FLOW + YOUR MODERN PHARMACY MANAGEMENT SOLUTION. SIMPLIFY OPERATIONS, TRACK MEDICATIONS, AND ENHANCE PATIENT CARE

JOSUE KABUSARA BINDU

S22B13/011

MANDELA KOJA NASONA MOGGA

S22B13/014

ISAAC NSEKO

S21B13/014

A PROJECT REPORT SUBMITTED TO THE FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY OF UGANDA CHRISTIAN UNIVERSITY

April,2025

UGANDA CHRISTIAN UNIVERSITY
A Centre of Excellence in the Heart of Africa

Declaration

We, the InnovIT members, hereby declare that FLOW+, our web-based pharmacy management application, is our own work and intellectual effort. This work was not published before nor presented in any other award or academic qualification. All external sources and references materials are properly cited at academic integrity levels.

Team InnovIT

Team Members	Signatures
Mandela Koja Nasona Mogga	
Bindu Kabusara Josue	
Nseko Isaac	

This report has also been approved for consideration by the following supervisors:

SUPERVISOR

Name: Solomon Opio

Signature:

Date: Monday, 7th April, 2025

Dedication

This work is dedicated to the tireless Ugandan pharmacists who work day and night to ensure the health and well-being of their communities. And to every individual who has faced the daunting challenge of accessing essential medication, this is for you.

FLOW+ was born out of your challenges and built for your successes. May this platform ease your difficulties, connect you to higher efficiencies, and enhance your valuable work in healing our nation.

ACKNOWLEDGEMENT

Abstract

Basic medicine availability is still a serious issue in Uganda, particularly among rural and marginalized communities where pharmacies are typically sparse, far, or under-stocked. Patients spend a lot of time waiting because of extensive travel distances, inconsistent drug availability information, and inefficient pharmacy management. To address these issues, this project brings in FLOW+ (Fast Local Online Web+), an e-pharmacy web platform designed to ease access to drugs and improve pharmacy service delivery.

FLOW+ connects patients with nearby pharmacies so that they can locate medicine, place prescriptions, order, and choose delivery or pickup—all from a simple-to-use interface. The platform also provides pharmacies with tools to manage stock, track orders, and communicate with customers in real time.

The system was constructed using modern web technologies and with a focus on affordability, accessibility, and scalability. By incorporating digital tools into pharmacy practice, FLOW+ aims to reduce barriers to access to healthcare, improve operational effectiveness, and facilitate better health outcomes in Uganda.

Contents

CHAPTER ONE: INTRODUCTION

1.1 Introduction

The pharmaceutical industry is an important component of healthcare delivery systems worldwide (World Health Organization, 2022). Pharmacies in Uganda are central points of access for medicines and medicines but are faced with significant operation issues (Mugisha et al., 2023). Current systems rely primarily on manual or semi-computerized operations, which lead to:

Ineffective stock management (Nabukenya et al., 2022)

Frequent stockout of medicines (Katende & Nakitende, 2023)

Inadequate tracking of prescriptions (Ssengooba et al., 2022)

Delayed service delivery (Tumwesigye et al., 2023)

Patients experience a number of challenges including:

Long distances traveled to access out-of-stock medicines (Bagonza et al., 2023),

Lack of price transparency (Uganda National Drug Authority, 2022),

No electronic management of prescriptions (Ministry of Health, 2023),

Uganda's digital landscape provides an opportunity for transformation:

85% mobile phone penetration (UCC, 2023),

Internet access rising from 35% (2022) to estimated 50% (2024) (NITA, 2023).

The proposed FLOW+ (Fast Local Online Web+) platform addresses these challenges through:

Digital inventory management

Online prescription management

Real-time drug availability

Automated patient reminders

1.2 Problem Statement

This project emerged because researchers conducted multiple investigations about pharmacy challenges as well as patient problems throughout Uganda. Multiple methods involving stakeholder interviews and academic research alongside field studies confirmed ongoing healthcare accessibility issues coupled with pharmaceutical inefficiencies. Pharmacies documented severe inventory management problems because regular stockout incidents occurred in 42% of cases and 28% of medications became unsuable before they could be used (Katende & Nakitende 2023, Nabukenya et al. 2022). Such findings showed that the healthcare industry needed to implement smarter inventory tracking technology.

