

Online Mobile App Farm Management System

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DECLARATION

I Akuma Jamal BU/UG/2021/3386 do hereby declare that this Project Report is original and I has not been published and/or submitted for any other degree award to any other University before.

Signed:.....Date:21.11.2024.....

APPROVAL

This Project was done under my supervision and is good enough.

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DEDICATION

My loving Mother, Leila Likicho whose parental love, support, and prayers have enabled me to achieve success in life, deserve to have this work dedicated to her.

I also dedicate this work to my dear brothers, sisters, and friends for all the assistance they provided me with while I was a student at Busitema University. Finally, I want to thank myself for the time and effort I sacrificed to make this happen.

I dedicate this work, above all, to the Almighty God, who has given me knowledge and wisdom and has thus far guarded me.

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ABSTRACT

The farmers have problems of inaccuracy in farm records and lack of real-time updates on farm records which affects decision making in the farm leading the creation of a Mobile App Farm Management System. The system keeps records of all farm activities and monitors their productivity. The records kept include; sales records, purchase records and Workers records.

Sampling method was used in the collection of data from the farm. Structured system analysis and design was used as the design methodology and Rapid Application Development (RAD) approach was used in developing the system development methodology. The data models used were the context diagram, Data Flow Diagram, and Entity Relationship Diagram (ERD) The system was developed using Kotlin for server-side scripting, HTML for designing data entry forms, other tools included CSS and Room Database for database management system. The system was tested and validated to ensure that it efficiently and effectively meets the Mobile App Farm Management system requirements.

This research aimed at developing a Mobile App Farm Management System to eliminate the manual way of record keeping. The farm owner logs in into the system through providing his password and phone number thus enabling him to register new workers, track new sales and purchase made by the workers on the farm via real-time updates. The workers will also have access to the system through providing their phone number and password enabling them to record sales and purchases that day from the farm.

The developed system is an efficient and effective tool which farmers can use for records management.

Chapter one

INTRODUCTION

1.1 Background of the Study

Farmers in recent years have started using information systems to organize their operational activities and track their farm transactions (Kaloxylos, 2012). In developed countries, it's a common place for farmers to use online systems to monitor their activities. Data is collected from the workers on the farm and these data assist the owner of the farm in managing and controlling their farms efficiently (McCown, 2002). These systems are called Online Farm Management Systems (OFMSs). An OFMS is a system used for collecting, tracking, and processing data to execute the operations of a farm.

Existing and previous systems in general, operate under a specific business model (Lundvall, 1999). Their main goal is to manually collect information from the workers and provide it to the owner to process it and provide several intelligent services.

In the existing systems, the owners of the farms record their daily activities through a manual system. The manual system helps to keep track of the daily activities and is not very efficient and reliable. It can capture the daily records of the farm activities being performed, it also shows the amount of the sales and purchases made on the farm each time and daily. It becomes hectic to keep on filling these records manually every single day and at times one might forget to update the records. The farm owners also have a difficult time getting to know exactly what is happening in their farms as the farm workers are not always available to keep on updating the owners every single time they update the records due to the workload they have daily. It also becomes expensive for the farm owner to keep on traveling to check on the progress of their farms frequently because while contacting their farm workers some of the details might be left out or forgotten.

In the existing systems, external service providers cannot provide new products and then interoperate with the existing systems since these systems do not provide the necessary means such as Application Programming Interfaces APIs (Wulf, 2020). The creation of APIs developed by independent service providers which end users can choose to use by giving them access, in a secure way, to their data could alleviate the aforementioned problems.

1.2 Problem statement

The current system used by most farm owners which involves recording data manually is inefficient and not reliable (Wolfert, 2017). The system makes many farm owners and the workers inclusive to make many errors that can cause several challenges later. It also becomes hectic for the farm owners to keep track of whatever is going on in their farms when they are not around. The workers sometimes take long to update the owners on what is going on due to the workload they have in the farm. The farm owners might also not be aware of what their farm workers are doing in terms of how they conduct the sales and purchases on the farm hence resulting in poor accountability (Poulton, 2010). The automation of the manual system will ensure that the records are kept well and the farm owner is updated each time an activity takes place on the farm.

1.3 Purpose of the Study

The purpose of the study is to develop an Online Farm Management Mobile App System. This system is developed to solve the problem identified.

1.4 Objectives of the study.

- 1 Review the literature and determine the requirements for the system.
- 2 Design the system
- 3 Implement the system
- 4 Test and validate the system.

1.5 Significance

The current system used by most farm owners which involves recording data manually is inefficient and not reliable (Wolfert, 2017). The system makes many farm owners and the workers inclusive to make many errors that can cause several challenges later. It also becomes hectic for the farm owners to keep track of whatever is going on in their farms when they are not around. The workers sometimes take long to update the owners on what is going on due to the workload they have in the farm. The farm owners might also not be aware of what their farm workers are doing in terms of how they conduct the sales and purchases on the farm hence resulting in poor accountability (Poulton, 2010).

The farm owners will be able to benefit from this system because they will be able to get updates on all the farm activities on their farms. They will also be able to know the total sales and total purchases made from the farm daily. The frequent updates from the workers will also help the farm owners to plan better on where to use their expenses and how to improve their farms to run more effectively.

Many similar research have been done before but based on the manual data collection system. Which at a certain time became risky in terms of storing and keeping the data for some long time. Because this manual information were exposed to risks like fire burn and theft.

1.6 Scope of Study

The system ensures that the owners get accurate daily updates on the farm activities which will help them know how exactly their farm runs and they can also be able to keep track of all their products on the farm which ensures that they don't incur losses. It also keeps track of the expenses on the farm and shows what exactly is being used and where it is being used. The limitations of the project are that it will ensure that the person who is using the system has a mobile phone where they will be able to download the application. They will also need to have access to the internet so that they can update any farm activity

The study was done in Matawa development farm, Matawa village, Siwa Sub County and Tororo District. The system took me a period of 6months for its completion.

Chapter two

LITERATURE REVIEW

2.1 Introduction

This chapter consists of a critical review of research work from journals, internet sources and other projects already done which is related to the Mobile App Farm Management System as well as an analysis of existing literature on the Mobile App Farm Management with the objective of revealing contributions, weaknesses and gaps. The following are the chapters;

2.2 Information System

Over the past years, farm management systems have undergone substantial evolution, taking use of mobile technology improvements to improve productivity, streamline operations and help farmers make better decisions (Javaid, 2022). With the availability of mobile applications designed specifically for farm management, traditional agricultural methods have undergone a revolution (M. Javaid, 2022). Farmers can now access vital data and insights instantly while on the road. The components and features of mobile app farm management systems are examined with an emphasis on their importance in contemporary agriculture (Rovira-Más, 2020).

Systems for managing farms using mobile apps combine a number of technologies to make farming more productive. These systems usually consist of a mix of cloud-based platforms, data analytics tools and mobile applications (Alam, 2021). Monitoring farm operations like making recording sales, new inputs, task scheduling and financial analysis are among the primary features. Through the centralization of agricultural data and its mobile device accessibility, these solutions enable farmers to make well-informed decisions and maximize resource usage (A. Khan, 2023).

2.3 Mobile application

Farmers mostly communicate with farm management system using the smartphone application. It has functionality and user interface that are easy to understand and catered to the unique requirements of agricultural users. Mobile farm management apps provide several functions such as:

2.3.1 User Authentication and Login

Farm Owner Login

The farm owner login credentials are secured and stored in a database. The data that is stored in the database is the same as the one that is entered in the login page. The owner credentials are recorded by the developer in accordance to the interest of the manager since it's the owner to manage everything in the farm.

Worker Login

The worker login credentials are separate from the farm owner login credentials. The worker's credentials are recorded and stored by the farm owner in the database. The worker and the farm owner are using the same login page but different dashboards. After recording and storing the worker's login credentials by the farm owner, the farm owner gives them access to the credentials which they use for logging in

2.3.2 Owner Dashboard

View performed sales

The farm owner views performed sales made by workers on the farm. This involves tracking real time updates on sales made by workers. Each time a worker makes a sale, the sale detail has to be recorded and stored in the database. This sale detail stored in the database will be tracked and displayed to the farm owner on the view sales card in the farm owner's dashboard. These sale details are tracked each time a sale is made and stored in the database.

Purchases Overview

The farm owner also views the purchase of inputs made by the workers on the farm. Each time a worker makes a purchase of an input, the details are recorded and stored in the database. These details are then tracked and displayed on the view purchases card in the farm owner's dashboard. These purchase details are tracked basing on real time updates on input purchase made by the workers.

