DEVELOPMENT OF AN INTEGRATED LOAN LENDING MOBILE APPLICATION FOR SELF-MICROFINANCE FUND IN TANZANIA

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

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ABSTRACT

The global growth of microfinance, particularly in Tanzania, is closely tied to mobile banking and lending technology. Technical hurdles, such as disjointed platforms like Oracle e-Business Suite, IMFAS, and Kopa Ada, impeded the operations of the SELF Microfinance Fund, a prominent Tanzanian lender. This fragmentation forced loan officers to rely on manual field registrations, which slowed down data processing and reduced efficiency. To address this, an integrated loan lending mobile application was developed for the SELF Microfinance Fund, incorporating their internal core microfinance system. The chosen tools for development were the Flutter framework, Dart language, MySQL database, and APIs, ensuring seamless integration and functionality. The project employed both quantitative and qualitative research methods to gain a comprehensive understanding of current loan lending processes and to gather user requirements. Quantitative data were collected via questionnaires and analysed using descriptive statistics and Python version 3.8.18 for visual representations. Qualitative data were obtained through focus group discussions and analysed using thematic analysis, revealing recurring themes and patterns through detailed transcription and coding of responses. The findings highlighted the critical need for an integrated loan lending mobile application that delivers strong security, rapid processing, user-friendliness, and efficient report generation. The developed system successfully processed various types of loan applications, provided immediate feedback to applicants, and allowed administrators full control over data functions. Evaluation of the application demonstrated user satisfaction with its intuitive interfaces, enhanced security, processing speed, and multiple language options. The application was tested through various scenarios, including stress testing, user acceptance testing, and performance evaluation. The results confirmed that the application effectively addressed the challenges posed by disjointed platforms and unlocked new opportunities for growth and improved service delivery for the SELF Microfinance Fund.

DECLARATION

I, Faith Felix, declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this project report is my original work and that it has not yet been submitted nor is concurrently submitted for a degree award in any other institution.

25/07/2025

Faith Felix — Date

The above declaration is confirmed by:

25/07/2025

Dr. Elizabeth Mkoba — Date

25/07/2025

Dr. Maranya Mayengo — Date

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CERTIFICATION

The undersigned certify that they have read and, at this moment, recommend for acceptance by The Nelson Mandela African Institution of Science and Technology a project report titled "*Development of an Integrated Loan Lending Mobile Application for Self-Microfinance Fund in Tanzania*" in partial fulfillment of the requirements for the award of the degree of Master of Science in Embedded and Mobile Systems of The Nelson Mandela African Institution of Science and Technology.

25/07/2025

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25/07/2025

Dr. Maranya Mayengo — Date

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DEDICATION

I want to dedicate this work to my family and young girls outside there who fear enrolling in Science, Technology, Engineering, and Mathematics (STEM) subjects.

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2FA	Two-factor Authentication
API	Application Program Interface
CEO	Chief Executive Officer
DFD	Data Flow Diagram
DFS	Digital Financial Services
EMI	Equated Monthly Installment
G	Generation
GB	Gigabyte
GHz	Gigahertz
GL	Group Lending
HDD	Hard Disk Drive
HQ	Head Quoter
HTTP	Hypertext Transfer Protocol
IDE	Integrated Development Environment
iOS	iPhone Operating System
KYC	Know Your Customer
MF	Microfinance Fund
MFA	Multi-factor Authentication
MFI's	Microfinance Institutions
MNO	Mobile Network Operator
MySQL	Structure Query Language
NM-AIST	Nelson Mandela African institution of Science and Technology
OTP	One Time Password
P2P	Peer- to -Peer
PC	Personal Computer
PL	Personal Lending
QR-CODE	Quick response
SDK	Software Development Kit
SELF	Small Entrepreneurs Loan Facility
SFA	Single-factor Authentication
SMEs	Small and Medium Enterprises
SOA	System Oriented Structure

SSD	Solid State Drive
STEM	Science, Technology, Engineering and Mathematics
TCRA	Tanzania Communication Regulatory Authority
UAT	User Acceptance Test
UI	User Interface
USSD	Unstructured Supplementary Service Data
Wi-Fi	Wireless Fidelity
XML	Extensible Markup Language

CHAPTER ONE

INTRODUCTION

1.1 Background of the problem

The SELF Microfinance Fund is a product of the government of the United Republic of Tanzania's "Small Entrepreneurs Loan Facility (SELF)" project, which began in 1999. The SELF Project was one of the government's poverty reduction initiatives, co-funded by the Tanzanian government and the African Development Bank (AfDB). The initiative aimed to strengthen the contribution of SMEs to economic growth and poverty reduction, as well as boost the micro-financing industry (Microfinance, 2022). The SELF Microfinance Fund was established on September 14, 2014, as a Company Limited by Guarantee under the Company Act of 2002, with the Government of Tanzania as the primary guarantor. The objective of the merger was to combine the human capital, financial resources, and business potential of the two organizations. Figure 1 illustrates the diverse branches of the SELF Microfinance Fund offices located in various regions.

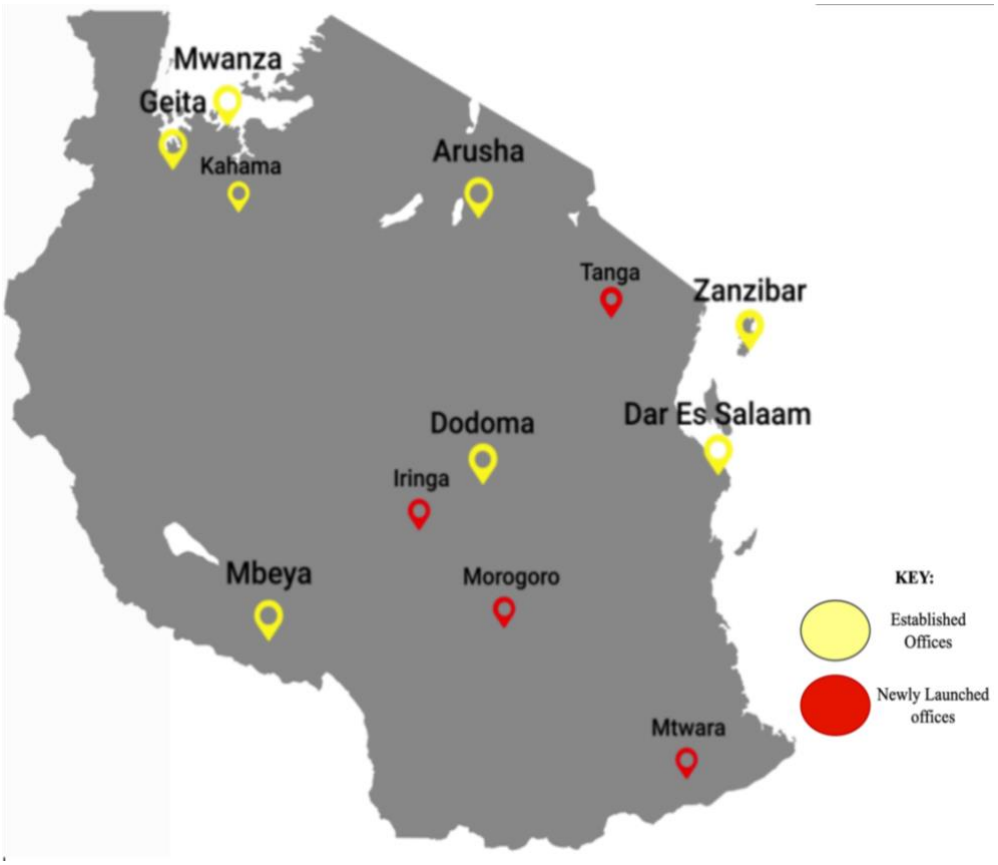


Figure 1: Tanzania's SELF MF offices are depicted by regions (Microfinance, 2022)

Microfinance is a mechanism that enables people in developing nations to borrow small amounts of money to start a small business (Weill & Woerner, 2018). It provides financial services to those who cannot access traditional commercial financial services like banks due to their inability to provide significant collateral (Rodriguez & Denyes, 2019). Microfinance institutions' tasks include providing small loans to low-income borrowers, creating job opportunities, and increasing borrowers' capacity by teaching skills such as loan utilization, entrepreneurship, and management (Josephat, 2018). Entrepreneurs could use small loans to start or expand their micro, small, and medium businesses. Savings enabled families within Tanzania to accumulate assets to pay school fees and improve their homes. Mobile Lending is a service offered by banks to mobile phone companies. Customers with busy schedules can efficiently conduct loan applications using their phones whenever they want (Ndagijimana, 2017). It focuses on providing financial assistance to the unbanked, who do not have bank accounts or bank access, are at the base of the economic pyramid, and frequently reside in remote areas. Mobile technology of financial technology is a unique, groundbreaking banking concept that connects people from all socioeconomic classes to financial service providers and promotes the expansion of financial inclusion globally (Schulte, 2018).

According to the Communication Statistics Report from the Tanzania Communication Regulatory Authority (TCRA), for the first quarter of the financial year 2022/2023, there were 51 655 454 telecom subscriptions, which represent 83.66% penetration. Meanwhile, smartphone users were reported at 30.71% in September 2022/2023. This necessitated integrating the mobile application with the Core Microfinance System (CMS) to validate loan applicant information, a key part of the loan appraisal process (Know Your Customer). A customer (an applicant who has been awarded a loan) would also be able to receive notifications at various stages of their loan cycle. Although a lot of people still use feature phones in Tanzania. However, due to the gradual switch from feature phones to smartphones based on technological growth and internet adoption, the need arises to develop an application for the early smartphone users to synchronize with future technological growth (Etim, 2012; Kanyam *et al.,* 2017; Theonest *et al.,* 2024).

This technology will also encourage digital inclusion and attract investors, while positioning itself for long-term success as smartphone adoption increases nationally. Hence, the main objective was to develop an application that can enhance the issuing of affordable loans to Tanzanians engaged in economic activities. This approach reached more customers in rural and remote areas more easily. Giving a loan is a cycle starting from the customer applying for a loan, validating the applicant (KYC), loan underwriting, disbursement, and recovery. The

SELF Microfinance Fund could reach many customers through mobile applications for smartphones, making data follow-up and management, loan monitoring, loan disbursement, loan collection, and loan termination processes easier through their Mobile System.

System Oriented Architecture (SOA) was used to integrate heterogeneous systems as an interoperability framework. It demonstrated that SOA and mobile-based apps had a strong technological link (Niknejad & Bahari, 2020). Mobile Application integration is the process of linking mobile device's applications to the existing systems in your ecosystem to share data and streamline workflows (Arnold, 2021). Therefore, an integrated loan mobile application is a mobile application connected to the core microfinance system to send and retrieve incoming loan information through this mobile system, linked to the existing system.

The main objective of this project was to develop the "Integrated Loan Lending Mobile Application for SELF Microfinance Fund in Tanzania" to enhance the efficiency and transparency of loan processes for officers and members of the fund. With a focus on Group Loan registration, Personal Loan registration, and integration features, the project aimed to create a user-friendly system that simplifies the recording, processing, report generation, and follow-up of loan applications. By ensuring transparent and reliable information, the application serves as a valuable tool for informed decision-making within the organization. This decision was given that the mobile application was a rapidly evolving technology that had become ingrained in people's daily lives and played a crucial role in boosting strategic breakthroughs.

1.2 Statement of the problem

One of the key challenges to financial inclusion is the time and transparency of the loan application process. In many countries, it can take weeks or even months to get a loan, and the terms and conditions of the loan may be unclear (Lee & Kim, 2020). The SELF Microfinance Fund (SELF MF) acts as a vital conduit for financial inclusion, aiming to empower marginalized communities within the Tanzanian landscape. However, despite its noble mission, inefficiencies in loan operations present a significant barrier to its impactful reach. This project analyzes the internal roadblocks impeding SELF MF potential and proposes avenues for enhancing its accessibility and effectiveness. Their disjointed database systems, with Oracle e-Business handling personal loans and IMFAS managing group loans, create a fragmented and inefficient loan process. Reliance on paper-based registration in remote areas introduces data inaccuracies and inefficiencies, while the lack of digital literacy support

excludes many potential clients. The main objective of the Developed of an Integrated Loan Lending Mobile Application was to address the technical gaps identified in previous studies (InitVent, 2023; James & Seibert, 2002).

This gap was bridged by a revolutionary integrated loan lending mobile application. By streamlining loan processing, improving data accuracy, and empowering users with intuitive interfaces, the app transformed SELF MF. Field officers (Loan officers), equipped with these digital tools, could now serve everyone, regardless of smartphone ownership, eliminating paperwork and delays.

1.3 Rationale of the project

One of the most significant global difficulties that Microfinance Institutions (MFIs) confront is frequently cited as technology-related. Even while effective use of technology can save costs, boost productivity, and broaden reach, many MFIs still struggle to realize their full potential and stay clear of their traps (Dang & Vu, 2020). The initial step, in many cases, was to digitize existing products, services, and activities for microfinance providers that wanted to embrace digital finance (Dorfleitner, 2022). The SELF Microfinance Fund has considered digitizing its current services and products. Most Tanzanian underserved rely primarily on other variables such as loan conditions, motivations for obtaining loans, and the impact of interest rates. However, they deal with challenges while agreeing to employ technology to enhance service delivery.

Additionally, the development of an integrated loan lending Mobile application relies on manual record keeping. In order to improve service delivery and management practices, technology must be incorporated into the Lending process and the Microfinance sector. This can improve and bring value to their businesses and improve how they are currently running. The developed loan lending mobile application has saved time and costs for customers of the SELF Microfinance Fund. Applicants were able to apply for loans from any location, and their applications were received, processed, and approved promptly. The mobile application included features such as group registration, individual registration, multi-factor authentication, and instant notifications after application submission, further improving the overall user experience.

1.4 Project objectives

1.4.1 General objective

The main objective of this project was to develop an integrated loan lending mobile application for the SELF Microfinance Fund in Tanzania that included the internal core microfinance system.

1.4.2 Specific objectives

(i) To identify system requirements for developing an integrated loan lending mobile application for the SELF Microfinance Fund in Tanzania.

(ii) To design and implement the architecture and functionalities of an integrated loan lending mobile application based on identified requirements.

(iii) To validate the developed system.

1.5 Project questions

(i) What are the requirements for developing an integrated loan lending mobile application for the SELF Microfinance Fund in Tanzania

(ii) How to develop the integrated loan lending mobile application?

(iii) How to validate the developed system?

1.6 Significance of the project

The project can give the SELF Microfinance Fund staff and their clients quicker turnaround times and a cost-free loan application that complies with the regulations. The company can eliminate loan application issues, such as long turnaround times and high time and resource costs, by enhancing access to loan applications. The created system can guarantee that the SELF MF community may access a loan application in the suggested time range and from any location. The mobile application can send out early notifications for loan applications that are accepted and rejected. Additionally, it can enable staff field visits to monitor a straightforward loan application activity that can be completed with minimal resources and reach clients in remote areas at the appropriate time. During the field tour, loan officers can visit customers in remote areas and those without smartphones, allowing them to submit free loan applications

while they are there. Additionally, the mobile application has provided SELF Microfinance Fund users with online access to loan-related information.

1.7 Delineation of the project

This development of an integrated loan lending mobile application is recommended for all microfinance businesses, not only those in the government sector or the SELF Microfinance Fund. Additionally, when loan officers are on a field visit, it can be straightforward to register new loan applicants in the area with this system. Moreover, that information will reach the other parties of the credit in time to be able to process the new applications without waiting for the officers in the field to return with the latest applications. In terms of credit, customers can use this system to apply for a loan wherever they are, and the application can respond to the request. Furthermore, they can receive notifications about their application. All SELF Microfinance staff are considered for this project to have smartphones that can download and install mobile applications. However, the loan application cycle needs to be improved for effective outcomes that raise production and inspire staff to work more.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This Chapter provides a comprehensive review of existing literature focused on the development, implementation, and usability of integrated loan mobile applications. It also provides succinct technical gaps identified from the existing solutions and relates to a proposed system.

