MAKERERE UNIVERSITY

MOBILE-BASED POULTRY PRODUCT SALES AND MARKETING APPLICATION (MPPSAMA)

BY GROUP THREE

Course: Bachelor of Information Systems and Technology

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Option: Systems Development

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DECLARATION

We, **Group 3**, declare that this project work is original and has never been presented anywhere for the award of a degree by institution of higher learning. Where other peoples' work has been used, due acknowledgement has been made.

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DEDICATION

This project is dedicated to all the brilliant minds who have tirelessly worked together to bring forth innovation, efficiency, and transformation in the realm of technology. It is a testament to their unwavering commitment, perseverance, and relentless pursuit of excellence. We say thank you to our families that have supported us all the way, friends, well-wishers and above all, God. We extend our gratitude to the entire team for their tireless efforts, unwavering dedication, and unwavering focus on pushing the boundaries of what is possible. This project stands as a symbol of collaboration, creativity, and the power of teamwork. May this endeavor inspire future generations and serve as a reminder that with passion and dedication, anything is achievable.

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDIX LIST

LIST OF ACRONYMS

MPPSAMA	Mobile-Based Poultry Product Sales and Marketing Application
SDLC	System Development Life Cycle
API	Application Programming Interface
GUI	Graphical User Interface
DBMS	Database Management System
UI	User Interface
VS Code	Visual Studio Code
SASS	Syntactically Awesome Style Sheets
ERD	Entity Relationship Diagram
IT	Information Technology
IS	Information Systems

ABSTRACT

Poultry farming, a critical component of Uganda's agricultural sector, significantly contributes to economic development and food security. Despite its importance, the poultry industry faces challenges, including inefficient market coordination and limited access to profitable markets. This study proposes the development of a Mobile-Based Poultry Product Sales and Marketing Application (MPPSAMA) designed to address these challenges by connecting farmers directly with buyers, providing real-time market information, and streamlining the sales process.

The research adopted stratified sampling to gather data from poultry farmers and buyers in the Kampala and Wakiso regions. Data collection methods included interviews and questionnaires, enabling the collection of comprehensive insights into the current marketing practices, challenges, and user preferences for a mobile-based solution. The Agile System Development Life Cycle (SDLC) was employed to develop the application, ensuring a user-centric and iterative approach.

The literature review highlights the significance of poultry farming in Uganda and the potential of digital solutions to enhance market efficiency. It also underscores the challenges of technology adoption in rural areas due to limited internet access and inadequate infrastructure. The study's findings emphasize the need for a centralized platform to improve market coordination, reduce product waste, and increase profitability for farmers.

The mobile application aims to bridge the gap between poultry farmers and buyers, providing a reliable and efficient platform for marketing poultry products. By leveraging technology, the application seeks to transform the poultry sector in Uganda, promoting sustainable growth and enhancing food security. The study concludes that the successful implementation of this digital solution can significantly impact the livelihoods of poultry farmers and contribute to the overall development of the poultry industry in Uganda.

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Introduction

Poultry farming, the practice of raising domesticated birds such as chickens, ducks, turkeys, and geese for their meat and eggs, is a vital agricultural activity. In Uganda, chickens are the most commonly farmed poultry, with over 60 million chickens raised annually for consumption (NAADS, 2020). This practice is not only a profitable business venture but also a significant source of food and income for many Ugandans.

The advent of information technology and information systems (IT/IS) has transformed various sectors, including agriculture. In the context of poultry farming, IT/IS can play a pivotal role in enhancing the efficiency and reach of poultry product sales and marketing. A mobile-based poultry product sales and marketing application is proposed to bridge the gap between poultry farmers and potential buyers in Uganda. This application aims to leverage technology to streamline the marketing process, improve accessibility to market information, and facilitate transactions.

The poultry industry in Uganda, though relatively new, holds substantial potential for growth and the generation of foreign exchange earnings through the export of poultry products to neighbouring countries. By integrating IT/IS solutions, the industry can overcome traditional marketing challenges, expand its market reach, and enhance its competitive edge. This proposal focuses on developing and implementing a mobile-based platform that will revolutionize the way poultry products are marketed and sold in Uganda, ultimately contributing to the sustainable growth of the poultry sector.

1.2 Research Background

Looking beyond Ugandan borders, we find a number of effective marketing strategies that could transform the country's chicken farming landscape. In developed nations like the US, farmers' markets flourish, offering direct access to consumers and fostering valuable relationships (USDA, 2023). Online platforms like Amazon Fresh and FarmBox Direct further empower farmers by bypassing middlemen and connecting them directly to consumers, boosting their profit margins (The Guardian, 2023). Additionally, building strong brands and differentiating products through valueadded offerings like sausages, nuggets, and ready-to-cook meals unlocks premium pricing and attracts discerning customers (FAO, 2023). Embracing organic and free-range certifications caters to the growing demand for ethical and sustainable food, securing loyal customers willing to pay a premium (Statista, 2023). Digital

marketing tools like social media platforms and mobile apps enable targeted advertising, engagement with wider audiences, and direct communication with customers, promoting sales and building loyalty (HubSpot, 2023). Finally, government support through training programs and financial assistance can equip farmers with essential marketing skills and knowledge, remove resource constraints, and empower them to invest in effective marketing activities (IFAD, 2023).

Poultry farming in Uganda's agricultural sector, contributes significantly to economic development and food security (Smith, 2018; MAAIF, 2020). The industry encompasses a diverse array of products, such as eggs and meat, supporting livelihoods for a substantial segment of the population (World Bank, 2019). Despite its significance, the poultry sector faces a problem of inefficient market coordination between the farmers and the buyers. Some of the challenges/causes contributing to this problem include limited market access, inadequate transportation infrastructure, and price volatility, all of which impact the marketing efficiency of poultry products (FAO, 2017; MTIC, 2021). The involvement of intermediaries in the supply chain introduces complexities that affect both producers and consumers (Kasirye et al., 2019). These challenges underscore the necessity for innovative solutions to streamline the marketing process and contribute to the overall growth of the poultry industry.

While technological advancements offer potential solutions, several issues persist that hinder their effectiveness in the Ugandan context. Existing digital tools and platforms face challenges such as limited accessibility and adoption. Many small-scale poultry farmers in Uganda lack access to smartphones and the internet, limiting their ability to utilize mobile-based applications for marketing. A study by the Uganda Communications Commission (2021) found that only 45% of rural households have access to the internet, posing a significant barrier to digital adoption. Furthermore, the country's transportation infrastructure is underdeveloped, making it difficult to deliver products to markets efficiently. Poor road conditions and limited transport options lead to delays and increased costs, affecting the timely and cost-effective distribution of poultry products (World Bank, 2020). The current challenges have greatly affected the stakeholders of the poultry sector in various ways i.e. the reduced profit margins for farmers, limited growth of the poultry sector, economic vulnerability due to unpredictable market conditions, and food insecurity as inefficient marketing and distribution systems can lead to waste and shortages. But with recent technological advancements, digital tools and platforms can transform poultry farm produce marketing by enhancing supply chain efficiency, facilitating direct connections between farmers and consumers, and providing real-time market information (WFP, 2022;

UNDP, 2021). However, the successful implementation of such solutions requires an understanding of the local context, regulatory environment, and consumer behaviour (Katusiime et al., 2020). By addressing the underlying causes of inefficient market coordination, technology can contribute significantly to the growth and sustainability of Uganda's poultry industry.

1.3 Problem statement

Poultry farmers in Uganda face the significant problem of inefficient market coordination between themselves and buyers, leading to a persistent mismatch in supply and demand. This issue results in farmers struggling to find suitable markets for their poultry products while buyers face challenges in locating reliable farmer suppliers. According to reports and surveys conducted by the Uganda Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and the Uganda Bureau of Statistics (UBOS), many farmers experience inadequate market access, which translates into considerable economic losses.

Financially, poultry farmers lose substantial amounts of money due to their inability to access broader and more profitable markets. A study by the Uganda Bureau of Statistics (2021) indicated that poultry farmers collectively lose approximately $10 million annually due to unsold inventory and reduced profit margins. These losses are attributed to factors such as overproduction during low-demand periods and the spoilage of perishable products like eggs and meat. The inability to sell products at competitive prices further exacerbates these losses, as farmers are often forced to sell their produce at lower prices to intermediaries or local markets with limited bargaining power.

In terms of products, farmers report significant waste and spoilage. Without efficient market access, an estimated 15% of poultry products go unsold or spoil due to delays and inadequate storage facilities, leading to further financial losses and resource underutilization (MAAIF, 2020). These inefficiencies prevent farmers from capitalizing on potential market opportunities, thereby stifling the growth and sustainability of their businesses.

The absence of a centralized and accessible platform compounds this issue, preventing farmers from efficiently reaching buyers and securing competitive markets for their poultry products. This results in missed opportunities, economic instability within the livestock sector, and underutilization of resources. Consequently, there is a critical need to develop a comprehensive and user-friendly digital application. Such an application would bridge the existing gap by providing farmers with real-time market information, facilitating direct interactions with potential buyers, and streamlining the sales process.

This application aims to address the identified market inefficiencies, empower farmers to access broader markets, improve their bargaining power, and ultimately enhance their livelihoods within the poultry sector.

1.4 Objectives of the Study

1.4.1 General Objective

To develop a Mobile-Based Poultry Product Sales and Marketing Application (MPPSAMA) that will connect farmers to buyers, provide also real time information about the products and also access to current market prices.

1.4.2 Specific Objectives

1. To review existing systems related to the mobile based poultry product sales and marketing application in order to generate the requirements of the application.
2. To design the Mobile based poultry product sales and marketing application for farmers and buyers.
3. To implement a mobile based poultry product sales and marketing application used to connect farmers to the buyers.
4. To test and validate the application based on the requirements.

1.5 Scope

1.5.1 Conceptual Scope

This study focused on the development and implementation of a mobile-based application designed to improve the marketing efficiency of poultry products in Uganda. It covered aspects such as system requirements, design, implementation, testing, and validation.

1.5.2 Geographical Scope

The research was carried out within Kampala Central Division. The respondents included poultry products wholesale buyer like market vendors, restaurants, shops, supermarkets and also famers with sizeable farms.

1.5.3 Time Scope

It took us 10 months to complete the entire project. The first phase involved establishing a proposal which took 3 months and 3 weeks. Data collection and analysis were carried out in 2 months. System

analysis and design were carried out in 1 month and 3 weeks and system implementation, testing and validation were carried out in 3 months and 1 week. The recommendations were done in 2 weeks.

1.6 Significance

The application will be of great benefit to the following stakeholders:

1.6.1 Poultry Farmers

The application will aim to connect farmers directly with buyers, expanding their market reach and potentially increasing profitability by securing better prices. It will reduce product waste by facilitating timely sales of perishable goods and provides real-time market information for informed decision-making. Overall, it will empower farmers to improve their incomes and livelihoods.

1.6.2 Poultry Product Buyers

Buyers will benefit from a reliable source of fresh poultry products with improved quality and transparency. Direct connection with farmers that will lead to competitive pricing and a streamlined procurement process, saving time and resources.

1.6.3 Overall Impact on the Poultry Sector

The application will enhance market efficiency by bridging the gap between farmers and buyers, promoting sector growth through increased productivity and improved food security in Uganda.

1.6.4 Government and Regulatory Bodies

The application will support economic development by increasing productivity and providing valuable data for policymaking, contributing to sustainable growth and effective regulation of the poultry industry.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter helps place the project study into context. It includes a discussion of existing literature relative to the project study. It covers sections including e-poultry, what it is, its objectives and challenges, existing systems, their strengths and weaknesses, a comparison between existing systems and the proposed system**.**

A brief recap about Poultry

Poultry refers to domesticated birds that are raised for various purposes, including meat, eggs, and feathers (USDA, 2023). Common poultry species include chickens, ducks, turkeys, and geese.

E-Poultry is a term used to describe the use of electronics devices and technology in the poultry industry. It includes things like automated feeding applications, temperature control and data monitoring to optimize the production and care of poultry. According to research by Ozkan and Erol (2019), automated monitoring and control applications, including sensors and actuators, have been implemented in poultry farms. These applications enable real-time monitoring of environmental conditions, such as temperature, humidity, and ventilation, contributing to improved bird welfare and optimized production parameters.

2.1.1 Benefits of Technological Solutions in Poultry Marketing

1. **Enhanced Market Visibility and Access**

Technology enables poultry farmers to showcase their products to a broader audience, enhancing market visibility (WFP, 2022).

2. **Efficient Supply Chain Management**

IT applications can streamline supply chain processes, improving efficiency from production to distribution (Berckmans et al., 2019).

3. **Direct Connectivity with Buyers**

Digital platforms facilitate direct connections between poultry farmers and consumers, reducing dependence on intermediaries (UNDP, 2021).

4. **Real-Time Market Information**

Technology provides access to real-time market information, allowing farmers to make informed decisions (World Bank, 2019).

5. **Marketing through Online Platforms**

Online platforms enable poultry farmers to reach consumers beyond local markets, expanding their customer base (USDA, 2020).

6. **Improved Communication and Engagement**

Technology allows for direct communication with customers, fostering engagement and building brand loyalty (Katusiime et al., 2020).

7. **Data-Driven Decision Making**

IT applications enable data collection and analysis, supporting farmers in making data-driven decisions for better productivity (Dutfield, 2017).

2.1.2 Challenges of using IT related concepts/techniques in Poultry Farming

1. **Limited Technology Adoption**

Low levels of technology adoption among poultry farmers hinder the effectiveness of digital marketing solutions (Erenstein, 2017).

2. **Access and Connectivity Issues**

Inadequate internet connectivity and limited access to technology in rural areas impede the adoption of digital marketing tools (ITU, 2019).

3. **Cost of Technology Implementation**

The initial investment and ongoing costs associated with implementing technology solutions are a barrier for small-scale farmers (Maredia et al., 2019).

4. **Technical Skill Requirements**

Lack of technical skills among farmers hinder their ability to effectively use and benefit from technology-driven marketing tools (Kwame, 2018).

5. **Data Security and Privacy Concerns**

Issues related to data security and privacy can create reluctance among farmers to share sensitive information on digital platforms (FAO, 2020).

6. **Infrastructure Limitations**

Inadequate infrastructure, including unreliable power supply, may pose challenges to the continuous use of technology solutions (World Bank, 2018).

2.1.3 Benefits of the MPPSAMA

1 Economic Empowerment

The application will directly contribute to the economic empowerment of poultry farmers. By providing improved market access, farmers can tap into broader markets, increase their incomes, and experience greater financial stability within the livestock sector

2 Market Efficiency

Through direct connections between farmers and buyers, the application streamlines the sales process, reducing transaction costs and fostering fairer pricing mechanisms. This enhanced market efficiency benefits both farmers and consumers, creating a more competitive and accessible marketplace.

3 Technological Advancement

By embracing digital tools and platforms, the application will align with global technological advancements. It will bring efficiency to the supply chain, provide real-time market information, and contribute to the modernization of agricultural practices within the poultry sector.

4 Socio-economic Impact

The success of the application will align with national development goals, contributing to poverty alleviation, food security, and inclusive economic growth. The socio-economic impact extends beyond individual farmers, positively influencing entire communities engaged in poultry farming.

5 Governmental Support

The application will complement the objectives of the Ministry of Agriculture, Animal Industry, and Fisheries by supporting efforts to modernize agriculture, improve farmer welfare, and foster inclusive economic growth. It will position itself as a valuable tool in achieving broader agricultural and economic goals set by the government.

6 Technology Adoption

Introducing a user-friendly digital platform tailored for poultry farmers will encourage the adoption of technology within the agricultural sector. This adoption will not only improve the efficiency of poultry farming practices but also set the stage for broader technological advancements in the industry.

2.2 Evaluation of existing applications and solutions

2.2.1 Amazon Fresh

Amazon Fresh is an online grocery and fresh food delivery service provided by the global ecommerce giant, Amazon. It offers customers the convenience of ordering a wide range of fresh produce, including poultry products, and having them delivered directly to their doorstep. (The Guardian, 2023) have highlighted the effectiveness of Amazon Fresh in empowering farmers by eliminating intermediaries and connecting them directly to consumers. The platform's extensive reach and customer base contribute to increased sales for farmers.

2.2.1.1 Strengths

Amazon Fresh facilitates a direct connection between farmers and consumers, reducing the reliance on middlemen.

The platform's vast user base provides farmers with exposure to a broad and diverse market.

2.2.1.2 Drawbacks

The commission fees charged by Amazon can significantly impact farmers' profit margins.

Farmers have limited control over the branding and marketing of their products within the Amazon Fresh platform.

2.2.2 FarmBox Direct

FarmBox Direct is an online platform that connects consumers with local and organic produce, including poultry products. It emphasizes the delivery of fresh, high-quality goods sourced directly from farmers. (UNDP, 2021) Acknowledges the effectiveness of FarmBox Direct in empowering farmers and providing consumers with locally sourced produce and also emphasizing on the positive impact on farmers' income and the promotion of sustainable farming practices.

2.2.2.1 Strengths

Promotes local agriculture by sourcing products directly from nearby farmers.

Emphasizes on sustainability by focusing on organic and locally sourced produce aligning with consumer preferences for sustainable and ethical products.

2.2.2.2 Drawbacks

Limited to specific regions, potentially excluding farmers from areas not covered by the platform.

Ensuring the timely and fresh delivery of perishable goods can pose logistical challenges.

2.2.3 HubSpot

HubSpot is an inbound marketing and sales platform that includes tools for social media marketing, content management, lead generation, and customer relationship management (CRM). It provides businesses, including poultry farmers, with tools to manage their online presence and engage with customers. According to (HubSpot, 2023), HubSpot has been instrumental in helping businesses; including those in agriculture, leverage digital marketing tools. Researchers have highlighted the platform's role in targeted advertising, customer engagement, and building brand loyalty.

2.2.3.1 Strengths

HubSpot provides a suite of tools for social media marketing, content creation, and customer relationship management in one platform.

The platform is known for its user-friendly design, making it accessible to businesses with varying levels of technical expertise.

2.2.3.2 Drawbacks

The full suite of HubSpot tools come with a significant cost, which limit small-scale farmers with limited budgets.

Implementing and fully utilizing all features require having knowledge about the tools which may be an obstacle to farmers unfamiliar with digital marketing practices.

2.3 Comparison of Existing Systems and Proposed Application

Table 2.1 Comparison of Existing Systems and Proposed Application

APPLICATION FEATURES	AMAZON FRESH	FARMBOX DIRECT	HUBSPOT	PROPOSED APPLICATION
Search and Filter	**NO**	**NO**	**NO**	**YES**
Product catalog and listings	**YES**	**YES**	**YES**	**YES**
Online booking and purchasing	**NO**	**NO**	**NO**	**YES**
Delivery and Tracking	**YES**	**YES**	**NO**	**YES**
Customer reviews and ratings	**NO**	**NO**	**YES**	**YES**
User accounts and profiles	**YES**	**YES**	**YES**	**YES**
Messaging and Notification	**NO**	**NO**	**NO**	**YES**
Inventory Management	**YES**	**YES**	**NO**	**YES**
Feedback and Support	**YES**	**YES**	**NO**	**YES**

2.4 Application Development Lifecycle

The Application Development Life Cycle (SDLC) is a systematic process that guides the development of information applications, from conceptualization to implementation and maintenance. (UNDP, 2021) discusses the importance of adopting an SDLC framework to ensure the efficiency, quality, and success of software development projects. The SDLC can be implemented using various approaches e.g. the

waterfall model, Agile and Spiral. The Agile approach will be used to achieve the project's objectives due to its flexibility and adaptability to changing requirements and emphasis on customer feedback throughout the development process, as described by (Beck et al., 2001).

2.5 Conclusion

The literature underscores the critical need for innovative solutions to address market inefficiencies in Uganda's poultry sector. By leveraging IT/IS solutions and understanding local challenges and opportunities, the proposed mobile application offers a promising pathway to enhance market access, improve profitability for farmers, and promote sustainable growth within the poultry industry.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This section introduces the various tools and methods that were used in achieving the project goals. The section will include tools and techniques, which enabled data collection, research design, system development, analysis of collected data and population study

3.2 System Development Methodology

For the Mobile-Based Poultry Product Sales and Marketing Application we chose to use the Agile development methodology.

Agile development methodology.

Agile methodology is a popular approach to software development that emphasises flexibility, collaboration throughout the development process. Kern, J. (2001) It is characterised by a focus on iterative development, continuous feedback, and flexibility in responding to changing requirements. This method involves breaking down the project into smaller, manageable tasks or features (such as user registration, product listing, search functionality, etc.), which can be developed and tested in short cycles known as sprints. This approach enables the development team to adapt to user feedback, incorporate new features, and address issues promptly throughout the development process, ultimately leading to a more user-friendly application. Additionally, Agile promotes collaboration between developers, stakeholders, and end-users, ensuring that the final product meets the needs and expectations of all parties involved.

Description of the phases

3.2.1 Concept Phase

In the initial phase, the project's scope, objectives, and deliverables were defined and key stakeholders identified.

3.2.2 Inception Phase

During this phase, we focused on gathering and interpreting requirements from stakeholders. This was done through interviews and questionnaires in order to understand user needs, functionalities and system interfaces.

1 Requirements Gathering and Sampling Techniques

We chose stratified sampling as a sampling technique for collecting data from poultry farmers around Kampala and Wakiso region i.e. (German poultry farm in Mbalwa-Namugongo, Wesige Mukama poultry farm in Naluvule-wakiso, Kalambi mixed farm in wakiso, BB poultry farm in Kampala among others. During the process the snowball sampling technique was also used as some farmers referred us to their colleagues and in some cases their buyers.

Stratified sampling is a process used to distinguish population members from one another based on some factors that are related to the subject you are studying. Such factors may include geographical location of the farmers and buyers where we chose the central region, size where a farm size of (500birds and above) was considered and buyers who buy products in bulk.

We chose to use stratified sampling because of the following Reason discussed below;

Stratified sampling was useful because it helped us to divide the population of interest into Subgroups, or strata, based on relevant criteria such as farm size and Geographical location. This enabled us to find out how these poultry farmers operate, the methods they use during selling and marketing their products, which their buyers are.

2 Target Population and Sample Size

The sample size for the study included a representative group of Poultry farms in Kampala and Wakiso regions where we collected data from 6 farms out of 15 farms. The project assessed the Usability and user satisfaction of the information system among the participating Poultry Farmers. Then about the buyers, the buyers mostly came from Kampala and Wakiso regions and we collected data from 20 buyers out of 40 buyers.

3.2.3 Iteration/Development Phase

This was the core phase of the methodology, it consisted of multiple iterations where each iteration lasted between 1-4 weeks. In each iteration, the development team chose features/functionalities, designed use-cases that aided in the development, tested and integrated new code. The was repeated until the desired level of functionality and quality was achieved.

The phase also involved designing the overall system architecture through diagrams like the context diagram, DFD diagram, use case diagram, and ERD, and dynamic modelling diagrams like, activity diagrams, sequence diagrams, collaboration diagrams and state chart diagrams. These are explained more in chapter 4.

3.2.4 Release Phase

This involved the final testing and deployment of the system.

1. Testing

The testing phase aimed to identify and fix bugs and ensure the application met the specified requirements. This included:

Unit Testing: This involved testing individual components or units of code to ensure they work correctly. Each unit was tested in isolation from the rest of the application. For example, testing a function that adds a new product to the database.

Integration Testing: Involved verifying that different modules or services within the application work together as intended. We tested the feedback and response communication between the buyer's interface and farmer's interface.

Usability Testing: Aimed to ensure that the application is easy to use and meets the needs of poultry farmers and buyers.

User Acceptance Testing (UAT): Involved end-users in the testing process to validate whether the application met their expectations and requirements.

2. Deployment

In the deployment phase, the application was prepared for release and made available to users. This phase included:

Release Planning: Involved creating a detailed plan for deploying the application, including timelines, resources, and rollback procedures.

Production Deployment: Involved deploying the application to a production environment where it could be accessed by end-users.

3.3 Data Collection Methods and Instruments

Data collection methods are the techniques and processes used to gather information from various sources in order to collect data for research, analysis, or decision-making purposes.

In our research we used interviewing and questionnaire to collect the relevant data about Poultry Products Sales and Marketing methods used.

3.3.1 Interviews:

This is a method which involves asking questions by the researcher and respondent gives answers.

We used interview guides for collecting data for the development of a Mobile-based Poultry Products Sales and Marketing Application because of the following reasons;

1. **User feedback**: Interviews were used to gather feedback from potential users of the mobile application, such as poultry farmers about their preferences for how the information would be organized and presented. This ensured that our mobile application is user-friendly and meets the needs of its intended audience.
2. **Identification of gaps:** Interviews were used to identify gaps in the information that was currently available about poultry products sales and marketing platforms used such as lack of platforms used by poultry farmers to connect directly to buyers

3.3.2 Questionnaire method

We formulated a questionnaire to derive ideas from Poultry farmers and buyers regarding how they operate, the challenges they face, and the platforms they use to sell and market their products, and their view about a shift to a Mobile-based Poultry Products Sales and Marketing Application

Google Forms were the instruments used in information gathering to find out the current methods used by the farmers and buyers and the respondents' opinions on our proposed application.