Worker Management

The farm owner manages the workers on the farm by viewing the workers on the farm. The farm owner adds new workers who are supposed to work on the farm. The worker details are the stored in the database. The details include the name, age, gender, phone number and the title. The farm owner also updates the list of the workers in the database by removing the person whose services are no longer needed then. These details stored by the farm owner in the database about the workers are the ones the workers use to login to access the services on the farm they are supposed to do.

Financial Tracking

The farm owner tracks the total amount of sales made by the workers each time they make a sale on the farm. They also track the total amount spent on inputs by the workers each time a purchase is made.

2.3.3 Worker Dashboard

Sales Recording

This is an interface to record each sale made by the worker. The worker always record and store the details of each sale made on the farm. It involves capturing details like the product, quantity and the customer the product will be sold to.

Purchases Recording

This refers to the log of all purchases of inputs made on the farm. The worker always record and store details of each input purchased on the farm. The details include the item price, quantity and brand of the input item.

Implementing these key features in the Online Farm Management System mobile app enhanced the overall efficiency and productivity of the farm operations while providing insights for decision making.

Even if the previous studies have highlighted the advantages and difficulties of these technologies, more needs to be done to build standardized frameworks and comprehend their socioeconomic effects. To fully realize the promise of mobile app farm management systems

and guarantee their successful integration into agricultural operations, it will be imperative to close these gaps.

2.4 Farm management

A variety of tasks are included in effective farm management with the goal of maximizing profitability, sustainability and production (S. Fountas, 2015). These tasks are made easier by mobile app farm management systems, which give farmers quick access to vital data and instruments for making decisions (Rovira-Más, 2020). Among the crucial facets of management that mobile apps assist are:

Precision agriculture. This is the application of data-driven insights to agricultural methods, maximizing input efficiency and reducing environmental impact while customizing practices to particular field conditions (M. T. Linaza, 2021).

Resource allocation. The distribution of workers, equipment and supplies according to the analysis and real-time tracking of field performance (Teizer, 2013).

Risk management. This is the proactive planning and decision-making process used to identify and mitigate various risks, including losses, pests, weather and market swings (Kumar, 2023).

Compliance and reporting. Automating record-making and documentation processes to streamline regulatory compliance and reporting needs (B. M. Zimkus, 2021).

2.5 Farm records

In order to guarantee traceability, compliance and ongoing improvement in agricultural operations, complete and accurate farm records are crucial (S. Fountas, 2015). Digital record keeping is made possible by mobile app farm management systems, which replaces the antiquated paper-based techniques with safe, centralized databases that are accessible via mobile devices (Prinsloo, 2017). The following farm records are kept up to date via mobile apps:

Transaction history. Documentation of crop rotation, planting schedules, types and yields for every plot or field.

Recording the amount of seed, fertilizer, pesticide and water used is necessary to monitor input costs and their effects on the environment.

Notes and observations on crop health, the prevalence of pests and diseases, meteorological conditions and soil quality are controlled in the field.

Financial transactions. Documents used for accounting, financial analysis and budgeting that include income, expenses, bills and payments.

Equipment maintenance. Logs detailing servicing dates, repairs and hours of operation for farm equipment.

With unprecedented access to real-time data and decision support capabilities, mobile app farm management systems are a paradigm change in agriculture technology (Zazueta, 2016). These technologies increase the efficiency, sustainability and profitability of farms by combining data analytics, cloud computing and mobile apps. In order to ensure the continuous evolution and uptake of mobile app farm management solutions in the agricultural sector, additional research and development activities are required to address issues including data interoperability, user adoption and cybersecurity.

The design, implementation and testing of the mobile app farm management in the context of the literature review are explained below;

2.6 Design

In order to guarantee the efficiency and usefulness of the mobile app farm management system, the design process in the literature study entails the following steps:

Analysis of requirements. A thorough examination of the requirements were performed, taking into account the unique requirements and difficulties that farmers encounter when running their farms. To acquire information about farm's workflows, problems and desired features, this entailed looking through previously published research, speaking with farmers and administering surveys.

User-Centered design. A strong emphasis was placed on this design methodology, which gives farmer's wants and needs first priority all the way through the design process. In order to relate to end users, and create an interface that is simple to use, developing personas, user stories and journey maps were involved.

Prototyping. To visualize the user interface and get input from stakeholders, interactive prototypes and wireframes for the mobile application were created. User feedback to iteratively improve the design, paying particular attention to usability, simplicity and clarity were used.

System architecture. The system architecture was described taking into account the data storage and integration layers, as well as the frontend (mobile app) and backend components. Scalable and modular architectures that enabled system updates and improvements in the future were created.

2.7 Implementation

The goal of implementation phase was to convert the functional software components from the design specifications.

Frontend development. The mobile application's frontend using the proper frameworks and tools including functionalities like task management, communication, inventory and tracking were created. This guaranteed compatibility, performance and responsiveness across many platforms and devices and adhered to the best practices for developing mobile apps.

Backend development. The system's backend elements such as the APIs for storing, manipulating and retrieving data were constructed. This enabled essential features like task scheduling, data analytics and integration with the other services (such as weather forecasts and market pricing).

Database setup. To ensure effective storage and retrieval of farm data, the database in accordance with the specified data model was created and configured. This improved performance and scalability, optimized database queries and indexes while taking concurrency and data volume into account.

2.8 Testing

Several testing methods were used during the testing phase to confirm the systems performance, security and functionality.

Unit testing. Unit tests were created and ran for every part of the system, such as database queries, backend APIs and frontend UI elements. This automated the testing process and found defects and regressions early in the development cycle. Testing frameworks and tools were used.

Integration testing. Data consistency and correct operation were verified by testing the points of integration between the system's various parts. The integration with external APIs and services were checked as well as the frontend and backend components.

Load testing. To evaluate the systems scalability and performance under large loads, situations with high traffic were simulated. This assessed response times, data flow and resource usage to find bottlenecks and enhanced system efficiency.

Security testing. To find and fix flaws like SQL injection, cross-site scripting (XSS), data disclosure and security assessments were conducted. Penetration testing and vulnerability scanning were conducted in order to detect possible security threats and put the necessary safeguards in place.

Developers can guarantee the successful creation and deployment of a mobile app farm management system that satisfies the goals stated in the literature review by adhering to an organized approach to design, implement and test. The efficiency and usability of the system in facilitating contemporary agricultural practices will be further improved by ongoing monitoring and improvement in response to user input and changing requirements.

Chapter 3

METHODOLOGY

3.1 Introduction

This is a detailed description of the development methodology used in the development of the Mobile App Farm Management system. This included the project design which described the tools, instruments, approaches, processes and techniques, major algorithms and data structures I used in the research study, data collection, analysis, synthesis, design, logical flow, implementation and testing.

3.2 Area of study

The study was conducted in Matawa Development Farm which is found in Matawa village, Siwa sub-county and Tororo district. The farm has an average population of about 20 workers. The study area was selected due to nearness and ease of accessibility.

3.3 Sampling and population.

The term population describes the set of people that the study tried to figure out and draw conclusions about. The population in this instance is made of the people who utilized the mobile app farm management system. These users consisted of:

Farm workers. These are the people who work in the farm and carry out the farm operations like recording the daily transactions on the farm like new sales and purchases.

Farm owner. This is the person who oversees the daily activities on the farm carried out by the farm workers.

The group as a whole from which the sample was taken is known as the population. However, due to limitations like time, expenses and accessibility, studying the entire population was not going to be possible and viable. As a result, when doing the research, sample or small portion of the population was chosen for the analysis.

When it came to the sampling, a strategy was employed to choose a representative sample of the population. This guaranteed the validity and generalization of the study findings. The sampling strategy that was used in the approach for the mobile app farm management system included the Random sampling.

Random sampling. This method selected people at random from the population to make sure that every possible user had an equal chance of becoming a part of the sample. The reasons for the use of random sampling included the following:

Removal of bias. The selection process was made less biased by using random sampling. There was no systematic bias against any certain group or an individual because every member of the population had an equal probability of being chosen. As a result, the results were more accurate and trustworthy because the sample was guaranteed to be fully representative of the population.

Random sampling improved the study's finding's capacity for generalization. It gave every member of the population an equal chance to be in the sample, which allowed secure extrapolation of findings to the whole population. This was especially crucial if the intention was to draw conclusions about a wider population from the sample's features.

In general, research studies including those on subjects like mobile app farm management systems benefit from random sampling because it can yield representative samples, improve generalization, guarantee statistical validity and respect ethical norms.

Table of respondents.

| Sample type | Number |
|-------------|--------|
| Farm owner | 1 |
| Workers | 5 |

3.4 Data collection methods

A qualitative research study, which is better suited for small samples and a thorough description and analysis of a research issue without restricting the scope of the research or the character of participants' responses, was undertaken to meet the objectives of the study.