2.2 Related works

2.2.1 New loan system based on smart contract

This study addressed inefficiencies within traditional lending systems, exemplified by the Musoni App's exclusive linkage to the Credit Reference Bureau and its reliance on credit scoring for automated lending decisions (Yang *et al.,* 2019a). To overcome this limitation, the proposed solution involved the integration of smart contracts and blockchain technology. The study posited that this integration could mitigate inefficiencies by providing a decentralized and transparent approach to financial agreements, enhancing transaction control, efficiency, and trust within the lending process (Yang *et al.,* 2019a). However, the study acknowledged technological limitations associated with the utilization of blockchain technology, recognizing potential challenges in fully realizing the transformative benefits proposed. These limitations posed considerations for the feasibility and effectiveness of implementing blockchain in financial applications like the Musoni App.

2.2.2 Digital transformation in microfinance: A catalyst for sustainable development

Pal *et al.* (2022) addressed the persistent challenges associated with paperwork in the loan application process and identified various complications within the loan application cycle. To tackle these issues, the study proposed the implementation of the Stawika loan app, introducing features such as loan registration, loan request, and loan repayment. This mobile application was designed to streamline and simplify the loan application process, aiming to enhance overall efficiency and accessibility. Additionally, the Stawika loan app is integrated with M-Pesa, a widely used mobile money service, and incorporates an automatic smartphone data evaluation tool. However, the study's limitations, as identified by Mwangi (2022), include reliance on two-factor authentication for loan access and being exclusive to the Android platform. These

limitations pose considerations for the user authentication (single-factor authentication) process and potential accessibility challenges for users on non-Android operating systems.

On the other hand, Pal *et al.* (2022) found that customers often rely on agents and can only open basic transactional deposit accounts. The LetsGoBlueBox device, proposed in Mozambique in 2016, attempted to address this by combining a smartphone and a tablet for agent-assisted banking. However, its functionality remained limited, restricting users to basic deposits and excluding features like cash withdrawals, interbank transfers, micro-insurance enrolment, and loan applications.

2.2.3 The impact of mobile business literacy interventions on loan repayment: An application to microfinance

Microfinance institutions (MFIs) in developing nations grappled with a persistent challenge. Widespread financial and business literacy gaps among their clientele, leading to disappointing loan repayment rates and stalled poverty alleviation efforts. Flick (2020) proposed a potential solution in "Frostiness/Financial," a mobile app designed to bridge this gap. The app delivered user-friendly financial education through pre-recorded audio and video content, covering loan processing, procedures, and key terms. The study yielded promising results, revealing a substantial positive correlation between app adoption and improved repayment behaviour. Users of "Frostiness/Financial" were found to be 60% less likely to fall into arrears compared to non-users. However, the study's reliance on pre-recorded media presented a technological limitation. Compared to more interactive tools or personalized financial coaching, "Frostiness/Financial" might have offered a less dynamic learning experience. While its findings were encouraging, the study also highlighted the need for further exploration of mobile learning resources that incorporate greater interactivity and tailored support to maximize their impact on MFI clients and bridge the financial knowledge gap more effectively.

2.2.4 Digital financial services

Pazarbasioglu *et al.* (2020) added that the prevalent challenges associated with traditional banking processes, notably the presence of bank lines and protracted credit reviews, were identified as impediments to efficient and accessible loan acquisition. To address these issues, the study introduced the Zenka App, a mobile loan application integrated with M-Pesa, featuring USSD loans, disbursement, promo codes, loan registration, and repayment capabilities. Positioned as a solution to expedite and simplify the loan application and approval process, the Zenka App leveraged the convenience of mobile technology. However, Zenka

(2020) acknowledged limitations in the app's accessibility, as it was technically restricted to Android phone users. Additionally, the security measures, confined to two-factor authentication (2FA), may have posed usability challenges for certain users. These limitations underscore the importance of considering technological and security constraints in evaluating the Zenka App's broader applicability and effectiveness, particularly in ensuring inclusivity across diverse user bases.

2.2.5 Strategies adopted by Equity Bank to gain a competitive advantage on mobile loan applications

The study conducted by Muturi (2022) addressed the cumbersome loan application procedures at Equity Bank, which were characterized by paperwork, guarantors, and significant time commitments. As a proposed solution, the Eazzy mobile loan app emerged, aiming to streamline the process through features like loan requests, repayments, disbursements, balance checks, type selection, and SMS notifications. By embracing technology to eliminate paperwork and enhance efficiency, Eazzy offered a user-friendly platform for loan management. However, acknowledging limitations was crucial in evaluating the app's true effectiveness. One such limitation, identified by Bank (2023), lay in its technical design. Eazzy utilized a single code base built with JavaScript, restricting its operation to either iOS or Android. This raised concerns about platform accessibility, potentially excluding users based on their preferred operating system. Additionally, while fingerprint and OTP two-factor authentication provided security, dependence on specific hardware for fingerprint scanning might have further limited accessibility for users with certain devices.

2.2.6 The KTDA-SACCO: A mobile-based loan application for calculating and processing loans

Aligned with the identified challenges in the loan application system addressed by a previous project. Latifa (2021) analysed the existing process at the Kenya Tea Development Agency (KTDA) SACCO. Both investigations highlighted the inefficiency and time-consuming nature of the system, characterized by excessive paperwork. In response, the project proposed a Loan SACCO mobile-based application as a solution to streamline the loan application and processing procedures, aiming to enhance efficiency and reduce paperwork burdens. However, it is crucial to acknowledge the limitations of the proposed mobile-based application outlined by Latifa (2021), which included concerns related to the technologies used for development, such as the Java programming language and Firebase database tool. These limitations

underscore the importance of a comprehensive evaluation of technological choices implemented in past projects, ensuring the effectiveness and adaptability of proposed solutions in addressing challenges like those identified in the loan application process at KTDA SACCO.

2.2.7 The development and implementation of an android-based savings and loan cooperative application

Sarosa *et al.* (2021) aimed to overcome data management inaccuracies and inefficiencies in Permata Ngijo Savings and Loans by developing an Android app. Powered by PHP and MySQL, the app successfully streamlined workflows with a 90% user success rate, yet faced limitations like scripting-based performance concerns, restricted OS compatibility, and potential security vulnerabilities. These aspects highlight the need for continuous improvement to ensure the app's long-term success and serve the cooperative's growing membership base effectively.

2.3 Challenges of the existing mobile and web-based loan application systems used at the SELF microfinance fund

The Oracle e-business suite is a full suite of business apps for controlling and automating operations throughout your company (James *et al.,* 2002). It has a number of features such as personal loan application, credit review, credit analysis, and loan approval. Also, an Integrated Micro Finance Automation Suite (IMFAS) is Initvent's flagship product. This is a comprehensive web solution for large-scale microfinance organizations. It aids the village or community organizations in terms of financial or banking activities (InitVent, 2023). This includes all aspects of fundamental financial administration, including member admissions, managing savings and loans, and overseeing accounting operations. The software has been designed to assist a variety of target customers, including community groups that practice collective savings and loans that are either externally supported or self-funded.

On the other hand, Kopa Ada loan is a web-based system that enables parents to borrow fees for their child's studies at school. This system is only for primary school students, and the money is sent directly to the respective school where the student is studying. However, those schools should be registered in this system. This system has the following features: Parent registration, school registration, login, language selection, and student registration. In a nutshell, the general limitations of these systems are no integration between them, and each is tailored for a specific loan purpose, and it involves paperwork or manual loan registration

during fieldwork. For iMFAS and Oracle e-business suite no customer intervention and no user-friendly interface.

2.4 Technical gap

The summary of the current systems and their limitations is shown in Table 1.

Table 1: Summary of an existing mobile-based loan application and processing

References	Problem Addressed	Proposed Solution	Limitation of the study
Pal *et al.* (2022)	In remote places, consumers can only open an essential transactional deposit.	LetsGoBlueBox agency banking model in Mozambique.	Only opened a bare transactional deposit, no loan application module.
Yang *et al.* (2019)	the issue of inefficiencies in traditional lending systems.	New loan System based on smart contract.	The study was technologically limited by the utilization of blockchain technology.
Latifa (2021)	Web-based loan applications, which involve paper manual processing.	Loan Sacco Mobile Application.	The study has limited to java technology choice which is platform oriented which is not allowed to use single code base to different platform.
Sarosa *et al.* (2021)	Used manual paper-based system: MS Excel, risk in data accuracy, loan time process less effective due to customer growth.	Android-based Saving and loan cooperative application.	The study technically limited to PHP, MySQL database and restricted to operating system compatibility and security.
Mwangi (2022)	Complexity on loan application: based on paperwork.	Stawika Loan App.	This study has limited to android platform and use single-factor authentication.
Bank (2023)	The loan applicant should have a guarantor and a filled in form.	Eazzy Mobile Loan App.	The study technically has limited to the Platform accessibility and security based on 2FA.
Zenka (2020)	Bank queued and prolonged credit action.	Zenka Loan App	The study has restricted to android users and security based on 2FA.
Flick (2020)	widespread financial and business literacy gaps among their clientele.	Frostiness/Financial education app.	The study's reliance on pre-recorded media presented to the customer.

The aforementioned studies in Table 1 collectively demonstrated the critical need to address limitations and enhance efficiencies in existing mobile and web-based loan application systems. The studies on systems like the Oracle e-business suite, Integrated Micro Finance Automation Suite (IMFAS), and Kopa Ada loan underscored the shortcomings, including a lack of integration, specificity to certain loan purposes, reliance on paperwork, and user interface challenges. While existing systems like Zenka and LetsGoBlueBox emphasized basic 2FA options, this approach might have posed accessibility challenges for some users and lacked the versatility offered by other methods like fingerprint scanning or one-time passwords. Drawing insights from these studies, the proposed solution involved the development of an integrated loan lending mobile application for the SELF Microfinance Fund.

This innovative application aimed to streamline workflows, improve user experience, and mitigate the identified limitations by integrating diverse features. Notably, the addition of Multi-Factor Authentication (MFA) as an extra technological layer enhanced security and user authentication in the loan application process. In essence, this mobile app held significant potential to transform SELF's microfinance services by improving accessibility, efficiency, and security, ultimately empowering its clients and driving financial inclusion. These unique features are classed under the MFA, having appreciable adaptation to the current digital age (Ali *et al.,* 2021).

2.5 Proposed system

The proposed system consisted of a loan lending mobile application integrated with the core microfinance systems. The core microfinance systems are comprised of iMFAS, Oracle, and Kopaada. The iMFAS is based on group loans, Oracle is based on personal loans, and Kopaada is a web-based online loan lending system for parents. First, the customer sends the loan request through the mobile application. The data can be pushed to the core microfinance system via API once processed. Subsequently, the information is sent to the loan officer via API. The loan officer reviews the loan application request and sends the processed request to the loan manager for further review, oversight, comments, and either approval or rejection of the loan application.

Also, there is an EMI calculator within this developed mobile application as a feature, whereby EMI is a helpful tool for estimating a loan's Equated Monthly Instalment (EMI) amount, considering four main factors: Loan amount, interest rate, tenure, and loan terms. By inputting these details, the calculator quickly computes the monthly repayment, including principal and

interest, enabling users to effectively budget and plan their finances. In addition, the Administrator is responsible for managing and authorizing users and accessing information from the database. Lastly, the customer receives a notification (SMS) about the requested loan, as shown in Fig. 2. A user-centric journey is prioritized in the developed integrated loan lending mobile app, starting with a streamlined and efficient registration process.

Friction is minimized by collecting only essential information like name, email, and phone number. A multi-factor authentication, implemented for secure access, features user-chosen strong usernames and passwords, followed by an additional layer of verification via one-time passwords (OTPs) delivered through SMS. For added convenience, fingerprint and facial recognition options are available on Android and iOS devices, respectively. This pre-application registration allows users to familiarize themselves with the app, pre-populate information, and avoid verification delays when applying for a loan. The loan application process integrates biometric verification (fingerprint and facial recognition) as a layer MFA, excels single-factor authentication by requiring verification from multiple independent credential groups, mitigating the risk of unauthorized access to critical systems and services (Sinigaglia *et al.,* 2020).

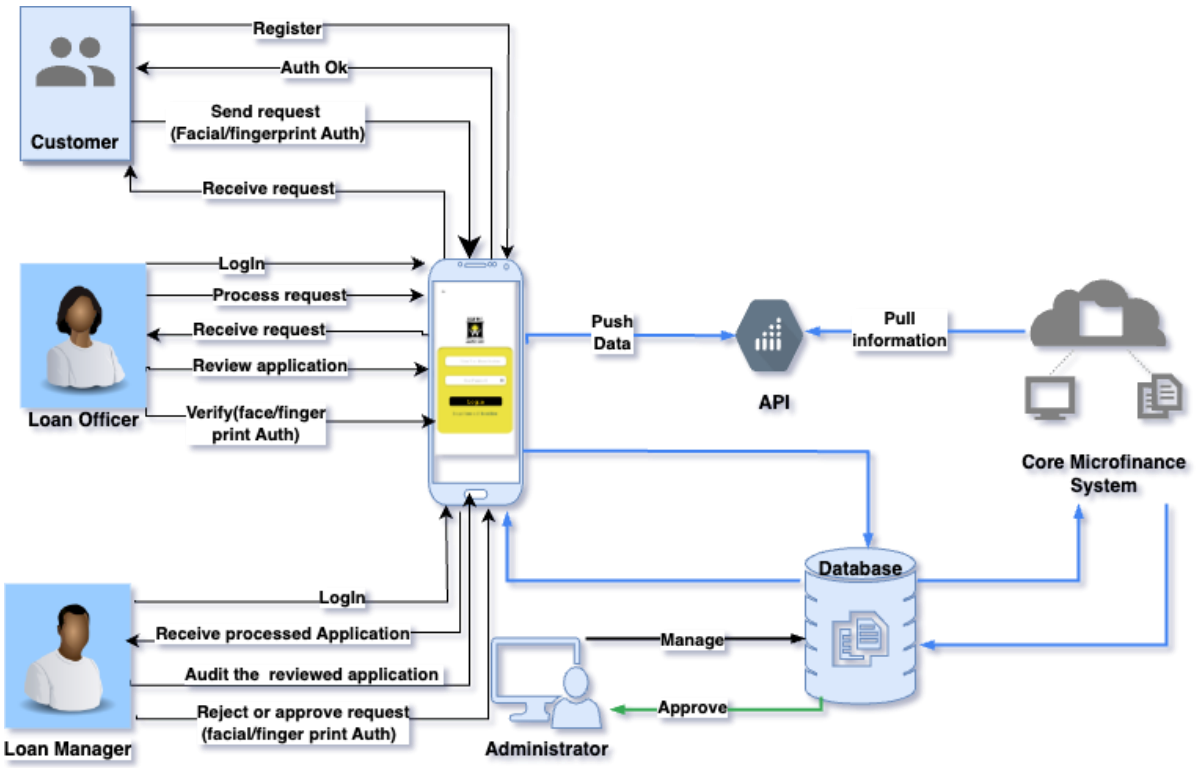


Figure 2: Proposed system

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter presents how the project was carried out. The project case study, project scope, and research methods are presented. Additionally, the target population, sample size, sampling procedure, data collection methods, data analysis, and the approach to system development are thoroughly provided.

3.2 Project case study and scope of the project

3.2.1 Project case study

This project's case study was in the Dar-es-Salaam region of Tanzania. The case study was chosen because the SELF Microfinance Fund Head Office is in this region, and there are eight microfinance branches in different areas of Tanzania as shown in Fig. 3. The project involved collecting data to understand how agents visit rural or remote locations using a traditional or standard paper form for loan applications.

Figure 3: Tanzania's SELF MF offices are depicted by regions, with Dar es Salaam serving as the country's administrative center

3.2.2 Project scope

Many tasks necessitate the use of an integrated loan lending mobile application. The suggested project exclusively dealt with the SELF Microfinance Fund, focusing on data fall-up management, user profile fall-up, loan applications, loan repayment, reminder for loan payback, and notifications of the requested loan. Also, it was integrated with the internal core microfinance systems (Kopaada, iMFAS, and Oracle database).