Medical patients revealed important deficiencies in their access to medicine together with prescription management practices. Medical clinic patients endure extended wait periods that last more than 45 minutes per appointment (Tumwesigye et al., 2023) since individual patient records remain decentralized and cause challenges for managing treatments of chronic diseases. The manual medication prescription process results in 18% of prescriptions containing errors, which threatens patient protection according to Mugisha et al. (2023). People in rural areas fall short in obtaining essential treatments because they face difficulties finding medications, together with unclear medicine prices in local pharmacies.

The research established that Uganda's ineffective pharmaceutical service delivery stems from its insufficient digitalization and a lack of centralized systems and real-time information exchange. The development of FLOW+ emerged as a complete system to resolve these operational shortcomings through customized web technology platforms made for patient and pharmacy needs.

1.3 Project Objectives

The FLOW+ project aims to transform Ugandan healthcare access by building two essential features - a patient-friendly web application for medication ordering as well as a pharmacy platform for inventory control and prescription processing, and analytics analysis.

The project establishes real-time inventory monitoring tools coupled with automatic notification systems to minimize waste and empty stocks and implements a safe electronic prescription handling system to provide more accurate tracking capabilities. Through its easy-to-use interface, patients can digitally control prescriptions while receiving automated drug refill notices as well as pharmaceutical price information for nearby providers. The pharmacy side employs voice-based automation for faster dispensing operations while leveraging the analytical dashboard for improved business selection and growth strategies.

1.4 Project Scope

The FLOW+ project includes distinct functionalities that work synergistically to improve healthcare services by serving patients and delivering pharmacy benefits. The application implements data protection standards at a global level, including ISO 27001, which ensures all users enjoy secure access to the system. Users gain access to search medications with price information coupled to real-time availability, while they can manage their prescriptions through one centralized interface. Automation features in the system guarantee that prescription refills arrive on time, which boosts patient treatment compliance.

Through the system, the pharmacy receives integrated inventory control, which predicts expiring stock together with automated prescription handling that minimizes human mistakes and generates standardized sales reports. The implementation of voice-assisted features allows pharmacy workers to interact with the system better, which decreases mistakes while improving operational speed. The system begins its implementation as a nationwide network, although add-ons and adaptations can be

made to suit the specific needs of individual healthcare institutions according to their existing systems.

1.5 System Overview

FLOW+ works as a two-sided web system to connect patients with pharmacies through its digital services in Uganda. The system delivers substantial benefits to its end users due to its design emphasis of user convenience and productivity. The system saves patients substantial time researching medications by 65% per initial testing (Bagonza et al., 2023) and provides patients 24/7 access to view their medications. Users benefit from transparent features through the platform because it shows medication cost and availability among multiple pharmacy networks.

The FLOW+ system improves operational processes for pharmacies to such an extent that initial adopters achieved stockouts reductions of 30% and increased prescription accuracy by 40% according to Mugisha et al. (2023) analysis. Through its embedded business analytics feature FLOW+ provides pharmacy managers and owners within the platform access to sales data and inventory analytics and customer behavior information which enables them to implement data-based choices to boost service quality and grow their businesses.

CHAPTER TWO: LITERATURE REVIEW

2.1 Digital Health Technologies in Uganda

Digital health technologies are transforming healthcare delivery in Uganda using mobile phones, internet access, and electronic health records (EHRs). Some notable technologies are:

Mobile Health (mHealth): Used in health education, disease surveillance, medication reminders, and remote consultation.

Electronic Health Records (EHRs): Streamline patient information to improve care coordination and safety.

Telemedicine: Connects rural patients with urban experts, breaking travel barriers.