The following methods of data gathering were employed:

3.4.1 Interviews

The goal of interviews was to obtain first hand, in-depth information from the farmers and farm owners in the farm management.

A wide group of people who will represent various farm activities like recording transactions such as sales and new inputs were chosen. An organized interview guide with open-ended questions intended to extract in-depth information about the procedures, problems and desired features of a farm management system as well as the tools and technologies currently in use created. Depending on the accessibility and preferences of the participants, interviews in person, over the phone and video conferencing were conducted. This was done in an atmosphere that was welcoming and comfortable for the candidate dialogue. Thorough notes throughout the interview were taken and exact answers were recorded. To learn more about the subject and to get insights and underlying motives, probing tactics were used.

3.4.2 Observation

The goal of observation was to get a first-hand look at the farm operations, processes and interactions with current tools and technology in the natural setting.

Farms that are representative of the intended user population and relevant farming techniques were chosen. A go-ahead from the farm owner was got before making any observations on their property. The aim of the observation was explained to the participants to ask for their permission to be watched. And they were assured that their data will be kept private and anonymous.

3.5 Data Analysis

The mobile app farm management system's creation required careful consideration of analysis.

3.5.1 Analysis of data

The acquired data was analyzed that entailed the look for trends, patterns and insights that are pertinent to the creation of the mobile app farm management system.

Processes.

The materials gathered were arranged such as the survey answers, observational notes and the other pertinent data.

Coding. Coding strategies were used to group and label information according to the themes, subjects and the other trends. This entailed the thematic coding in which information was categorized based on the recurrent themes and ideas.

Qualitative analysis. Methods like content analysis and narrative analysis were used to glean insightful information from the qualitative data such as the transcripts of the interviewees and the observational notes.

Combining the mobile app development with analysis.

The following were the ways in which the design and development of the mobile app farm management system were directly influenced by the analysis and synthesis of data gathering findings.

User-Centered Design The features, functionalities and the user interfaces of the app were designed with the wants and preferences of the users in mind by using insights from data synthesis and analysis.

Upgrades and enhancements of the app were prioritized by identifying user requirements and pain areas. This helped in focusing on the needs of the farm owner and the workers that were most urgent.

Usability testing. It was made sure that the app successfully tackles the user concerns and improves the farm management workflows by using the synthesized findings to design the test scenarios and the usability testing methodologies.

Continuous improvement. The application was adjusted according to the user inputs and changing project needs by incorporating insights from continuous analysis and synthesis into iterative design and development cycles.

The foundation for the successful design and development of the mobile app farm management system that successfully satisfied the needs of the farm owners and the workers was laid through careful analysis and synthesis of the data gathered. This allowed for the gaining of important insights into user needs, preferences and the challenges.

3.6 Design Methodology

The design methodology used in the mobile app farm management system was the Structured System Analysis and Design Method (SSADM). It is a widely used approach for analyzing and designing information systems. It provided a framework for developing the system that met the user requirements effectively.

The system analysis and design method (SSADM) helped in determining the feasibility and the viability of the developing the mobile app farm management system. It helped in the access of technical and operational factors involved in the implementation of the system. And it helped in identifying potential risks, constraints and dependencies that may impact the project's success.

The system analysis and design method (SSADM) helped in using techniques like data flow diagrams (DFDs) and Entity-Relationship Diagrams (ERDs) to model the current farm management processes.

Under the system analysis and design method Rapid Application Development (RAD) was used in the Mobile App Farm Management System.

In order to generate high quality software solutions fast, prototyping and iterative development cycles were prioritized in the rapid application development (RAD) methodology. Rapid application development (RAD) offers various benefits, including speed, flexibility, and responsiveness to user feedback, when used in the creation of mobile app farms. The following is an example of how RAD was used while creating the mobile app farm management system.

Prototyping. The first step in the RAD was the development of quick prototypes that highlight the main features and user interface of the mobile application. This entailed creating wireframes and mockups for the farm management system that showed functionalities like tracking of the sales and purchases made by the workers by the farm owner, tracking of the financial transactions made by the workers and recording of sales and purchases by the workers on the farm. Early in the development phase, workers and the farm owner offered comments by using prototypes as a visual guide.

Iterative Development. After the first prototypes were accepted, a sequence of iterative cycles of development were initiated. A subset of features or improvements were implemented throughout each iteration in the response to user feedback and changing requirements. For instance, simple functions login functions like storing the user credentials and user authentication were given priority in the first iteration, while more sophisticated features like data analytics and decision support tools were included in the later iterations.

Collaborative Approach. Throughout the development process, RAD promoted cooperation between me and the farm owner and the workers. Frequent brainstorming sessions, feedback loops and meetings to ensure that the project goals were aligned and that communication was ongoing. This cooperative approach guaranteed that the app satisfies the unique requirements and preferences of the workers and the owner in the context of the mobile app farm management system.

Rapid prototype tools. A variety of tools and technologies were used by RAD to promote rapid prototype and iteration. Designers can swiftly create and iterate on app interfaces with the help of design tools like XTML. A platforms for low-code or no-code development speed up the implementation of essential features without requiring a lot of programming. Furthermore,

cross-platform development frameworks such as Kotlin simplify the process of deploying the application across many operating systems and devices.

Continuous Integration and Deployment. Rapid Application Development (RAD) places a strong emphasis on continuous integration and deployment techniques to guarantee that new features were smoothly incorporated onto the app and made available to the end users as soon as they were ready. Throughout the development lifecycle, I can uphold a high standard of code quality and dependability thanks to automated testing frameworks and deployment pipelines. Continuous integration and deployment pipelines were configured to automatically test and publish changes for the mobile app farm management system.

Feedback-driven Optimization. To continuously hone and enhance the app, RAD gives precedence to data-driven optimization and user feedback. By giving me insights into how users interact with the app, analytics tools and user engagement metrics enabled me to prioritize feature upgrades and identify areas for development. The software was kept in line with the user requirements and preferences through frequent feedback loops, usability testing, and user surveys which resulted into more user-friendly and efficient farm management solution.

One way to expedite the creation of a mobile app farm management system without sacrificing functionality or quality is to adopt Rapid Application Development creation (RAD) concepts. Because RAD is iterative, I can quickly adjust to shifting requirements and user feedback, making the app more responsive and user-centric and better able to fulfill the changing needs of the farm owner and the workers.

3.7 Software Development Tools

Industry-standard software development tools such as IDEs (Integrated Development Environment) e.g. Android Studio and IntelliJ, version control systems like GitHub and project management tools utilized for efficient development.

Mobile App Development Frameworks.

Appropriate frameworks such as Kotlin and HTML were selected for cross-platform mobile app development to ensure compatibility across different devices and operating systems.

User-Centered Design Approach.

A user-centered design approach was adopted to involve farmers and the workers in the development process, ensuring that the mobile app meets their needs and preferences. It involves understanding the user's perspectives, involving them in the design process, and iteratively refining designs based on their feedback. The goal of User-Centered Design is to create products and systems that are intuitive, efficient and enjoyable to use.

Application of User-Centered Design in Mobile App Development.

In the context of mobile app development, User-Centered Design involved several key steps:

User Research. Conducting research to understand the target users, their goals, preferences and pain points. This involved interviews and observations to gather insights into user behavior and needs.

Prototyping. Creating prototypes of the mobile app's interface and functionality based on user research findings. Prototypes were low-fidelity wireframes or high-fidelity mockups that simulated the app's interaction and flow.

Usability Testing. Testing the prototypes with real users to identify usability issues and gather feedback. Usability testing sessions involved tasks and scenarios designed to evaluate the app's ease of use effectiveness.

Iterative Design. Iteratively refining and improving the app based on user feedback. I incorporated the feedbacks from the usability testing sessions to make iterative changes to the app's design and functionality.

Accessibility. Ensuring that the app is accessible to all the users, including those with disabilities or impairment. I followed accessibility guidelines and best practices to ensure that the app is usable and navigable to all the users.

By applying a User-Centered Design approach in mobile app development, I created the app which was intuitive, user-friendly and responsive to user's needs and preferences. User-Centered Design helped to ensure that the final product meets the expectations of the users and provided a positive user experience.

3.8 Design and Logical flow

Developing the mobile app farm management system required careful attention to design and logical flow, particularly when wire framing, prototyping and iterative design reviews were taken into account.

Prototyping and wire framing. The goal of wire framing and prototyping were to envision the layout, navigation and interaction flow of the mobile application by producing visual representations of its capabilities.

Procedures.

First conceptualization. User wants, preferences and workflow requirements were taken into account to brainstorm and sketch potential features and interfaces for the app.