3.3 Research methods

The research methods employed in this project were qualitative and quantitative. The structured questionnaire was developed to collect data from SELF microfinance fund clients, as shown in Appendix 1. The focus group discussion guide, as shown in Appendix 2, was used to collect data from SELF microfinance fund employees. The document analysis was used to review literature from several peer-reviewed journal articles and books.

3.4 Target population

This project involved people who are entitled to access loans from Microfinance. The targeted population was SELF Microfinance Fund employees and SELF MF customers in the remote city area of Dar es Salaam, Tanzania.

3.5 Sampling technique and sample size

The project used random sampling techniques where all the participants had a chance to be selected. This approach ensured unbiased data collection, enabling the refinement of application features based on the varied preferences (Stratton, 2021). A sample size of fifty-one participants from the SELF Microfinance Fund in Dar es Salaam HQ and Mwasonga-kigamboni in Dar es Salaam. The sample was suggested for use since it was realistic to get the information from various SELF Microfinance Fund clients in the Dar es Salaam region. Also, because this project employed a census approach, meaning all members of the targeted population were included in the analysis. Given the small population size, this strategy provided comprehensive data without the need for sampling techniques.

3.6 System requirements

The following techniques and resources were utilized to create the system requirements.

3.6.1 Data collection methods

Data collection is the act of gathering, gauging, and analyzing precise data from a range of relevant sources to address issues, provide answers, assess results, and predict trends and possibilities (Pandey & Pandey, 2021). Surveys, questionnaires, as shown in Appendix 1, and focus group discussions, as shown in Appendix 2, were used to gather primary data. In addition, news articles, books, journals, research reports, dissertation stations, and websites on the internet were also used in this project.

3.6.2 Data analysis

The quantitative data collected through the survey questionnaire were stored in Comma-Separated Values (CSV) files. Python served as the tool for data analysis, and specifically, the Matplotlib.pyplot library was employed for effective visualization (Karsdorp *et al.,* 2021). This approach allowed for the presentation of figures, improved percentage representation, and the introduction of analysis results in the form of tables and figures. The qualitative data from focus group discussions were transcribed and coded (Vindrola-Padros & Johnson, 2020). These qualitative findings were then interpreted and presented in narrative form within the project, providing a comprehensive understanding of the qualitative insights obtained from the focus group discussions as explained in Chapter four.

3.7 System development approach

This project utilized an Agile software development methodology based on the Extreme Programming (XP) agile paradigm as shown in Fig. 4. This method was used because it's easier to handle changes with iterations compared to other Agile methods, and it is time-saving and cost-saving in development (Sysoieva & Pohrishchuk, 2020).

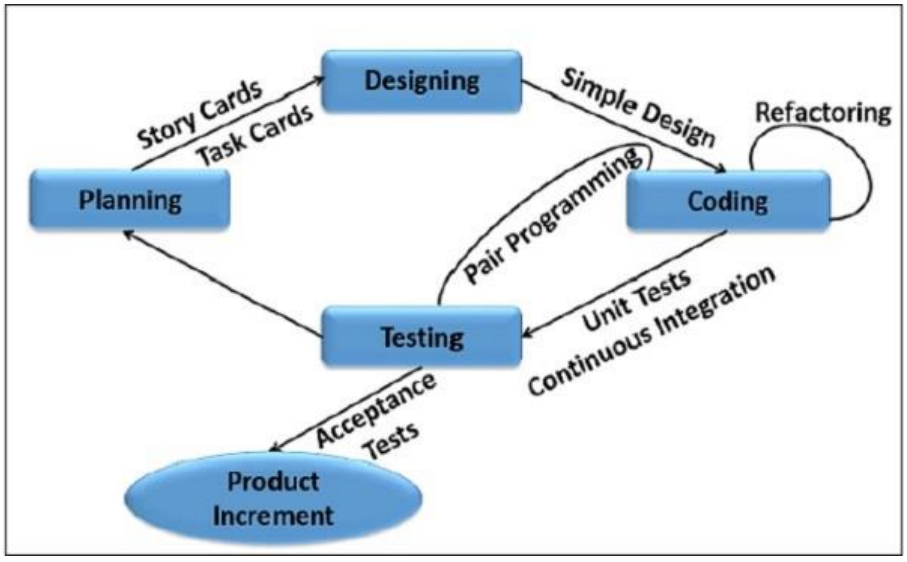


Figure 4: Extreme programming iteration cycle (Anwer, 2017)

The XP iteration cycle was an agile development approach to building mobile applications. It involved planning the objectives and requirements, designing the application's architecture, implementing features through coding, testing for functionality and quality, integrating code continuously, seeking feedback from stakeholders and users, releasing increments of the application, reflecting on the iteration through retrospectives, and repeating the cycle for further improvements. This iterative and collaborative process enabled the development team to deliver high-quality mobile applications aligned with user needs and evolve based on continuous feedback and enhancement.

3.8 System design

3.8.1 Conceptual design

In Fig. 5, explain the conceptual design. The user interface components play a vital role in interacting with various user roles, including customers, loan officers, loan managers, and admins. They offer tailored functionalities and interfaces to meet the specific needs of each role. These components establish communication with the Core Microfinance System, enabling the retrieval and updating of loan-related information, customer data, and loan statuses.

It has synchronized its current systems (Kopaada, Oracle, and iMFAS) with a credit reference bureau and identity verification systems for tasks such as credit checks, loan repayments, and customer authentication. According to the SELF MF business process, customers can get approved loan payments through the bank account provided during the loan application process. Also, generate the control number for loan repayment. There is no bank integration in

core microfinance systems, as the SELF MF business process is based only on the credit business. The mobile application's network infrastructure is safeguarded by a firewall, ensuring secure and controlled access to the system from the internet. All pertinent data is stored and managed within the database, ensuring data consistency, security, and availability for the integrated loan mobile application.

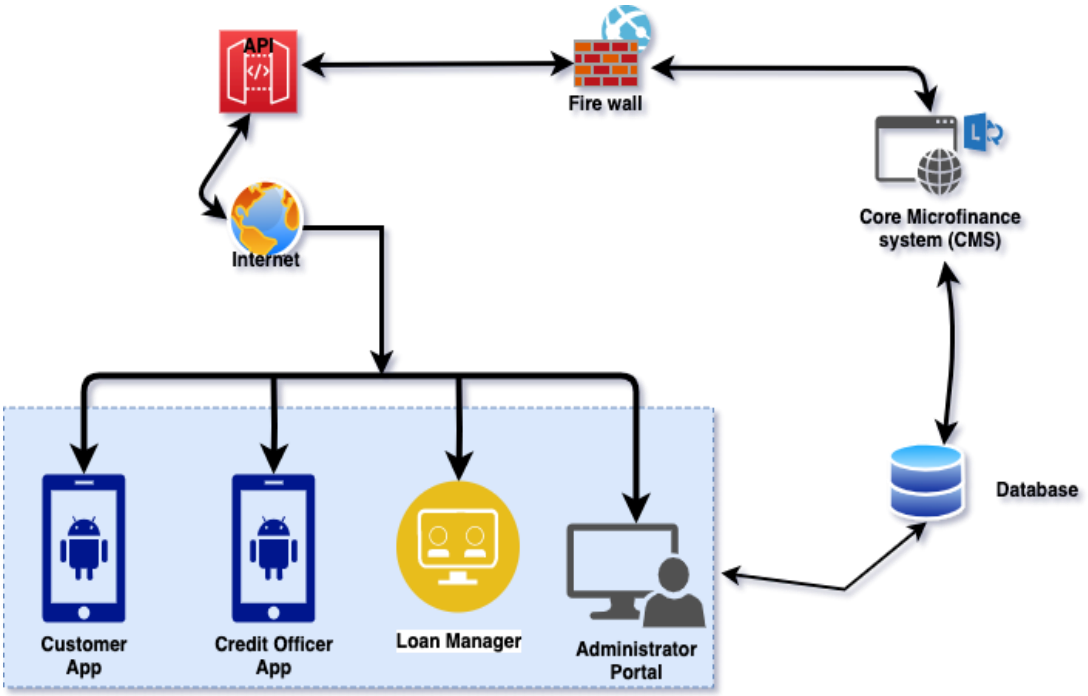


Figure 5: System conceptual design

3.8.2 Context diagram

This is also known as a Level 0 Data Flow Diagram. It shows the general layout of the suggested application system. It involves a central system communicating with external entities by determining the information flow. As a result, the diagram depicts the system's high-level view. The application system's context diagram is shown in Fig. 6.

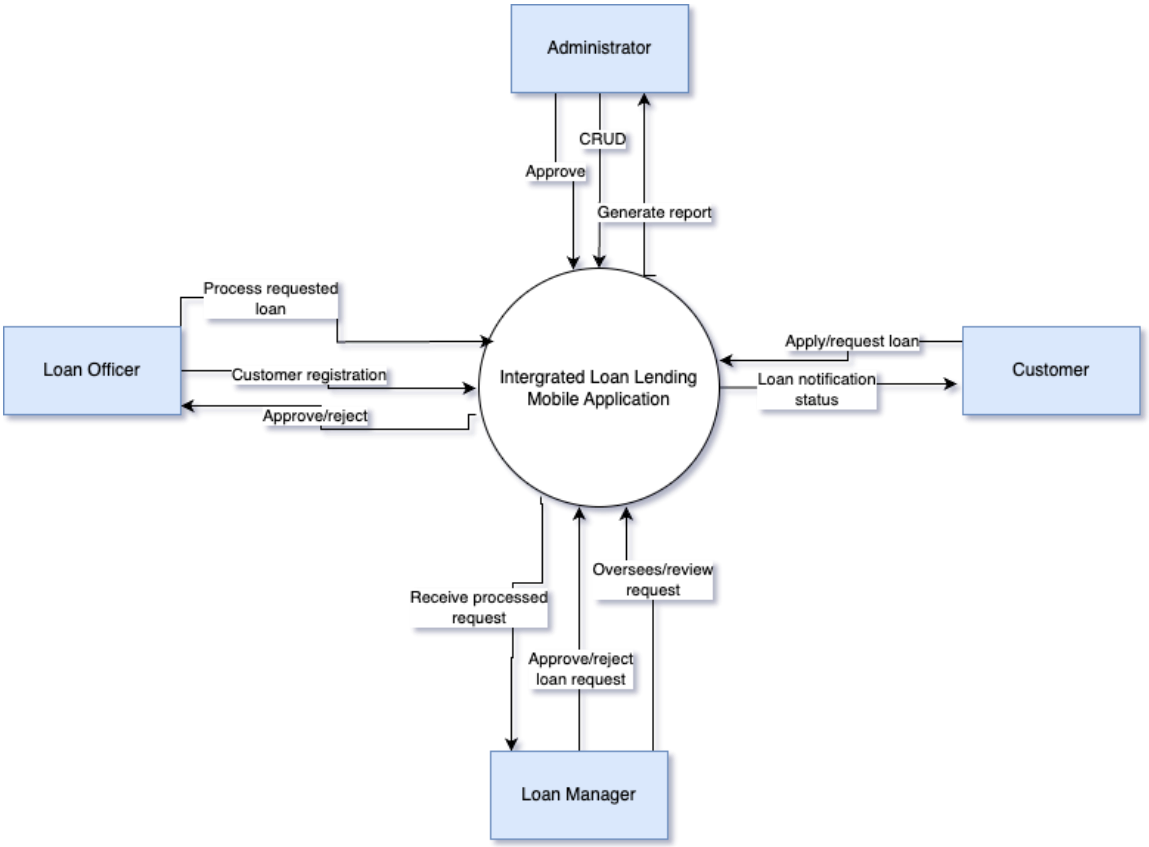


Figure 6: Application Context Diagram (level 0)

3.8.3 Data flowchart diagram

The integrated loan lending mobile application has four main entities: The borrower, the admin, the lender (credit officer), and the loan application reviewers (Loan Manager). The borrower can apply for a loan, view their loan status through the app. The lender can approve or deny loan applications, view a borrower's payment history, process the loan application, and manage their account. Finally, the loan application reviewers oversee processed loan applications and determine eligibility. With the integrated loan mobile application, borrowers can easily access loans, and lenders can efficiently manage loan applications, making the loan process faster and more convenient for everyone involved. The use case diagram for the suggested mobile application is shown in Fig. 7.

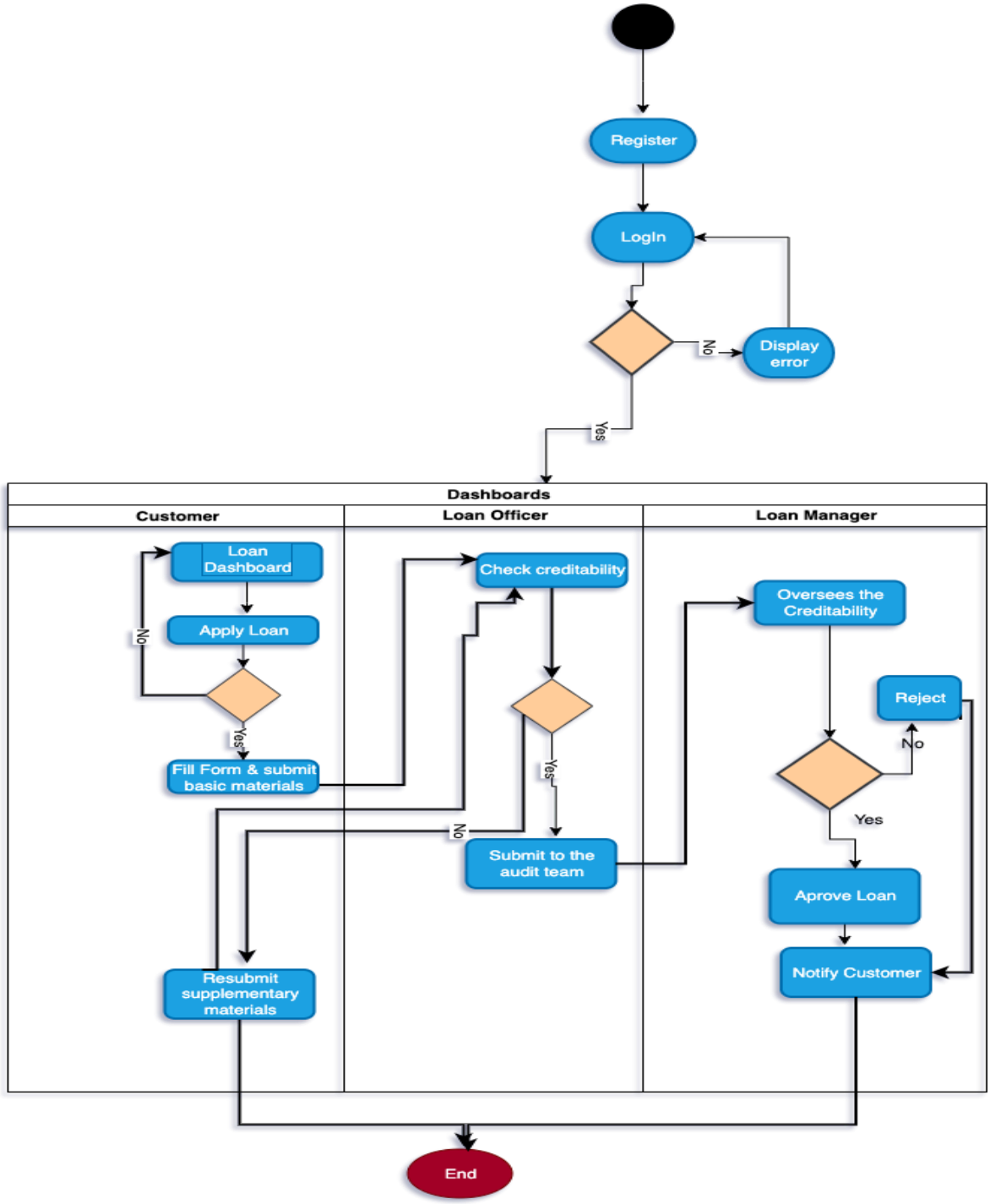


Figure 7: Application Data Flow Diagram

3.8.4 Database entity relationship diagram

The relational structure utilized in the database design architecture is depicted in Fig. 8. It provides a graphical depiction of the database system and the relationships between the data that will be kept within.