We chose the above data collection method for the development of a Mobile-based Poultry Product Sales and Marketing Application due to the following;

1. **Efficient**: Questionnaires could be distributed to a large number of respondents simultaneously, making them an efficient way to collect data from a broad range of stakeholders, including Poultry farmers and buyers.
2. **Structured**: Questionnaires were structured, with standardized questions that all respondents answered. This helped to ensure that the data being collected was consistent and could be easily analysed

CHAPTER FOUR: SYSTEMS ANALYSIS AND DESIGN

4.1 Introduction

The Mobile-Based Poultry Product Sales and Marketing Application (MPPSAMA) is a digital platform designed to enhance market accessibility for poultry farmers and buyers. By addressing the current inefficiencies in market coordination, this application aims to streamline the process of selling and purchasing poultry products. Farmers will benefit from easier access to a broader market, while buyers will find it more convenient to locate reliable suppliers. The platform incorporates features such as user management, product management, order management, search and filter functions, and feedback mechanisms to facilitate seamless interactions between farmers and buyers. Through the integration of robust security measures, user-friendly interfaces, and scalable architecture, the application promises to significantly improve the efficiency and transparency of poultry product transactions.

4.2 Description of the designed system

The Mobile-Based Poultry Product Sales and Marketing Application (MPPSAMA) is a comprehensive digital platform designed to transform the poultry market by enhancing accessibility and operational efficiency for both poultry farmers and buyers. This system leverages modern technological solutions to address existing inefficiencies in market coordination, facilitating a smoother, more transparent transaction process for all stakeholders involved.

4.2.1 Functionality

1. User Management

The system should provide a secure login and registration feature for farmers and buyers. Users should be able to create personal accounts, manage their profiles, and access the system's functionalities.

2 Product Management

The system should allow farmers to add, edit and delete products from the application. They should also be able to specify product details such as name, description, quantity, price, and location.

3 Search and Filter

The system should allow buyers to search and filter products based on a criterion such as product name, type, price range, location, and farmer.

4 Order Management

The system should allow buyers to place and confirm orders for the products they wish to purchase, specifying quantities and delivery preferences.

6. Feedback and Rating

The system should allow buyers to provide feedback and ratings for farmers' products which are then displayed publicly to facilitate transparency and trust among users.

4.2.2 Design Considerations

Design considerations for the Mobile-Based Poultry Product Sales and Marketing Application are crucial to ensure the platform meets the needs of its users both poultry farmers and wholesale buyers while maintaining high standards of usability, security, and scalability. These include;

1. **User Interface (UI):** The UI should be user-friendly, and accessible on mobile devices. It should prioritize ease of use for both farmers and buyers.
2. **Security:** Robust security measures must be implemented to protect user data, including secure authentication, data encryption, and secure payment processing.
3. **Scalability:** The platform should be scalable to accommodate a growing user base and increasing product listings. It should be able to handle large volumes of transactions and interactions.
4. **Location Services Integration:** Integration with location services is essential for proximity-based matchmaking, allowing buyers to find nearby farmers and vice versa.
5. **Feedback Mechanism:** A feedback mechanism should be in place to collect and address user feedback, ensuring continuous improvement of the platform.

4.2.3 Assumptions and Dependencies

1. **Internet Connectivity:** The application assumes that users have access to reliable internet connectivity to access the platform and perform transactions.
2. **Regulatory Compliance:** The application assumes compliance with relevant regulations and laws governing online transactions and agricultural sales.

3. **Payment Gateways:** Dependency on reliable payment gateways for secure transactions and payment processing.
4. **User Engagement:** Assumption that users will actively engage with the platform, including listing products, searching for products, and engaging in transactions.

4.2.4 General Constraints

1. **Technology:** The software must be compatible with various mobile devices and operating systems (iOS, Android).
2. **Internet Connectivity:** Access to the internet might be limited in rural areas where many farmers are located. The application should accommodate both online and offline functionalities.
3. **Data Security and Privacy:** Personal and financial data of users need to be securely handled to maintain trust.
4. **Scalability:** The application should be designed to handle a potentially large user base as it gains popularity.
5. **Usability:** The application should be intuitive and easy to use for both farmers and buyers, including those with limited technical expertise.
6. **Technology Stack:** Selection of appropriate technologies and frameworks for frontend (e.g., React Native, Flutter) and backend (e.g., firebase, Node.js, Django, Laravel) development.

4.2.5 Goals and Guidelines

The Mobile-Based Poultry Product Sales and Marketing Application is developed with the primary aim of enhancing market efficiency and transparency for poultry farmers and buyers. This section outlines the key goals and guidelines that drive the development and implementation of the platform. These goals and guidelines ensure that the application not only meets the immediate needs of its users but also remains adaptable to future enhancements and industry changes.

1. **Market Accessibility:** The primary goal is to connect poultry farmers with potential buyers, thereby reducing market inefficiencies
2. **Reliability:** Ensure that the platform provides reliable information about the availability of poultry products and the credibility of farmers and buyers.

3. **Transparency:** Foster trust between users by providing transparent information about product quality, pricing, and transaction history.
4. **Efficiency:** Streamline the process of finding and connecting with suitable buyers or sellers, reducing time and effort for both parties.
5. Design for flexibility and extensibility to accommodate future enhancements and changes in requirements.
6. Implement a feedback system to allow users to rate and review each other, improving accountability and quality control.

4.3 Data Analysis and results

Data analysis is a critical component of any research or investigation, as it involves examining and interpreting collected data to uncover meaningful insights and draw valid conclusions. Through the application of statistical techniques and analytical methods, data analysis enables researchers to identify patterns, trends, and relationships within the data. The findings derived from data analysis provide valuable information that can support decision-making, inform strategies, or contribute to the overall understanding of a specific topic. By meticulously analysing and interpreting the data, researchers can extract actionable insights and generate evidence-backed conclusions, enhancing the credibility and impact of their work.

4.3.1 Methods used to analyse data

Analysis was carried out using Google forms that provided the detailed analysis of questionnaire responses by transforming qualitative data in form of strings into quantitative data inform of integers represented in graphs and pie charts

4.3.2 Presentation of findings

We collected data using two data collection techniques that is to say; interviews and questionnaires
To enable us to justify the need for the proposed mobile based poultry product sales and marketing application. We came up with an interview guide that helped us determine which questions we were to find responses based on the level of priority.

Interviews were administered using a face-to-face approach by directly interviewing both farmers and the wholesale buyers.

Using interviews for data collection enabled us to capture a wide variety of data based on the use of open-ended questions allowing us to capture results and analyse them to provide a better understanding and justification for the proposed web application.

We also used a web-based questionnaires to gather data from the participants. This had more benefits compared to the interview methods of data collection which enabled us to capture responses from a wider participant group based on our scope.

The use of web-based questionnaires using Google forms.

4.3.2.1 Demographics of the respondents

The demographics of the respondents are typically based on both the farmers and the buyers.

4.3.3 Findings

The findings of the study were divided into two parts. The first part presented the findings from interviews with farmers, and the second part presented the findings from interviews with wholesale buyers.

4.3.3.1 Farmers

These were asked a variety of questions in order to help us understand the various ways the market and sell their products and all these are attached in the appendix under the farmer's interview guide. Basing on our scope and targeted group that our system was applicable to, we looked at different aspects i.e. the farm location, gender of the farm owner and their level of education. A summary of all the replies for each of the questions are shown below.

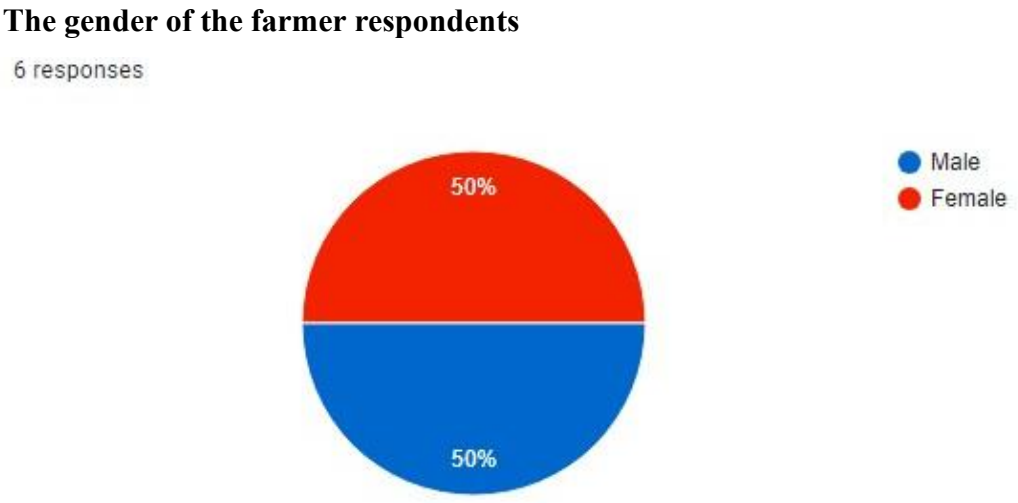


Figure 4.1 Pie chart showing the gender of the farmer respondents

For our findings based on questionnaire, we administered out of 6 respondents, 3 were males and other 3 were females giving a percentage of 50% respectively implying there were same number of males and females who actively participated in the survey.

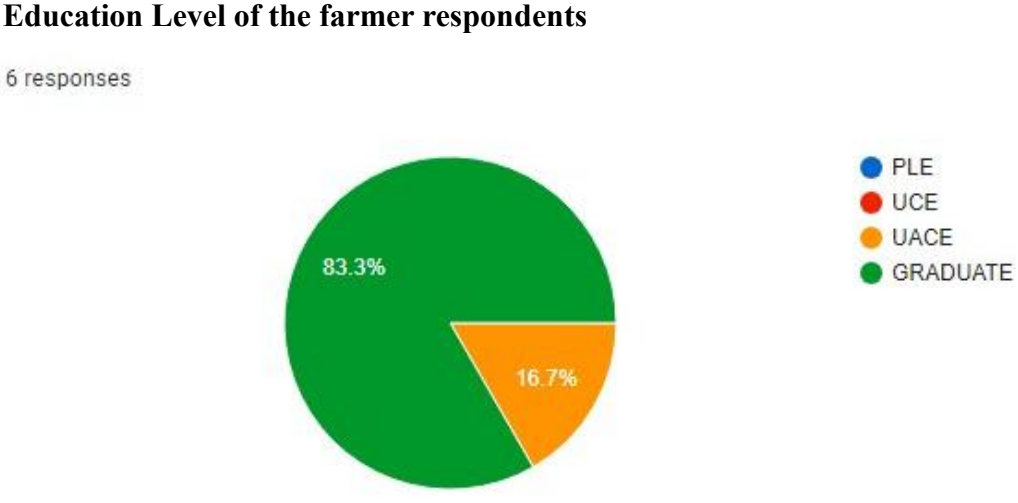


Figure 4.2 Pie chart showing the education Level of the farmer respondents

The questionnaire also showed that out of the 6 participants of different levels of education, those that graduated still proved to be more with 83.3%, followed by A level with 16.7% while the other levels of education e.g. UCE and PLE didn't have participants

Location of the farms

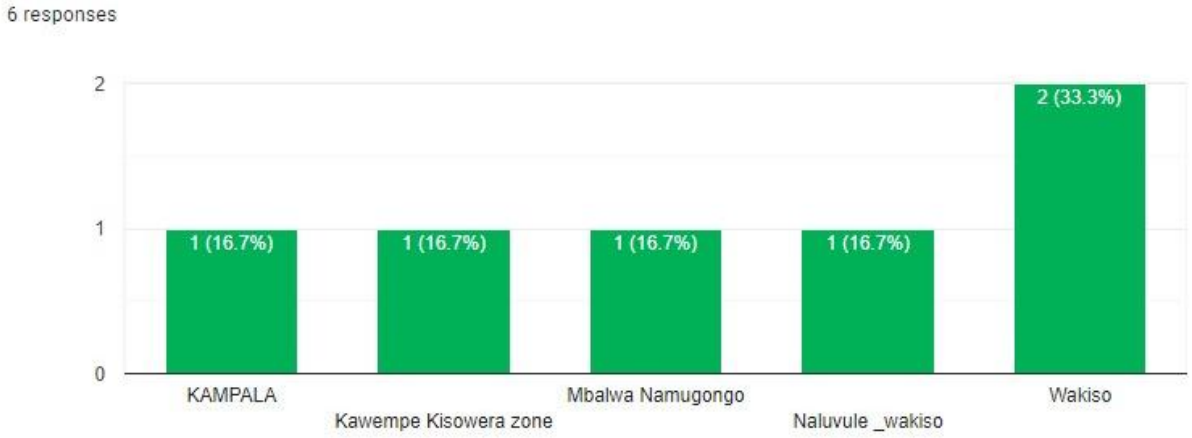


Figure 4.3 A graph showing the location of the farms

In our findings based on the 6 responses we received using web-based questionnaires, we determined the location of the farms giving Kampala a percentage of 16.7%, then Kawempe (16.7%), Namugongo (16.7%), Wakiso Naluvule (16.7%), and also wakiso with 33.3%.

Benefits of manually marketing and selling products

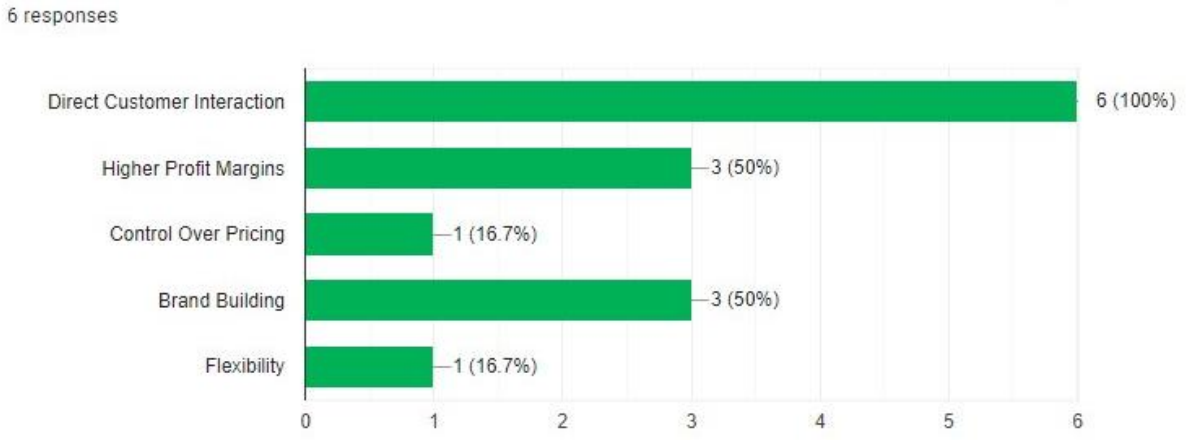


Figure 4.4 A chat showing the benefits of manually marketing and selling products.

The findings indicated that out of the 6 farmers, all the 6 responded by saying direct customer interaction has been a benefit of manually marketing and selling their products with 100%, then high profit margin with 50%, control over pricing with 16.7 %, brand building with 50% and also flexibility with 16.7%

Challenges of manually marketing and selling products

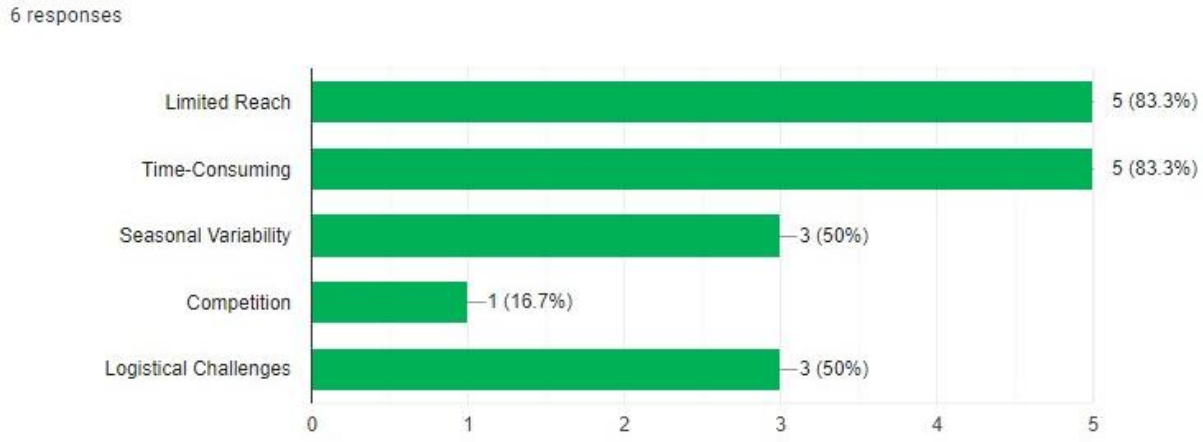


Figure 4.5 A chat showing the challenges of manually marketing and selling products

Regarding the challenges faced by farmers while manually marketing their products, with 83.3% with limited reach, 83.3% with time consuming, 50% with a challenge of competition, 50% with logistical challenges.

Suggested solutions by the farmer

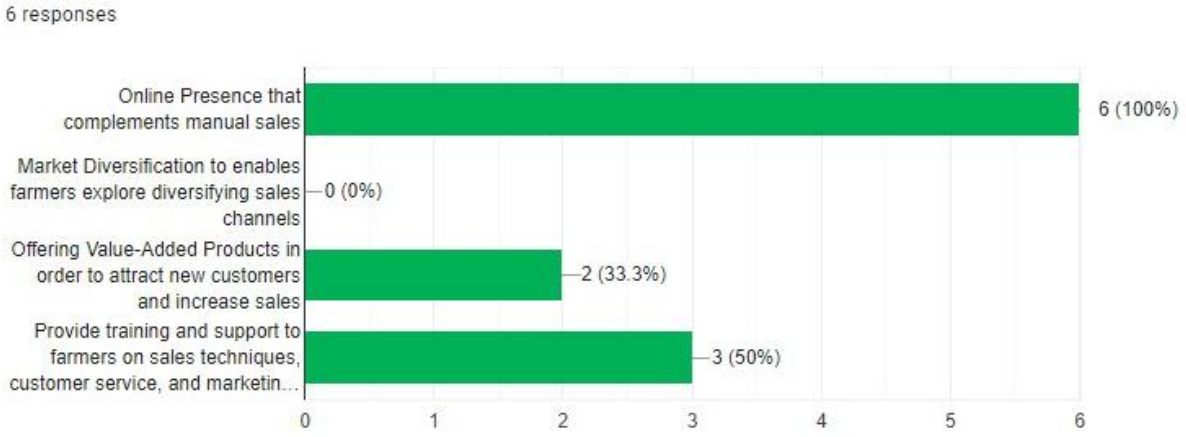


Figure 4.6 A chat showing the suggested solutions.

Level of digital literacy

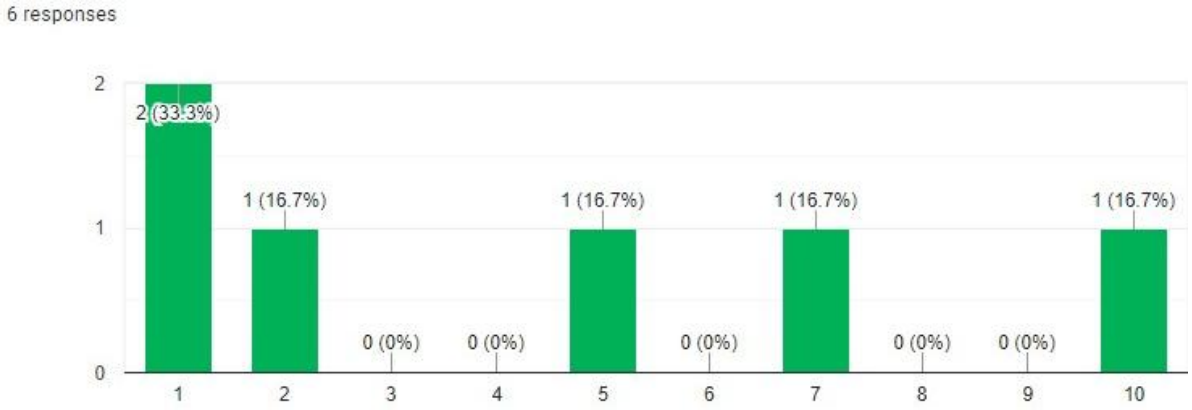


Figure 4.7 A graph showing the level of digital literacy.

According to the findings, the level of digital literacy out of 10 showed that 33.3% of famers had low level of digital literacy while 16.7% showed high levels of literacy

4.3.3.2 Buyers

These were asked a variety of questions in order to help us understand the various ways how they get their products and all these are attached in the appendix under the buyer's interview guide. Basing on our scope and targeted group that our system was applicable to, we looked at different aspects i.e. the buyer location, gender and their level of education. A summary of all the replies for each of the questions are shown below.

Gender of the buyers

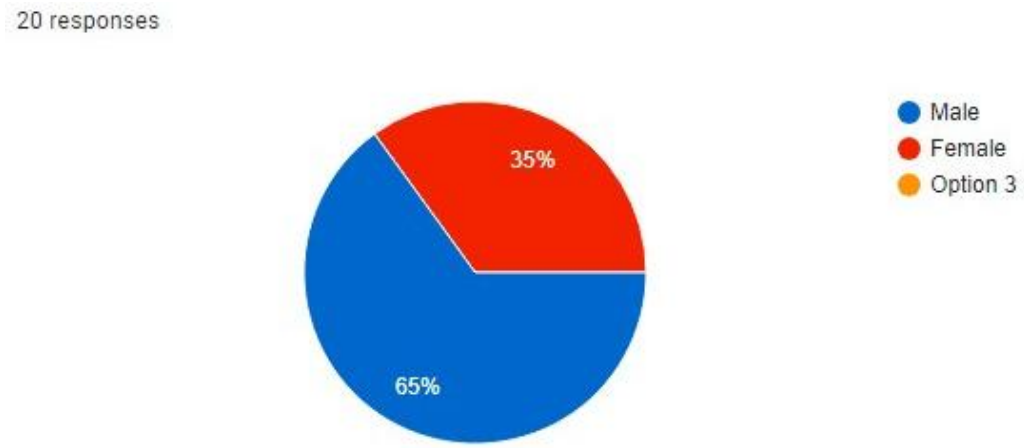


Figure 4.8 A pie chart showing the gender of the buyers

For our findings based on questionnaire, we administered out of 20 respondents, 13 were males and other 7 were females giving a percentage of 65% and 35% respectively implying the number of males were more than the number of females who actively participated in the survey.

Location of businesses

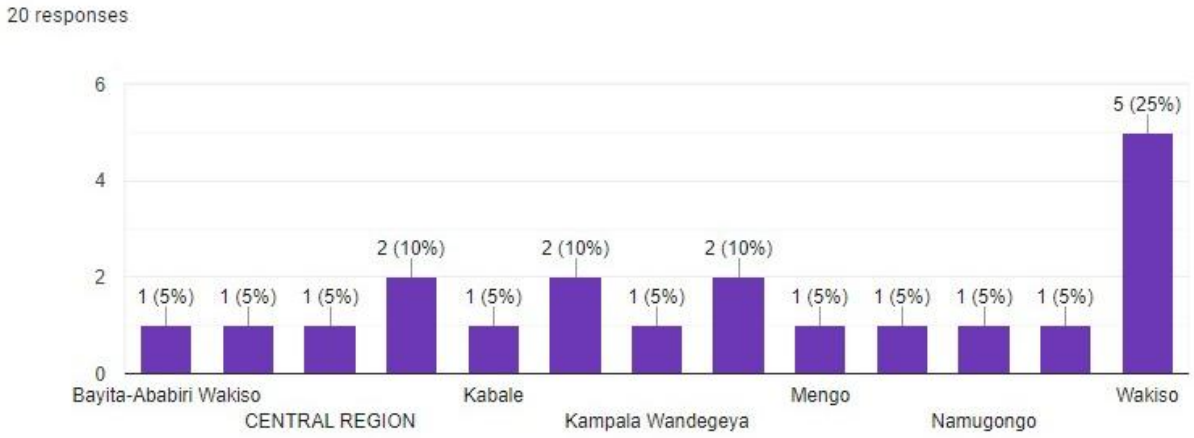


Figure 4.9 A graph showing the location of the business

Buyer Education Levels

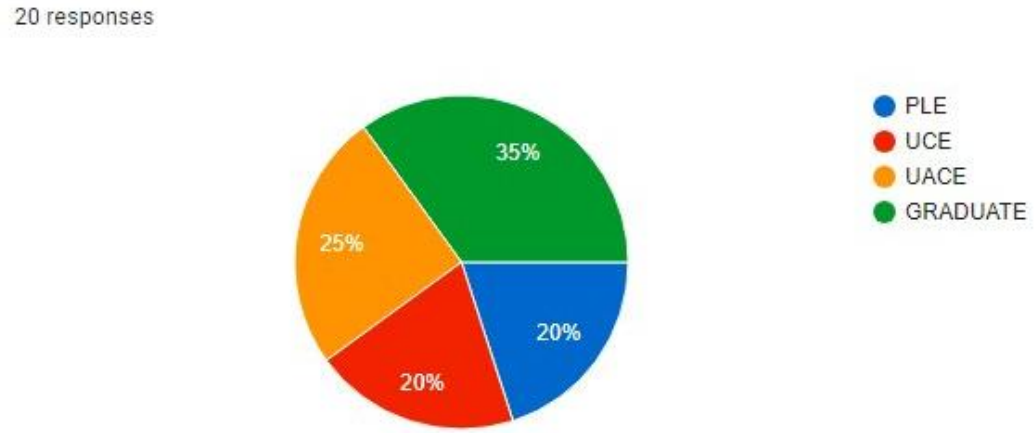


Figure 4.10 A pie chart showing the level of education.