Wire framing. Design software's like sketch, and figma were used to create low-fidelity wire frames. The app screen layouts, including navigational components, content placement and fundamental interactions were outlined in wire frames. Wire frames are the basis for interactive prototypes, which are then developed with additional functionality and detail to mimic the user experience. The farm owners and the workers engaged with the prototypes of the app and offered input on its functionality and usability.

Iterative Refinement. Based on the input from the farm owner and the workers, iterations were made on the wire frames and the prototypes to address usability concerns, enhanced user flow and conformed to the project requirements and goals.

Iterative design reviews.

The goal of iterative design reviews was to get input from users on the functionality and the appearance of the app and then make changes to the design in response to that input.

Processes.

Engaging the farmers. Participation in design review sessions was done with the stakeholders, such as the farm owner and the owner. The stakeholders were provided with prototypes and wire frames so they may comment and assess them.

Feedback gathering. Stakeholders were asked for their opinions on the usability, aesthetic appeal, feature prioritization and compatibility of the app with different user needs.

Collaborative discussion. Stakeholders were encouraged to contribute their thoughts, ideas and worries regarding the app's functionality and design by facilitating collaborative conversations during design review sessions. Design modifications and additions were prioritized in accordance with the stakeholder feedback. Critical usability concerns were addressed first, and then the app was made to meet user expectations.

Iterative refinement. To enhance the overall user experience and efficiency of the app, iterations were made on the design based on the input from design sessions, implementing suggested modifications and refinements.

Integration with Mobile App Development.

The design and logical flow process, including wire framing, prototyping and iterative design reviews directly influence the development of the mobile app farm management system in the following ways.

User-Centered Design. Wireframes and prototypes were used to implement a user-centered design approach, ensuring that the app's interface and functionality met the needs and preferences of the farm owner and the workers.

Usability Testing. Usability testing sessions with prototypes were conducted to identify usability issues and gather feedback from users, informing iterative refinements to the app's design and logical flow.

Feature Prioritization. App features and enhancements based on feedback from iterative design reviews were prioritized focusing on implementing the most valuable and impactful features for the users.

Iterative Development. The app's design and logical flow in response to stakeholder's comments and changing projects needs were adjusted by incorporating design review feedback into iterative development cycles.

The mobile app farm management system was created with a user-centric approach, optimized for usability and in line with the requirements and preferences of the farm owner and the workers by embracing wire framing, prototyping and the iterative design reviews.

3.9 Implementation and Testing

Development. The mobile app was implemented using the Rapid Application Development framework, incorporating the design specifications, features and the functionalities identified during the design phase.

Unit and integration Testing. Unit testing was conducted to validate individual components and modules of the mobile app, followed by the integration testing to ensure seamless interaction between different parts of the system.

User Acceptance Testing (UAT). Collaboration with the farm owner and the workers was made to conduct user acceptance testing sessions, allowing them to test the mobile app in a real-world environment and provide feedback on its usability, performance and effectiveness in farm management tasks.

3.10 Iterative improvement

Feedback incorporation. Feedback was continuously gathered from the farm owner and the workers to identify areas for improvement and prioritize feature enhancements through iterative development cycles.

Updates and maintenance. Updates and patches are to be released regularly to address bugs, security vulnerabilities and the user feedback maintaining the relevance and reliability of the mobile app over time.

By following this detailed methodology, the study aimed to develop an effective and user-friendly mobile app farm management system that addresses the needs and challenges of the farm owner and the workers, ultimately enhancing agricultural productivity and sustainability.

Chapter 4

FIELD STUDY AND SYSTEM DESIGN

4.1 Introduction

This is a detailed description of the system design.

4.2 Background information (current system)

Matawa Development Farm is a farm in Matawa village, Siwa Sub County and Tororo District that uses a system that involves a manual method for recording sales and inputs in the farm. The farm records transactions using antiquated, paper-based techniques. This implies that all sales and purchases performed by the farm workers are manually recorded on paper forms. The farm's workers are in charge of keeping track of sales and purchases. When a purchase or a sale is made, the workers fill out paper forms to record the pertinent information about the transactions. Every transaction is duly documented on paper, with facts like the date of the transaction, the items that were bought or sold, their quantity, price and the other relevant information. After recording the transactions on paper, the workers physically deliver the paper forms to the farm owner. The farm owner participates in the process of getting these paper forms first hand. The farm owner then manually enters the data into their financial system and records and review it.

4.3 Strength of the current system

The current manual system at Matawa Development Farm possesses several strengths.

Low initial costs. There is little software or technology investment needed to implement a manual system. Simple paper forms are used by the farm to record transactions without the requirements for costly software licenses and equipments.

Usability. Paper-based solutions are typically simple to use and comprehend. The farm workers don't need much training because they can learn how to fill out the paper forms quickly.

Physical documentation. A tangible and enduring type of documentation is offered by paper records. Paper records can be safely saved and accessed without the need for electronic devices, in contrast to digital records which may be vulnerable to data loss or corruption.

Direct supervision. Direct supervision of financial transactions is ensured by the farm owner's participation in the receipt and examination of the paper forms. This practical method might improve accountability and openness in the farm's operations.

Flexibility. Paper-based solutions are easily customized to meet the unique requirements and preferences of the farm. Advanced technical knowledge is not necessary to design or alter custom forms as needed.

4.4 Weaknesses of the current system

While current system at Matawa Development Farm has its strengths, it also possesses several weaknesses.

Human error prone. Entering data by hand raises the possibility of mistakes including typos, incorrect computations and missing information. These errors may affect decision-making and result in inaccurate financial records.

Time-consuming. Manually recording transactions on paper forms takes a lot of time. The farm workers must spend important time filling out paperwork, time that would be better spent on other worthwhile projects.

Restricted accessibility. Paper-based records are retained in physical storage and are only accessible there. This restriction impedes rapid decision-making and collaboration by making it impossible for the farm owner to access information remotely and in real-time.

4.5 System Requirements

4.5.1 Functional Requirements

The operations of Matawa Development Farm were completely transformed by the Mobile App Farm Management System, which improved productivity, streamlined procedures and offered insightful data. The functional specifications for the system were as follows:

- User verification and control access.
- Keeping Records and managing transactions.
- Financial management.
- Data security.

By fulfilling the functional requirements, the mobile app farm management system significantly improved Matawa Development Farm's operational efficiency, decision-making processes and overall productivity.

4.5.2 Non-Functional Requirements

Rather than defining what the system should be able to do, non-functional requirements outline the characteristics and features that indicate how the system should operate. The following are the non-functional needs that emphasize commendable aspects for the mobile app farm management system.

- Achievements.
- Dependability.
- Usability.

4.6 System Design

Architecture of the system. The architecture of the mobile app farm management system highlighted the different layers, components and their interactions.

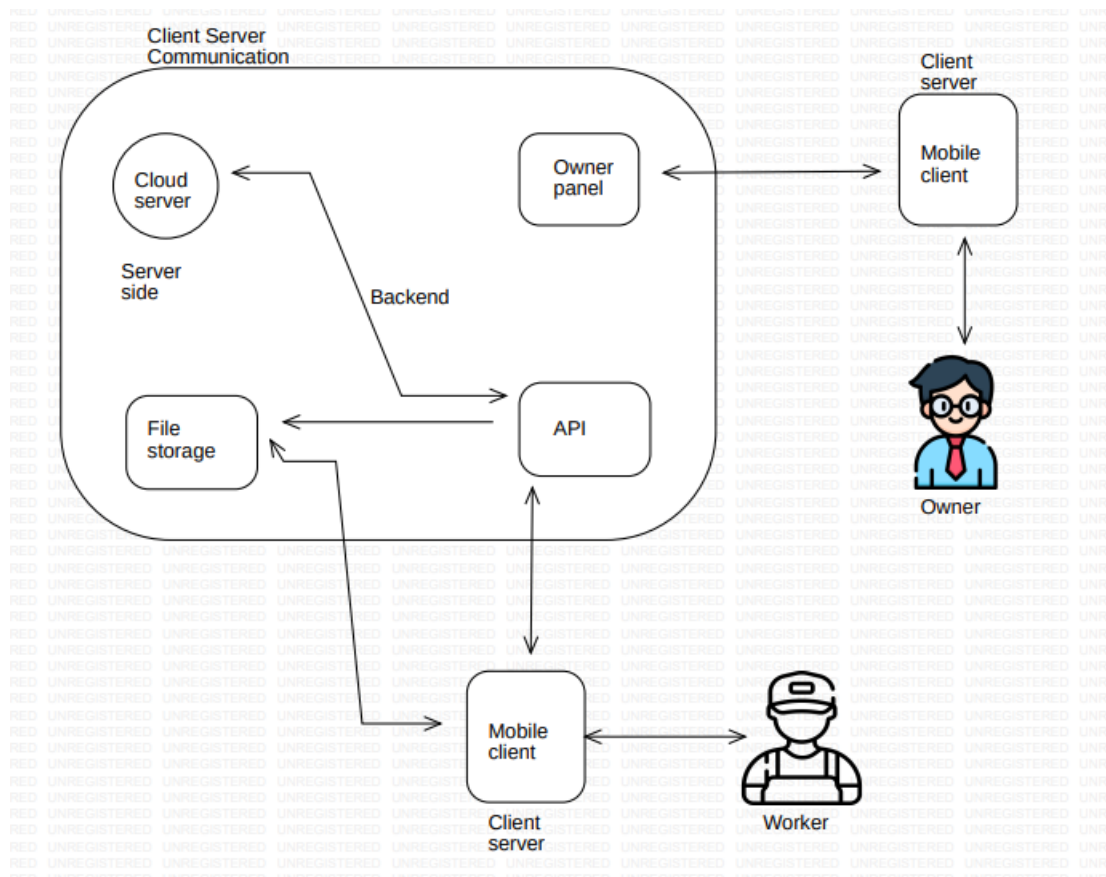


Figure 1 Mobile application architecture

4.6.1 Client-Server (Mobile App)

This layer represented the user's mobile device (Android)