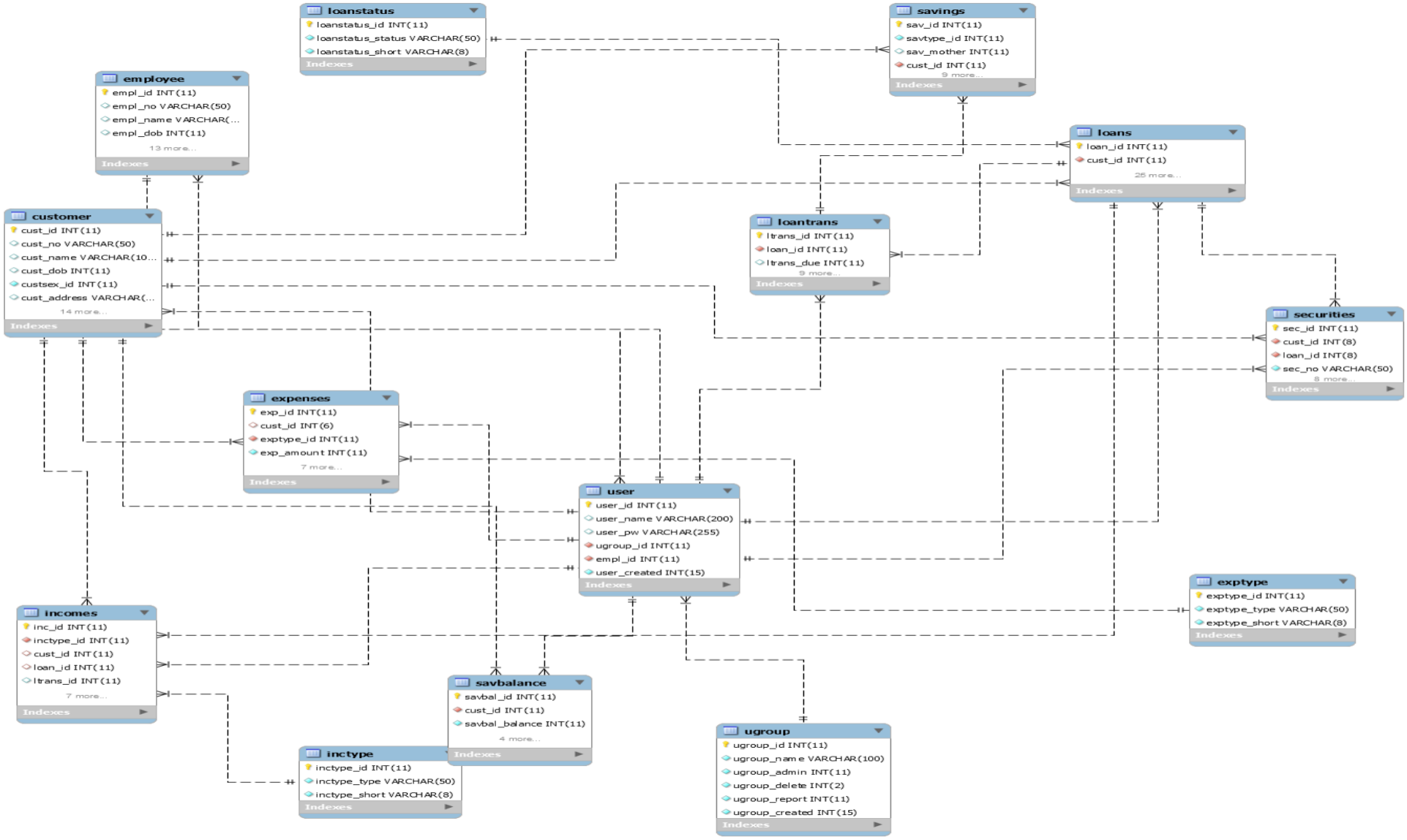


Figure 8: Database Entity Relationship Diagram

3.8.5 Data flow diagram level 2

The concept from DFD level 2 is also expanded upon at this level. Both the data that flows and the DFD level 2 subprocesses are included as shown in Fig. 9.

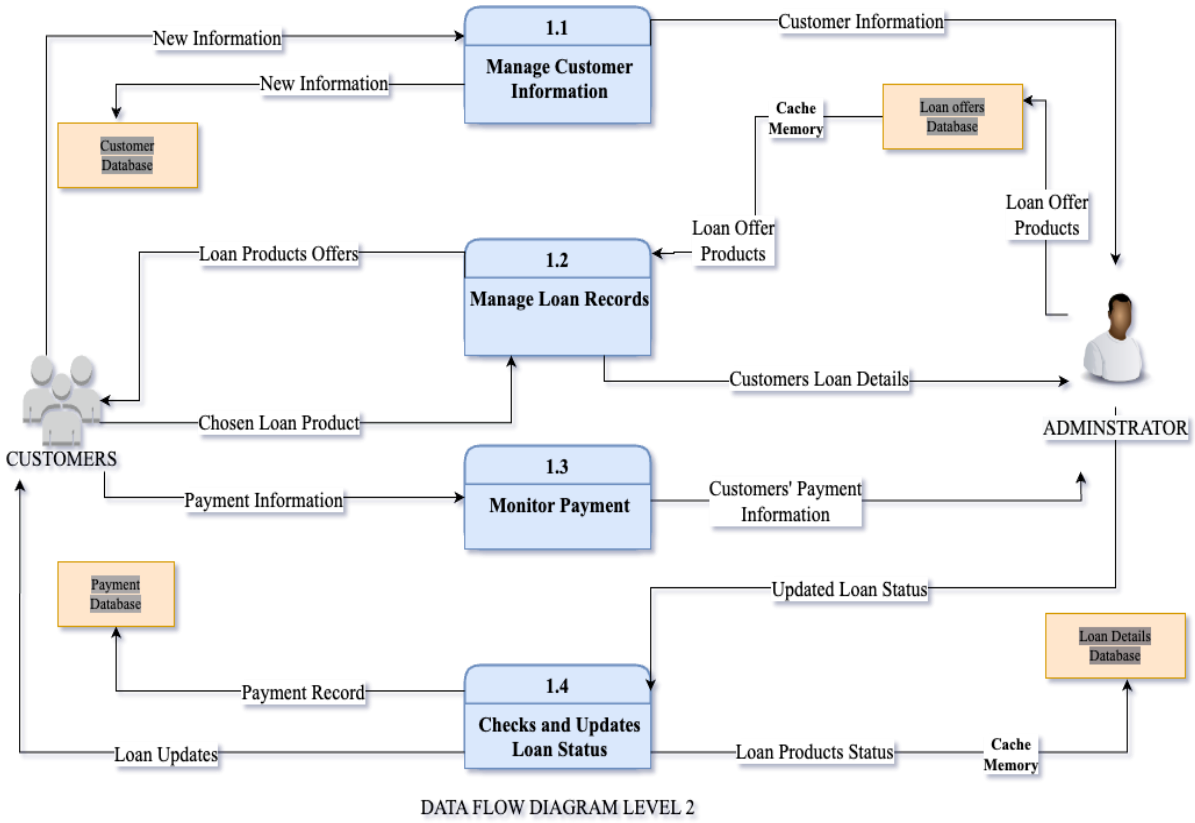


Figure 9: Data Flow Diagram level 2

3.8.6 Use case diagram

The use case diagram showcases a comprehensive interaction framework involving four essential actors. The customer initiates an integrated loan lending mobile application by registering personal details, then proceeds to apply for a loan, monitor their loan status, request support, and receive notifications. The loan officer intervenes with pivotal responsibilities such as reviewing loan applications, deciding on loan approval or rejection, and notifying the customer accordingly. In parallel, the loan manager undertakes significant actions, including loan auditing, reviewing approved loans, overseeing their progress, and executing rejections or approvals when necessary. At the core, the admin role is characterized by CRUD (Create, Read, Update, and Delete) actions, encompassing vital data management functions. Additionally, the admin's role extends to generating reports, contributing to the decision-making process with valuable insights derived from the system's data flow, as shown in Fig. 10.

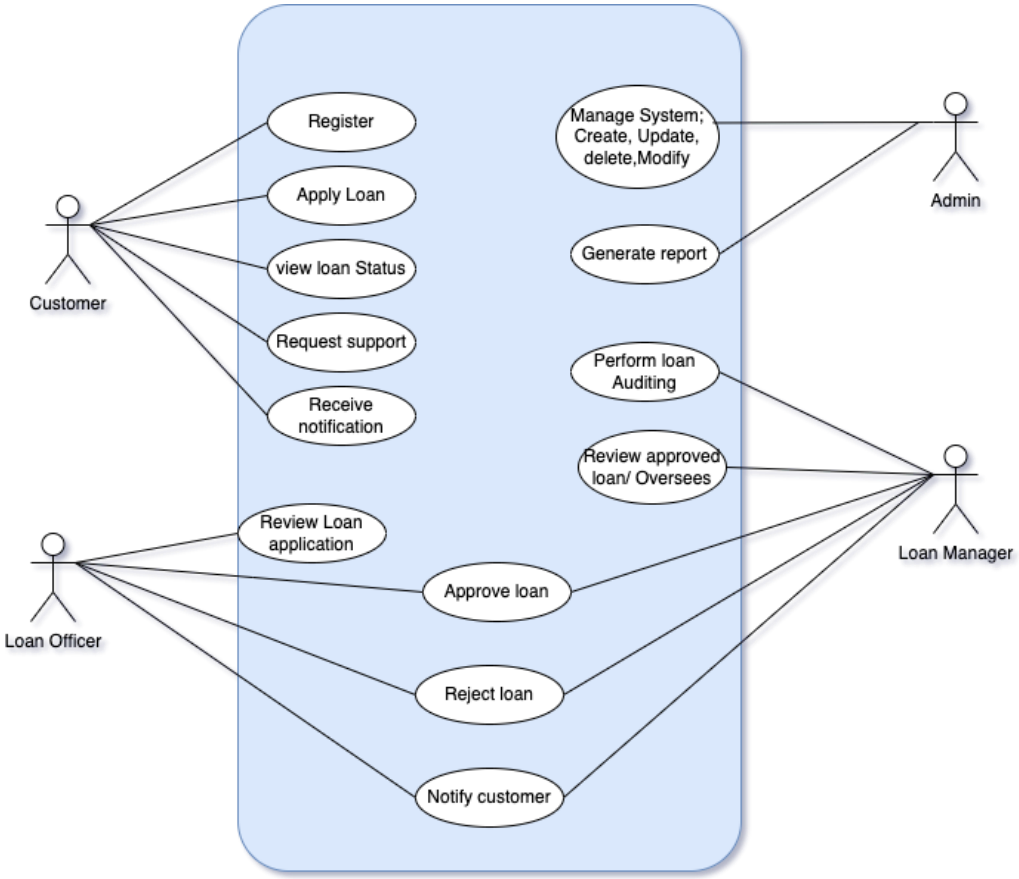


Figure 10: Use case diagram for the proposed system

3.9 System development

3.9.1 Software requirements

The following were the software tools used during the development of an integrated loan mobile application as described below:

(i) Visual studio

Visual Studio is a popular Integrated Development Environment (IDE) developed by Microsoft, commonly used for developing desktop, web, and mobile applications (Johnson, 2012). For example, in the development of an integrated loan mobile application, Visual Studio was used with Flutter to provide a rich development environment for building high-quality and responsive mobile applications.

(ii) Flutter framework

Flutter Framework is Google's portable user interface toolkit for building outstanding natively produced mobile, web, and desktop apps from a single codebase (Boukhary & Colmenares,

2019). Flutter is open-source and free, and it integrates with existing programs. The Flutter framework was used in the development of an integrated loan lending mobile application because of its cross-platform development capabilities, hot reload feature, rich set of widgets, faster development speed, and better performance. The use of Flutter helped to reduce development time, improve user experience, and provide a high-quality mobile application.

(iii) The MySQL database

The MySQL is an open-source relational database management system used in integrated loan lending mobile application development for efficient storage, retrieval, and management of structured data (Setiyadi & Setiawan, 2018). In developing an integrated loan lending mobile application, a MySQL database was used to provide a structured and efficient way to store and manage data. By setting up a MySQL database and developing a backend API that is informed by an XML file to communicate with an integrated loan lending mobile application. An integrated loan lending mobile application can interact with the database through HTTP requests. The API handles these requests, performing necessary operations on the database, and returning the data or results to the mobile app. This approach ensures better security as sensitive operations are handled on the server side, and it allows for proper error handling and optimization of data retrieval.

3.9.2 Hardware requirements

(i) A mobile device

Mobile phones were not used directly in the development of an integrated loan lending mobile application. However, Android and iOS mobile devices were used to test the application during the XP iteration cycle. The SELF MF team installed the application on their smartphone and tested it in different scenarios to ensure it was functioning correctly. This allowed identifying and fixing bugs or issues before releasing the application to the public. Additionally, end-users used mobile phones to access the application, making it essential for the application to be optimized for a mobile device. The mobile device specifications for an integrated loan lending mobile application are as shown in Table 2.

Table 2: Proposed Mobile Application mobile device specifications

S/N	Component	Specification
1	Operating System (OS)	Minimum supported: Android 5, for new devices: Android 7. X and above. For an iPhone from iOS 16.1 SDK and above.
2	Random Access Memory (RAM)	From 1Gb, recommended is 2Gb or more
3	Processor	Recommended; 4 cores,1.2 GHz
4	Storage	From 8Gb and more
5	Screen Size	At least four and above
6	Camera	At least 5 Megapixels
7	Connectivity	At least 3G or above and Wi-Fi compatibility of 2.4 GHz

(ii) Personal computer

The personal computer was essential in developing an integrated loan lending mobile application. The PC was used to write code, test, and debug the application code, and also used to install a variety of software tools like Integrated Development Environments (IDEs), debuggers, and emulators, which enable building and testing of the application before deploying it to mobile devices. Additionally, the PC provided a comfortable workspace for the development process for extended periods without straining eyes or backs. The PC specifications for an integrated loan lending mobile application as shown below in Table 3.

Table 3: Personal Computer Specifications for Mobile Application Development

S/N	Component Name	Specification
1	Disk Drive	256 for SSD and 500GB for HDD
2	Processor	Core i3, at least 5th generation
3	Random Access Memory	At least 4GB or recommended is eight or above
4	Graphics	NVIDIA GeForce
5	Display size	15.6 inch

3.10 System testing

To test the development of an integrated loan lending mobile application using the Extreme Programming Agile Methodology, the following steps were taken:

(i) During the development of an integrated loan lending mobile application, the first step involved a dedicated focus on User Stories and Acceptance Testing. They collaborated extensively with development and product teams to refine User Stories, ensuring clarity in defining loan application, loan processing, and repayment functionalities from both customer and lender perspectives. Subsequently, the meticulously crafted acceptance criteria for each User Story outline specific testing parameters and success criteria. To

ensure user-centricity, usability testing was conducted with diverse customer segments, ensuring the application's intuitiveness and alignment with user needs.

(ii) Adapting Test-Driven Development (TDD) for mobile app development constituted the second step. Comprehensive UI and API tests were written to guarantee a seamless user experience and reliable backend functionality. The incorporated mobile-specific testing tools, such as Appium and Robotium to simulate touch events and automate testing across various devices. Special attention was given to performance and security testing, evaluating the application's behaviour under different network conditions and prioritizing security measures for data protection.

(iii) The third step involved embracing Continuous Integration and Delivery (CI/CD). The automated mobile app builds and deploys, integrating them seamlessly into the CI/CD pipeline to facilitate frequent testing and rapid updates. Cloud-based testing platforms were leveraged to run tests concurrently on a variety of devices and operating systems (iOS and Android). Prioritizing regression testing ensured key functionalities were consistently covered, preventing regressions in new releases.

(iv) Collaboration and Pair Programming marked the fourth step, where test automation engineers and developers collaborated closely, engaging in pair testing on actual mobile devices to identify UI and usability issues early in the process. Knowledge sharing was facilitated through workshops and code reviews, fostering a culture of team ownership of quality, where everyone took responsibility for identifying and resolving defects.