Our findings showed that 35% of the respondents were graduates, UACE with 25%, UCE with 20%, and PLE with 20%

Types of Businesses

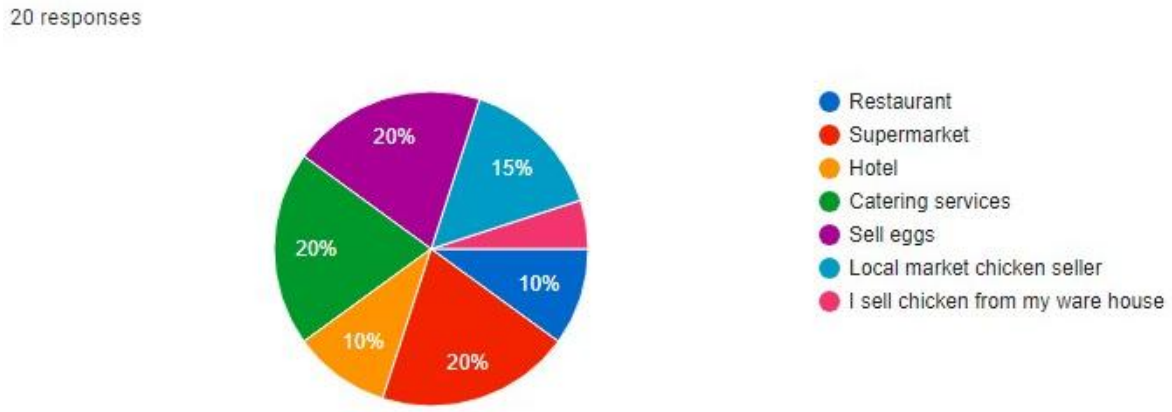


Figure 4.11 A Pie Chart showing the type of business being operated by the buyers.

According to our findings, we found out that 10% of the buyers operate restaurants, 10% are local chicken sellers,20% sell eggs ,20% operate supermarkets and then 10% operate hotels.

Commonly Bought Poultry Products

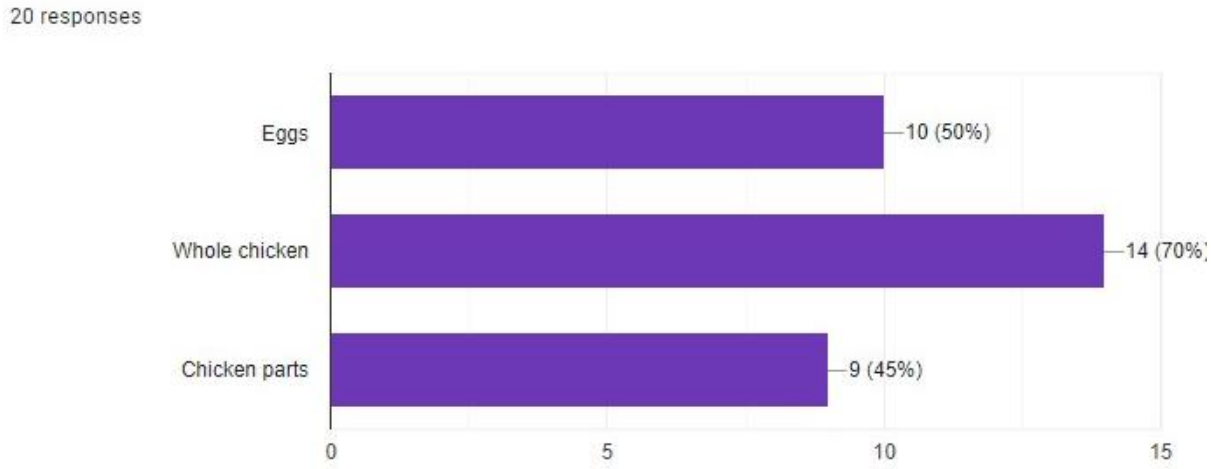


Figure 4.12 A chat showing the poultry products typically bought.

According to the findings, the percentage of people who typically buy eggs is 50%, then whole chicken is 70% and 45% of the people typically buy chicken parts.

Restock Periods

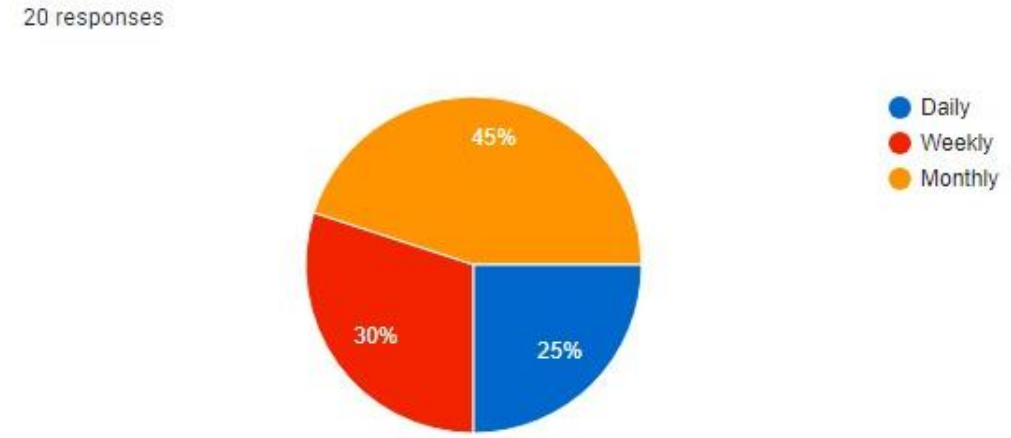


Figure 4. 13 A Pie chart showing how frequently the buyers restock the poultry products.

45% of the respondents restock their poultry products monthly, then 30% restocks weekly and 25% restocks the poultry products daily.

Benefits of manually buying products from the farmer

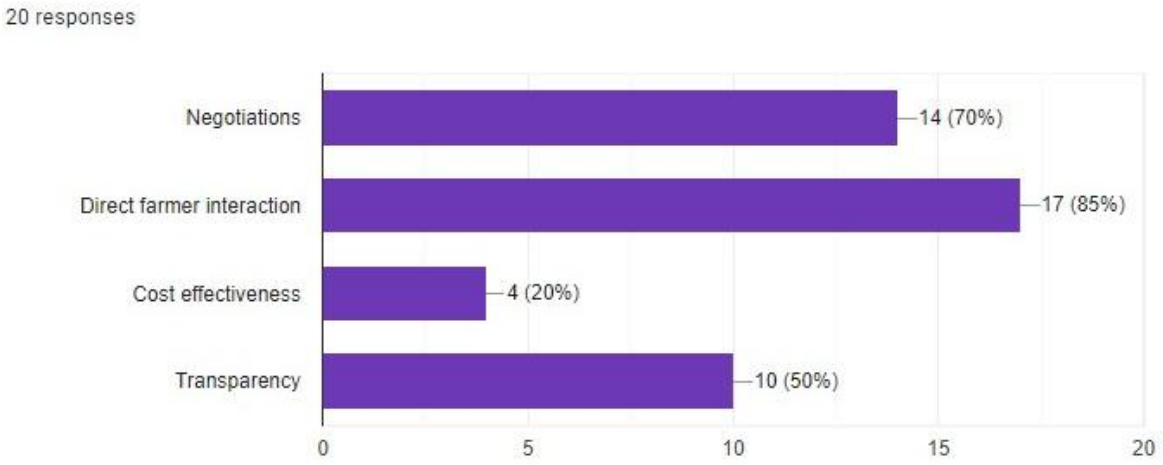


Figure 4.14 A chat showing the benefits of manually buying products from the farmer

Challenges while manually buying products from the farmer

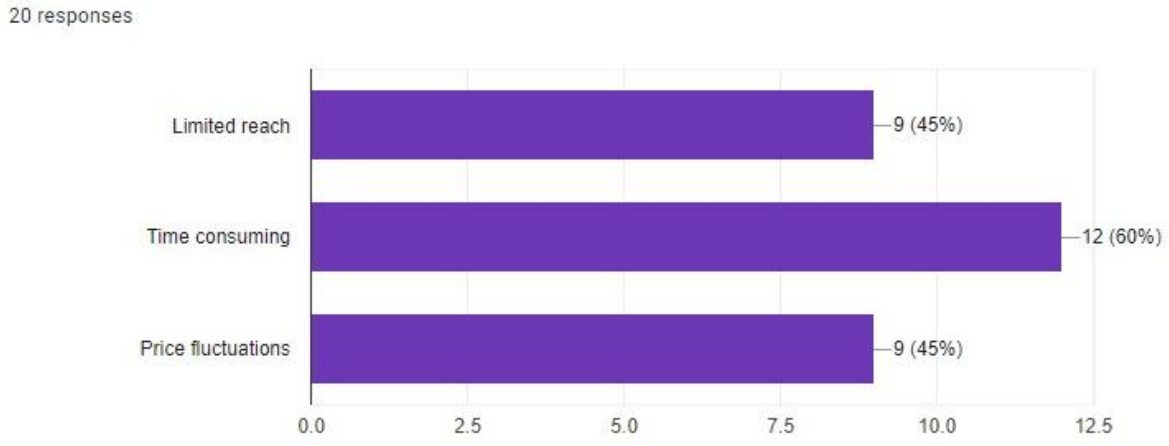


Figure 4.15 A chat showing the challenges while manually buying products from the farmer

Features that would most be valuable to the buyers

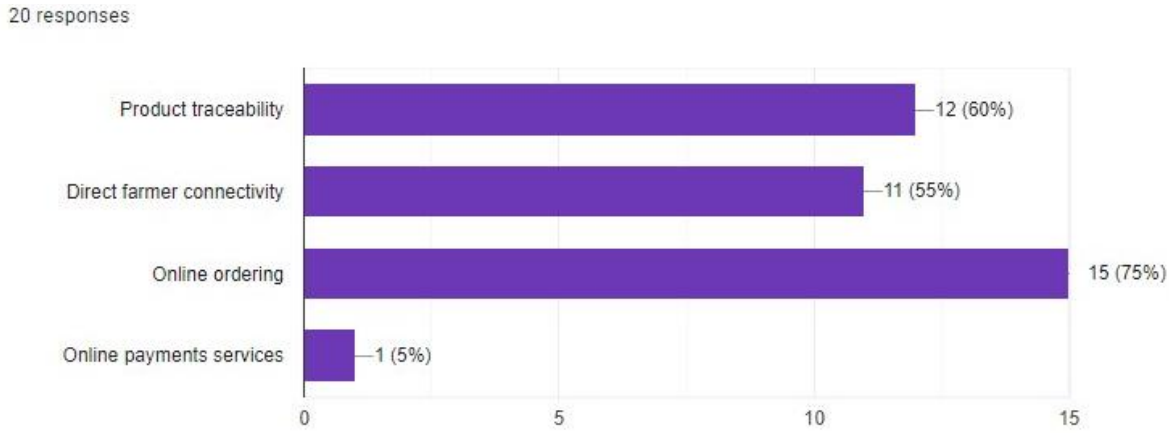


Figure 4.16 A chat showing the opinions of features that would most valuable to the buyers

4.4 System User Requirements

We interviewed the intended users of the application and collected first-hand information about what the expected features of the Mobile Based poultry product sales and marketing application and the following were the findings.

1. An application that is easy to learn and use
2. An application that is fast, flexible and convenient.
3. An application that restricts access to information to only authorized personnel
4. An application that provides attractive interfaces with easy navigation throughout it.
5. An application that is user friendly

4.5 Functional and Non-functional Requirements

Functional requirements define the specific actions, tasks, and behaviours that a system must perform to fulfill its intended purpose and meet the needs of its users. Non-functional requirements encompass essential constraints and qualities that a software or system must possess to ensure its effectiveness, performance, security, and usability**.**

4.5.1 Functional Requirements

Functional requirements refer to the functions that the system is capable of executing and they are outlined as follows.

1. User Management

The system should provide a secure login and registration feature for farmers and buyers. Users should be able to create personal accounts, manage their profiles, and access the system's functionalities.

2. Product Management

The system should allow farmers to add, edit and delete products from the application. They should also be able to specify product details such as name, description, quantity, price, and location.

3. Search and Filter

The system should allow buyers to search and filter products based on a criterion such as product name, type, price range, location, and farmer.

4. Order Management

The system should allow buyers to place and confirm orders for the products they wish to purchase, specifying quantities and delivery preferences.

5. Feedback and Rating

The system should allow buyers to provide feedback and ratings for farmers' products which are then displayed publicly to facilitate transparency and trust among users.

4.5.2 Non-Functional Requirements

Non-Functional requirements refer to the description of the expected system behaviour. The following non-Functional requirements were determined for the application.

1. Usability:

The application should have an intuitive and user-friendly interface for both farmers and buyers.

2. Performance:

Fast response times and minimal latency, especially during peak usage periods.

Ability to handle concurrent user sessions and large volumes of data effectively.

3. Security:

Robust authentication and authorization mechanisms to protect user accounts and data.

Encryption of sensitive information such as user credentials, payment details, and personal data.

4. Reliability:

High availability and minimal downtime of the application to ensure continuous access for users.

Implementation of backup and disaster recovery mechanisms to safeguard against data loss and system failures.

5. Scalability:

Ability to scale horizontally and vertically to accommodate growing user demand and increasing data volumes.

Support for cloud-based infrastructure for scalability and flexibility.

4.5.3 System Requirements

System requirements will provide some of the hardware and software components needed to run the system.

Software requirements

Table 4.1 Shows software requirements

Software	**System requirement**
Operating system	Windows OS
Browser	Google chrome, Microsoft Edge,
Database	Firebase

Hardware requirements

Table 4.2 Shows hardware requirements

Hardware	**System requirements**
RAM	8 GB
Hard disk	120 GB
CPU	Dual/ Quad Core and above is recommended

4.6 High level architecture of the developed system

The system architecture of the Mobile-Based Poultry Product Sales and Marketing Application is designed to ensure scalability, reliability, and performance. It comprises multiple layers, including the presentation layer, application layer, and data layer, each serving specific functions within the platform.

1. **Presentation Layer**

User Interface (UI): This layer handles the presentation and interaction with users. It includes the graphical user interface (GUI) elements and user input/output functionalities.

Mobile Application: The mobile application interface allows users to interact with the platform using their smartphones or tablets. It provides a user-friendly interface for accessing features such as product listings, search, ordering, and feedback submission.

2. **Application Layer**

Business Logic: The application layer contains the business logic responsible for processing user requests, executing application functionalities, and managing data flow between the presentation and data layers.

Server-Side Components: Server-side components include the application servers, middleware, and web services responsible for handling user requests, executing business logic, and interacting with the data layer.

API Endpoints: Application Programming Interface (API) endpoints enable communication between the mobile application and the server-side components. They define the protocols and methods for exchanging data and executing operations within the application.

3. **Data Layer**

Database Management System (DBMS): The data layer consists of the database management system, which stores and manages the application's data. It includes relational databases, NoSQL databases, or a combination of both, depending on the specific data requirements.

Data Storage: Data storage components store various types of information, including user profiles, product listings, orders, feedback, and system configurations. They ensure data integrity, availability, and security.

Data Access Layer: The data access layer provides interfaces and mechanisms for accessing and manipulating data stored in the database. It includes data access objects (DAOs), repositories, or ORM frameworks for performing CRUD (Create, Read, Update, Delete) operations.

4. Integration Points

Third-Party Services: Integration with third-party services such as payment gateways, location services, and notification systems enhances the functionality and usability of the platform.

Authentication and Authorization: Integration with authentication and authorization services ensures secure access control and user authentication mechanisms within the platform.

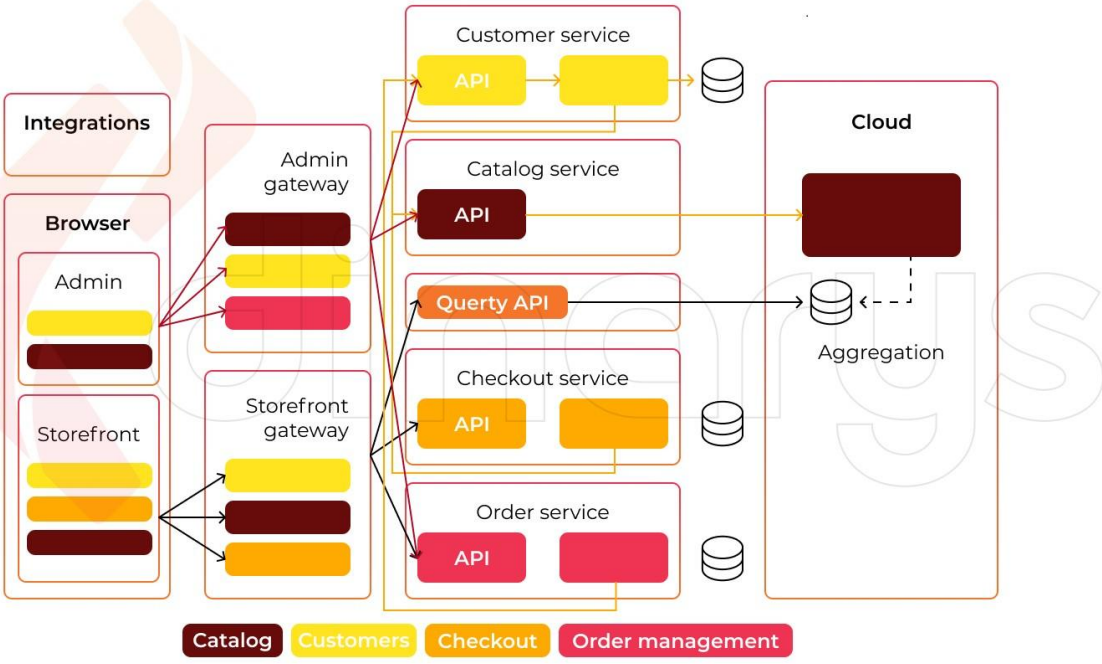


Figure 4.17 High level Architecture diagram

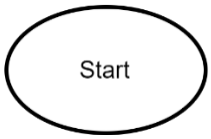
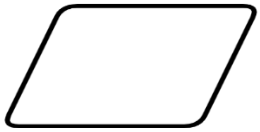
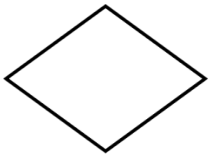
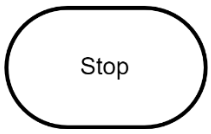
4.7 The Flow Chart of the developed Poultry Product Sales and Marketing Application

A flow chart is used to show the steps followed in a process and it makes use of different shapes to offer a visual description of how information flows and the activities involved in the various steps. The visual descriptions offered make it easy to understand how the system works and can be used to identify and eliminate any potential errors in the system.

The symbols used in the flow chart are described in the table below

SYMBOLS USED TO DESIGN THE FLOW CHART

Table 4.3 Symbols used to design the flow chart

Symbol	Name	description
	Start	It shows the start of the flow chart
	Input	This shows input of data
	Arrow	It shows the flow of information.
	Process	This is used to show a specific task
	Decision	This is where a process can take different parts based on a condition
	Stop	This ends the flowchart

A Flow Chart for A Farmer Interacting with The Application

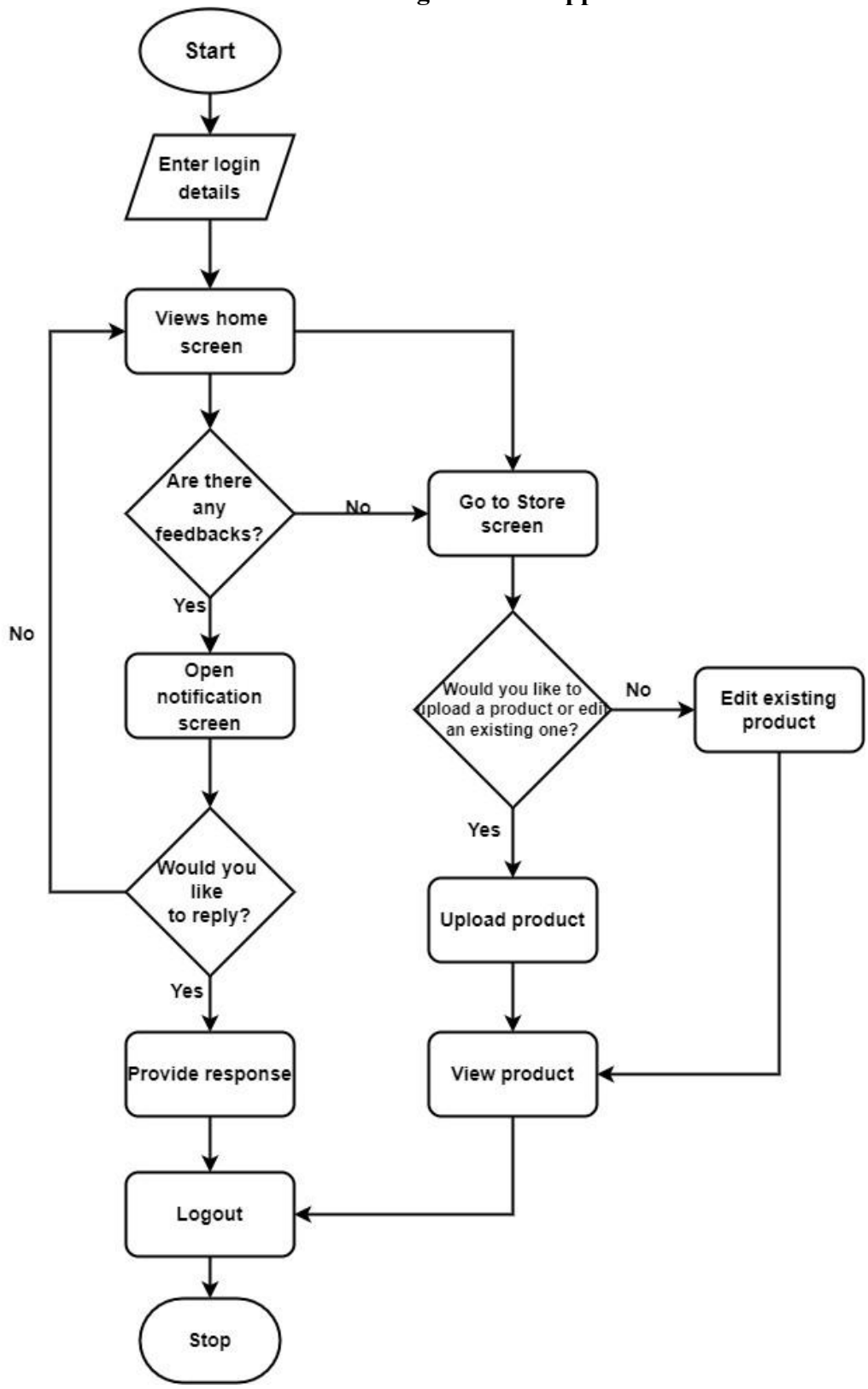


Figure 4.18 A flow chart of the farmer interacting with the application

for A Buyer Interacting with The Application

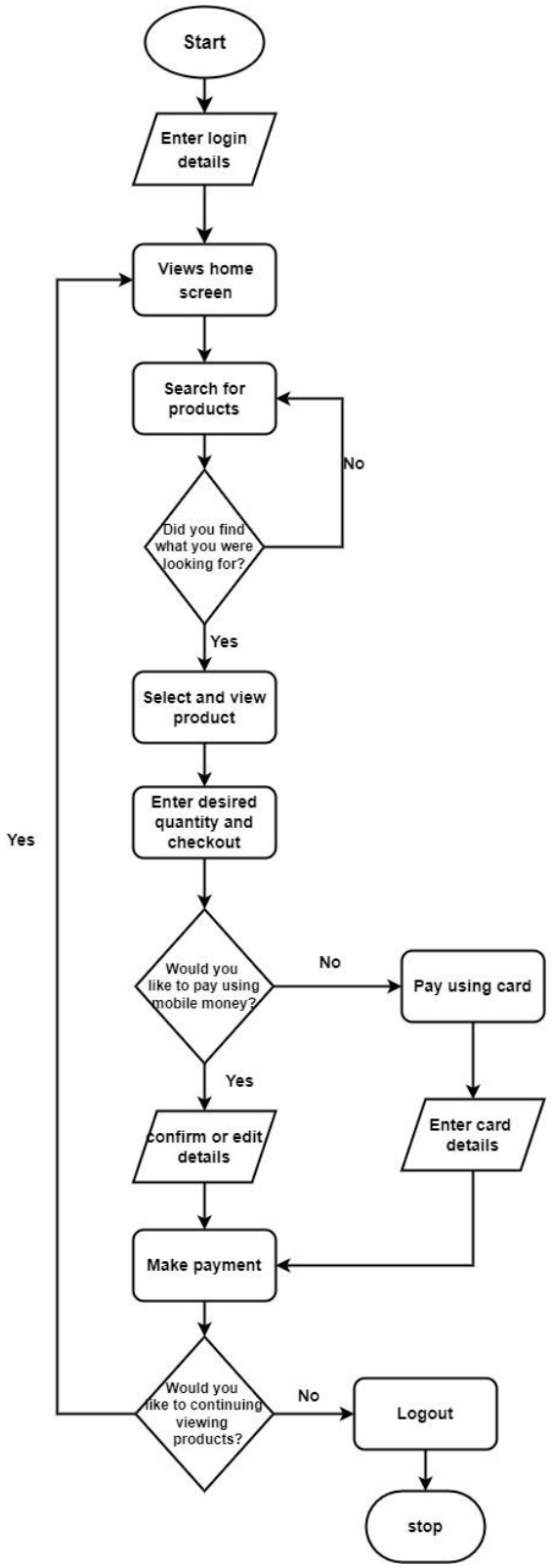


Figure 4.19 A flow chart of the buyer interacting with the application **of the Admin Interactions**