Its components included the user interface (UI), this displayed the app's interface for the users such as the farm owner and the workers to interact with. It also had an application logic that implemented the client-side business and the user interactions. And the data storage used for caching and offline access.

4.6.2 Client-Server Communication

This layer represented the internet-connected mobile device.

It comprised of an API Gateway that acted as a single entry point for the client-server communication, handling requests and routing them to the appropriate backend services. An Authentication Service that managed user authentication and authorization, generating tokens for secure access to backend resources. Backend Services that implemented various functionalities such as user management, transaction processing and the transaction management.

4.6.3 Server-Side (Backend)

This layer presented the cloud-based infrastructure such as Remote servers.

It comprised of a Load Balancer, distributing incoming requests across multiple instances of the backend services for load balancing and scalability. Micro services that were responsible for specific business functionalities such as user management and transaction management. Database cluster such as relational databases for storing structured and unstructured. Message

Queue that facilitated asynchronous communication and event-driven processing between the micro services.

4.6.4 Data storage and Integration

This layer represented the cloud-based and on-premises data storage systems.

It comprised of relational database management system for storing structured data and related to farm operations and transactions. Room database for storing unstructured and semi-structured data such as sensor readings, logs and the farm activities.

4.7 Context diagram

A context diagram is a high-level, graphical representation that illustrates the scope and boundaries of the system and its interactions with external entities. It a bird's-eye view of the system's environment, showing how it interacts with users, other systems and external stakeholders.

The primary purpose of the context diagram was to depict the relationships and interactions between the system and its external environment.

It helped the farm owner and the workers to understand the context in which the system operates and the boundaries within which it functions.

The main components of the context diagram included:

System. The central focus of the diagram, representing the system being analyzed and designed.

External entities. Entities outside the system boundary that interact with the system. These included the farm owner, the farm workers, hardware devices and external data sources.

Data flows. Arrows representing the flow of data between the system and the external entities, indicating inputs to and outputs form the system.

System boundaries. A boundary box around the system, demarcating its scope and distinguishing it from the external environment.

Context Diagram was created during the early stages of the system analysis and design, as part of the requirements elicitation and system modelling. It served as the basis for further elaboration and refinement of system requirements, providing a starting point for more detailed and design activities.

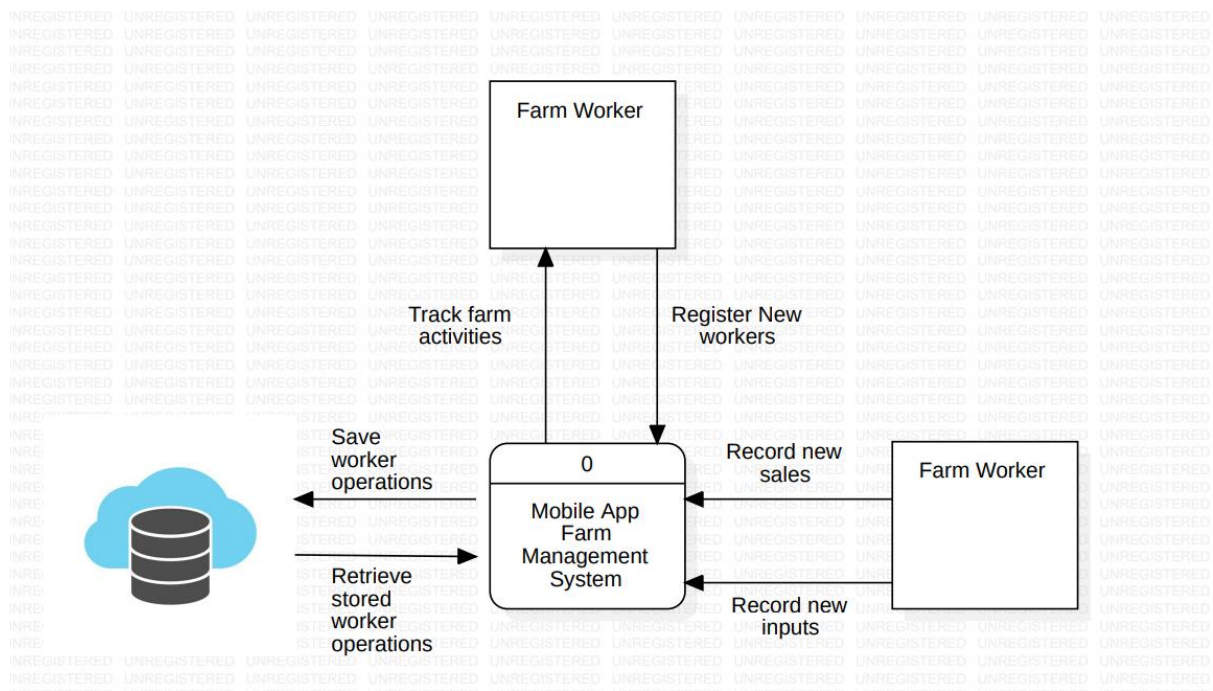


Figure 2 Context Diagram

4.8 Data flow diagram

A data flow diagram is a graphical representation that depicts the flow of data within the system and between its external entities. It provided a visual overview of how data moves through the system, from input to processing to output.

The primary purpose of the data flow diagram was to model the flow of data within the system, illustrating how data is input, processed, stored and output. It helped the stakeholders to understand the functional requirements of the system and the interactions between different components.

Its components included:

Processes. Represented functions and activities that transformed input data into output data.

Data flows. Represented the movement of data between processes, external entities and data stores. Data flows were depicted as arrows indicating the direction of the data flow.

External entities. Represented entities outside the system boundary that interact with the system. These included the farm owner and the workers and external data sources.

Data stores. Represented repositories where data is stored within the system. Data stores were depicted as rectangles.

Data flow diagrams were typically organized into multiple levels of detail, ranging from a high-level overview to a more detailed view of specific processes or sub-systems.

Level 0 DFD. Provided the high-level overview of the entire system, showing the main processes, external entities and data flows.

Lower-level DFDs (Level 1, Level 2 etc.). Decomposed the main processes into sub-processes, providing more detailed insights into the system's functionality.

| | id | f_name | l_name | title | phone | password | gender | age | image |
|----|--------|----------|----------|----------------|-------------|-----------|--------|--------|--------|
| | Filter | Filter | Filter | Filter | Filter | Filter | Filter | Filter | Filter |
| 1 | 1 | Peter | Ivan | Owner | 0704253811 | 123456 | NULL | NULL | NULL |
| 2 | 2 | Derrick | Mutebi | Manager | 0704253812 | mutebi | NULL | NULL | NULL |
| 3 | 3 | James | Lunda | Worker | 0701234567 | james | NULL | NULL | NULL |
| 4 | 4 | Liz | Nagawa | Sales Manager | 0780001234 | nagawa | NULL | NULL | NULL |
| 5 | 5 | Karungi | Isabella | Milkmaid | 0744556677 | karungi | NULL | NULL | NULL |
| 6 | 6 | waro | Mbale | waro | waro | waro | NULL | NULL | NULL |
| 7 | 7 | Jacob | Jacob | Worker | 0704 | Jacob | NULL | NULL | NULL |
| 8 | 8 | Namisi | Joji | Manager | 0561288 | namisi | NULL | NULL | NULL |
| 9 | 9 | Mulayi | Alex | Branch Manager | 08545299 | mulayi | NULL | NULL | NULL |
| 10 | 10 | David | Tim | Manager | 07855565555 | David | NULL | NULL | NULL |
| 11 | 11 | Simon | King | Manager | 07854212335 | simon | NULL | NULL | NULL |
| 12 | 12 | Jojo | Nokia | Engineer | 078888888 | password | NULL | NULL | NULL |
| 13 | 13 | Jone | Fore | Foreman | 0788888 | 12445 | NULL | NULL | NULL |
| 14 | 14 | Dani | Craig | Poultry Farmer | 0755888777 | danicraig | NULL | NULL | NULL |
| 15 | 15 | rth | dfghhhh | dfghh | 44555 | asdfgg | NULL | NULL | NULL |
| 16 | 16 | Nicholas | Cage | Poultry | 758555777 | me | NULL | NULL | NULL |
| 17 | 17 | Sheldom | Cooper | Farm boy | 0785698 | we | NULL | NULL | NULL |
| 18 | 18 | Rissa | G | Farm Manager | 078365214 | qwe | NULL | NULL | NULL |
| 19 | 19 | George | Cooper | Harvester | 0785234 | qw | NULL | NULL | NULL |