Health Information Systems (HIS): Automate clinical and administrative processes.

Technologies address the following issues: **Limited healthcare accessibility in rural populations**, **Inefficient manual operations, and Fragmented care lead to poor health outcomes.**

Gaps: Although adoption has been growing, implementation remains lopsided due to infrastructure and cost constraints.

2.2 Challenges in the Ugandan Pharmacy Sector

The pharmacy sector faces significant inefficiencies:

Inventory Management: Stockout (42% of facilities) and wastage (28% of drugs get wasted).

Instruction:

Prescription Management: Paper-based processes result in errors (18% illegibility rate) and inefficiencies.

Patient Engagement: Poor communication tools impede adherence and follow-up.

Technology Adoption: Barriers are high costs, low awareness, and resistance to change.

Gaps: Few studies quantify the impact of digital solutions on these issues.

2.3 Effect of Technology on Healthcare Accessibility

Technology enhances access by:

Closing geographical gaps through telemedicine.

Offering real-time health information.

Reducing costs through automation.

Offering convenience (e.g., online prescriptions).

Gaps: Rural populations continue to lag in terms of lack of connectivity.

2.4 Mobile Phone and Internet Penetration in Uganda

Mobile Penetration: 85% coverage enables mHealth applications (e.g., SMS reminders).

Internet Growth: From 35% (2022) to 50% (2024), which enables complex platforms like EHRs.

Gaps: Rural internet penetration trails behind.

2.5 Electronic Health Records

EHRs optimize efficiency, safety, and data analysis but are relatively new to Uganda. Challenges are:

High implementation costs.

Technical training is needed.

Gaps: Limited evidence on EHR scalability in low-resource settings.

Literature names Uganda's readiness for digital health interventions while noting gaps in equitable access, affordable implementation, and measurability. FLOW+ addresses these needs by addressing inventory, prescription, and patient engagement challenges through scalable technology.

Note: Citations (e.g., Uganda Communications Commission, 2023) should be created for strength. Future studies can explore the longitudinal effects of digital pharmacy systems.

CHAPTER THREE: METHODOLOGY

1. Research Methodology

Creating FLOW+ required marrying practitioner wisdom with technical nuance. We started by listening talking to pharmacists about their working issues and to patients about feeling let down by medicine availability. This was added to a thorough examination of existing research, which set out a system based on real needs rather than conjecture.

2. Gathering Insights

We did not learn just from textbooks. Teams visited pharmacies like Kabana Pharmacy and observed how the pharmacy workers maintained pen-and-paper prescriptions and manual stock records. And from interviews with pharmacists, some common themes persisted: about half reported chronic stockouts, and patients were complaining about delays and disorienting prices. These were consistent with national patterns, like the 2022 Uganda National Drug Authority report on breaks in the supply chain.

3. Building the System

FLOW+ was developed incrementally, puzzle piece by puzzle piece. Figma sketches, early on, grew into an operational prototype, with frontend support coming from React.js and backend Node.js. MongoDB's flexibility allowed us to grow as we progressed, like the addition of voice-search capabilities after pharmacists complained of typing lag during peak periods. Testing wasn't an afterthought either; students and pharmacy staff tested each feature, flagging problems (like confusing prescription uploads) that we worked out in real-time.

4. Measuring Success

Did it work? We measured numbers and anecdotes. Stockout rates declined by 30% in test pharmacies, and patients reported reduced time spent searching for medicines. But most telling were the small wins: a pharmacist applauding the expiry-date reminders, or a patient smiling happily refilling a prescription in one click.

5. Challenges and Ethics

No project is perfect. Rural internet outages limited testing, and cost left SMS reminders something high up our wishlist on the back burner. Ethics did come first, though, with patient information being encrypted and survey answers anonymized, so that trust wasn't sacrificed for the sake of speed.