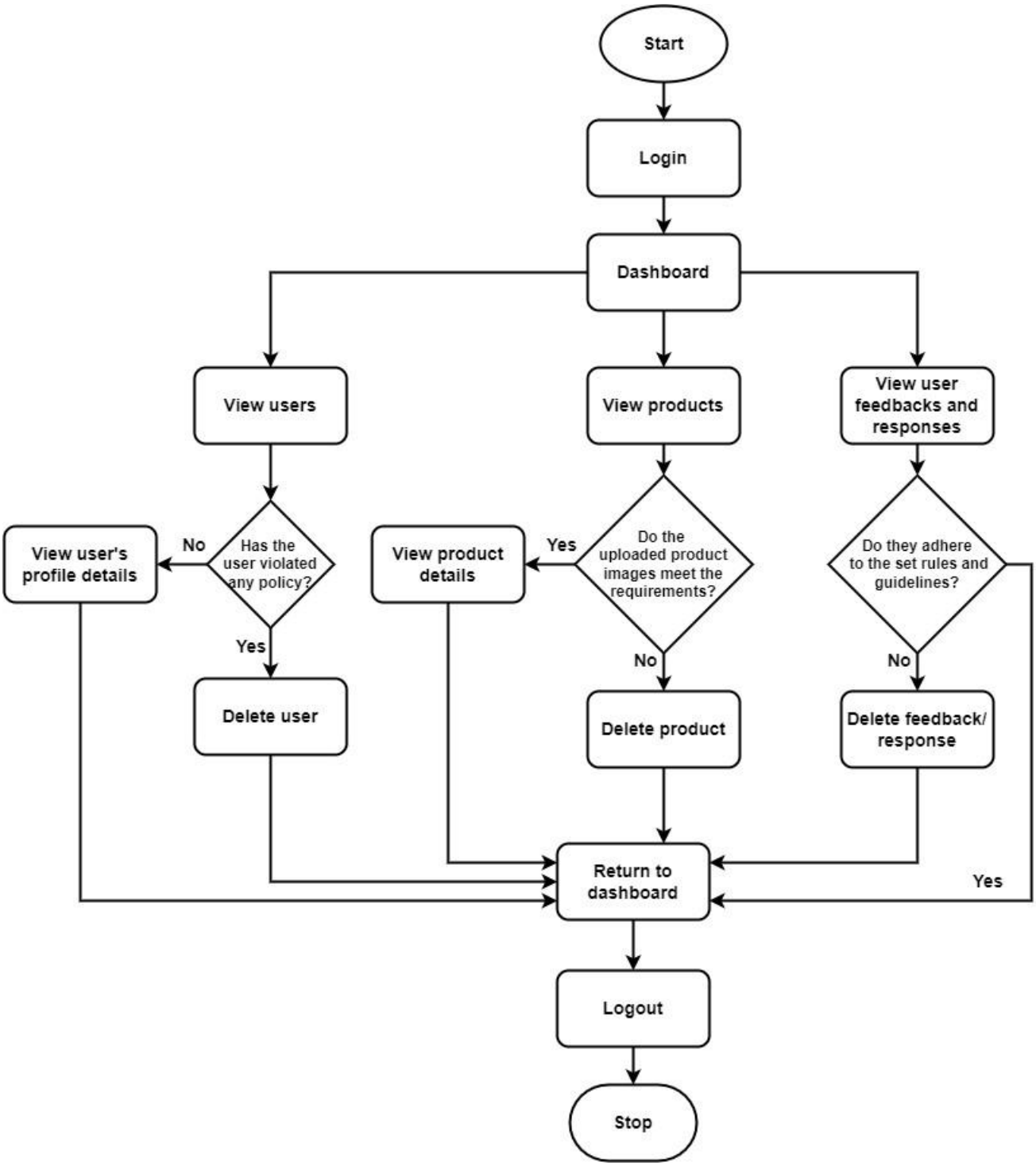


Figure 4. 20 Flow chart of the Admin interactions

4.8 The Context Diagram

A context diagram is a visual representation that illustrates the scope and boundaries of a system, as well as its interactions with external entities. It provides a high-level overview of the system and its environment, helping stakeholders understand what the system does and how it interacts with its surroundings.

It contains different elements and these include**:**

Product: This represents the system that is being interacted with and that is the mobile based poultry product sales and marketing application.

External entities: These include people, objects or organizations that operate outside the system but interact with it and they are depicted with squares. The entities that interact with the application are buyer, farmer and the payment gate way.

Flow lines. These are lines that connect the external entities to the object and texts added to them represent the action taken or data exchanged

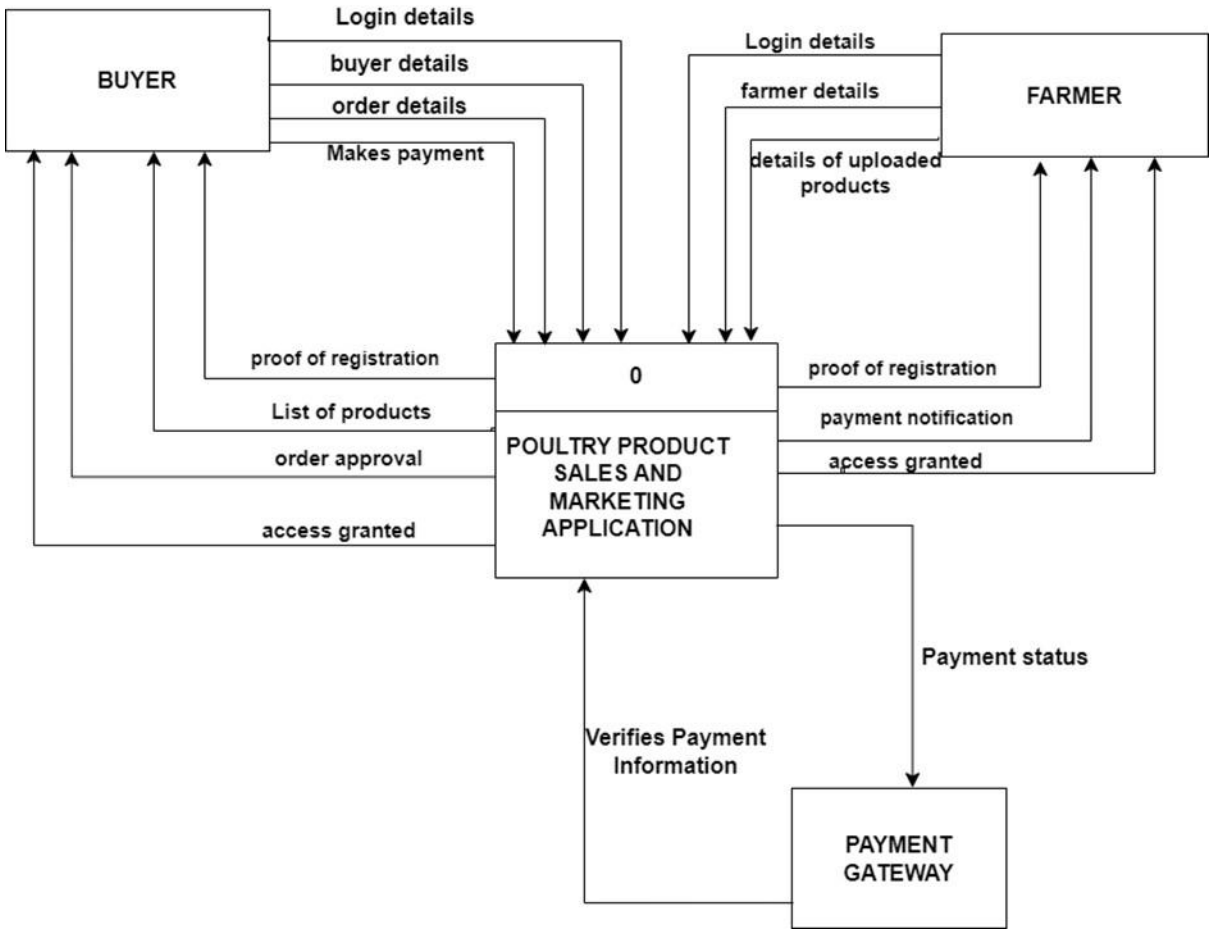


Figure 4.21 Context Diagram

4.3.1 The Level one DFD

A Data Flow Diagram (DFD) is a graphical representation of the flow of data within a system. It's used to model the processes involved in a system, the data flowing between these processes, and the external entities that interact with the system. DFDs are helpful for understanding system requirements, identifying data sources and destinations, and designing or analysing system architecture.

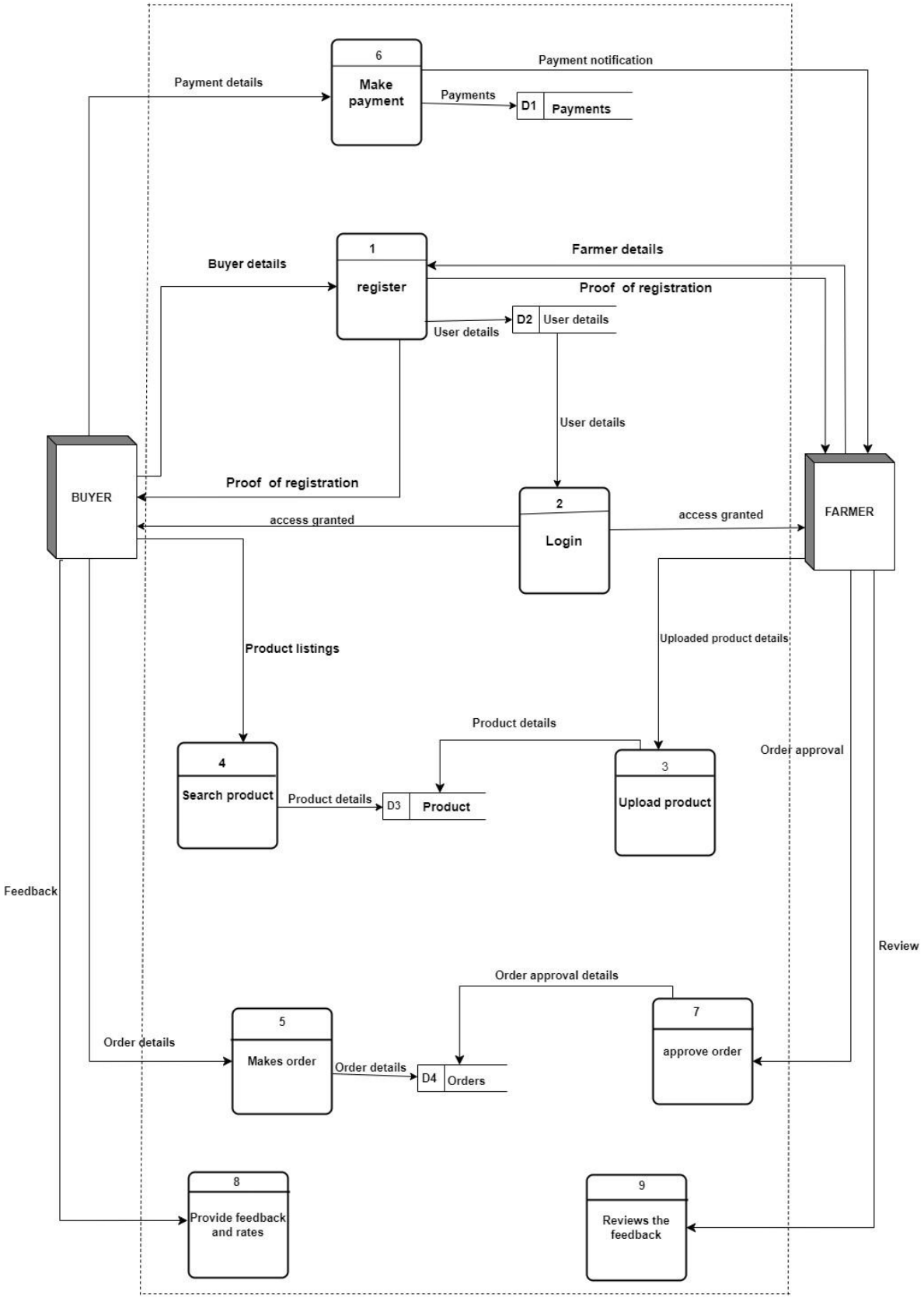


Figure 4.22 Data Flow Diagram

Table 4.4 DFD processes and their descriptions

Process	**Description**
Register	This receives buyer and farmers details, creates an account for them and stores their information in the user details data store.
Login	Registered users are allowed to gain access by inputting their details.
Upload product	A farmer uploads the different poultry products and the product details are stored in the product data store
Search Product	A buyer searches for the product
Make order	A buyer makes an order of the product and the order including its details is sent to the farmer.
Make payment	A buyer makes payment and the payment notification is sent to the farmer
Approve order	Farmer approves the order upon receiving the payment notification
Provide feedback	This handles responses from the buyers in regards to rating the product they ordered for
Reviews the feedback	Farmer reviews the feedback from the buyers about their products

Table 4.5 DFD symbols and their descriptions

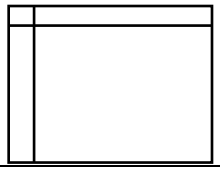
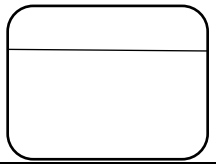
Symbol	Name	Description
	Entity	Shows the different entities of the system
	Process	Shows the different processes in the data flow
	Data Store	It holds and stores data that has been collected
	Data Flow	It shows the direction to which different information is moving

Table 4.6 DFD Data store and their descriptions

Data store	Description
User details	Used to hold data for the registered users that is account information
Product	This holds the data of the details about the product
Order	This holds data for the orders for example the order details
Payment	This holds the proof of payment information.

4.9 Use Case Diagram

A use case diagram is a visual representation that depicts the interactions between the actors (users or external systems) and a system. It provides an overview of the functional requirements and the behaviours of the system, focusing on how users or the external entities interact with it to achieve the specific goals or tasks

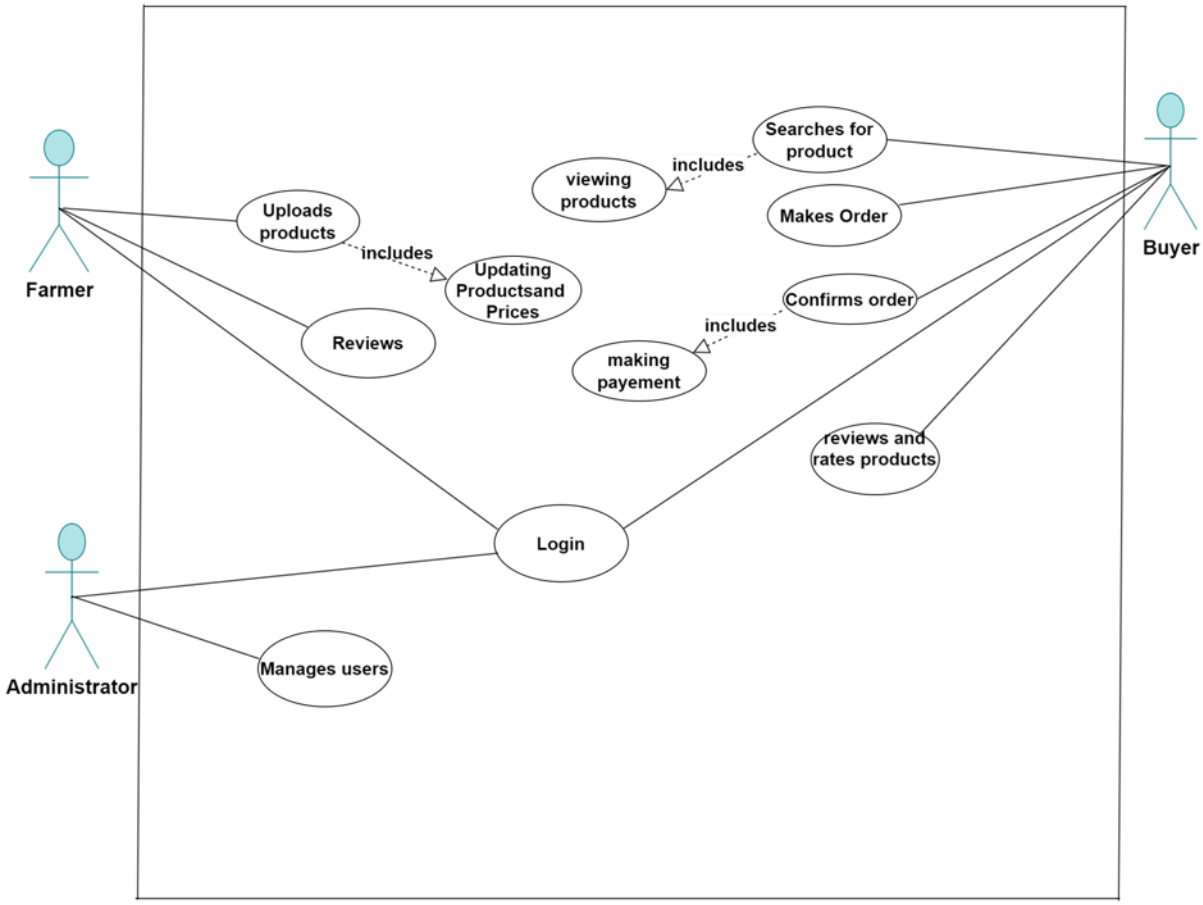
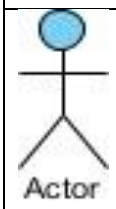
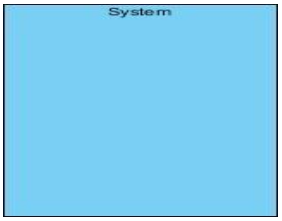


Figure 4.23 Use Case Diagram

Table 4.7 Use case symbol descriptions

Symbol	Description
	Actor triggers use case(s). Actor has a responsibility toward the system (inputs), and Actor has expectations from the system (outputs).
	A use case describes the specific interaction between an actor (user or external system) and a system to achieve a particular goal.
Communication Link	The participation of an actor in a use case is shown by connecting an actor to a use case by a solid link.
<<includes>>	This Relationship adds additional functionality not specified in the base use case.
	The system boundary is the entire system as defined in the requirements document.

4.10 Entity Relationship Diagrams

An Entity-Relationship Diagram (ERD) is a visual representation of the entities (objects or concepts), their attributes (properties), and the relationships between them within a system or a database and its relationships.

Table 4.8 Entities and the attributes

Entity	Attributes
Farmer	Farmer id, first name, last name, contact
Buyer	Buyer id, first name, lastname, contact, address
Order	Order id, farmer id, buyer id, order date, order status
Product Listing	Product listing id, farmer id, product id
Product	Product id, type, unit, price
Payment	Payment id, buyer id, date, amount

Multiplicities used in the entity relationship diagram.

They are used to show how entities relate to each other. The multiplicities used in the diagram above are shown in the table below visa vee their meanings

Table 4.9 Multiplicities and their meaning

Multiplicity	Meaning
1	One and only one
0..*	Zero to many
1..*	One to many

1. A buyer makes one to many orders and an order can be made by one and only one buyer.

Figure 4.24 Relationship between buyer and order

2. A farmer receives one to many orders and an order can be received by one and only one farmer

Figure 4.25 Relationship between farmer and order

3. A farmer can have one to many product listings and a product listing can be owned by one and only one farmer

Figure 4.26 Relationship between farmer and product listing

4. A product can have one and only one product listing and a product listing can have one to many products.

Figure 4.27 Relationship between product and product listing

5. A buyer makes zero or many payments and a payment can be made by one and only one buyer.

Figure 4.28 Relationship between buyer and payment

6. A farmer uploads one to many products and a product can be uploaded by one-to-many farmers.

Figure 4.29 Relationship between farmer and product

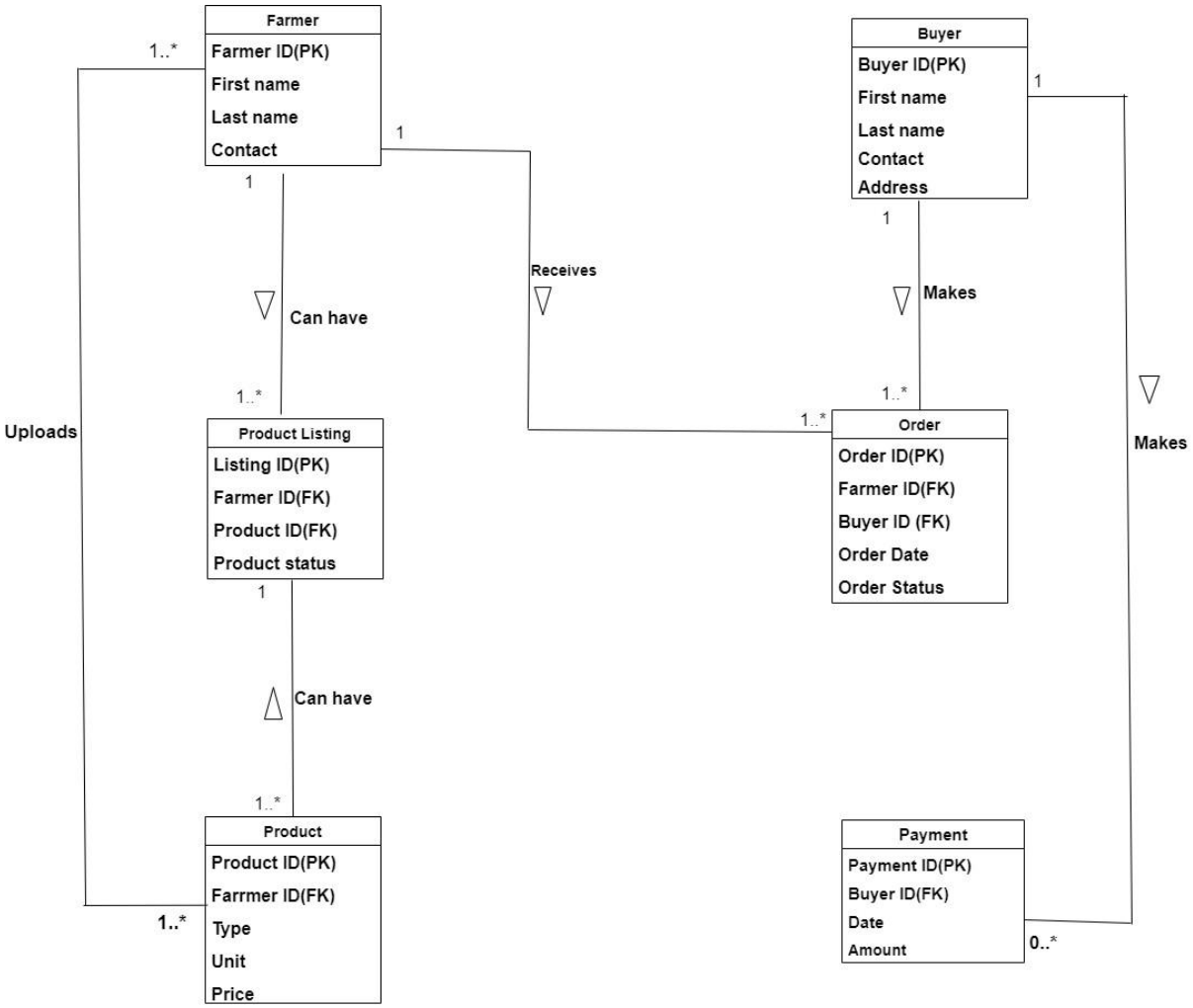


Figure 4.30 Entity Relation Diagram

4.11 Dynamic Modelling

4.11.1 Activity Diagrams

Activity Diagram Activity diagram describes how actions, processes and task are performed to provide a service or work flow. It shows the flow from one activity to another emphasizing the sequence and dependencies.