Figure 5 Database Structure 1










| | |
|--|---------|
|  id | INTEGER |
|  f_name | TEXT |
|  l_name | TEXT |
|  title | TEXT |
|  phone | TEXT |
|  password | TEXT |
|  gender | TEXT |
|  age | TEXT |
|  image | TEXT |

Figure 6 Database Structure 2

4.10 System modelling

System modelling using a use case diagram was a technique employed to visualize and specify the functional requirements of the system from the user's perspective. Use case diagrams helped in understanding how the users interact with the system and what functionalities were required to meet their needs.

The primary purpose of the use case diagram was to depict the interactions between the users (actors) and the system under consideration.

Its main components included:

Actors. Actors represented the external entities like the users, systems and other entities.

Use cases. Use cases represented the functionalities and tasks that users can perform with the system.

Relationships. Relationships defined the interactions between actors and the use cases as well as between the different use cases.

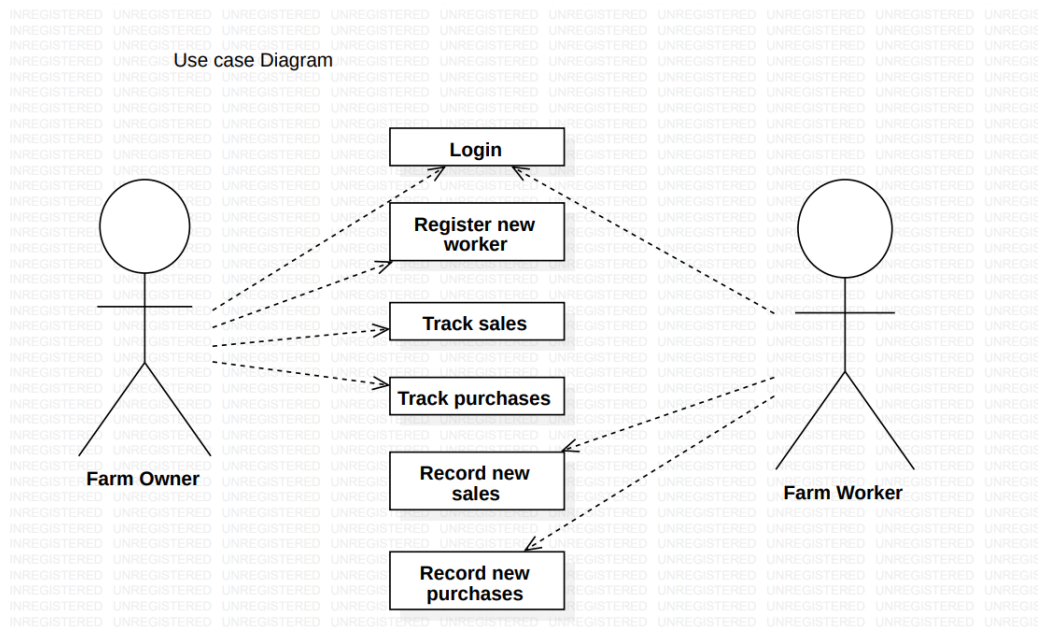


Figure 7 Use case Diagram

Chapter 5

SYSTEM IMPLEMENTATION AND TESTING

5.1 Introduction

This is a detailed description results and findings of the project.

5.2 Login and security for the users

The implementation of the mobile app farm management system represented a significant advancement in the modern farm practices. By leveraging mobile technology, this system revolutionized the way farmers managed their operations, streamlined tasks and made informed decisions. In today's fast paced agricultural farm landscape, where efficiency and productivity are paramount, the integration of mobile applications offered unprecedented convenience and flexibility to farmers and the farm owners alike.

Traditional farm management methods often relied on manual record-keeping, paper-based systems and physical presence on site for monitoring and decision-making. However, these methods are increasingly becoming outdated and inefficient in meeting the demands of modern farming. The advent of mobile technology presents an opportunity to transform the agricultural sector by providing the farmers with real-time access to critical information, enabling remote management, and enhancing operational efficiency.

The mobile app farm management system aimed to address key challenges faced by farmers including the burden of keeping the paper-based farm records and limited access to real-time updates from the workers. By providing a centralized platform accessible via mobile devices, farm owners easily monitored various aspects of their operations such as recording of new sales and inputs by the workers.

The implementation of the mobile app farm management system offered benefits beyond individual farm operations. It facilitated collaboration and knowledge sharing among the workers and the farm owner fostering a more connected and resilient agricultural community. Through data analytics and reporting functionalities, the system also enabled stakeholders to identify trends, optimize resource allocation and drive sustainable agricultural practices.

In the implementation of the mobile app farm management system, the login and security mechanisms were crucial components to ensure that only the authorized users can access the system and its data.

5.2.1 User authentication

The user authentication was a process to verify and identify users before granting them access to the system. This typically involved validating a user's credentials such as the phone number and password. In the mobile app farm management system, the users (the farm owner and the farm workers) were required to log in using their credentials to access the app features and data. Authentication was implemented using phone number and password. Users enter their unique phone number and password, which were then validated against stored credentials in the system's database.

5.2.2 Data encryption

To protect the sensitive data transmitted between the mobile app and the server, data encryption techniques were employed. This ensured that even if intercepted, the data remained unreadable to unauthorized parties.

5.2.3 Authorization and access control

Authorization determined what actions or resources a user was allowed to access within the system after successful authentication. Access control mechanisms were implemented to enforce the authorization rules and permission-based access control.

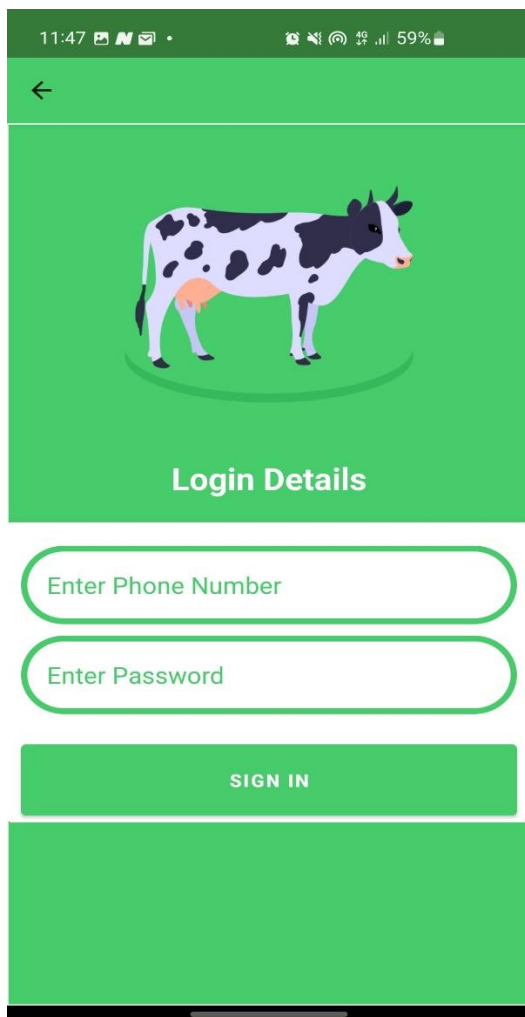


Figure 8 Login page

User table.

Farm owner login.

| User activity type. | System activity. |
|---------------------|------------------|
| Phone Number | Authentication |
| Password. | |

Farm worker registration.

| Farm owner activity type. | System activity. |
|---------------------------|------------------|
| Fill registration form. | Store Data |

Farm worker login.

| User activity type. | System activity. |
|---------------------|------------------|
| Phone Number | Authentication |
| Password. | |

Tracking farm activities.