(v) The final step involved Metrics and Feedback. Key testing metrics such as test coverage, defect escape rate, and mean time to repair (MTTR) were meticulously tracked to assess the effectiveness of the testing efforts. User feedback was continuously gathered through surveys, crash reports, and in-app feedback mechanisms, contributing to ongoing improvements in the app's usability and functionality. The testing strategies and tools were adapted and refined based on this valuable feedback and empirical data, ensuring a continually optimized testing process.

3.11 System validation

An integrated loan lending mobile application was validated for end-users using a questionnaire, as shown in Appendix 3. The questionnaire collected users' feedback on the

application's features and overall usability. The system validation results are discussed in Section 4.8 of Chapter four.

3.12 Ethical considerations

Ethical considerations were crucial in conducting this project. Firstly, the project approval letter from the NM-AIST was received before data collection from the selected sample of participants began. Secondly, participants voluntarily agreed to volunteer their time for the study and understood the purpose and potential consequences of the project. Lastly, confidentiality ensured that participants' personal information was kept private in a secured database and not shared with anyone else, respecting their rights and privacy.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This Chapter presents the results from the survey questionnaire, focus group discussion, system requirements, system design, developed mobile application, system testing, and system validation. The discussion is also provided.

4.1.1 Results from the survey questionnaire

(i) Findings on the effect of an integrated loan mobile application for SELF Microfinance Fund

The survey conducted with 51 respondents from the SELF Microfinance Fund's team, and clients revealed that 88.2% of participants agreed that an integrated loan mobile application would be beneficial for loan applications. These findings indicate strong support for the idea of digitizing the loan process. The design of the mobile application was influenced by this positive reception, leading to the inclusion of features like easy loan application submission, real-time tracking of loan status, and automatic notifications for loan approvals or rejections, all of which streamline the process and make it more accessible to users.

The high level of agreement (88.2%) as presented in Table 4 shows a clear demand for such a system, driving the decision to prioritize features that simplify loan applications, track loan progress, and provide reminders for repayment deadlines.

Table 4: Results from the survey on the effects Integrated Loan Lending Mobile Application

Degree	Frequency	Percent (%)
Yes	45	88.235
No	6	11.765
Total	51	100

(ii) Characteristics of the respondents

The demographic analysis shows that 51% of the respondents were female, while 49% were male. Additionally, 52.9% of respondents lived in village areas, while 47.1% lived in towns. These characteristics suggest that the loan application system needs to be accessible and user-friendly for both male and female users, and it should cater to both rural and urban populations,

many of whom might have limited access to smartphones or internet connectivity. The respondent's characteristics are illustrated in Fig. 11.

Table 5: Characteristics of the Respondents

Demographic Characteristics	Number of Respondent	Percent (%)
Gender		
Male	25	49.0
Female	26	51.0
Area of Residence		
Village	27	52.9
Town	24	47.1

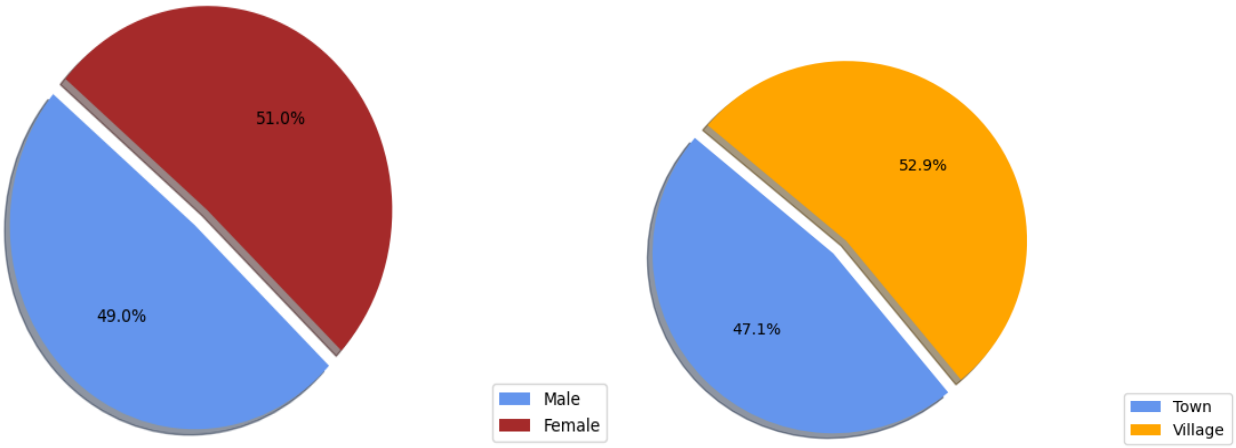


Figure 11: Demographic characteristics of respondents

(iii) Level of education of the respondents

The survey found that 47.1% of respondents had a higher level of education, and a significant portion (21.6%) had secondary education. This indicates that the majority of users are sufficiently educated to navigate a mobile application, but there is also a portion with lower education levels who may need additional support (Fig. 12).

Table 6: Education status level of the Respondents

Level of Education	Number of Respondent	Percent (%)
Higher level Education	25	47.1
High School level	1	2.0
Ordinary level	11	21.6
Primary level	10	19.6
Other	5	9.8
Total	**51**	**100**

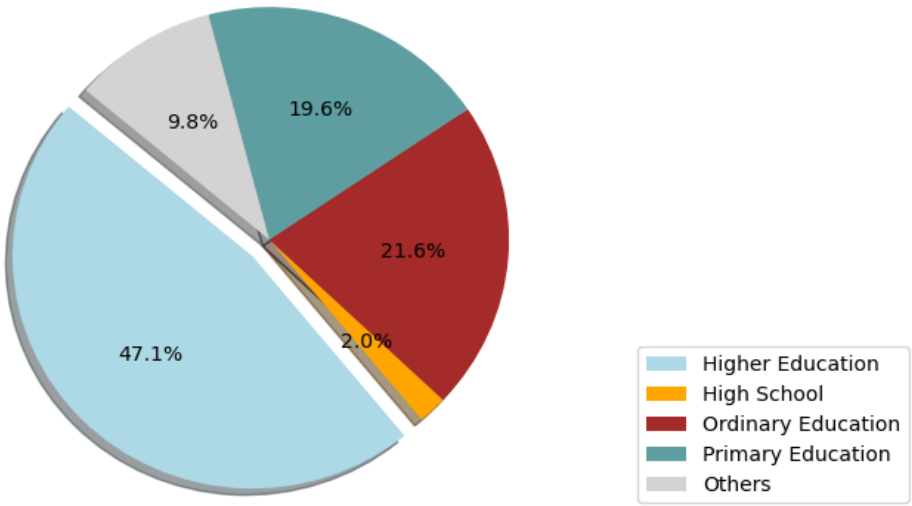


Figure 12: Summary of the Respondents' education level

(iv) Respondent age distribution

Understanding the age distribution of respondents is crucial for designing an application that caters to a specific age group. The survey did not provide specific numerical values in the description but understanding that age can influence digital literacy is key. The response *as* shown in Fig. 13.

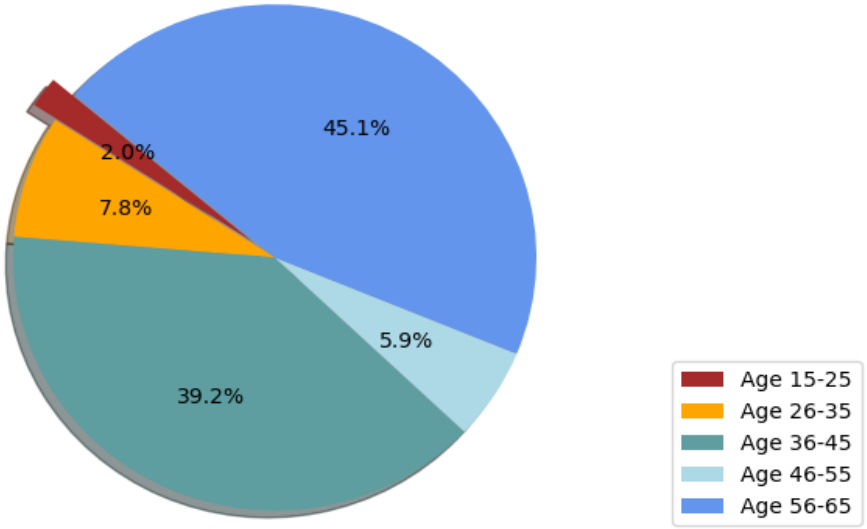


Figure 13: Respondents Age Distribution

(v) Employment level of the respondents

The survey results indicates that 33.3% of respondents were employed, while 66.7% were self-employed. Self-employed individuals may have less stable income and may require more flexible loan options.

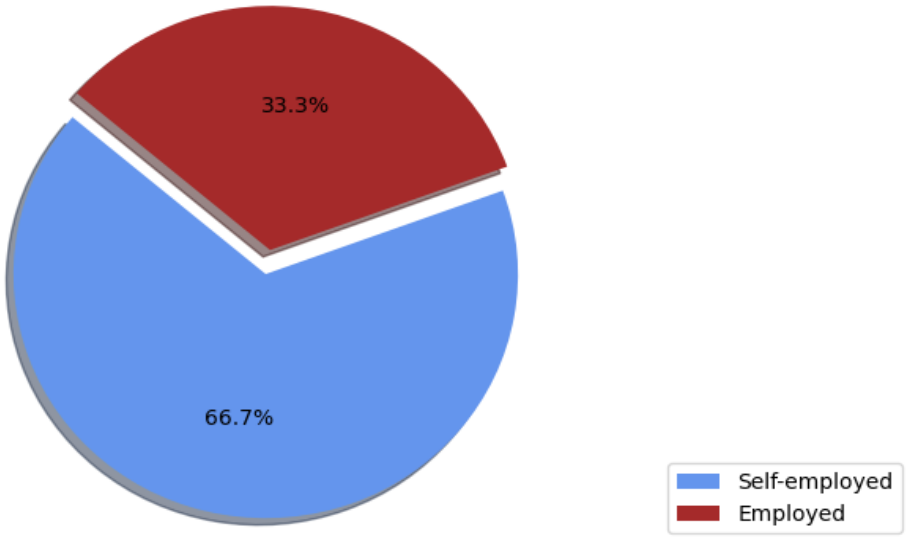


Figure 14: Employment level of the Respondents at SELF Microfinance Fund

(vi) Residential ownership of the respondents

The survey reveals that 39.2% of respondents owned their land, while a large portion (45.1%) owned other types of property. This suggests that property ownership is an important factor in loan applications, as these individuals may use their assets as collateral.

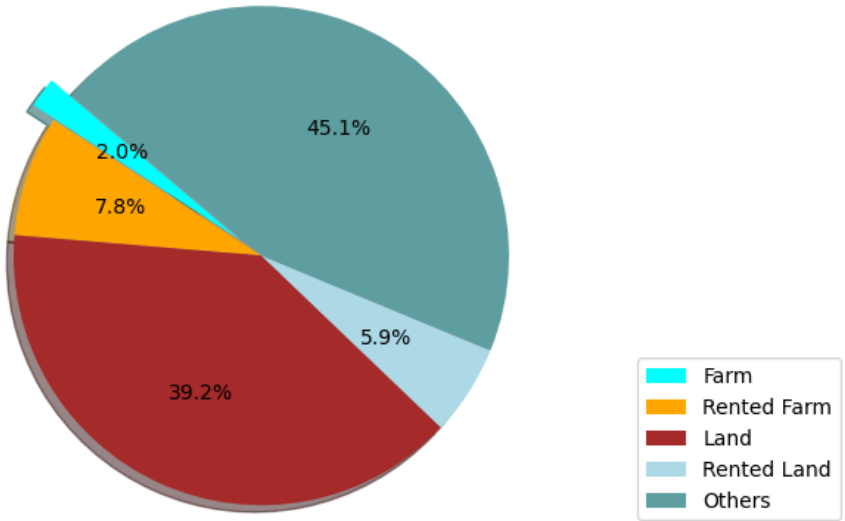


Figure 15: Residential ownership of the respondents

(vii) Types of mobile phone owned by the respondents

The question asked *"what kind of phone do you own?"*. As fig. 16 shows that 84.3 % of the respondent's own smartphones while 15.7% own regular phones. These results entail that most of the respondent's own smartphones.

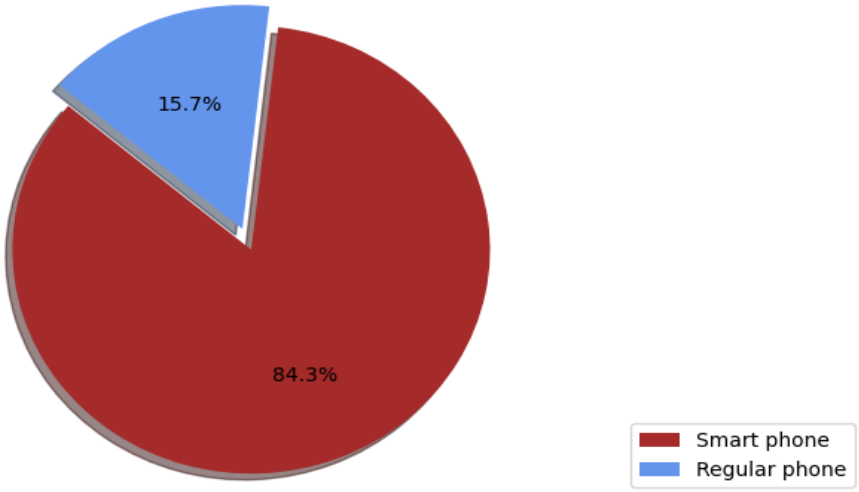


Figure 16: Type of mobile phones owned by respondents

(viii) Developed mobile app features from respondents

The respondents shared their opinions on whether or not they had ever used a mobile app, and developed features that should be featured in the integrated loan lending mobile application. The respondents proposed the following features: Feedback notification, security, faster, ease to use, and report generation. The question asked *"what exactly would you prefer to be included in this loan Mobile application?"* as described in Fig. 17. The results indicate that most of the respondents (71.2%) developed that security is important to the integrated loan lending mobile application.

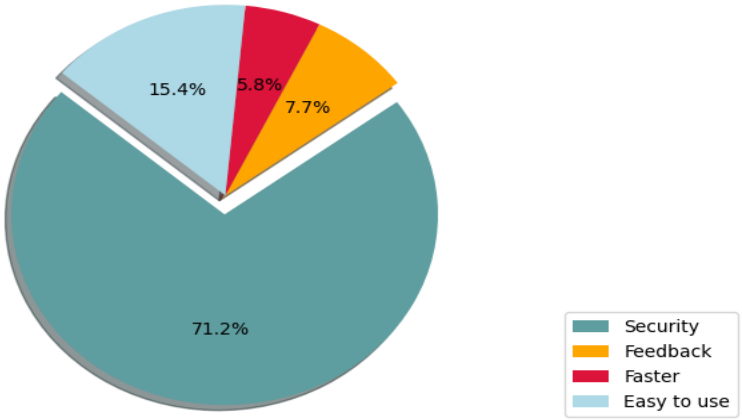


Figure 17: Features developed by respondents

4.1.2 Focus group discussion results

Focus group discussion was conducted to employees to learn more about SELF Microfinance Fund's existing and future loan processing styles. The focus group discussion guide is shown in Appendix 2. The focus group discussion session included a live loan application

demonstration using an Integrated Loan Lending Mobile Application prototype. The participants were encouraged to comment on how well the feature fit into both traditional and digital loan application methods. A focus group discussion with a randomly chosen sample of SELF Microfinance Fund system users reveals that most respondents had issues with the current loan processing method. They suggested developing a new system to do all loan processes from anywhere, including their branches, especially with targeted customers from remote areas. They said that:

> *We need a digital field application which will help us do all loan process activity in one platform (system) to simplify the lending process and reach many targeted customers in a remote area."* Another respondent said, *"We need an efficient loan mobile application for both customers and staff members of SELF MF.*

(i) Focus group discussion with SELF MF credit officers

Question: What issues or concerns have you had with this current method of loan process for customers?

Answer: "The focus is on remote area customers, the current methods failed to reach many remote area customers due to avoidance reasons like data accuracy and the cost of processing the loan for the customers."

Question: The credit system you are currently using, does it allow you to make group loans?