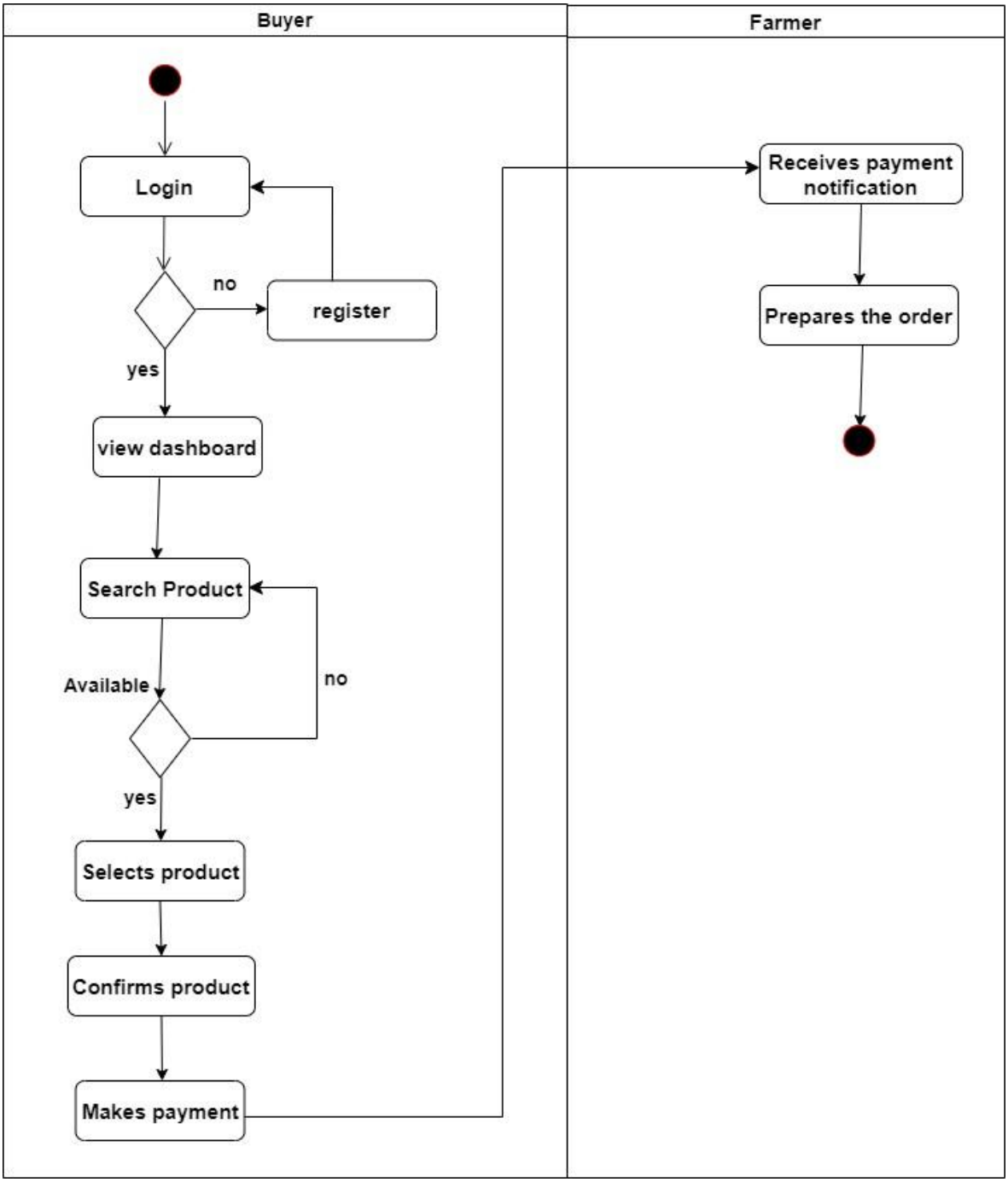
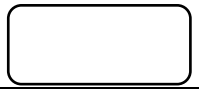
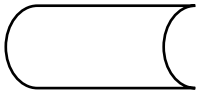
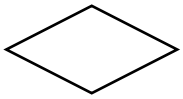
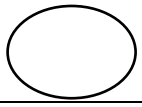


Figure 4.31 Activity Diagram

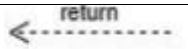
Table 4.10 Activity Notation Descriptions

Notation	Name	Description.
	Process	This represents a single step or action within a process.
	Stored data	This represents a data store or database where information is kept within the flowchart. It indicates a place where data is archived or retrieved during the process.
	Decision	This indicates a point where a decision needs to be made. It has one incoming line and two or more outgoing lines labeled with relevant options based on the decision.
	Terminator	This marks the beginning or end of the flowchart, labeled "Start" or "End".
	Data	This represents data entering or leaving the process. It can depict user input, printed data, or information exchanged with external systems.
	Flow Line	This connects symbols and shows the flow of the process

4.11.2 Sequence Diagrams

A Sequence Diagram is the diagram that represents the interactions or sequences of messages between objects or components within a system over time. It illustrates how objects collaborate with each other to achieve a specific functionality or scenario.

Table 4.11 Sequence diagram shapes and their meaning

Shape	Name	Meaning
	Actor	Represents a person that interacts with the system
	Action line	Shows the phase in which the actors interact with the system
	Life line	Vertical dashed line
	Message	Shows message exchanged between the actors and the system
	Return message	Used to show return messages

Farmer Registration and Product Upload Process

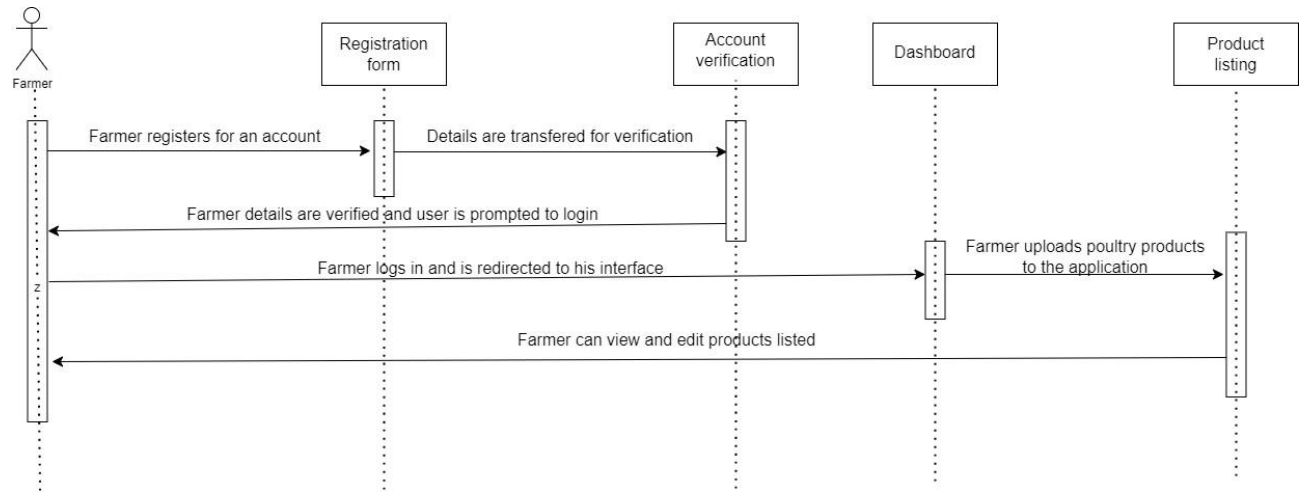


Figure 4.32 Farmer Registration and Product Upload Process

Buyer Registration and Ordering Process

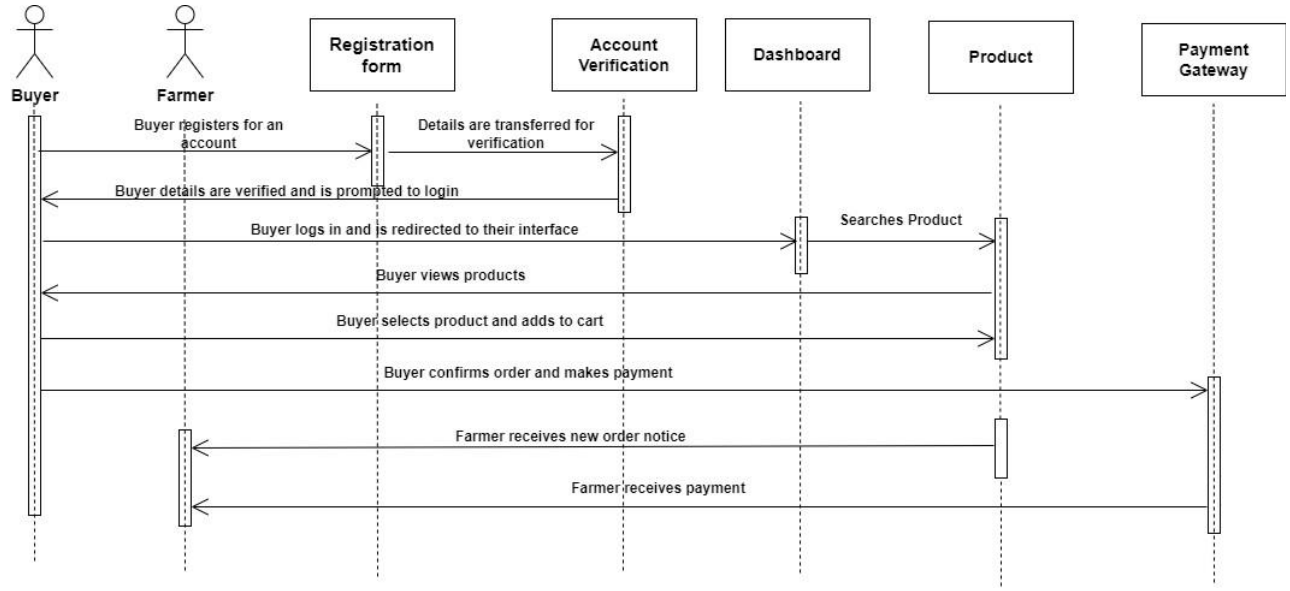


Figure 4.33 Buyer Registrations and Ordering Process

4.11.3 Collaboration Diagram

Buyers Collaboration Diagram

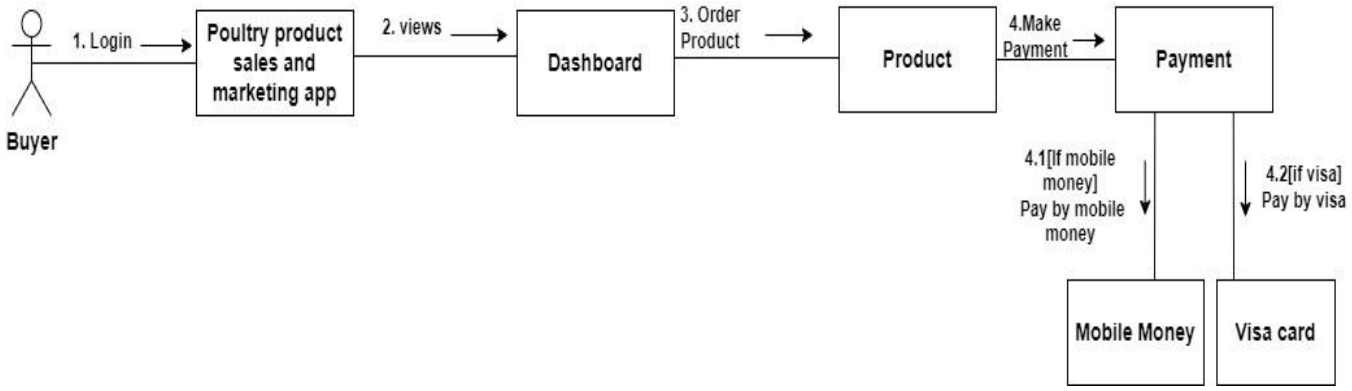


Figure 4.34 Buyers Collaboration Diagram

Description

The buyer logins into the application using their details to gain access, he/she then gains access to the application and views the dashboard. The buyer then searches and orders for a product, he/she then makes a payment using the available payment methods that is mobile money or visa card, then the payment notification is sent to the farmer.

FARMERS COLLABORATION DIAGRAM

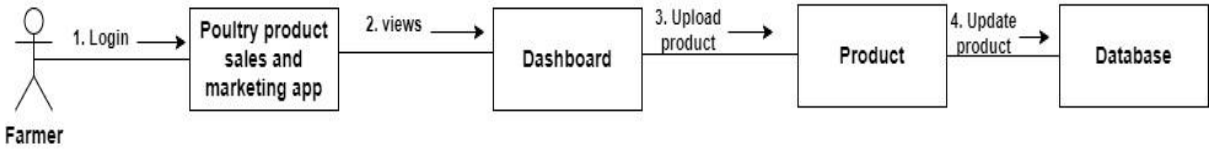


Figure 4.35 Farmers Collaboration Diagram

Description

The farmer logins into the application using their credentials to gain access, he/she then views the dashboard after being granted access. The farmer then uploads the products and updates them.

4.11.4 State Chart Diagrams

A state chart diagram, also known as a state machine diagram or state transition diagram, is a visual representation of the states and transitions of a system or an object.

Components.

States: Represent the different conditions or modes in which an object or system can exist

Transitions: Represent the movement or change from one state to another in response to an event or condition.

Initial State: Represents the starting state of the object or system.

Events: Represent the external or internal stimuli that trigger state transitions.

Actions: Represent the activities or behaviours associated with a state or transition.

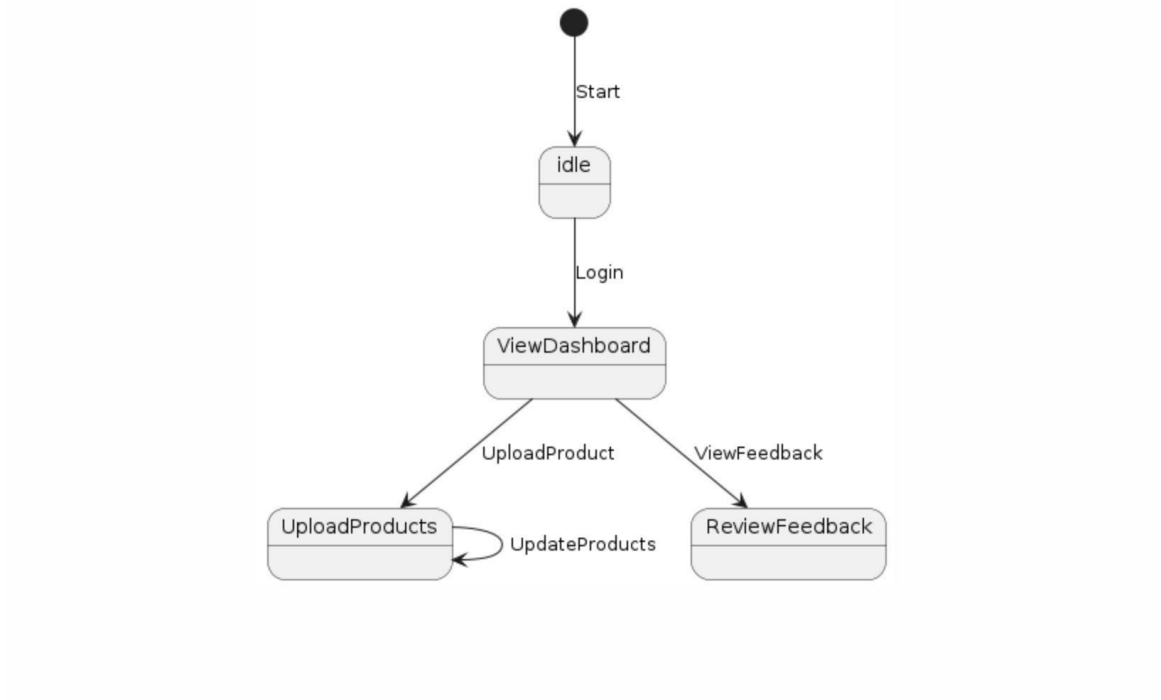


Figure 4. 36 Farmer's state chart diagram

States

1. **Idle:** Initial state when the farmer is logged in but hasn't started any actions.
2. **View Dashboard:** Farmer views the main dashboard upon logging in.
3. **Upload Products:** Farmer uploads new poultry products or updates existing ones.
4. **Review Feedback:** Farmer reviews feedback/comments from buyers regarding their products.

Transitions

1. **Login:** Transition from Idle to View Dashboard upon successful login.
2. **Upload Product:** Transition from View Dashboard to Upload Products when the farmer decides to upload products.
3. **Update Product:** Transition within Upload Products state to update existing product details.
4. **View Feedback:** Transition from View Dashboard to Review Feedback to check buyer feedback.

Actions

1. **Display Dashboard:** Action upon entering View Dashboard state.
2. **Upload Product:** Action triggered when the farmer adds a new product.
3. **Update Product Details:** Action to modify product details within the Upload Products state.
4. **Review Feedback:** Action to read and respond to buyer feedback.

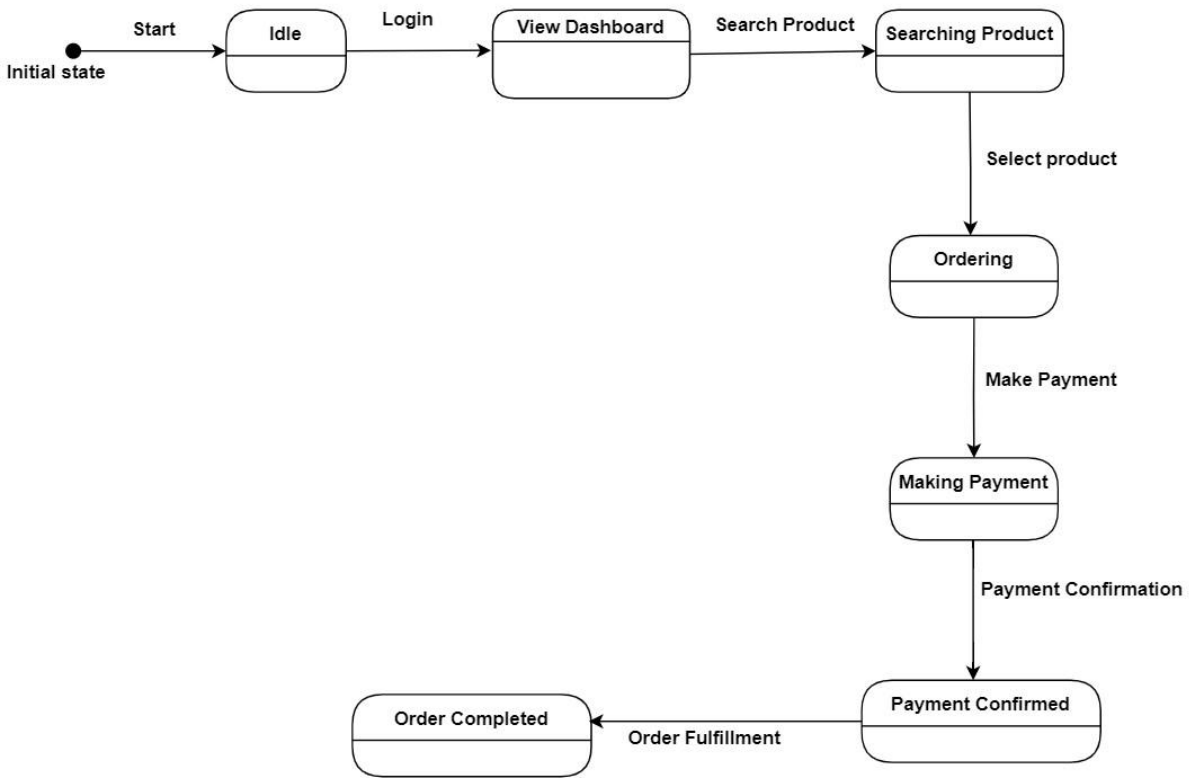


Figure 4.37 Buyer's state chart diagram

States

1. **Idle:** Initial state when the buyer is logged in but hasn't started any actions.
2. **Searching Product:** Buyer is actively searching for poultry products.
3. **Ordering:** Buyer has selected a product and is in the process of placing an order.
4. **Making Payment:** Buyer is making a payment for the selected order.
5. **Payment Confirmed:** Payment has been successfully confirmed.
6. **Order Completed:** Buyer's order has been successfully completed.

Transitions

1. **Search Product:** Transition from Idle to Searching Product when the buyer starts searching.
2. **Select Product:** Transition from Searching Product to Ordering when the buyer selects a product.
3. **Make Payment:** Transition from Ordering to Making Payment when the buyer confirms the order.

4. **Payment Confirmation:** Transition from Making Payment to Payment Confirmed upon successful payment.
5. **Order Fulfillment:** Transition from Payment Confirmed to Order Completed when the farmer approves the order.

Actions

Display Product List: Action upon entering the Searching Product state.

1. **Select Product:** Action triggered upon selecting a product to order.
2. **Confirm Order:** Action triggered when the buyer confirms the order.
3. **Initiate Payment:** Action when the buyer initiates payment.

CHAPTER FIVE: IMPLEMENTATION AND TESTING

5.1 Introduction

This chapter delves into the implementation and testing phase of the Mobile-Based Poultry Product Sales and Marketing Application. It outlines how the system was developed, the tools and technologies employed, and the process undertaken to ensure the system operates as intended. The implementation phase translates design specifications into a functioning system, while the testing phase ensures that the system is reliable, efficient, and meets the requirements of its users.

5.2 Data Outputs

Data outputs are results produced by an application after it has received and processed data based on provided instructions. The developed application receives user data through forms which provide a structured and interactive way to collect data from users. This data is thereafter processed and the application provides results. The forms used to collect the data and the results provided are defined below.

5.2.1 System Forms

System forms are interactive components that facilitate data input and management within the application. They include:

1. **Registration Form:** Allows users (farmers and buyers) to create an account by entering personal and contact information.
2. **Login Form:** Enables registered users to securely access their accounts.
3. **Product Management Forms:** Includes forms for adding, editing, and deleting poultry products, capturing details such as product name, description, quantity, price, and location.
4. **Rating and Feedback Form:** Enables buyers to rate products and provide feedback on their purchasing experience, helping to build trust and improve product quality.
5. **Search and Filter Products Form:** Allows buyers to search and filter products based on criteria such as price, quantity, and location, making it easier to find desired products.
6. **Payment Form:** Facilitates the payment process for buyers, allowing them to enter payment details and complete transactions securely.

5.2.2 System Screenshots

System screenshots provide a visual representation of the application's interface and functionalities.

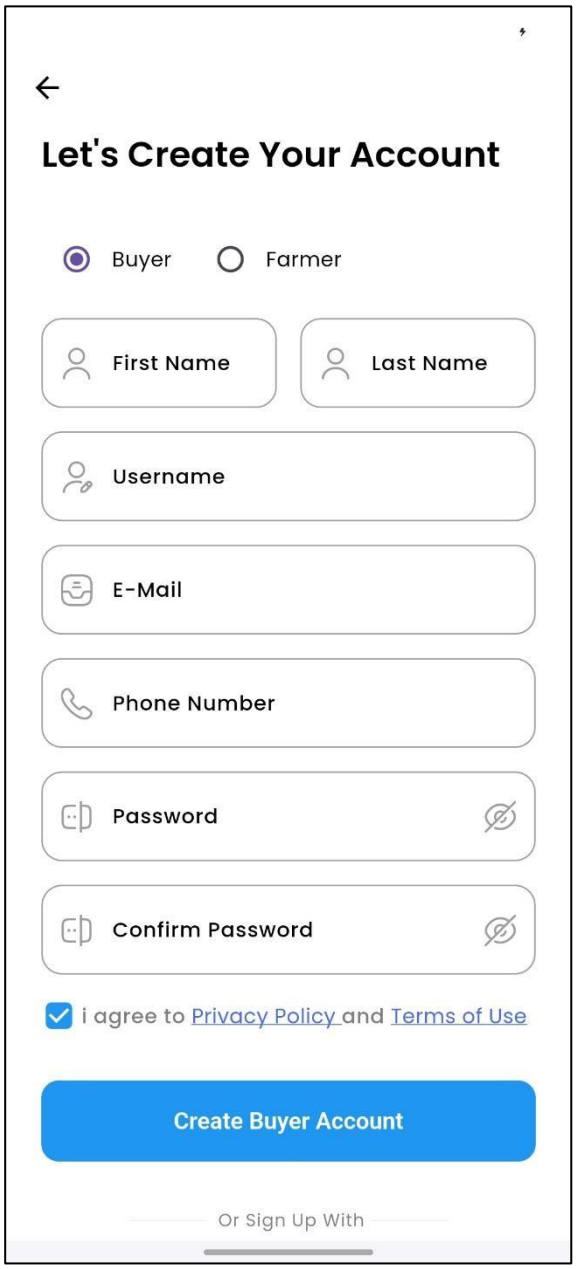
These include:

1. System Form Screenshots

User Registration Forms

When the users (farmer and buyer) click on the sign-up button, they are directed to a create account page where they are required to enter a set of details which are required to create an account on the application. This is mainly information about the users (farmer and buyer)

After the user has entered all their details, they can go ahead to click the sign-up button and they will immediately be logged into the application.