After logging in, the farm owner is directed to the owner's dashboard. Here the owner will be able to see total amount of sales and purchase stored in the database tracked on the dashboard. The farm owner will also be able see the sales and purchases recorded by the farm workers in the database tracked on the dashboard.

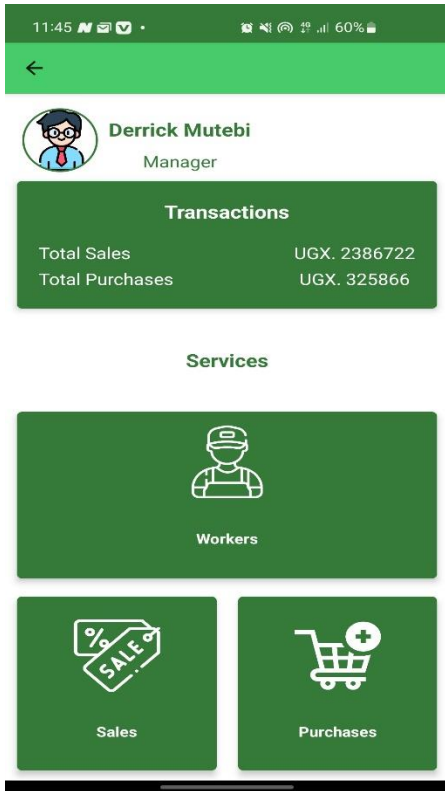


Figure 9 Owner dashboard

On the owner dashboard, the farm owner is able to register new workers in the farm.

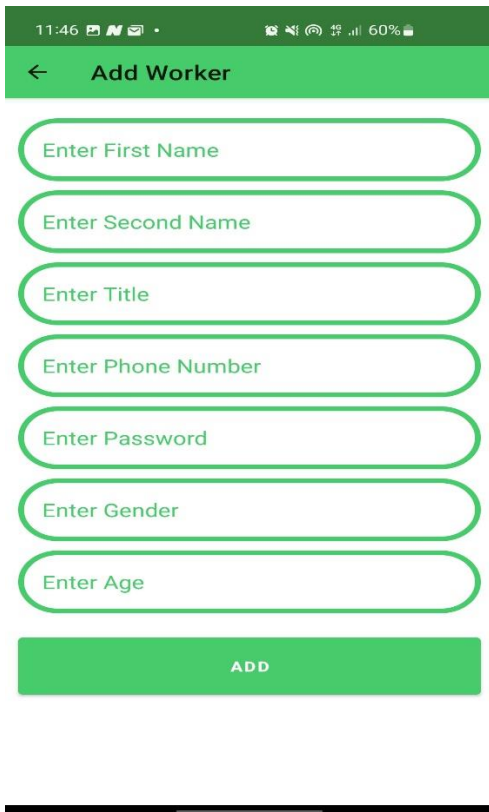


Figure 10 Worker registration page

After successfully registering a new worker, the new worker will immediately be added to the list of workers registered in the farm.

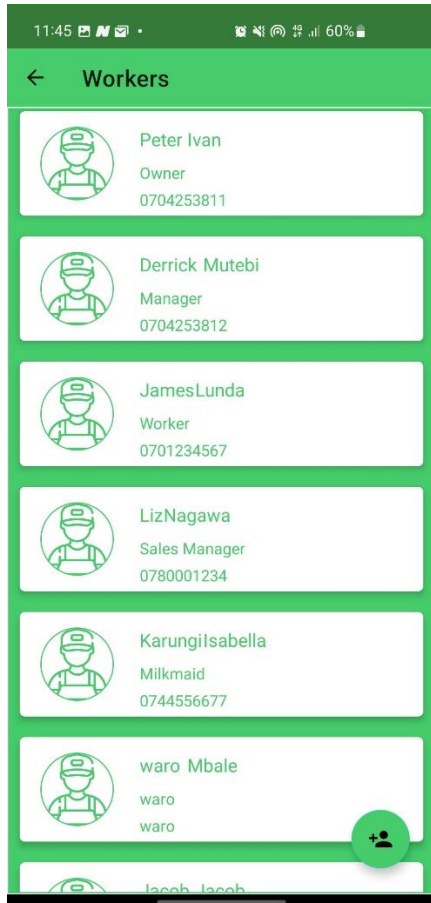


Figure 11 Worker list page

The farm owner can also view the sales made by the workers in real-time updates.

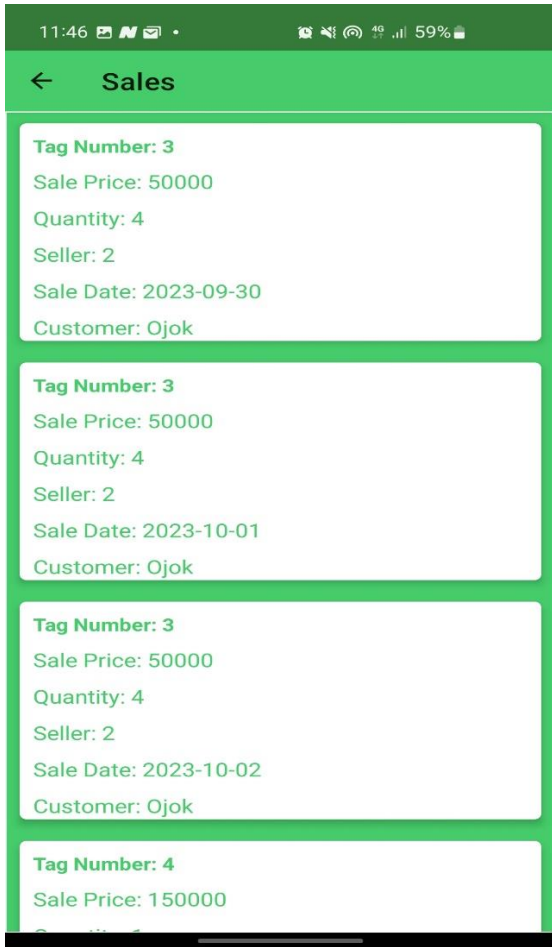


Figure 12 Recorded sales

The farm owner can also view the purchases made on the farm by the workers.

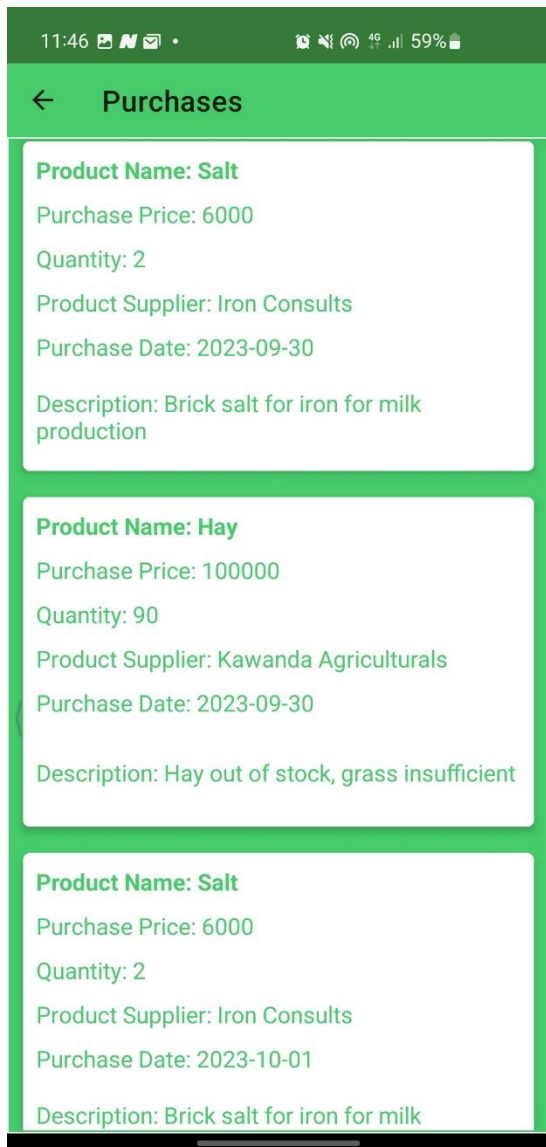


Figure 13 Recorded inputs

Recording farm activities.

After successfully logging in as the farm worker, the worker's dashboard will be opened. Here the worker will be able to record each sale and purchase made on the farm. The sales and purchases recorded are then stored in the database.