Answer: "*We have different systems which carry additional loan registration for group and Individual registration. It would be nice if we had a system that includes all sub-systems, so you do not have to enter another system to find out who someone is. It will make work easier for loans, and it will also cut down on paperwork."*

Question: Which way did you reach the remote areas and the group loan registration?

Answer: By the traditional method, we use printed paper to enter the information of the borrowers; when we come back, we have to enter the information into the concerned system, which takes time and is costly.

Question: What recommendations would you provide to the director of this program if you had the chance?

Answer*: "To have a digital field application like a mobile application that will help us in the lending process to reach many customers, reduce cost, and reach our remote area targeted customers."*

(ii) Focus group discussion with SELF MF credit managers

Question: What are the problems that remote Tanzanian areas face?

Answer: "*lack of resources for thorough follow-up, departmental system breakdown, irregularities in the management of credit risk, and insufficient regulatory requirements*."

Question: Consider how you initially got connected with this lending-related service. What were your initial thoughts?

Answer: *"Credit score, current income, employment history, occupation, repayment history, amount of loan, purpose of the loan, surplus income, and value of your collateral."*

Question: I would like you to assist me in evaluating Kopaada, group and personal loan lending services. I want to know how I can enhance the service and its impact on customers and staff of SELF MF. What did I overlook? Is there anything you think I should have discussed but I did not?

Answer: *"security issue as we deal with money issues and customers' information, notification features, report generation, combining Kopaada, group and personal loan lending registration options in one system, and putting all products into one Application. So that it will be easier for the customer and staff to process promptly".*

4.1.3 Identified system requirements

Requirements, as defined by the Business Analysis Body of Knowledge (BABOK), are a practical illustration of a business need (Rosenberger & Tick, 2018). A questionnaire and Focus Group Discussion guide, as shown in Appendix 1 and Appendix 2, respectively, were used to collect information on the system's requirements.

(i) Functional requirements

Functional Requirements are requirements for product features or capabilities that developers must include to allow consumers to perform their duties. The development team and the stakeholders must make them apparent. Functional requirements often explain how a system can behave under particular circumstances, as shown in Table 8.

Table 7: Functional requirements

S/No.	Functional Requirement	Description
1	Registration of users	The system should allow users to register by providing their information and creating their profiles. Also, users should be able to generate their usernames and passwords.
		The system should allow All staff members to register according to their roles and respective duties.
2	Account Management	The system should allow the System Administrator to set roles, update, delete, edit, create, add, verify, and manage the whole system (users, branches, and products).
3	Log In	The system should allow the users to log into their account with their credentials (username and Password)
4	Generate Report	The system should allow the users to generate reports according to their needs and roles.
5	Select branch	The system should allow the user to select the branch located during the loan application.
6	Notification	The system should be able to send notifications via SMS to the users about their application status and also reminder notifications on repayment.
7	Loan Category	The system should allow the users to select a loan category for either personal or group loans.
8	Apply Loan	The system should allow the borrowers to apply for a loan.
9	loan verification	The system should allow the credit team to oversee, review and verify the loan application.
10	Basic details interface	The system should allow the customer to fill in basic details based on the loan product. Moreover, upload the necessary documents.
11	Loan status view	The system should allow the users to view the status of the applied loan. (Pending or approved, rejected).
12	EMI calculator	The system should allow the users to determine the amount of debt they can take on and the amount they can set aside each month for loan repayments. It displays the interest rate charged on the principal loan amount across various payback terms.

(ii) Non-Functional requirements

The non- functional requirements are as shown in Table 9.

Table 8: System Non-Functional Requirements

S/No.	Non-Functional Requirement	Description
1	Security	The system should be able to send a security code for login verification, as the system uses two-factor authentication for security purposes. When a user logs into an account, this might help confirm their identity. To safeguard against possible hackers, accounts may be locked after several failed login attempts.
2	Localization	The system should be able to provide language selection according to geographical location, for this app has two languages (Swahili and English). Also, currently use Tanzania currency only.
3	Speed	The system should respond fast to user commands even when multiple applications run.
4	Usability	The system should be able to provide usable applications with interactive navigation, compelling user interfaces, and purposeful/determined features.
5	Maintainability	The system should be able to be maintained by adding, editing, remove both requirements features.

4.1.4 System design result for integrated loan lending mobile application for SELF microfinance fund

Integrated a mobile lending app with core Microfinance systems required careful consideration of crucial architecture components. These components facilitate smooth communication and data exchange between the app and the Microfinance infrastructure, enhancing functionality and user experience, as the design in Fig. 18 depicts the platform architecture.

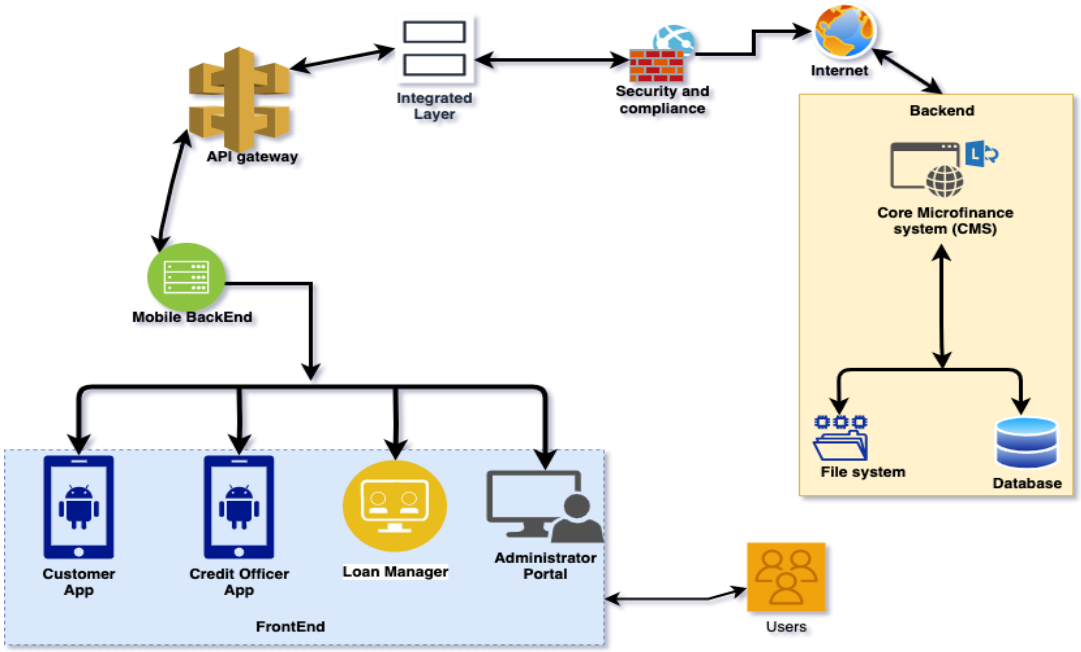


Figure 18: Integrated Loan Lending Mobile Application Architecture

The Mobile App Interface provides a user-friendly layer for users to interact with lending features. In addition, the Mobile App Backend acts as an intermediary, handling business logic and data synchronization between the app and Microfinance systems. The API Gateway acts as a unified interface for communication between the app and Microfinance systems, ensuring the security and routing of API requests. The Integration Layer enables seamless data exchange between systems through adapters, connectors, or middleware.

The core microfinance systems include Kopaada, iMFAS (group loan), and Oracle (personal loan) database. Data Storage and Database components ensure data integrity, security, and scalability for loan-related data. The Security and Compliance component focuses on protecting sensitive information and complying with regulations. By incorporating these components, the mobile lending app could be integrated effectively with core Microfinance systems, enabling efficient and secure lending operations.

4.1.5 Mobile application developed results

(i) Integrated loan lending mobile application results

The ten main parts of the developed mobile app are the splash screen and login screen, registration screen, Administrator dashboard, customer screen, user profile, product screen, credit officers screen, report, EMI calculator, and database. Integration loan lending mobile application aims to improve and simplify communication between an organization's internal

Core Microfinance systems and its relationships with outside parties. System integration helps accelerate the flow of information and reduce operational costs. Internal communications between users at various levels are intended for use with this mobile application. Each user will need to get initial registration information to facilitate first-time login. To help the user feel at ease and valuable when exploring the program, the user profile is displayed in the app's navigation drawer. The backend code of an integrated loan lending mobile application prototype code shown in Appendix 4. Therefore, the main components are explained below.

Login screen

This screen asks users to enter their login information (phone number and password). However, for the staff who log in with their phone number, the verification codes are sent to their phone number via regular SMS so they can access the main interface. Using a cryptographic hash function, the password is hashed, and the values are kept for comparison. This makes it possible for the application system to be secure and uninvaded. An UI for signing into the mobile application is shown in Fig. 19.

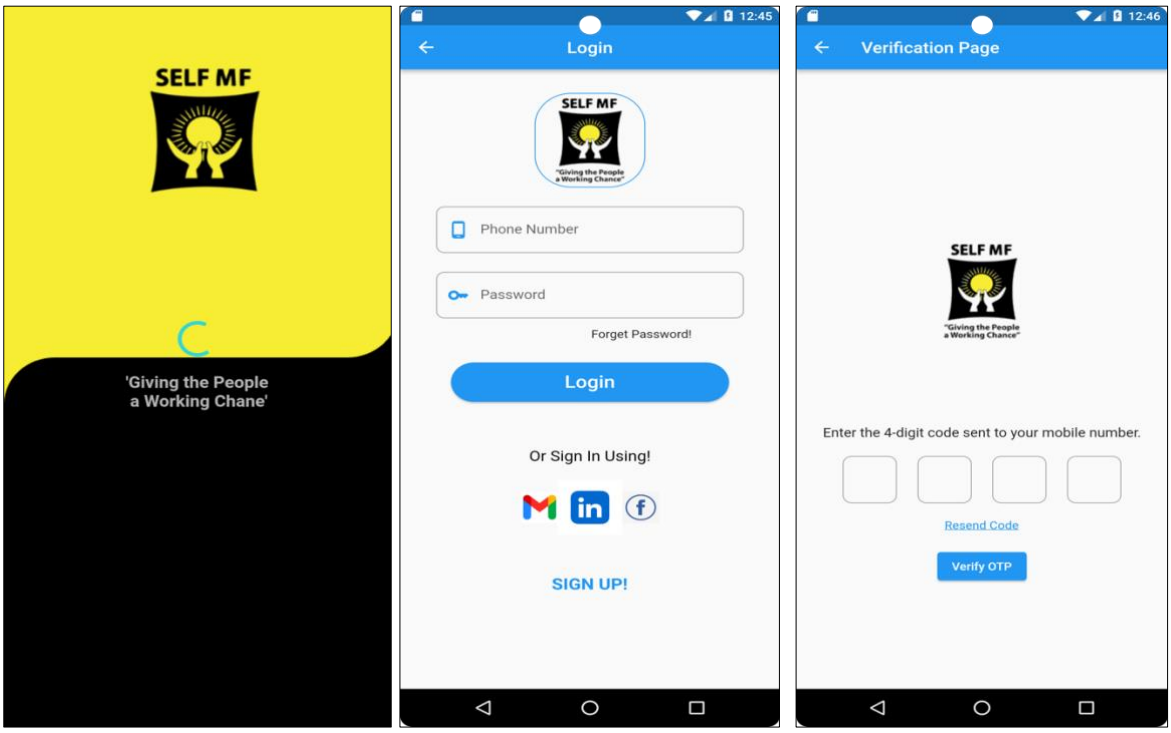


Figure 19: Initial splash screen and login user interface

Product interface/main dashboard

This is the user's homepage, which comprises many widgets that the user can navigate through. It has several different categories of loan products, each with its customized icons, such as the following: Kilimo Loan, Biashara Loan, Mkulima Loan, Mshahara Loan, Pamoja Loan, Kopa Ada Loan, and Makazi Loan. When the customer clicks on the Kilimo loan product, they are able to fill in the basic information for the loan application. The primary screen interface is shown in Fig. 20.

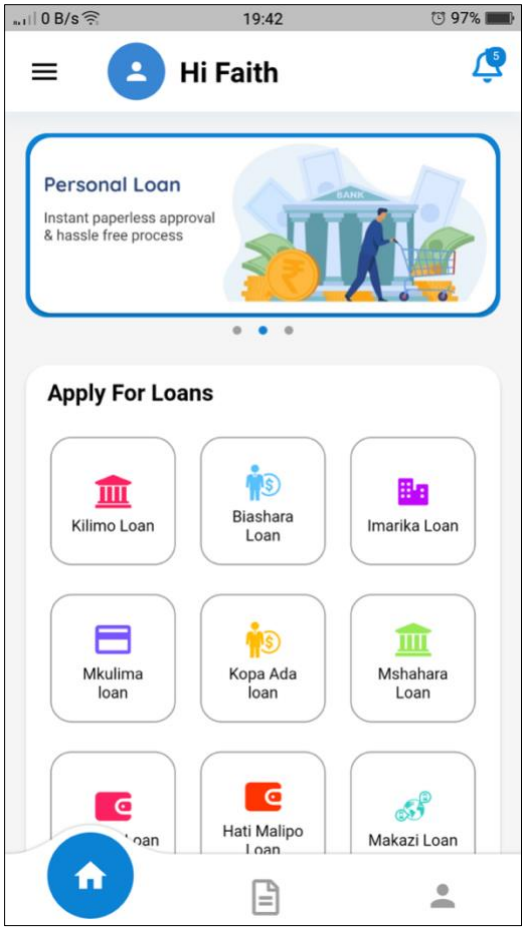


Figure 20: Home Screen for loan product application

The Applications interface screen

The application interface form is a user interface that allows users to input their personal and financial information to apply for a loan in an integrated loan mobile application. It typically includes fields for personal information, employment information, and documentation to ensure accuracy. The design was user-friendly, easy to navigate, and provided clear instructions and error messages. The Fig. 21 describes the application form.

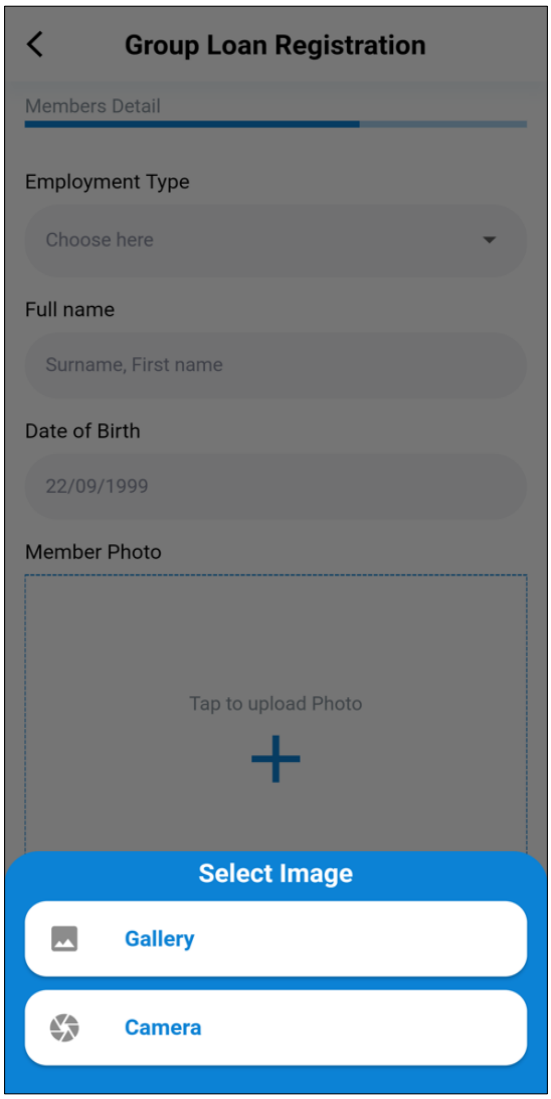


Figure 21: Loan application interface Screen

Applications view screen

In a nutshell, the loan application page lists all the loans that have been applied for and are now in pending status, assigned status, or verification status. In a nutshell, it gives the current status of the applied loan, as seen in Fig. 22.