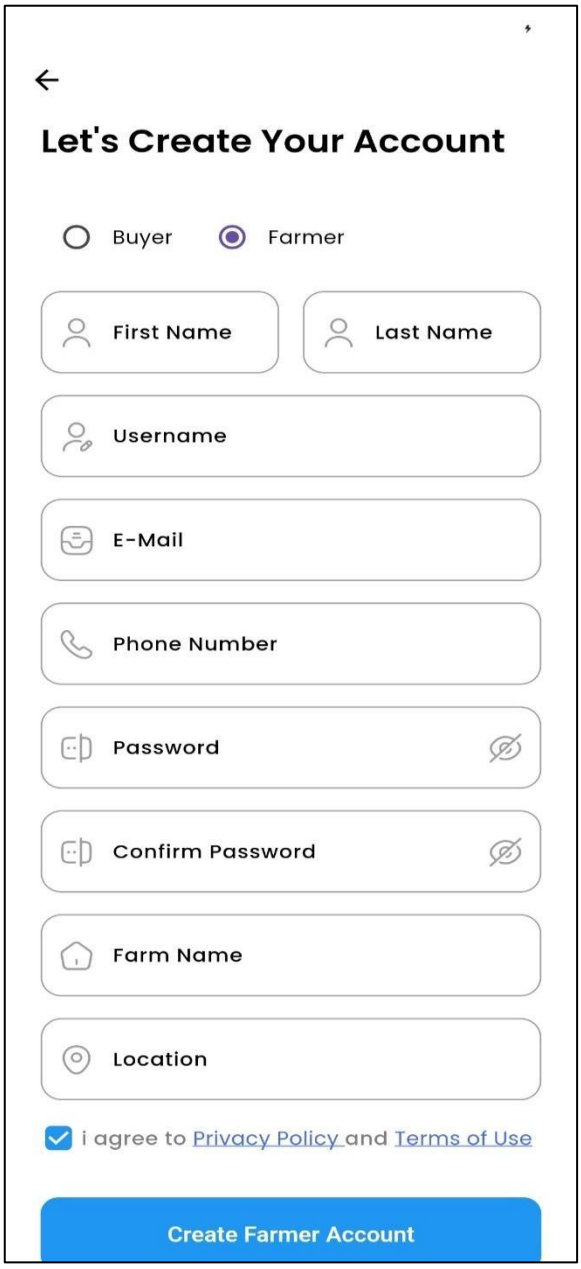


Figure 5.2 Buyer's Registration form Figure 5.1 Farmer's Registration form

User Login Form

This form is the initial page a user sees when they access the application and it is where they can login in with their registered information. The user (buyer and farmer) input their information if they have registered accounts and gain access to the application.

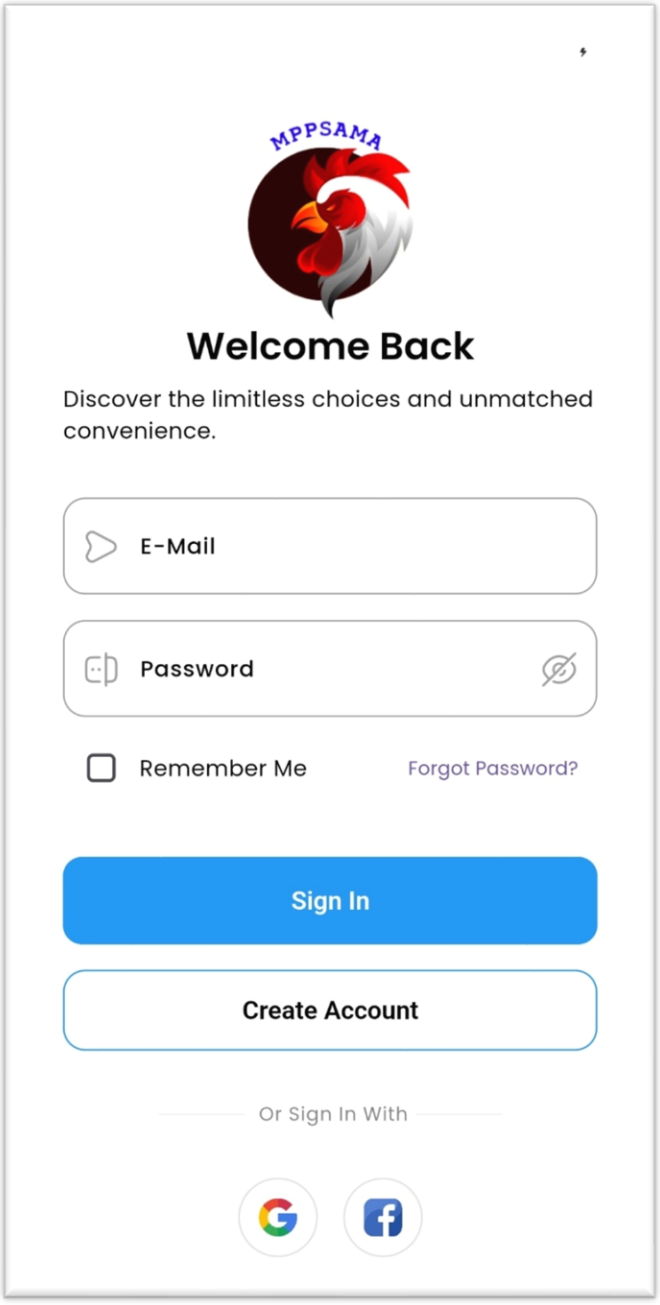


Figure 5.3 User Login Form

Search Filter Product Form

This form allows buyers to search and filter products based on criteria such as price, quantity, and location, making it easier to find desired products.The buyer enters the details of the minimum or maximum price of the product he/she wants, enters the minimum and maximum quantity and then places the apply button thus the product he or she wants is displayed.

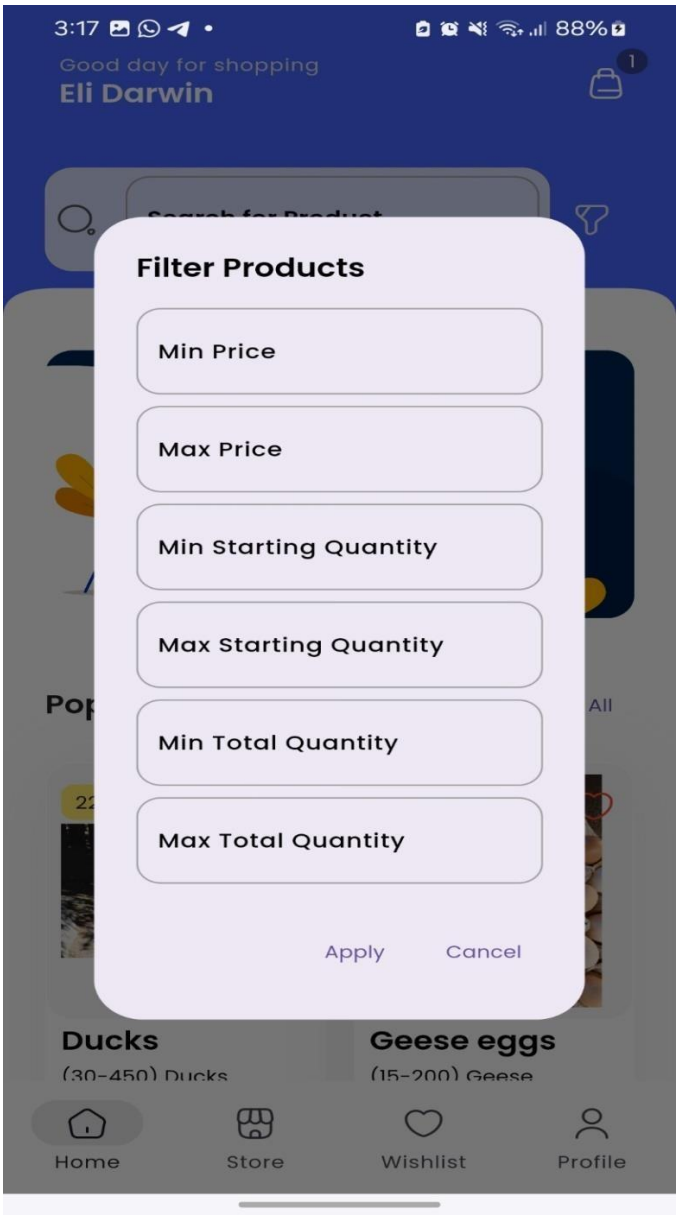


Figure 5.4 Search Filter Product Form

Buyer Rating and Feedback Form

This screenshot shows the feedback and rating page of the buyer. The buyer enters feedback about the product and then submits the information then the farmer receives a feedback notification.

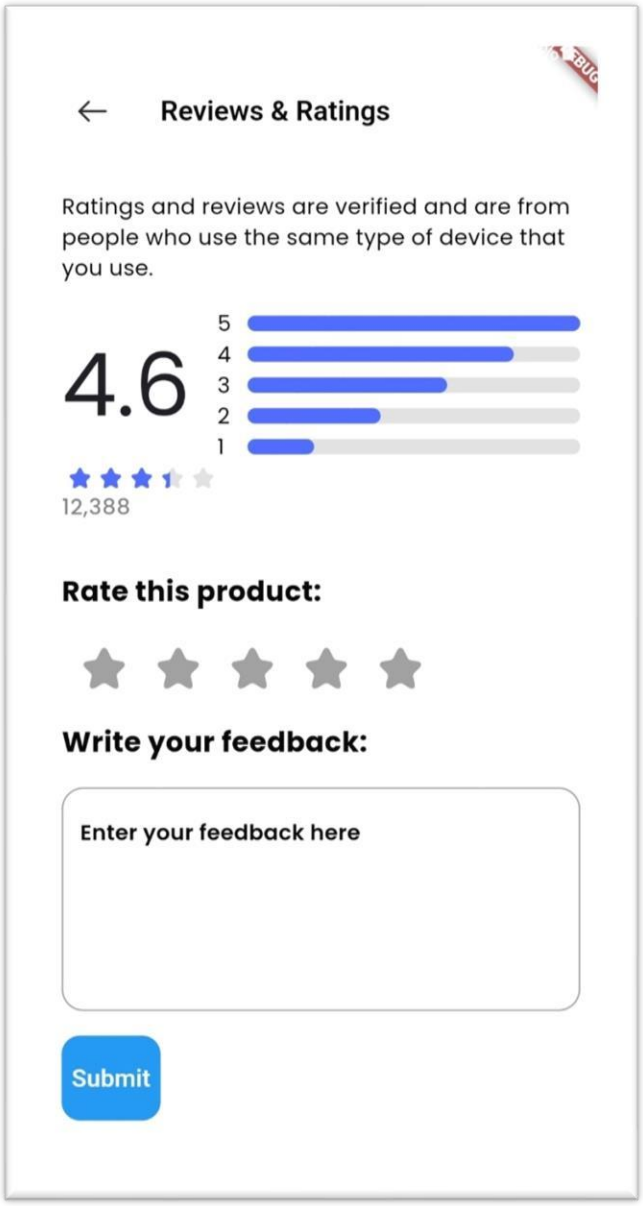


Figure 5.5 User Feedback Form

System Screenshots

On this page, the farmer uploads a product by inputting the product information for example the price of the product, the quantity and then places the upload product button for the products to reflect on the interface

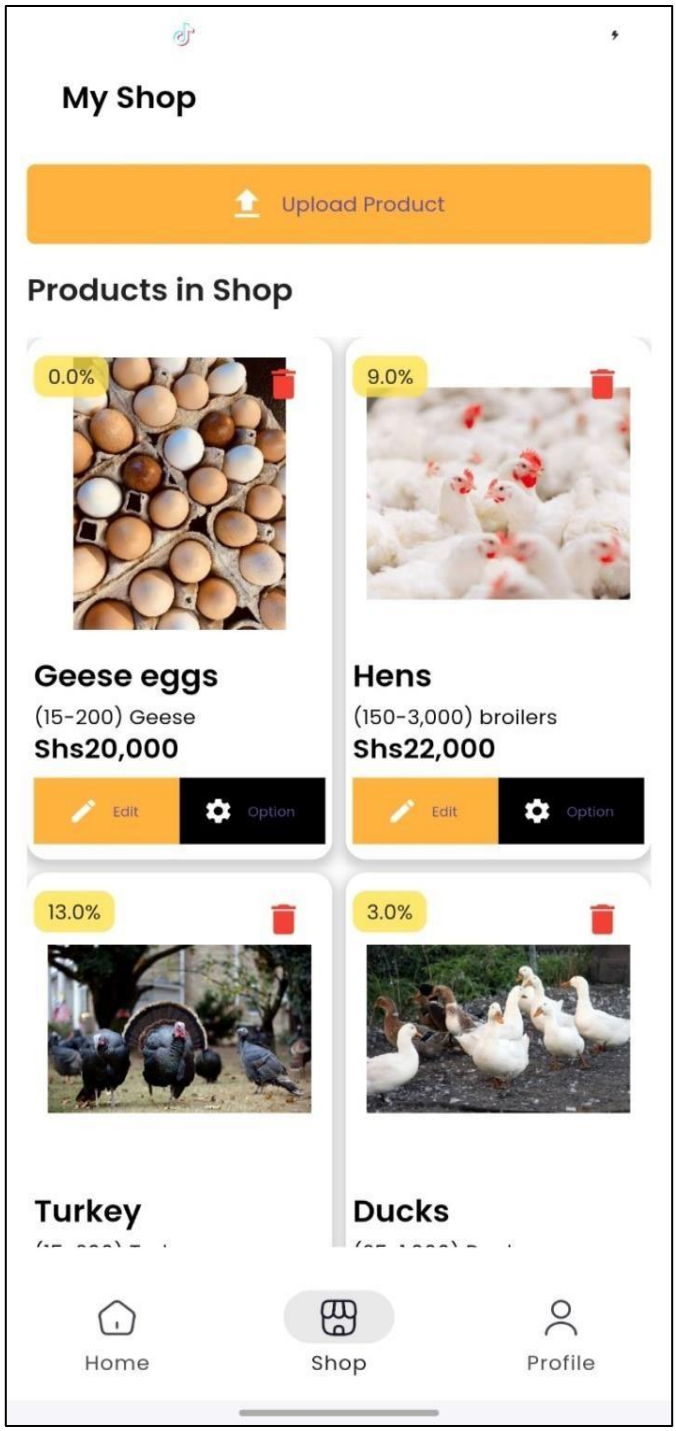


Figure 5.6 Farmer's Shop Screen

The buyer chooses the most suitable mode of payment and the two payment options available are paying with card and paying with Mobile money

Figure 5.7 Buyer's payment Screen

Admin Dashboard

The screenshot depicts the admin login page, which enables the admin to input in their right credentials in order to gain access to the application. The login credentials of the admin include the email and the Password

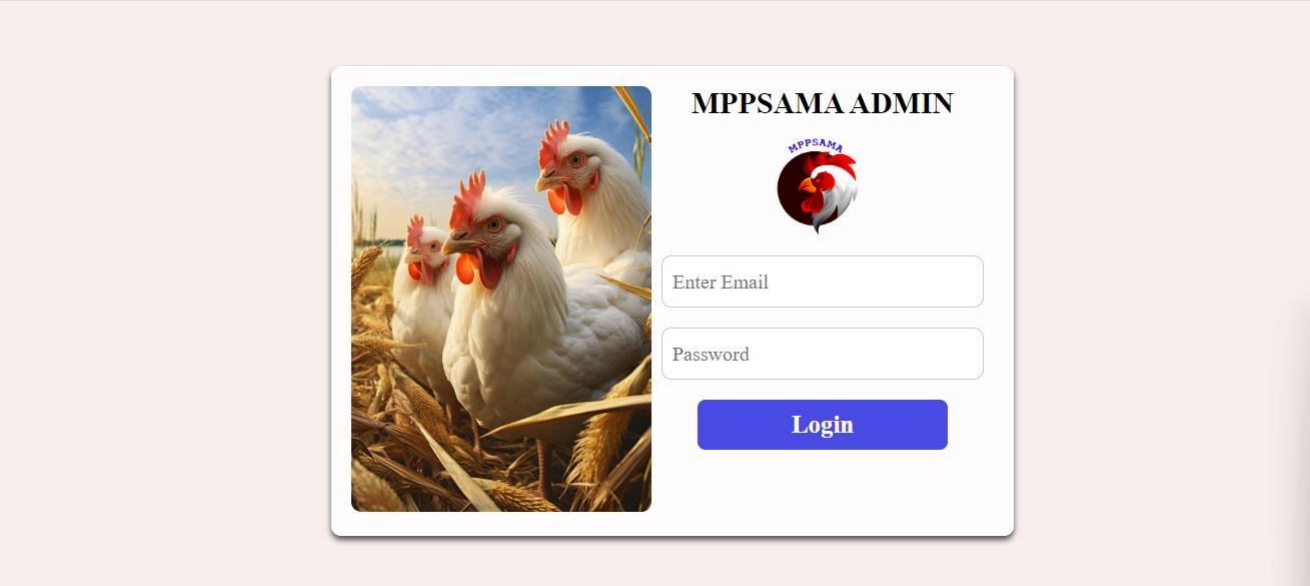


Figure 5.8 Admin Login Page

This screenshot displays the admin dashboard, which shows the users of the application, the products and the orders made by the buyers and the user feedback.

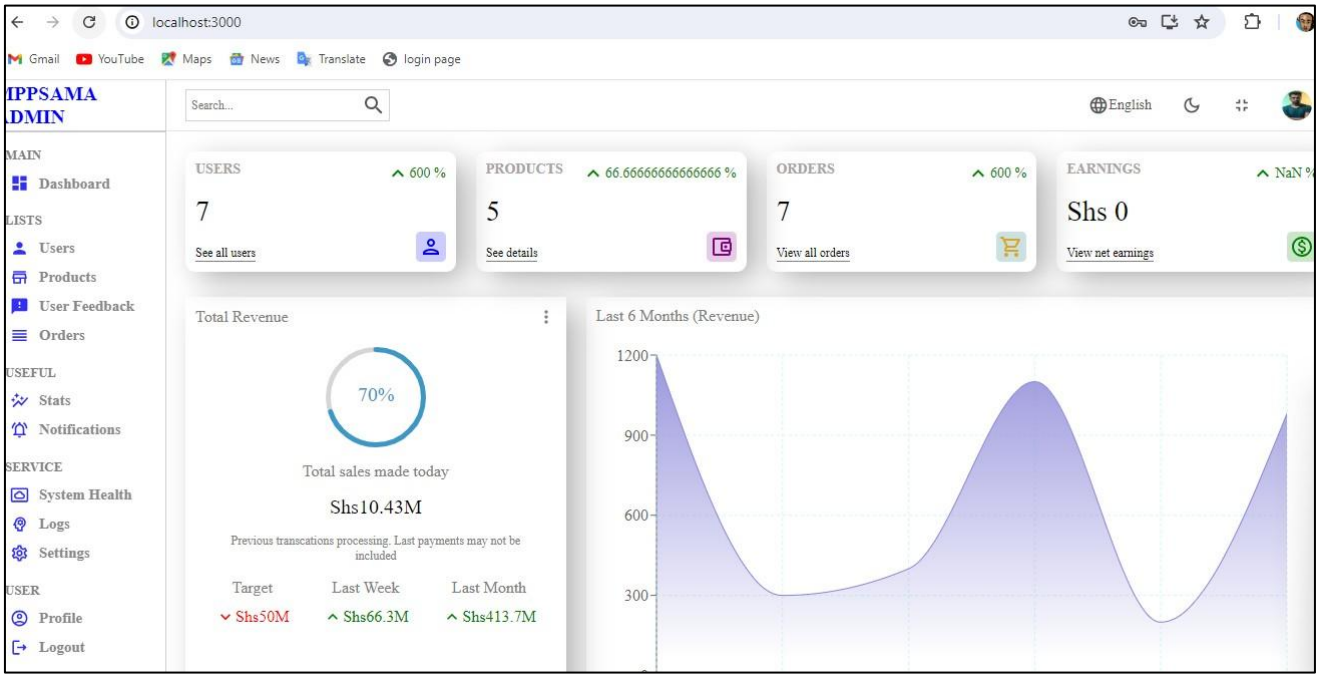


Figure 5.9 Admin Dashboard

This screenshot displays the users screen that shows the user details for example the user ID, Username, Email, phone number and on the same screen, the admin is able to view the single user details and can delete the user account as well.

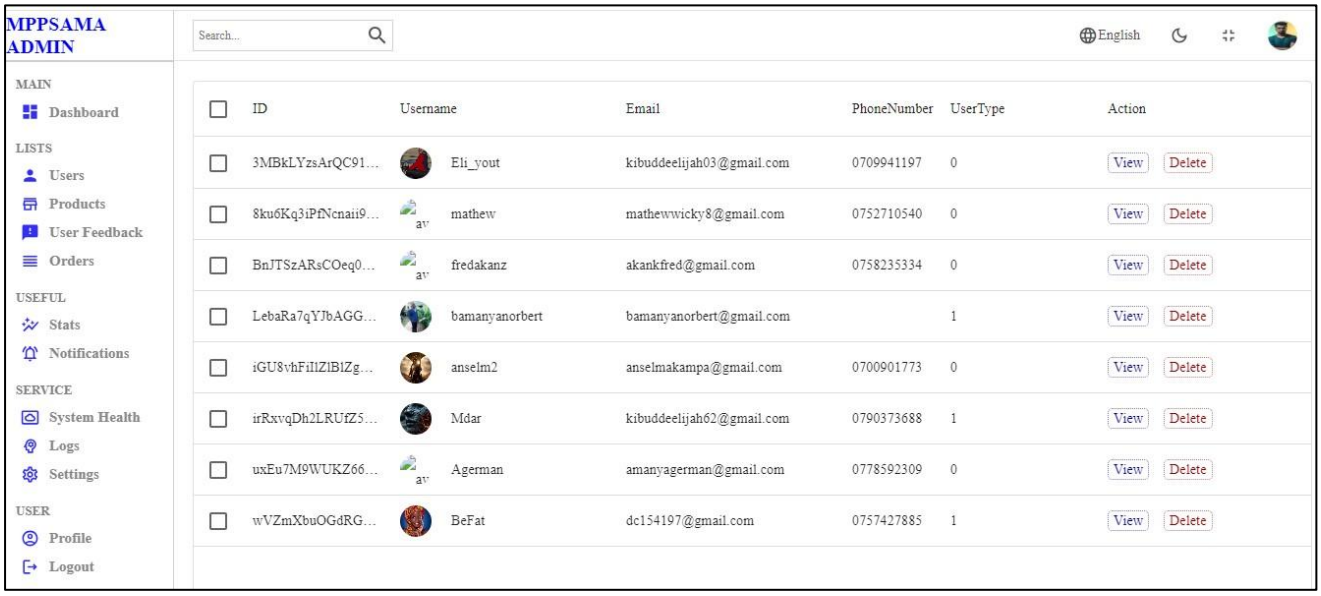


Figure 5.10 Users Screen

This screenshot shows the information of a single user of the application. Here, the admin can suspend the account of a user incase the user has created more than one account and can as well reactivate the account and the user is able to login again.

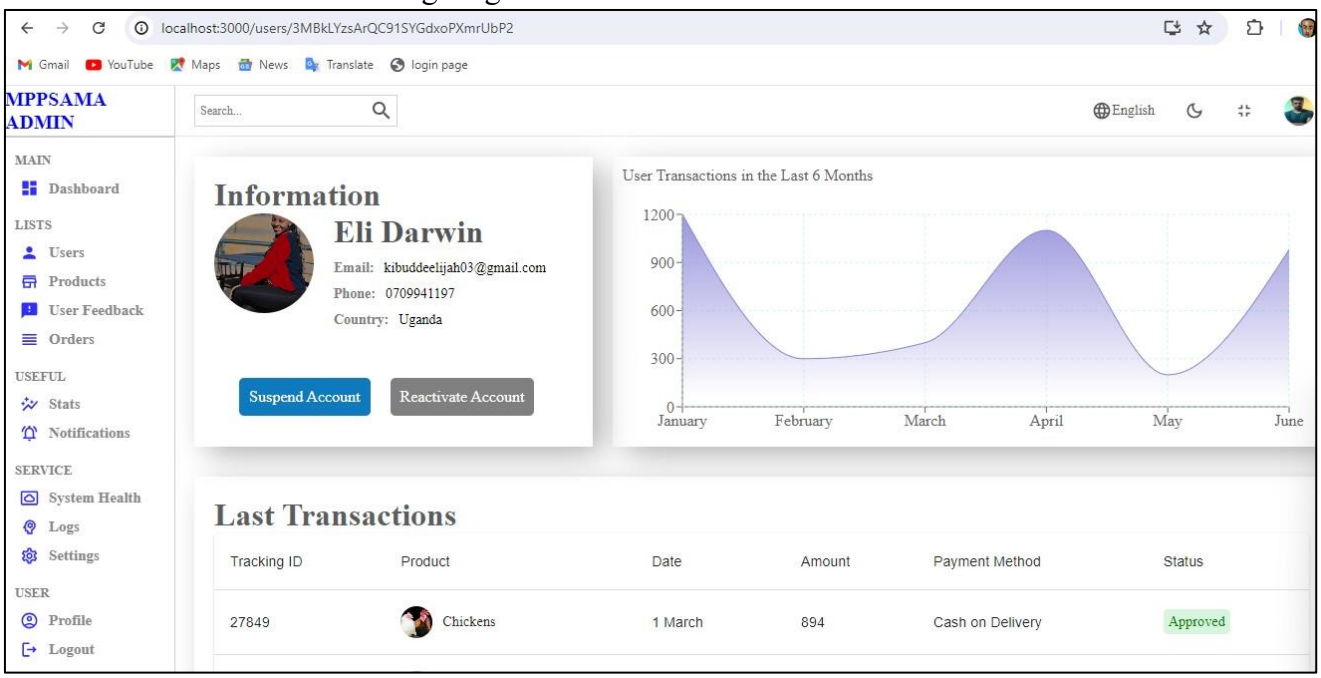


Figure 5.11 View Single User Screen

The screenshot below displays a screen with products information for example the product name, product description, price, category and the image of the product.

