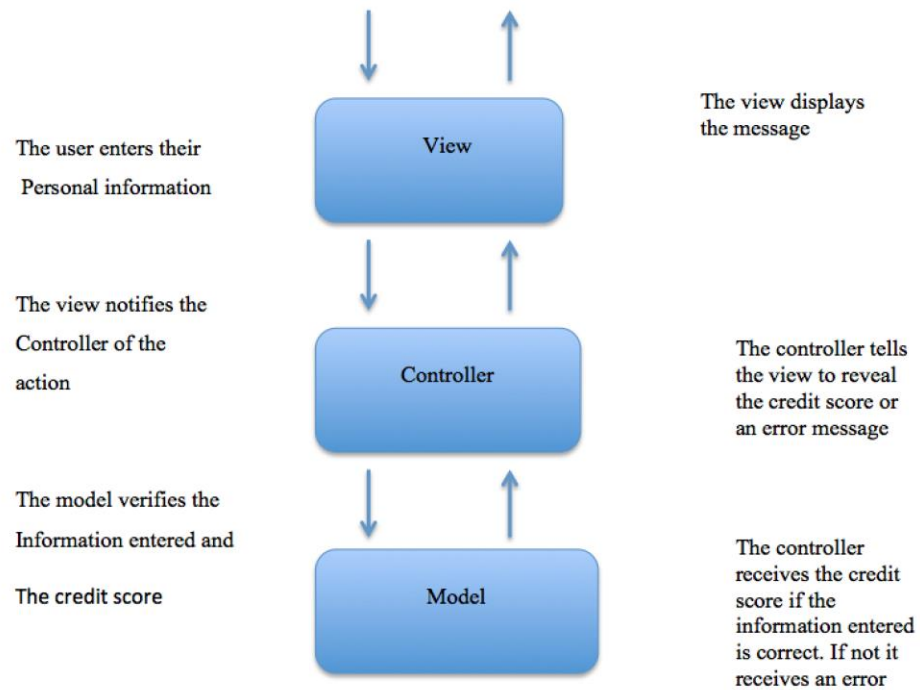


Figure 4.8 System architecture

4.3.2 Implementation Resources

The system was developed using four different technologies: HTML, Bootstrap CSS, JavaScript, and Flask. The front end of the system was built using three different technologies: HTML, Bootstrap CSS, and JavaScript while Flask was used to develop the Rest API.

4.3.3 Implementation

The front-end of the system was created using HTML [6]², Bootstrap CSS [7]³, JavaScript technologies [23]⁴, and Flask. A form takes in inputs then sends the data in JSON format using jQuery to the Rest API and finally displays responses from which the credit score is calculated.

The API is implemented using Flask and hosted on Heroku. In the Rest API, two functions are used to calculate the credit score. One adds up the credit score for example addition of score per characteristic and the other function calculates the score per characteristic. This information is obtained from a scorecard that was created based on the FICO scorecard [9].

² HTML is a publishing language that is used by the World Wide Web

³ Cascading Style Sheets are useful tools that are used to modify the presentation of a document or a group of documents.

⁴ JavaScript is used as web browser's main scripting language

Chapter 5: Conclusion and Future Work

5.1 Summary

This research sought to find out how effective a credit scoring system would be in addressing the non-payment of loans by the customers of service providers and proposed an online platform that provides users with financially related information and a credit scoring system that can help both lenders and borrowers check the credit worthiness of an individual before they get access to loans.

The project implemented a Rest API whose function is to check the credit scores of customers. This was intended for both the service providers of mobile money loans and the customers of the mobile money service providers. This was rendered through a website that was meant to imitate the service providers website whereby, the customer would visit the site enter their name and request for their credit score and the service provider would provide them with their score. For the proof of concept, the project assumes that we are the service providers and therefore we created a scorecard that imitates how an actual scorecard would look like when the user enters their information, we use it to calculate their score based on the scorecard.

The data for the paper was collected through guided interviews and questionnaires. The participants of the research were semi-literate people of the Berekuso community and these participants were identified through snowballing.

5.2 Limitations

This section of the research discusses the aspects of the research that did not go as planned yet they had the potential to improve the overall performance and the quality of the project.

1. Lack of actual data from the service providers. As stated in the analysis the credit scoring system got information to calculate the credit score from a scorecard. The scorecard was used to simulate how credit scoring would be calculated in real life. If data from the service providers were used it would have made the credit score more accurate and it would have made it easier to tailor the algorithm used to calculate the score specifically to the different service providers used by the participants.
2. Lack of input from the service providers. The research would have benefited immensely from the input of the service providers on how they select the aspects of the user information to use in calculating a credit score. This would have made it better to accurately determine the data used in the API.

5.3 Suggestions for Future Work

Apart from employing measures to address the limitations mentioned above, this section offers suggested extensions to this study.

1. A refinement of the algorithm in order to accurately predict the user creditworthiness.

This could be done using a machine-learning model that would gather data and analyze it before generating a credit score.

2. Tailoring the algorithm to specific service providers. The algorithm gives a credit score based on some information about the user you enter. The information used is generalized to all the service providers although it is acknowledged that different service providers have different levels of importance to the different characteristics and therefore the system should be tailored to cater to the different characteristics.

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