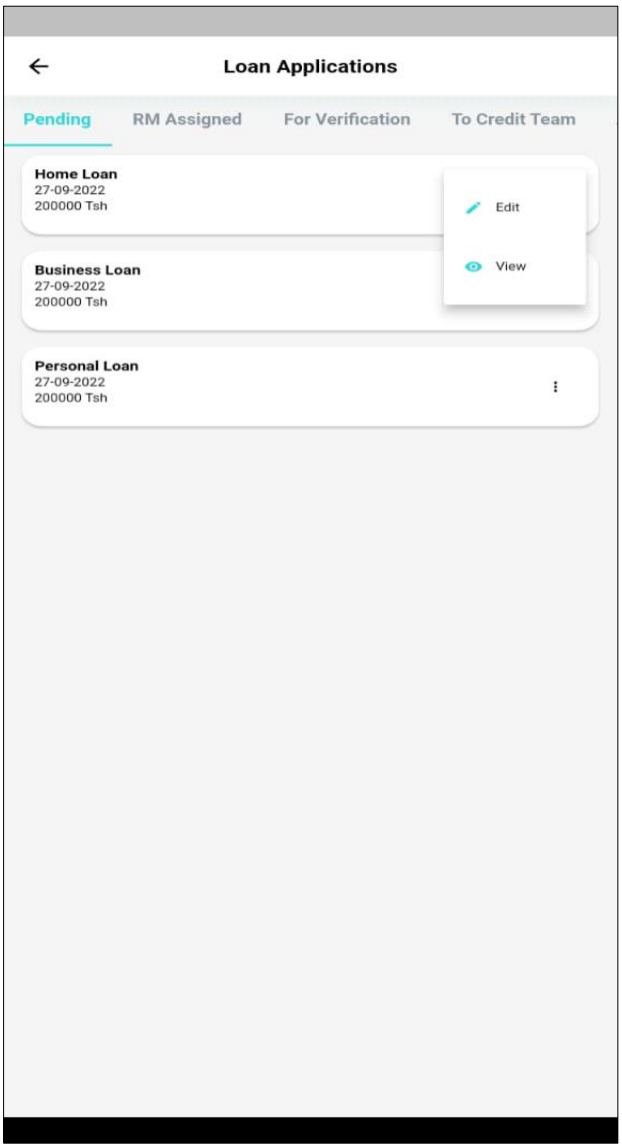


Figure 22: Loan application status view

Administrator dashboard

An admin dashboard for an integrated loan mobile application provided administrators with an overview of the critical metrics and data related to the loan application process. It includes features such as approved users, total loan approval, total loan requested, loan product, user groups, and reports. The dashboard allowed administrators to make informed decisions and take action when necessary, such as managing user accounts and loan products, generating reports, and analyzing user behavior, as shown in Fig. 23.

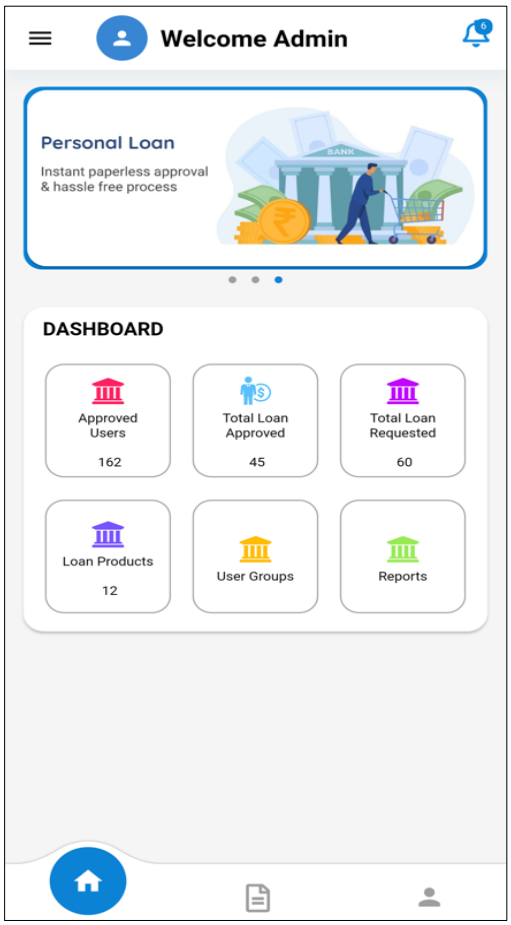
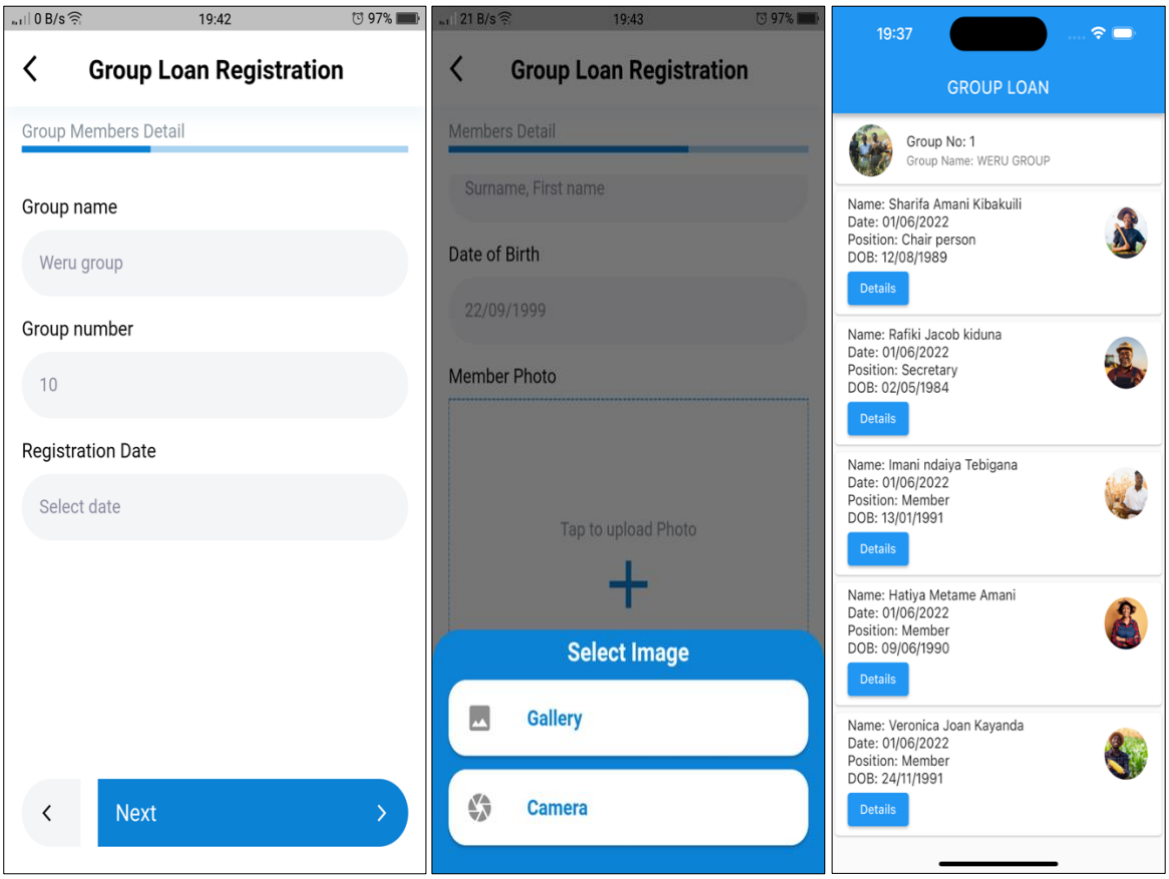


Figure 23: Shows Administrator's Screen

Group loan

In an integrated loan mobile application, applying for a group loan where each person is a guarantor of another involves downloading and installing the app, forming a group, filling out a loan application form, credit assessment, signing the guarantor agreement and uploading it, and loan repayment. Therefore, the mobile application offers a more efficient and convenient way to apply for a group loan, sign the agreement, and monitor repayments as shown in Fig. 24.

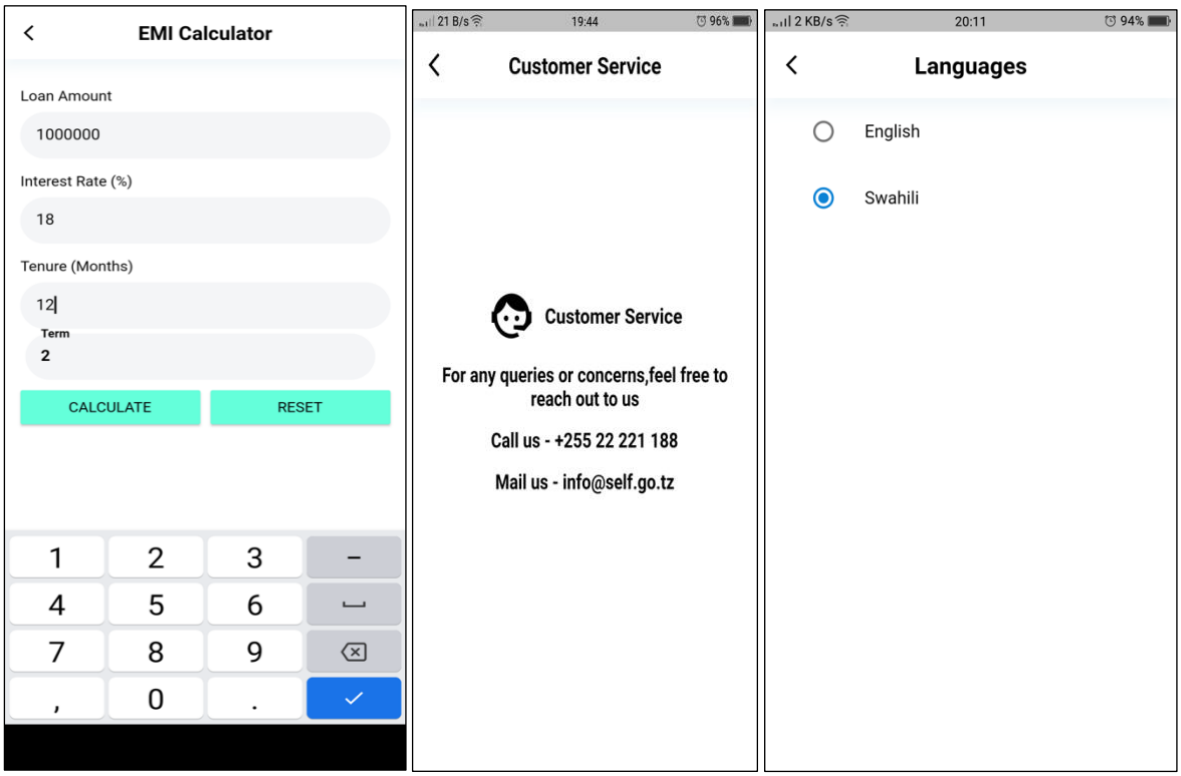


(a) **(b)** **(c)**

Figure 24: Shows group registration in (a) and (b), and (C) represents the group output details

Settings

The system has a settings page that allows the user to select other services available in this system. An example of the items on the settings page is shown in Fig. 25 (a), an equated monthly installment (EMI), (b) customer service, where you can find helpful information, and (c) the languages page, which is used to change languages.



(a) **(b)** **(c)**

Figure 25: Shows three of the settings pages; (a) Loan EMI calculator, (B) customer service, and (c) Languages change page

4.1.6 System testing result

(i) Unit testing

Each prototype unit underwent testing to ensure that it produced usable output. This is then utilized to determine a general evaluation of the units' functionality. System testing is judged based on login, user registration, dashboard, report generation, and other factors. The outcomes of the unit for the user authentication process are shown in Table 10.

Table 9: The user authentication unit test

Unit Testing Area	Outcome Testing	Results
User Registration	User should be able to create an individual username on the system and register themselves if they have not already.	PASS
Login	The system should allow the registered user to login into a system with a unique username (phone number) and shall be able to receive OT P.	PASS
User Roles update	The system should enable the creation, suspension, and deletion of user accounts for customer and all staff representatives by the system administrator.	PASS
View loan products	The information should be accessible to every user that successfully logged in.	PASS
Select loan type	Customers should be able to select the type of loan to apply for, either a Group loan or a Personal Loan.	PASS
Logout	Users are capable of logging out of the mobile application.	PASS

(ii) Integration testing

Each test case is listed in a row in Table 11, with columns for the test description, expected result, actual result, and pass/fail status. The expected result column describes what happened when the test was run, while the actual result column shows what happened. Finally, the pass/fail column indicates whether the test passed or failed based on comparing the expected and actual results.

Table 10: System testing for an integrated loan lending mobile application with a core microfinance system

Test Description	Expected Result	Actual Result	Pass/Fail
Verify user login functionality	User should be able to login successfully.	User was able to login successfully.	Pass
Verify loan application form submission	Loan application form should be submitted successfully.	Loan application form was submitted successfully.	Pass
Verify loan approval process	Loan should be approved if the application meets the criteria.	Loan was approved as the application met the criteria.	Pass
Verify loan repayment process	Loan repayments should be processed successfully.	Loan repayments were processed successfully.	Pass
Verify user account management	User should be able to manage their account settings.	User was able to manage their account settings successfully.	Pass

(iii) System testing

System testing entails evaluating the entire system. Testing is conducted using a fully functional and comprehensive approach to ascertain whether the system satisfies the precise criteria and that functionalities operate as needed. Testing was done to ensure that the development of an integrated loan lending mobile application and vice versa could retrieve information entered into the database of the Core Microfinance System.

Table 11: System testing for an integrated loan mobile application with a core microfinance system

System requirement testing criteria	Testing outcome	Results
Registration of users	System users register with their complete details, full name, phone number, email address, and set password, then click the register button to the information added to the database.	PASS
Account Management	The system administrator could approve the requests, assign roles, update, delete and edit.	PASS
Log In	All successfully registered users could log in to the system; if they failed, the system requested to log in again. Then, the successful login goes to the next page after clicking the login button.	PASS
Generate Report	Generate loan application report	PASS
Select branch	The customer and credit officer select the branch's region location where they belong or make the loan application.	PASS
Notification	The customer received the notification of their loan status as soon as the application was reviewed, successful or failed, and also notified the borrowers about the repayment schedule before the deadline	PASS
Loan Category	Users select the loan category according to their kind of loan application, either belongs to a Group loan or a Personal loan.	PASS
Apply Loan	After successfully logging in, go to the loan product page and click the loan product item will direct take to the basic details page to fill in the basic information needed for the loan application.	PASS
loan verification	Verify the received loan application	PASS
Basic details interface	Fill in the needed Identity details, which will match some official document details, and upload the approved document for reference.	PASS
Loan status view	Viewing the loan application status can either be pending, verified, or rejected.	PASS
EMI calculator	Calculating EMI	PASS

4.1.7 System validation results

To validate an integrated loan lending mobile application with a sample of 20 participants out of 51, a questionnaire, as shown in Appendix 3, was used to collect feedback on the app's usability, functionality, and overall user experience. The steps include developing a

questionnaire, recruiting participants, conducting the test, and analyzing the results. The results are presented in a tabular format that summarizes the ratings on different aspects of the app. In the development of an integrated loan lending mobile application, User Acceptance Testing (UAT) was used as the final phase of testing before the application was released to end-users. During UAT, a selected group of 10 representative clients from Mwasonga, Kigamboni, and 10 from the SELF MF team were involved. Typically, the application's target audience interacts with the mobile app and provides feedback based on their experience.

The main objectives of User Acceptance Testing were to validate business requirements, assess usability and user experience, validate functionality, identify bugs, and collect feedback. Successful UAT ensured that the development of an integrated loan lending mobile application was ready for widespread use and met the needs and expectations of its intended users. Any identified issues were addressed, and the application was refined based on user feedback, enhancing its chances of success when it went live. Users find the loan lending mobile app highly engaging with an aesthetically pleasing interface. It excels in usability, offering a clean layout for seamless navigation. Security satisfaction is generally high, with optimism about enhanced loan access. The app empowers users with transparent information, and multilingual support enhances communication. It successfully caters to both remote and urban beneficiaries, ensuring swift performance. Overall, the app demonstrates positive user response, with potential for refinement in user guidance. The results of system validation results are shown in Table 13.