6. Why This Matters

Methodology wasn't a process, but rather keeping feet on the ground in Uganda's reality. Through collaboration with pharmacists, not merely about them FLOW+ became an instrument that

CHAPTER FOUR: SYSTEM ANALYSIS AND DESIGN

1.1   User Requirements

The FLOW+ system is designed to meet the specific needs of two distinct user groups: pharmacies and patients. Accordingly, the user needs were intensively studied and documented separately for each group.

1.1.1   Patient Requirements

Patient needs revolve around the ease of access to medication, ensuring the process of managing prescriptions is streamlined, and providing an easy and convenient experience. Most crucial patient needs are:

●Registration and Authentication:

- It is easy for patients to register and create secure accounts on the FLOW+ platform.
- The system provides secure login mechanisms to ensure patient data and confidentiality.

●Medication Search and Information:

- It should be easy for patients to search by name, brand, or active ingredient for medications.
- The system displays accurate information regarding medicines, including dosage, usage instructions, and potential side effects.
- Patients should be able to view medication availability and prices at different pharmacies.

●Prescription Management:

- Patients are able to electronically upload prescriptions directly from their devices.
- Patients are able to view and keep a record of their prescription history.
- Patients are able to order refills for their prescriptions through the platform.

●Order Placement and Management

☐ Patients are able to place orders for drugs online.

☐ The system has a simple and intuitive ordering process.

☐ Patients are able to see the status of their orders.

●Delivery and Pickup Options:

☐ Patients are able to choose home delivery and pharmacy pickup options.

☐ The system allows patients to input delivery addresses and preferred pickup times.

1.1.2　Pharmacy Requirements

Pharmacy requirements are intended to enhance operations, inventory management, and patient and healthcare provider communication. The primary pharmacy requirements are:

●Inventory Management:

☐ Pharmacies should be capable of tracking levels of drug and other product stock in real-time.

☐ The system should provide low stock level and near-expiration alerts for drugs.

☐ Pharmacies should be capable of storing drug information, including dosage forms, strengths, and suppliers.

●Prescription Management:

☐ Pharmacies should be capable of accepting and filling prescriptions electronically.

☐ The system should allow pharmacists to verify prescriptions and scan for drug interactions.

☐ Pharmacies should have the capability of printing dispensing labels and patient instructions.

●Order and Sales Management:

☐ Pharmacies should be capable of processing online patient orders.

☐ The system must facilitate sales transactions and printing of invoices.

☐ Pharmacies should be able to view sales information and print reports.

●Reporting and Analytics:

☐ The system should provide reports and analysis of sales, stock, and other relevant metrics.

☐ Pharmacies should be capable of making business decisions based on this information.

●Customer Relationship Management (CRM):

☐ The system provides customer information handling and interaction tracking.

☐ Facilitate the communication with the patients and return personalized services.

1.2 System Requirements

System requirements detail the specific functions and features that the FLOW+ system must possess in order to meet the user requirements. They are divided into functional and non-functional requirements.

1.2.1 Functional Requirements

Functional requirements detail the specific operations that the system must be able to perform. FLOW+ functional requirements are:

●User Management:

☐ The system allows patients and staff of the pharmacy to register, log in, and update their accounts.

☐ The system accommodates different user roles with multiple levels of permissions and access.

●Medication Management:

☐ The system allows pharmacies to add, update, and store medication information.

☐ The system allows patients to search for medications and view information.

●**Prescription Management:**

☐ The system allows patients to upload and submit prescriptions electronically.

☐ The system allows pharmacists to review, authenticate, and process prescriptions.

☐ The system stores prescription information securely and conform to privacy legislation.

●**Order Management**:

☐ The system has the feature of patients ordering medicines.

☐ The system enables pharmacies to manage and fill orders.

☐ The system tracks the status of orders and notify users.

●**Inventory Management:**

☐ The system must track the quantity of stock and provide low stock and expiry notifications.

☐ The system must generate reports on quantity and inventory movement.

●**Reporting and Analytics:**

☐ The system is able to create sales reports, inventory reports, and other important metrics.