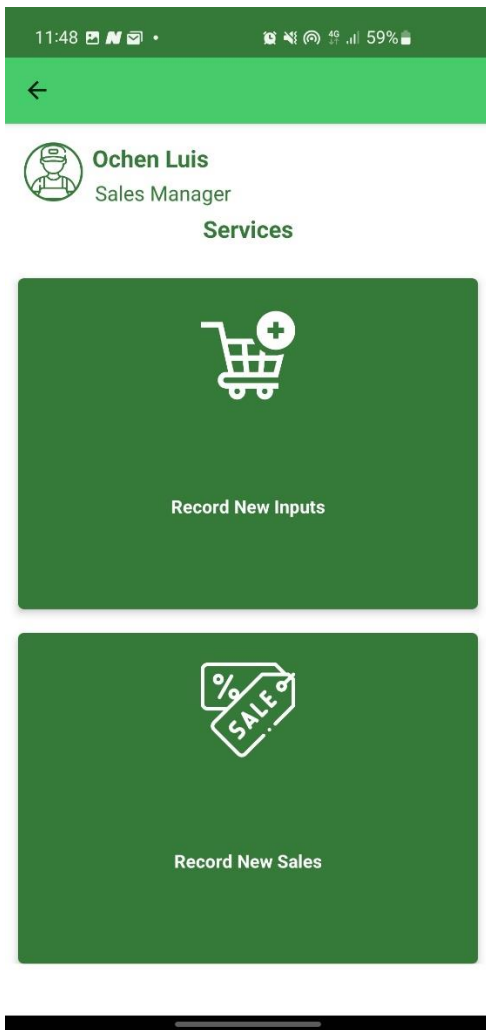


Figure 14 Worker dashboard

After accessing the worker dashboard, the worker can record the input details each time a purchase is made.

11:48 [notification icons] [status icons] 59%

← Record New Input

Enter Product Name

Enter Product Price

Enter Product Seller

Enter Purchase Date

Enter Product Quantity

Enter Product Description

RECORD

Figure 15 Recording new input page

And also after accessing the worker dashboard, the worker can record the sale details each time a sale is made.

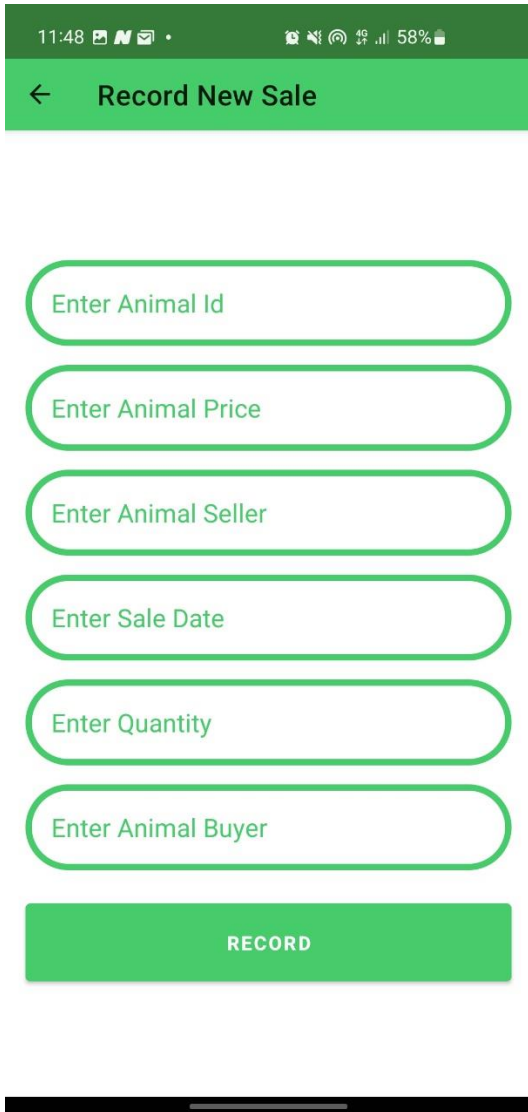


Figure 16 Recording new sales page

Chapter 6

DISCUSSION, CONCLUSION, RECOMMENDATIONS, LIMITATIONS AND FUTURE WORKS

6.1 Introduction

This section presents a conclusion to the project report highlighting in the summary the results and any recommendations from the project and way forward.

6.2 Discussion

Technology integration is becoming more and more essential in today's quickly changing agricultural scene to improve production, sustainability and efficiency in farm management techniques. The major development was the introduction of mobile app farm management system, which provided farm workers and the owners with never-seen-before levels of accessibility, convenience and decision-making power. This system used mobile technology to automate a number of farm tasks, such as the financial management, inventory tracking. This talk examined the possible advantages, difficulties and suggestion related to the adoption and the use of the mobile app farm management system in contemporary agriculture.

The discussion of the findings were presented in accordance to the research objectives of the study.

6.2.1 Theme (Objectives)

6.2.1.1 To review the literature and determine the requirements for development of the mobile app farm management system.

In the literature review, the need for a mobile app farm management is established based on the evolving landscape of agricultural technology. It highlights the significance of mobile applications in revolutionizing traditional farm management practices, enabling farmers to access vital data and insights instantly while on the go. The review identifies key components and features of mobile app farm management systems, emphasizing their importance in contemporary agriculture. Through a critical analysis of existing literature, the review reveals contributions, weaknesses and gaps in the field laying the groundwork for determining the requirements for the development of the system.

6.2.1.2 To design the mobile app farm management system.

Drawing upon insights from the literature review, the design phase focuses on translating specified requirements into a logical and user-friendly mobile app interface. User-Centred design principles are applied to ensure that the system meets the needs and preferences of farm owners and workers. The design process involves analysis of user workflows, creation of personas, user stories and journey maps and development of wireframes and interactive prototypes. The system architecture is defined to support scalability and modularity, enabling future updates and improvements.

6.2.1.3 To implement the mobile app farm management system.

Based on the design criteria and requirements identified in the literature review, the implementation phase involves developing the mobile app farm management system. Rapid Application Development (RAD) methodologies are employed to facilitate iterative development and incremental implementation of features. Frontend and backend infrastructures are created and code is written to enable data processing, storage and communication. Testing methods, code reviews and quality assurance processes are conducted

throughout the implementation phase to ensure the system's performance, functionality and dependability.

6.2.1.4 To test the mobile app farm management system.

During the testing phase, the mobile app farm management system is rigorously evaluated to ensure that it fulfils all specified requirements, works as planned and offers a positive user experience. Functional, usability, performance and security testing are conducted to verify various components of the system. Test cases are created to validate feature interactions, user authentication, data input validation and system.

6.3 Conclusions.

Through the methodical processes that included requirement determinations, system design, implementation and testing, the mobile app farm management system was successfully crafted to meet the changing needs of farm workers and owners.

By conducting a thorough review of the existing literature and interacting with the stakeholders, important insights were gained into the key requirements and functionalities essential for effective farm management. This informed the design and development of a user-centric system that prioritizes usability, functionality and scalability.

6.4 Recommendations

Keep up with technical innovations. Farmers should keep abreast of the latest developments in mobile technology and farm management systems. Stay up to date on industry publications, research papers and best practices concerning agricultural technology in order to take advantage of the newest instruments and solutions for enhancing farm operations.

Engage in user feedback sessions. Farmers ought to take part in user feedback sessions and share their requirements, difficulties and expectations regarding farm management systems. Contribute their experiences, problems and ideas for enhancements to help shape the creation of intuitive and practical mobile applications that are suited to the needs of farmers.

Adopt user-centric farm management solutions. Keeping their demands and preferences in mind, farmers should give top priority to the adoption of user-centric farm management solutions. To enable smooth integration into agricultural routines, pick mobile applications with user-friendly interfaces, adaptable functionality and extensive support.

6.5 Limitations

Access and connectivity problems. Mobile app farm management systems need on dependable internet access is one of their main drawbacks. It may be difficult for farmers to access and use system efficiently in rural agricultural areas where internet availability is patchy or inconsistent.

Device compatibility. Tablets or smartphones are frequently needed for mobile app farm management solutions to function. Not many farmers could have compatible gadgets or feel at ease utilizing mobile technologies. Adoption maybe hampered by this especially among older or less-tech savvy farmers.

Data security issues. Sensitive information on crop yields, financial transactions and other facets of agricultural operations are gathered and stored by farm management systems. It is vital to protect the security and privacy of this data, but many farmers could be worried about data breaches or illegal access to their personal information.

6.6 Future Works

Offline functionality. Research and development initiatives in the future might concentrate on improving mobile app farm management system's offline capabilities. These systems would be more dependable and accessible if they included capabilities that let users access and enter data without any internet connection, especially in places with spotty connectivity.

Enhancement to the user interface and experience. Increasing the usability and adoption rates of farm management apps among farmers may be possible by making improvements to the user interface and experience. This entails creating user-friendly interfaces, offering precise instructions and adding visual aids to accommodate people with different degrees of technology proficiency.

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