Table 12: System Validation Results

The Validation Features	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree
The system's user interfaces are interactive and aesthetically pleasing.	0	0	1	9	10
The mobile application interfaces are cleanly laid out and simple to use without any guidance.	0	0	0	4	16
I'm satisfied with the app's security.	1	0	2	5	12
The loan mobile application meets the conditions to enhance loan access from SELF Microfinance Fund.	0	0	3	6	11
The Loan Mobile App will provide us with all the information we need to access.	0	1	2	5	12
Language selection will enhance the loan communication process.	0	0	0	2	18
The mobile loan app will help remote and urban loan beneficiaries to get this service easily and quickly.	0	0	1	2	17
I'm happy with how well the mobile app performs and how quickly it responds to put commands.	0	0	0	0	20
Using this mobile app does not require any training or assistance.	10	5	2	0	3

The results presented in Table 13 show the feedback and perceptions of users regarding various aspects of the development of an integrated loan lending mobile application. Overall, a positive reception was observed among users, particularly concerning the system's user interfaces, widely considered interactive and aesthetically pleasing, with the majority of users agreeing or strongly agreeing. The mobile application interfaces also received favourable responses, with users finding them cleanly laid out and easy to navigate without guidance. Satisfaction with the app's security was expressed by a substantial number of respondents.

Additionally, a majority of users believed that the loan mobile application met the necessary conditions to enhance loan access from the SELF Microfinance Fund. The application's role in providing comprehensive information for users was acknowledged positively, and the inclusion of language selection was widely appreciated for enhancing communication. The mobile app was perceived as beneficial for both remote and urban loan beneficiaries, making service accessibility convenient. Users unanimously expressed satisfaction with the app's performance and responsiveness. However, a noteworthy aspect was the differing opinions on the need for training or assistance, with a segment of users indicating a preference for additional guidance. In summary, while the overall user feedback was positive, the findings highlighted specific areas for potential refinement and user guidance, particularly in addressing the training needs of a subset of users.

4.2 Discussion

Comparing the functional requirements of the mobile application with those of a previous study conducted by Sarosa *et al.* (2021), it is evident that both studies recognized the importance of features such as loan data records, savings installment history, notification, and group chat. However, this current study expanded on those features by incorporating additional functionalities such as group loans, administrator access, credit officer support, board of directors, or loan reviewer features, and a loan calculator. These additions were made to improve the accessibility, responsiveness, and overall user experience of the mobile application. To cater to the needs of non-educated end-users, the study also incorporated language change features, similar to a study conducted by Flick (2020) . This addition aims to enhance the interaction and usability of the application for individuals with limited education or language barriers, further emphasizing the inclusivity and user-friendliness of the developed solution.

Overall, the findings of this project shed light on the perspectives, characteristics, and preferences of the respondents regarding the implementation of an integrated lean lending mobile application. The results highlight the potential of such an application to address the financial needs of the target population, particularly among self-employed individuals with collateral assets. The study's contribution lies in its expansion of functional requirements and inclusion of non-functional elements to improve the accessibility, responsiveness, and security of the mobile application.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The project findings reveal that the primary beneficiaries of the SELF Microfinance Fund's loan program are largely individuals in the low-income working class, including many who are basic school graduates and reside in rented homes within Dar es Salaam's urban areas. The project's overarching objective was to develop an integrated loan-lending mobile application that enhances accessibility and efficiency for these targeted beneficiaries, streamlining their loan application process and promoting financial inclusivity. To gather the findings, this study employed a combination of qualitative and quantitative methods, including stakeholder interviews, user surveys, and a needs analysis to identify system requirements. The development process incorporated Agile methodology, which allowed iterative testing and feedback from potential users, ensuring that the application effectively met user needs and requirements for functionality and usability. During the application's development, several challenges emerged, such as ensuring data security, enabling offline access for field officers, and creating an intuitive interface accessible to users with varying levels of digital literacy. To overcome these, the study implemented robust data encryption protocols to safeguard sensitive information. The also incorporated a local caching mechanism, allowing field officers to access essential data offline during remote visits. Additionally, we designed a simplified user interface with multilingual support to enhance accessibility for a diverse user base.

5.2 Recommendations

Based on the reached conclusion in this study, the following recommendations were made:

(i) The developed system eases the loan applications, which led to high loan turnaround time and cost in time and resources. It is also user-friendly, cost-effective, efficient, and timesaving to do loan application. It may be installed on smartphones, and microfinances can use the created system if a policy is developed by the Ministry of Finance and Planning. The development of an integrated loan lending mobile application for the SELF Microfinance Fund in Tanzania has enhanced financial inclusion and efficiency. As the microfinance regulator under The Microfinance ACT No. 10 of 2018, the Bank of Tanzania can prioritize data security and regulatory

compliance, adapting to the evolving technological landscape. Ongoing collaboration and dialogue between financial institutions and regulators are crucial for navigating the challenges and opportunities presented by the growing FinTech ecosystem.

(ii) The microfinances business might still profit greatly from the system, even though it is anticipated to have a substantial influence on the sector. Allowing clients to process their requests for applying for their loan online and sending them alerts when their requests are approved is one of these benefits.

(iii) The developed loan lending mobile application is its inability to function offline, attributed to the lack of integrated USSD functionality. This limitation arises from the necessity for clients to navigate a step-by-step loan application menu via USSD, which makes offline usage impractical. Thus, the application becomes unusable for individuals who do not possess a smartphone, significantly restricting its accessibility in regions with low smartphone penetration or in demographic groups that predominantly use feature phones. On the other hand, the integrated loan lending mobile application was exclusively designed for credit services, posing a challenge for borrowers to track their remaining amount or transaction history within the system.

(iv) The Future development of the integrated loan lending mobile application will include USSD functionality to enhance accessibility for users without smartphones. Additional features such as QR code scanning, advanced authentication security layers, multi-number OTP registration, and fraud detection mechanisms will be incorporated to improve customer identification and overall system security.

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APPENDICES

Appendix 1: Survey questionnaire for SELF microfinance fund clients

DEVELOPMENT OF AN INTEGRATED LOAN LENDING MOBILE APPLICATION FOR SELF-MICROFINANCE FUND IN TANZANIA

QUESTIONNAIRE FOR CLIENT

Section A: Demographic Data

Interviewee label ……....

1. What is your gender?

A. Male [ ]

B. Female

2. What is your education level?

A. Higher Education Level

B. Ordinary Level

C. High School Level [ ]

D. Primary Level

E. other

3. What is your Age?

A. 55-65

B. 46-55

C. 36-45 [ ]

D. 26-35

E. 15-25

Section B: Key Questions

4. What kind of phone do you own?

A. Smartphone

B. Normal phone [ ]

5. which occupation?

A. Employed [ ]

B. Self-employed/entrepreneur

6. The procedure of processing Loan at SELF MF

A. Difficult

B. Not difficult [ ]

7. Where do you get information about SELF MF?

A. From Mass media

B. From SELF MF customers

C. From Neighbor [ ]

D. From SELF MF staff

8. what do you own?

A. The land/plot where you live

B. Rented land/plot

C. Rented farm [ ]

9. Do you have ownership documentation to prove?

A. YES

B. NO [ ]

10. Do you have an important identity that identifies you?

A. YES

B. NO [ ]

If YES, which type of identity?

A. National Identification card

B. National Identification number

C. Zanzibar resident ID [ ]

D. TASAF identification card

E. Driver's license

If NO gives reasons for its absence/scarcity

i. ……

11. Which place do you live in?

A. Town

B. Village/remote area [ ]

12. If in Qn 11 above your choice is Village, is there availability of electrical power to charge your phone?

A. YES

B. NO [ ]

13. If No in Qn 12 then give other sources of power which you may be available.

…….

14. In terms of borrowing money, which of these companies would you feel most comfortable dealing with?

A. Banks

B. SACCOS

C. Pension Fund

D. Mobile Money Service Providers [ ]

E. Individual Moneylenders in the community

F. Family/friend

Section C: Effect of an Integrated Loan Mobile Application for SELF Microfinance Fund to you.

15. What do you think we can implement Mobile Application for Loans?

A. Helpful

B. Not helpful [ ]

16. what exactly would you prefer to be included in this loan Mobile application?

……

17. for the type of phone you have, you will prefer?

A. The mobile app

B. USSD Code [ ]

18. In your opinion do you think "Integrated Loan Mobile Application" will be beneficial to you?

A. YES

B. No

C. I don't know [ ]

Thank you for your valuable time!

Appendix 2: Survey focus group discussion guide for SELF microfinance fund team

DEVELOPMENT OF AN INTEGRATED LOAN LENDING MOBILE APPLICATION FOR SELF-MICROFINANCE FUND IN TANZANIA

FOCUS GROUP DISCUSSION GUIDE FOR SELF MF TEAM

1. The topic for today is "Integrated Loan Mobile Application for SELF Microfinance Fund" (Explanation). How do you feel about it in general?
2. What do customers desire from Self?
3. How would you like interactions with your customers to be?
4. How do you envision technology can improve your interactions with your customers?
5. What type of phones do you own?
6. What do you already know about this product? What is something you would like to learn more about it?
7. What issues or concerns have you had with this current method of loan process towards customers?
8. What features do you think our competitor's product has that we don't?
9. What would you say to a developer person if you didn't want to utilize the product but were being pushed to buy it?
10. On average, how much money do you spend on data bundles e.g., per week? (If they cannot afford large bundles)
11. What is your information literacy level e.g., are they capable of reading and understanding simple explanations?
12. What feature of this product would you eliminate if you had the option, and why? What feature of our product is your favorite, and why?
13. What are some of your basic values and beliefs that inspire you to choose this product over others?
14. What will change in your use of this product over the last three years?
15. Is there anything else you'd like to contribute to this product's discussion?

Thank you for your valuable time!

Appendix 3: System validation questionnaire

VALIDATION QUESTIONNAIRE FOR "DEVELOPMENT OF AN INTEGRATED LOAN LENDING MOBILE APPLICATION FOR SELF-MICROFINANCE FUND IN TANZANIA"

System Feature	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree
The system's user interfaces are interactive and aesthetically pleasing.					
The mobile application interfaces are cleanly laid out and simple to use without any guidance.					
I'm satisfied with the app's security.					
The loan mobile application meets the conditions to enhance loan access from SELF Microfinance Fund.					
The Loan Mobile App will provide us with all the information we need to access.					
Language selection will enhance the loan communication process.					
The mobile loan app will help remote and urban loan beneficiaries to get this service easily and quickly.					
I'm happy with how well the mobile app performs and how quickly it responds to input commands.					
Using this mobile app does not require any training or assistance.					

Appendix 4: The final prototype codes

```
//flutter
import 'dart:convert';
import 'package:credit_app/controllers/RegistrationController.dart';
import 'package:credit_app/controllers/otp_verification_controller.dart';
import 'package:credit_app/views/Home/home_screen.dart';
import 'package:credit_app/views/Home/home_screen2.dart';
import 'package:credit_app/views/LoanApplications/loan_application_screen.dart';
import 'package:credit_app/views/OtpVerification/otp_verification_screen.dart';
import 'package:credit_app/views/bottom_loan_screen.dart';
import 'package:credit_app/views/bottom_navigation_screen.dart';
import 'package:credit_app/widget/appBarWidget.dart';
import 'package:credit_app/widget/common_padding.dart';
import 'package:credit_app/widget/custom_textformfield.dart';
import 'package:credit_app/widget/primary_button.dart';
import 'package:flutter/cupertino.dart';
import 'package:flutter/material.dart';
//packages
import 'package:get/get.dart';
import 'package:http/http.dart' as http;
class LoginController extends StatefulWidget {
  @override
  State<StatefulWidget> createState() {
    return _LoginPage();
  }
}
class _LoginPage extends State<LoginController> {
  ScrollController scrollController = ScrollController();
  String errormsg;
  bool error, showprogress;
  String phone_number, password, user_type;
  final _username = TextEditingController();
  final _password = TextEditingController();
```

```
startLogin() async {
  String apiurl = "http://sccult.greenrevo.co.tz/login.php"; //api url
  final data = {
    'phone_number': phone_number, //get the username text
    'password': password, //get password text
  };
  var response = await http.post(Uri.parse(apiurl), body: data);
  if (response.statusCode == 200) {
    var jsondata = json.decode(response.body);
    if (jsondata["error"]) {
      setState(() {
        showprogress = false; //don't show progress indicator
        error = true;
        errormsg = jsondata["message"];
      });
    } else {
      print("blahaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa $jsondata");
      //888888888888888888888888 FOR ADMIN USER
88888888888888888888888888888888888
      if (jsondata["mtumiaji"] == "admin") {
        setState(() {
          error = false;
          showprogress = false;
        });

        if (jsondata['mtumiaji'] == "admin") {
          Navigator.of(context).pushNamedAndRemoveUntil(
              '/HomeScreen', (Route<dynamic> route) => false);
          _username.clear();
          _password.clear();
          setState(() {
            errormsg = "";
          });
        }
```

```
        //88888888888888888888888 END FOR ADMIN USER
8888888888888888888888888888888888888
        //88888888888888888888888 FOR A NORMAL USER
88888888888888888888888888888888888888
      } else if (jsondata["mtumiaji"] == "user") {
        setState(() {
          error = false;
          showprogress = false;
        });
        if (jsondata['mtumiaji'] == "user") {
          List dataRequired = [
            phone_number,
            jsondata['phone_number'],
            jsondata['uid']
          ];
          Navigator.of(context).push(MaterialPageRoute(
              builder: (c) => BottomNavigationScreen(phone_number:
jsondata['phone_number'])));
          _username.clear();
          _password.clear();
          setState(() {
            errormsg = "";
          });
  //888888888888888888888888 FOR SELF USER
888888888888888888888888888888888888888888
      } else if (jsondata["mtumiaji"] == "loan_officer") {
        setState(() {
          error = false;
          showprogress = false;
        });
        if (jsondata['mtumiaji'] == "loan_officer") {
          print(jsondata);
          List dataRequired = [phone_number, jsondata['email'], jsondata['uid']];
```

```
          Navigator.of(context).pushNamedAndRemoveUntil('/HomeScreen',
(Route<dynamic> route) => false, arguments: dataRequired);
          _username.clear();
          _password.clear();
          setState(() {
            errormsg = "";
          });
        }
        //88888888888888888888888 END FOR SELF MF USER
88888888888888888888888888888
      } else {
        showprogress = false; //don't show progress indicator
        error = true;
        errormsg = "Something went wrong.";
      }
    }
  } else {
    setState(() {
      showprogress = false; //don't show progress indicator
      error = true;
      errormsg = "Error during connecting to server.";
    });
  }
 }
 //TextEditing
 var mobileNumber = TextEditingController();
 var refferalcode = TextEditingController();
 var dsacode = TextEditingController();
 bool agree = false.obs();
 void setAgree() {
  agree = !agree;
  update();
 }
 @override
```

```
void onInit() async {
  super.onInit();
}
@override
void onClose() {
  super.onClose();
  // }
  void resetForm() {
    mobileNumber.text = '';
  }
  @override
  void initState() {
    phone_number = "";
    password = "";
    errormsg = "";
    error = false;
    showprogress = false;
    _username.text = "defaulttext";
    _password.text = "defaultpassword";
    super.initState();
  }
  @override
  Widget build(BuildContext context) {
    // TODO: implement build
    return WillPopScope(
      onWillPop: () {
        return null;
      },
      child: Scaffold(
          appBar: MyCustomAppBar(
            leading: Icon(
              Icons.arrow_back_ios,
              size: 0,
            ),
```

```
  height: 80,
  appbarPadding: 0,
  title: Text('Sign in'),
  centerTitle: true,
),
body: CommonPadding(
  child: SingleChildScrollView(
    child: Column(
      crossAxisAlignment: CrossAxisAlignment.start,
      children: [
        Padding(
          padding: EdgeInsets.only(top: 59),
          child: Column(
            children: [
              Align(
                alignment: Alignment.center,
                child: Text(
                  'Login',
                  style: Theme.of(context).textTheme.headline4,
                ),
              ),
```

POSTER PRESENTATION