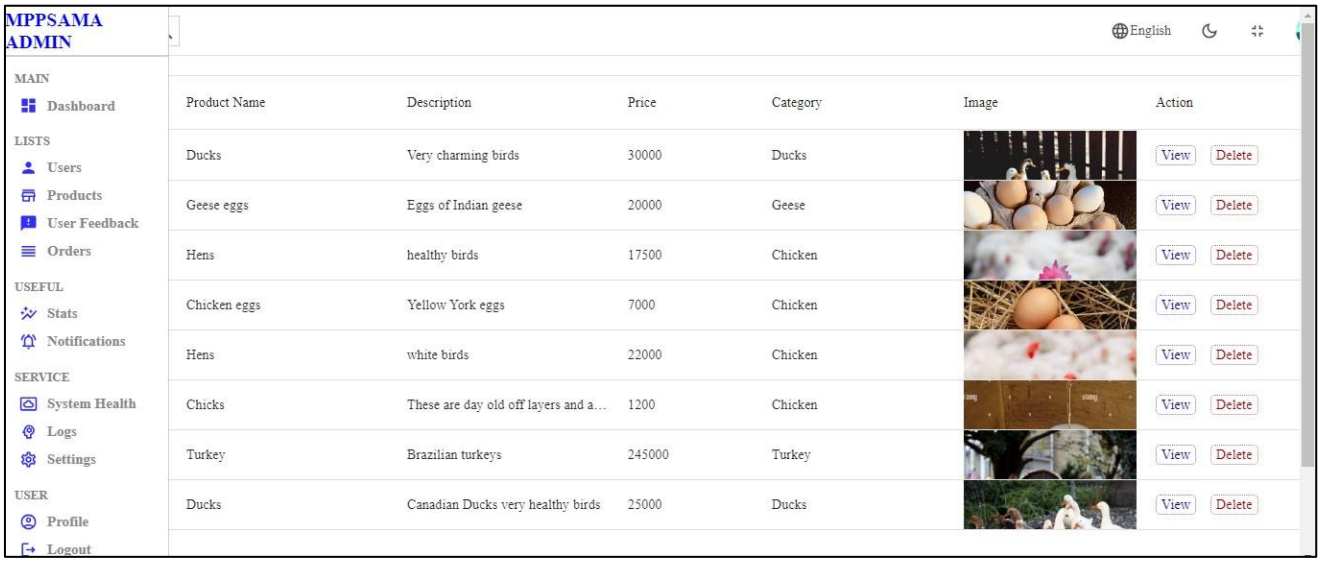


Figure 5 12 Products Screen

This screenshot shows the single product information for example description, price and category and the admin can be able to delete the image of the product if it doesn't meet the standards and can upload a new product image

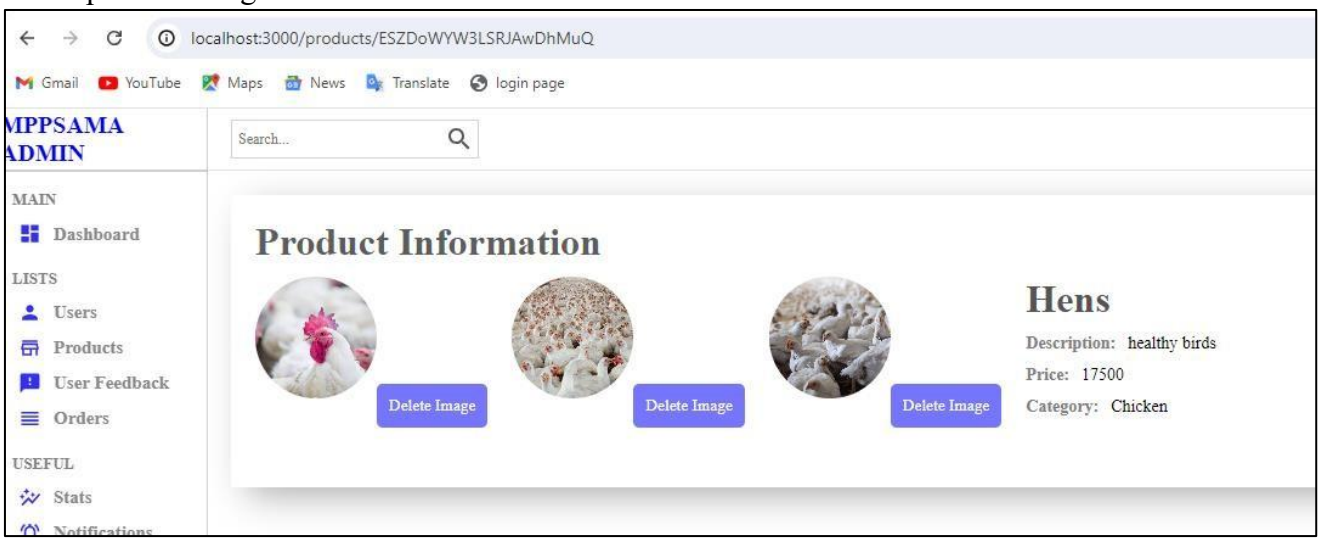


Figure 5.13 View Product Screen

This screenshot shows the feedback and responses screen. It displays the buyer's feedback about the product and the farmer's response to the buyer's feedback.

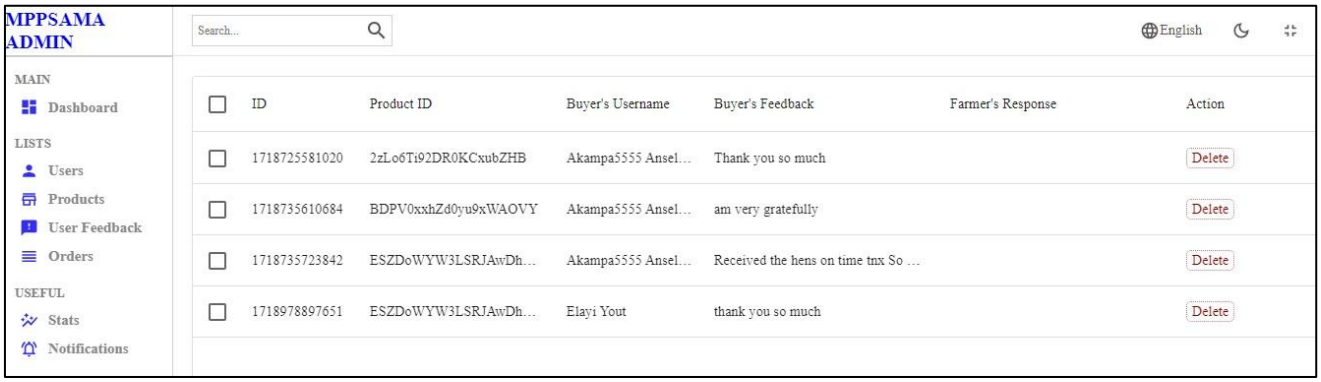


Figure 5.14 Feedback and Responses Screen

5.3 The Programming Languages Used

The development of the Mobile-Based Poultry Product Sales and Marketing Application leveraged several programming languages tailored to different components of the system.

5.2.3 Frontend

Developed using Flutter and Dart. Flutter provides a robust framework for building natively compiled applications for mobile from a single codebase, while Dart is the programming language used for Flutter development.

5.2.4 Backend

Implemented using Firebase, a platform that offers backend services such as authentication, database, and cloud storage, ensuring seamless data management and real-time updates.

5.2.5 Admin Dashboard (Web Application)

Created using React and SASS. React is a JavaScript library for building user interfaces, particularly single-page applications, and SASS (Syntactically Awesome Style Sheets) is a preprocessor scripting language that is interpreted or compiled into CSS. Firebase is also used as the backend for the web application, providing consistent backend services across both the mobile and web platforms.

5.2.6 Integration and Data Flow

The integration between the frontend and backend systems ensures smooth data flow and synchronization across different components. The mobile application communicates with Firebase to manage user data, product listings, and orders, while the admin dashboard provides an interface for administrative tasks, including user management and system monitoring.

5.3 The Tools

5.3.1 Git and GitHub

Used for version control and collaboration, allowing multiple developers to work on the project simultaneously and manage code changes effectively.

5.3.2 Visual Studio Code

The primary code editor used for writing and debugging code.

5.3.3 Firebase Console

For managing backend services, including database management, user authentication, and hosting.

5.4 System Testing

System testing is a crucial phase that ensures the application performs as expected under various conditions.

This involved several testing methodologies to validate different aspects of the system.

The goal of testing was to not only detect flaws in our system, but also to identify ways to improve its efficiency, accuracy, and usability. This section explains the steps we undertook to test our system.

5.4.1 Unit Testing

Involved testing individual components or units of code to ensure they function correctly in isolation.

For example, we entered invalid inputs in the registration form to see how it handles wrong inputs.

Figure 5.15 Unit testing of the Registration page

5.4.2 Integration Testing

Involved verifying that different modules or services within the application work together as intended. We tested the feedback and response communication between the buyer's interface and farmer's interface.

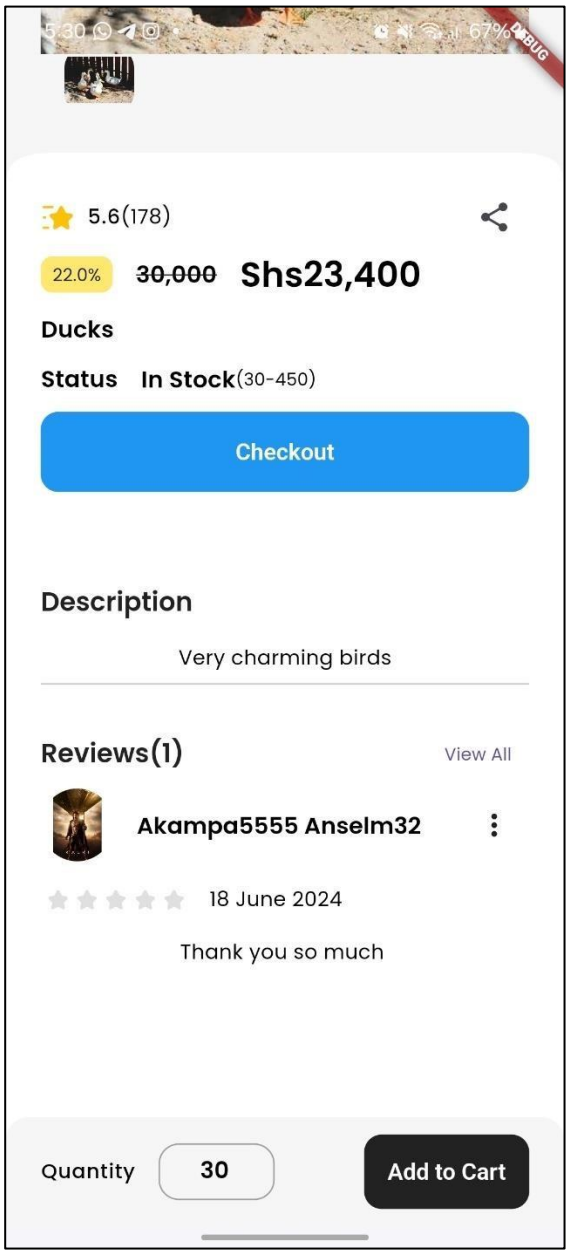


Figure 5.16 Shows Feedback from the buyer

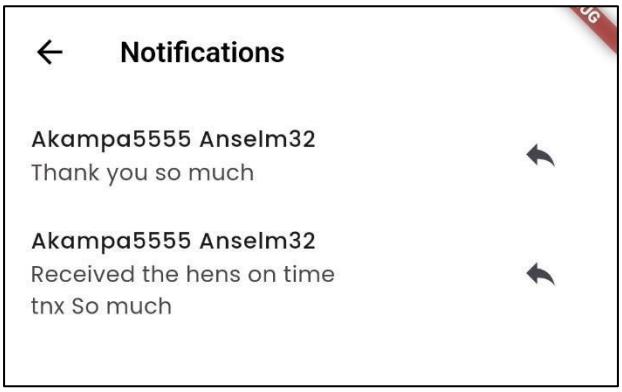


Figure 5.17 Response from the farmer

CHAPTER SIX: DISCUSSION, RECOMMENDATIONS, FUTURE WORK AND CONCLUSIONS

6.1 Discussion

This discussion highlights the key features and benefits of the system while addressing its implementation challenges and future considerations.

Table 6.1 Discussion

Objective	**Status**
To develop an application (MPPSAMA) to connect farmers to buyers	The application was designed and implemented properly
Reviewing existing literature and identify gaps	A number of online and hard copy literature was reviewed to identify gaps within existing systems and the recommendation of this literature was properly followed to solve the challenges and fill the gaps
To gather requirements for MPPSAMA	Questionnaires and interview guides were designed that helped us to collect data from the farmers and buyers
Testing and validation for the system	Testing was done in two phases that is unit testing and integration testing and after the system passes the tests it was validated by deploying it to the users who used it in real life experience
Multifactor authentication (MFA) and additional authorization policies are planned.	Not implemented
Creation of user profiles and accounts	Fully implemented
Feedback mechanism	Fully Implemented

Payment's mechanism	Partially Implemented
Search and filter functionality	Fully Implemented

6.2 Limitations

Several limitations were encountered throughout the project development process and these were mainly in data collection difficulties, Mobile Money API Integration

1. Data collection difficulties

During data collection, difficulties arose in securing farmer and buyer participation in interviews. This led to the failure in getting certain information and resulted in increased time required for data collection, consequently impacting subsequent project steps.

2. Mobile Money API Integration

Another significant limitation was the inability to integrate the mobile money API due to the delayed procedures for approving the use their endpoints. Despite multiple attempts to expedite the process, the approval took much longer than anticipated, preventing timely implementation. This delay hindered the project's progress, as mobile money integration was a critical component for facilitating secure and efficient financial transactions within the application.

6.3 Recommendations

Based on the project's objectives and limitations, here are some recommendations to enhance the implementation of the Mobile based poultry product sales and marketing application.

6.3.1 Expand outreach and Training programs

Implement training programmers to enhance the farmers and buyers' technical skills and familiarity with the application ensuring wider adoption.

6.3.2 Enhance data security measures

Strengthen data protection measures through ensuring robust encryption protocols are in place for sensitive user data. Conduct regular security audits and implement access controls to prevent

unauthorized access. Educate users (farmers and buyers) about data privacy best practices to enhance their confidence in using the application**.**

6.3.3 Plan for scalability

This is by designing the application architecture to accommodate growth in user base and data volume. Ensure the sustainability of the project by securing long-term funding or support mechanisms for maintenance, updates, and user support.

6.3.4 Establish a structured feedback mechanism

This will help to continuously improve the application. Regularly solicit input on usability, functionality, and any emerging challenges. Use this feedback to prioritize future updates and enhancements**.**

6.3.5 User Interface (UI) and User Experience (UX) Improvements

Simplify the application interface to make it more intuitive and user-friendly. Provide clear instructions and support resources to assist users who may have limited technical skills.

6.4 Future Works

1. **Artificial Intelligence Integration:** will explore the potential integration of Artificial Intelligence (AI) into the application. This could provide real-time notifications and alerts for important events, such as new listings, price changes, and transaction confirmations.
2. **Advanced Analytics and Reporting.** This will propose the implementation of advanced analytics and reporting features to provide farmers and buyers with actionable insights or information. This could include; Sales Trends, Market Analysis, Performance Metrics.

3. **Offline Access and Synchronization:** Develop offline functionality to allow users (farmers and buyers) to access the application without an internet connection. Implement synchronization features to ensure that any changes made offline are automatically updated when connectivity is restored

6.5 Conclusion

In conclusion, the development of the mobile-based poultry product sales and marketing application has shown promising results in connecting farmers and buyers online. The project successfully

addressed its primary objective of facilitating market access for poultry products while enhancing convenience for users. However, several limitations surfaced during the development process, including challenges in data collection, privacy and security concerns, technical barriers for users, and operational complexities.

Moving forward, addressing these limitations is crucial for the application's sustained success. Recommendations for future work include enhancing privacy and security measures, mitigating technical barriers through user interface improvements and continuously gathering and utilizing user feedback, and ensuring scalability and sustainability of the platform.

By implementing these recommendations, future iterations of the application can overcome current challenges, improve user engagement, and better serve the needs of farmers and buyers. This ongoing refinement will be essential in maximizing the application's impact and establishing it as a reliable tool in agricultural market connectivity.

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APPENDICES

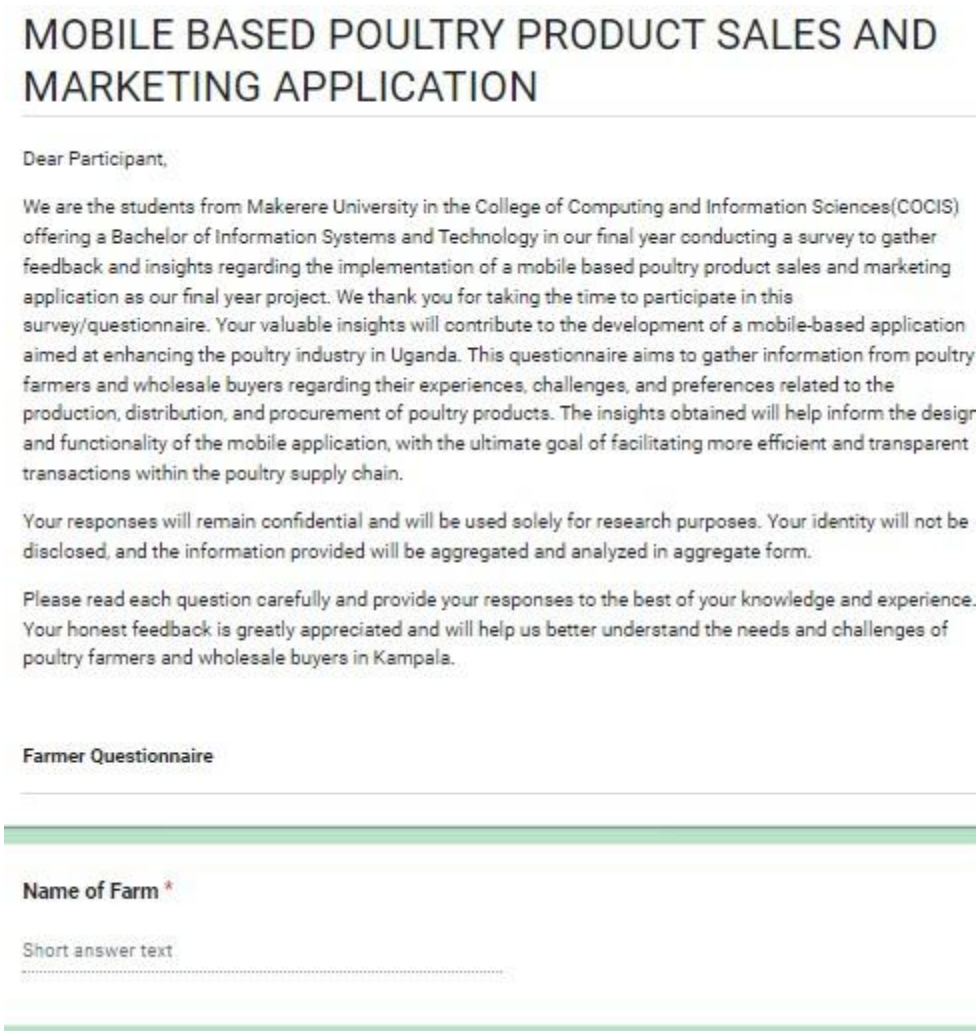
Appendix 1 Questionnaires

FARMER QUESTIONNAIRE

We developed, designed and published a questionnaire online for **Farmers** via Google forms at

https://docs.google.com/forms/d/1b3yamJtlkNsKMo-R5_J4QWuxpUgjt71R6PYQ4jS_tWY/

Below are screenshots showing the several questions that were included in the questionnaire



MOBILE BASED POULTRY PRODUCT SALES AND MARKETING APPLICATION

Dear Participant,

We are the students from Makerere University in the College of Computing and Information Sciences(COCIS) offering a Bachelor of Information Systems and Technology in our final year conducting a survey to gather feedback and insights regarding the implementation of a mobile based poultry product sales and marketing application as our final year project. We thank you for taking the time to participate in this survey/questionnaire. Your valuable insights will contribute to the development of a mobile-based application aimed at enhancing the poultry industry in Uganda. This questionnaire aims to gather information from poultry farmers and wholesale buyers regarding their experiences, challenges, and preferences related to the production, distribution, and procurement of poultry products. The insights obtained will help inform the desigr and functionality of the mobile application, with the ultimate goal of facilitating more efficient and transparent transactions within the poultry supply chain.

Your responses will remain confidential and will be used solely for research purposes. Your identity will not be disclosed, and the information provided will be aggregated and analyzed in aggregate form.

Please read each question carefully and provide your responses to the best of your knowledge and experience. Your honest feedback is greatly appreciated and will help us better understand the needs and challenges of poultry farmers and wholesale buyers in Kampala.

Farmer Questionnaire

Name of Farm *

Short answer text

What's your gender *

- ○ Male
- ○ Female

Location (District/Region) *

Short answer text

Years of Experience in Poultry Farming *

Short answer text

What is your Education level? *

- ○ PLE
- ○ UCE
- ○ UACE
- ○ GRADUATE
- ○ Other...

How many birds do you typically raise per cycle? *

Short answer text

What is the size of your poultry farm? (Number of birds e.g. 1000 birds) *

Short answer text

Does your farm market and sell it's products? *

- ○ Yes
- ○ No

If yes, select how it is done? *

- ○ Manually
- ○ Electronically

If manually, how exactly is it done?

- [ ] Direct sales (selling your poultry products directly to the customers or in local markets)
- [ ] Word of mouth (relying on referrals and recommendations from existing customers)
- [ ] Local advertisements (advertising through local newspapers)
- [ ] Middlemen
- [ ] Sales calls(making direct sales calls to potential buyers like restaurants or hotels)

What are the benefits of manually marketing and selling your products?

- [ ] Direct Customer Interaction
- [ ] Higher Profit Margins
- [ ] Control Over Pricing
- [ ] Brand Building
- [ ] Flexibility

What are the challenges you face while manually marketing and selling your products?

- [ ] Limited Reach
- [ ] Time-Consuming
- [ ] Seasonal Variability

What are some of the solutions you would suggest?

- [ ] Online Presence that complements manual sales
- [ ] Market Diversification to enables farmers explore diversifying sales channels
- [ ] Offering Value-Added Products in order to attract new customers and increase sales
- [ ] Provide training and support to farmers on sales techniques, customer service, and marketing strategies ..

If electronically, how exactly is it done?

- [ ] Online Marketplace like e-commerce platforms
- [ ] Mobile Applications
- [ ] Social Media Platforms
- [ ] Farm Websites

What are the benefits of electronically marketing and selling your products?

- [ ] Wider Reach
- [ ] Convenience
- [ ] 24/7 Availability
- [ ] Customer Insights
- [ ] Automation

What is your level of digital/technology literacy? *

	1	2	3	4	5	6	7	8	9	10	
low	○	○	○	○	○	○	○	○	○	○	high

Suggest features that you think can help any farm improve the sale and marketing of its products *

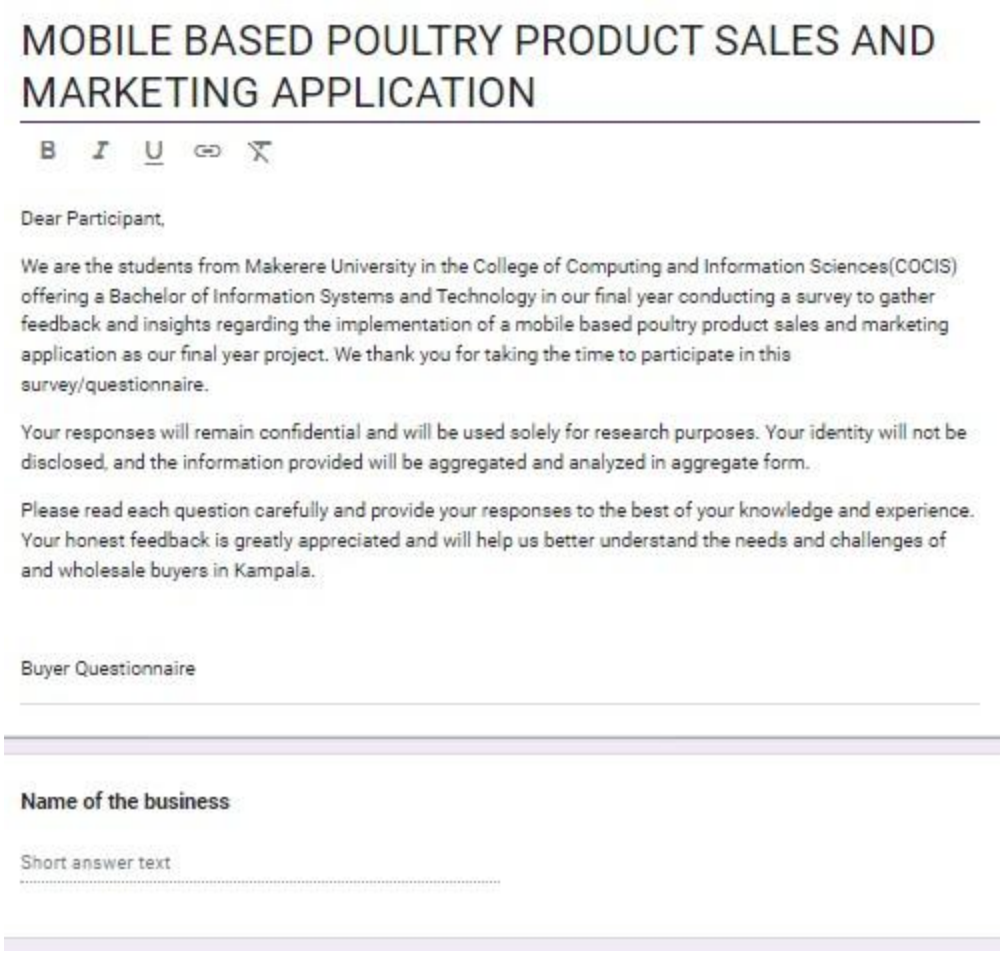
- [ ] Online Ordering System
- [ ] Product Catalog
- [ ] Customer Reviews and Ratings
- [ ] Promotions and Discounts
- [ ] Customization Options
- [ ] Integration with Social Media
- [ ] Real-Time Inventory Management
- [ ] Delivery Tracking
- [ ] Customer Support
- [ ] Educational Resources
- [ ] Integration with Payment Gateways

BUYER QUESTIONNAIRE

We developed, designed and published a questionnaire online for **buyers** via Google forms at

https://docs.google.com/forms/d/1tOkbJPeKNS5r7Chn9UIB640lBWArVJHDrNlSDQRGYmU/

Below are screenshots showing the several questions that were included in the questionnaire



MOBILE BASED POULTRY PRODUCT SALES AND MARKETING APPLICATION

B I U

Dear Participant,

We are the students from Makerere University in the College of Computing and Information Sciences(COCIS) offering a Bachelor of Information Systems and Technology in our final year conducting a survey to gather feedback and insights regarding the implementation of a mobile based poultry product sales and marketing application as our final year project. We thank you for taking the time to participate in this survey/questionnaire.

Your responses will remain confidential and will be used solely for research purposes. Your identity will not be disclosed, and the information provided will be aggregated and analyzed in aggregate form.

Please read each question carefully and provide your responses to the best of your knowledge and experience. Your honest feedback is greatly appreciated and will help us better understand the needs and challenges of and wholesale buyers in Kampala.

Buyer Questionnaire

Name of the business

Short answer text

What is your gender? *

- ○ Male
- ○ Female
- ○ Option 3

Location of the business (District/Region) *

Short answer text

What is your level of education? *

- ○ PLE
- ○ UCE
- ○ UACE
- ○ GRADUATE
- ○ Other...

What type of business do you operate? *

- ○ Restaurant
- ○ Supermarket
- ○ Hotel
- ○ Catering services
- ○ Sell eggs
- ○ Local market chicken seller

What types of poultry products do you typically buy? *

- ☐ Eggs
- ☐ Whole chicken
- ☐ Chicken parts
- ☐ Other...

How frequently do you need to restock the poultry products? *

- ○ Daily
- ○ Weekly
- ○ Monthly

What factors are important to you when choosing a platform for buying the poultry products? *

- [ ] pricing
- [ ] reliability
- [ ] convenience

What features or services would you find most valuable? *

- [ ] Product traceability
- [ ] Direct farmer connectivity
- [ ] Online ordering
- [ ] Other...

What methods of payment do you prefer? *

- [ ] cash
- [ ] mobile money
- [ ] bank transfer
- [ ] Other...

Do you buy directly from the farmer? *

- ◯ Yes
- ◯ No
- ◯ Other...

If yes , how is it done? *

- ◯ Manually
- ◯ Electronically

If manually , how exactly is it done? *

- ☐ Direct buying (buying products directly from the farmers)
- ☐ Word of mouth (relying on the referrals from the fellow buyers)
- ☐ Making direct calls to farmers
- ☐ Buying through local advertisements

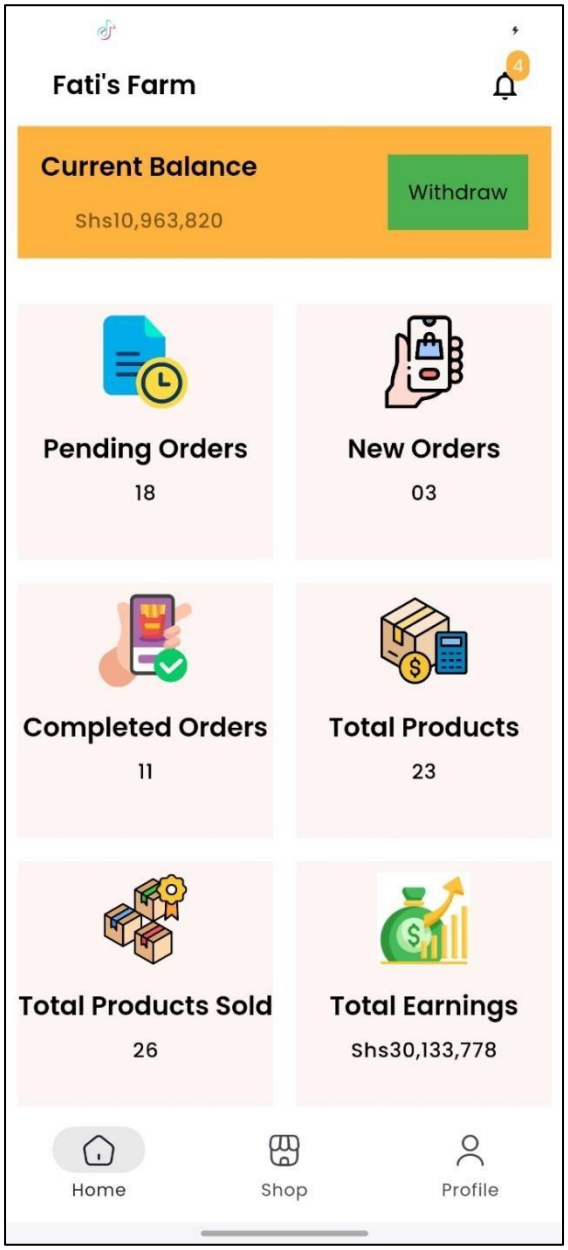
Appendix 2 Interview Guides Interview Guide for Farmers

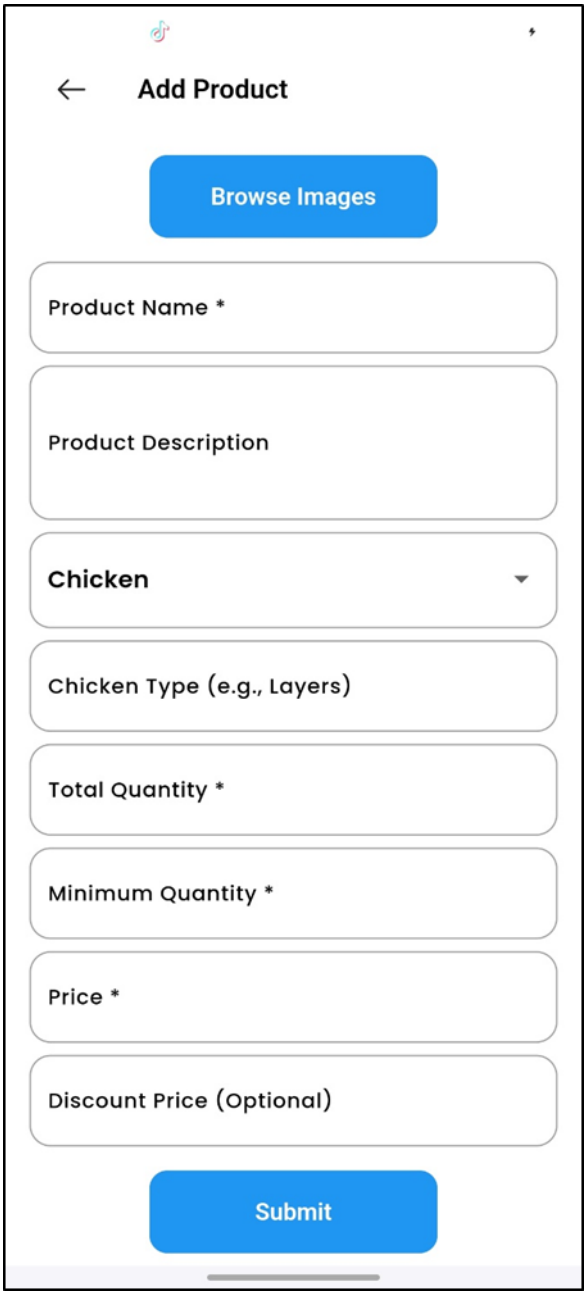
1. Can you provide some background information about your poultry farming operation, including how long you've been involved in poultry farming and the scale of your operation?
2. Could you describe your poultry farming practices, including the types of poultry you raise, housing systems, and feeding practices?
3. How do you currently sell your poultry products? Can you describe the sales channels you utilize and the markets you typically access?
4. What challenges do you encounter in accessing markets for your poultry products?
5. Are you currently using any digital tools or technology platforms to manage your poultry farm or market your products?
6. What are your thoughts on using mobile applications or online platforms to connect with potential buyers and streamline sales?
7. What are the main challenges you face in selling your poultry products?

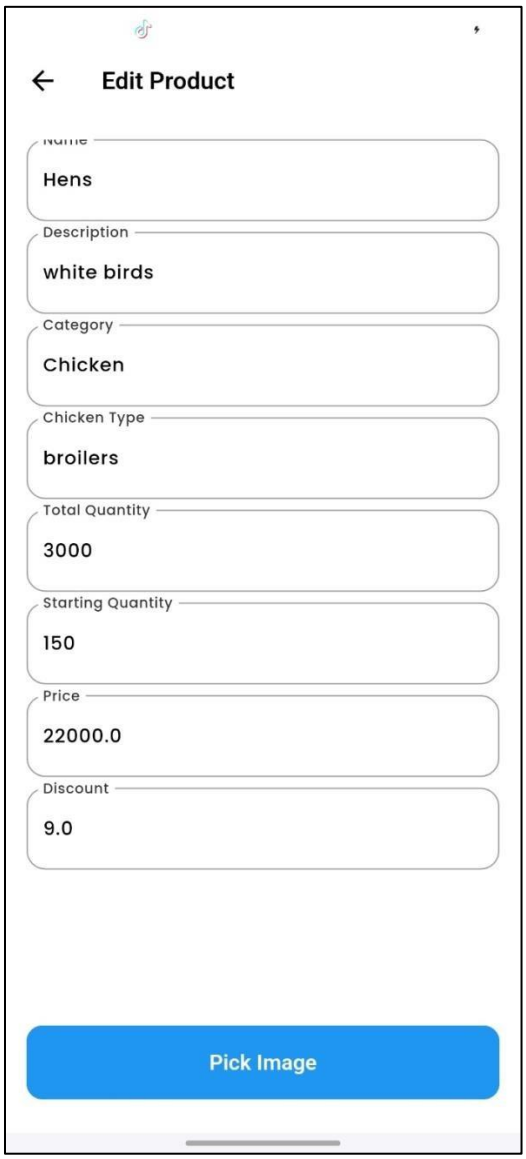
Interview Guide for Buyers

1. Can you tell us a bit about your business?
2. What types of poultry products do you typically purchase for your business operations?
3. How do you currently source and purchase poultry products for your business? Can you describe your procurement process and any specific criteria you consider when selecting suppliers?
4. What are the main challenges you encounter in sourcing poultry products for your business?
5. Are there any specific preferences or requirements you have when purchasing poultry products, such as quality standards or delivery options?
6. Are you open to using technology platforms or mobile applications to purchase poultry products more efficiently?
7. What features or functionalities would you find most valuable in a mobile application designed for purchasing poultry products?
8. Based on your experiences, what improvements or enhancements would you like to see in the process of purchasing poultry products for your business

Appendix 5 Application screenshots



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Hens
Description
white birds
Category
Chicken
Chicken Type
broilers
Total Quantity
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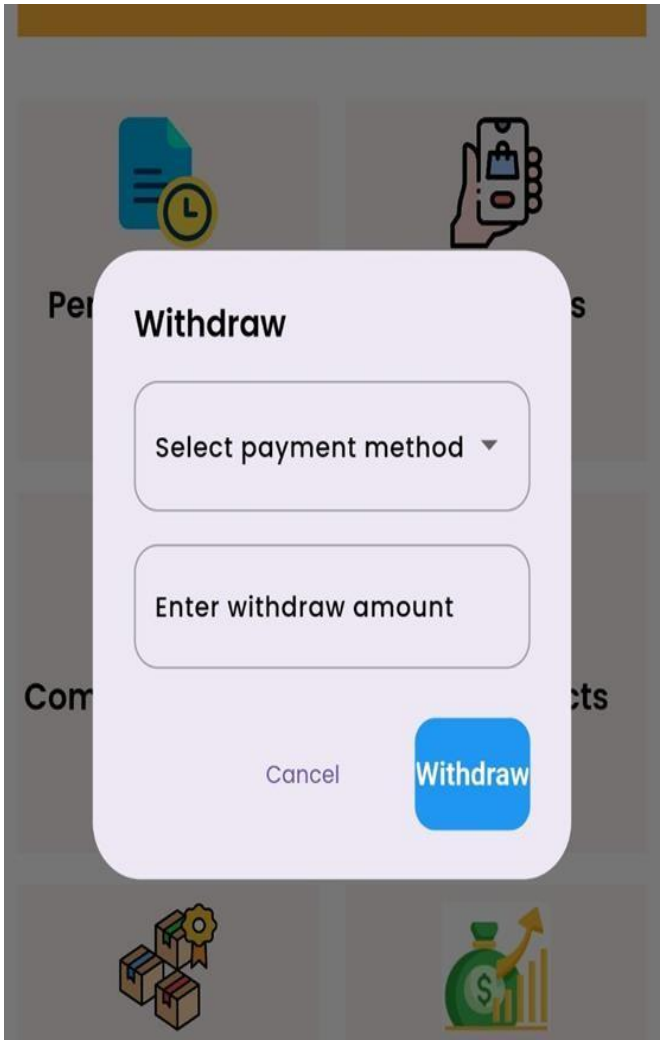
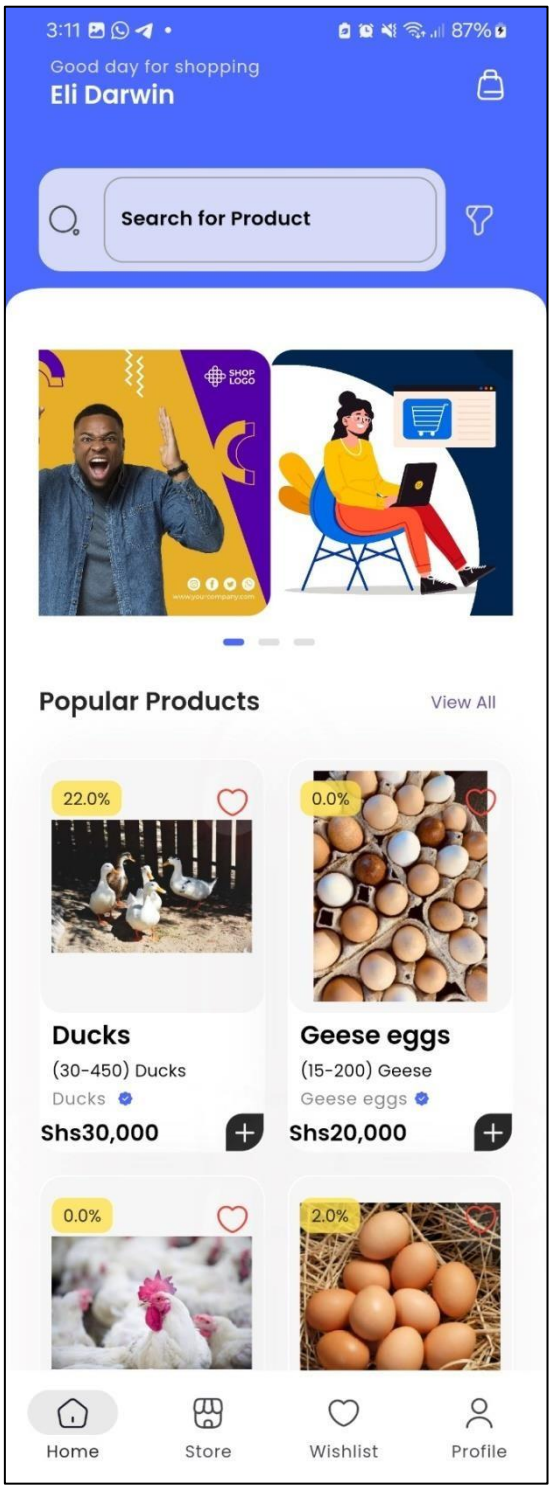
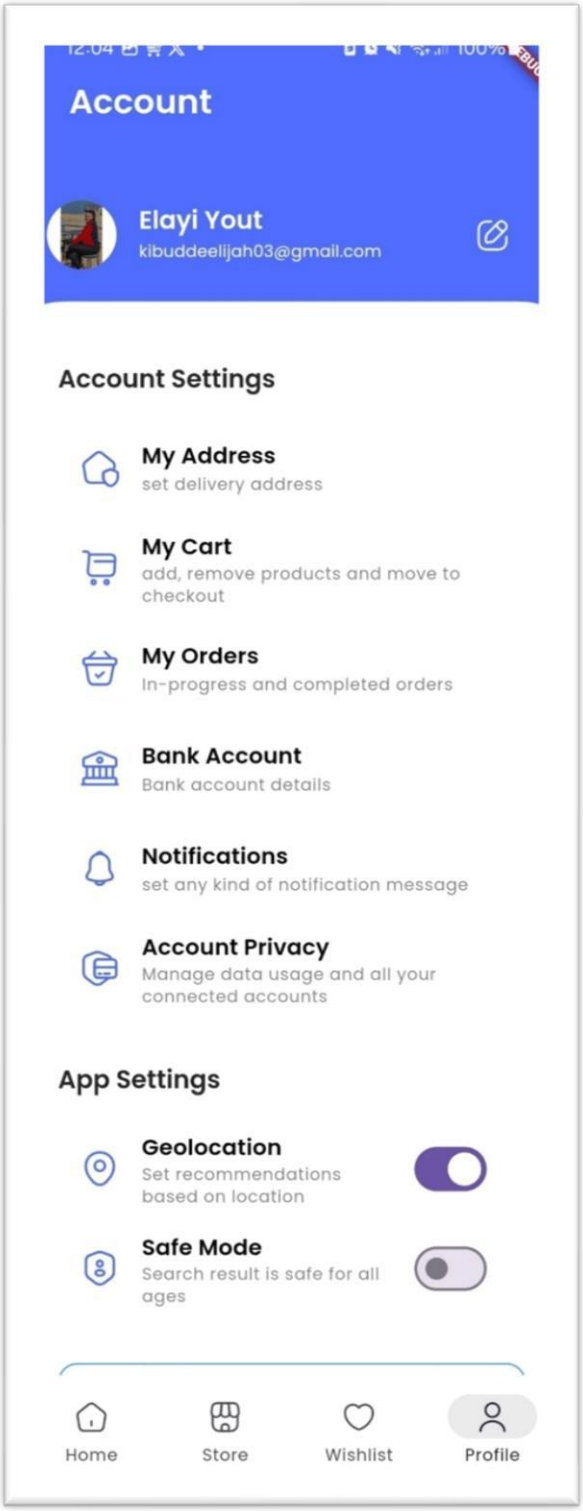
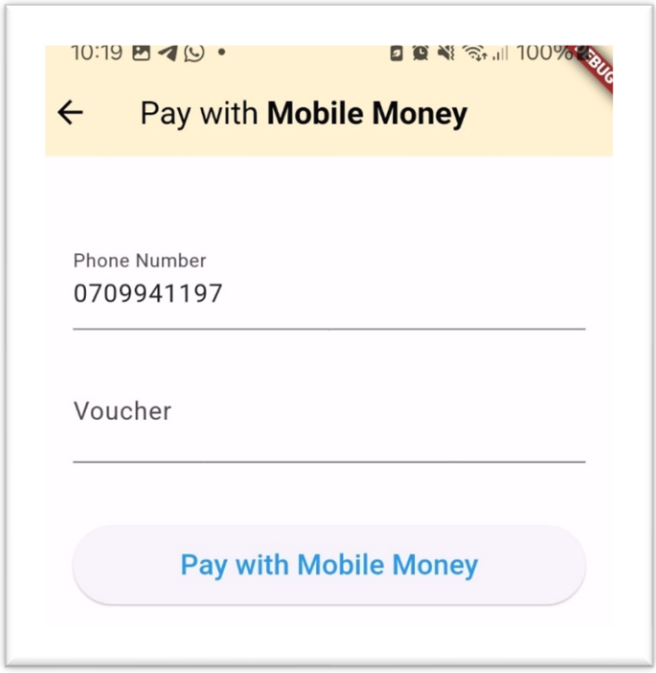
Starting Quantity
150
Price
22000.0
Discount
9.0
Pick Image


Withdraw
Select payment method
Enter withdraw amount
Cancel
Withdraw


3:11
87%
Good day for shopping
Eli Darwin
Search for Product
SHOP LOGO
Popular Products
View All
22.0%
0.0%
Ducks
(30-450) Ducks
Ducks
Shs30,000
Geese eggs
(15-200) Geese
Geese eggs
Shs20,000
0.0%
2.0%
Home
Store
Wishlist
Profile


Account
Elayi Yout
kibuddeelijah03@gmail.com
Account Settings
My Address
set delivery address
My Cart
add, remove products and move to checkout
My Orders
In-progress and completed orders
Bank Account
Bank account details
Notifications
set any kind of notification message
Account Privacy
Manage data usage and all your connected accounts
App Settings
Geolocation
Set recommendations based on location
Safe Mode
Search result is safe for all ages
Home
Store
Wishlist
Profile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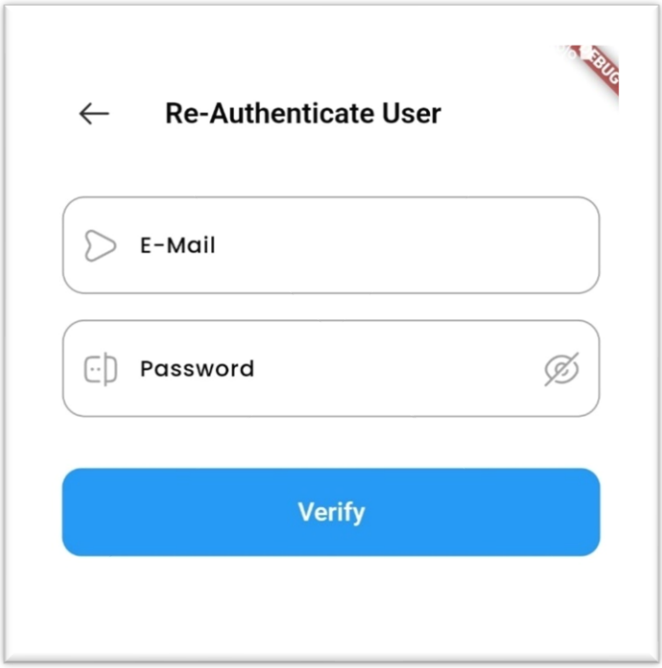
100%
Pay with Mobile Money
Phone Number
0709941197
Voucher
Pay with Mobile Money


Re-Authenticate User
E-Mail
Password
Verify