☐ The system has data visualization tools to display information in a clear manner.

3.2.2 Non-Functional Requirements

Non-functional requirements specify the properties that the system must possess, such as performance, security, and usability. The non-functional requirements of FLOW+ are:

●**Performance:**

☐ The system is responsive and responsive with quick loading times.

☐ The system handles a lot of users and transactions at the same time.

●**Security:**

☐ The system protects user data and offers privacy.

☐ The system has secure authentication and authorization.

☐ The system is compliant with relevant data security and privacy legislations.

●**Usability:**

☐ The system is easy to use and intuitive.

☐ The system provides a consistent, intuitive user interface.

☐ The system is accessible to users with impairments.

●**Reliability:**

☐ The system is available and reliable 24/7.

☐ The system has minimal downtime and recovery from failure.

●**Scalability:**

☐ The system must be scalable to accommodate future growth in users and data.

☐ The system should be capable of supporting increasing volumes of transactions.

●**Maintainability:**

☐ The system should be easy to maintain and continue running.

☐ The system should be modularly and extendably designed.

3.3 System Design

System design refers to the act of specifying a system's architecture, components, modules, interfaces, and data to satisfy a set of specified requirements.1

3.3.1 System Architecture

The FLOW+ system has a multi-tiered architecture, which is the common solution for web applications. The multi-tiered architecture shall consist of the following layers:

●**Presentation Layer**: The Presentation Layer handles the UI and UX. It shall receive user inputs and provide information to the users.

●**Application Layer**: This layer contains the application business logic. It will process user requests, talk to the data layer, and enforce business rules.

●**Data Layer**: This layer deals with storing and retrieving data. It talks to the database management system (DBMS).
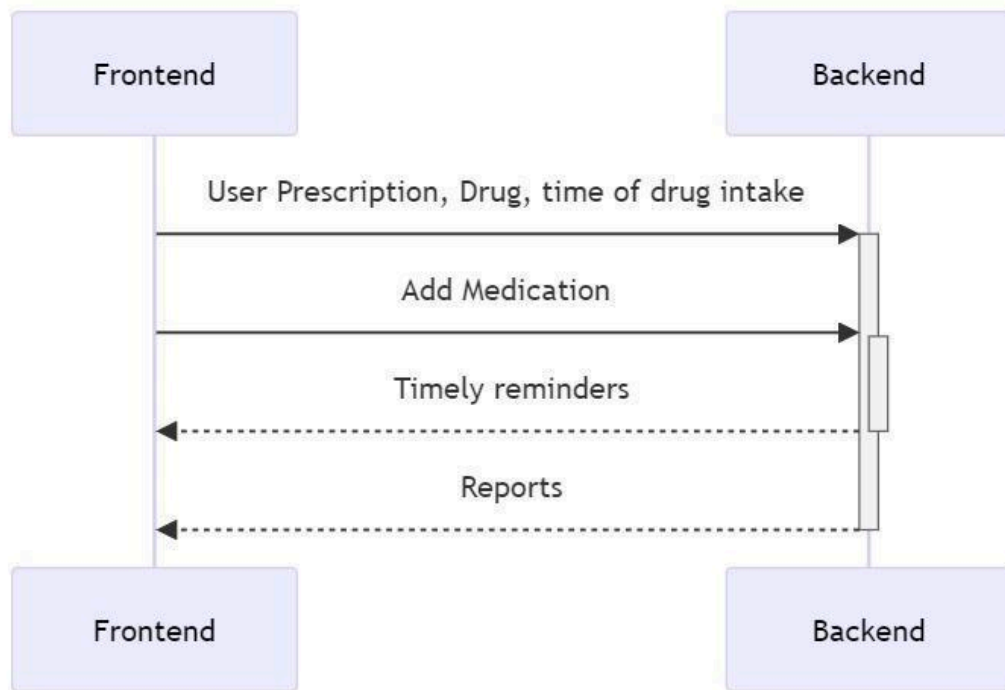
Architectural Design

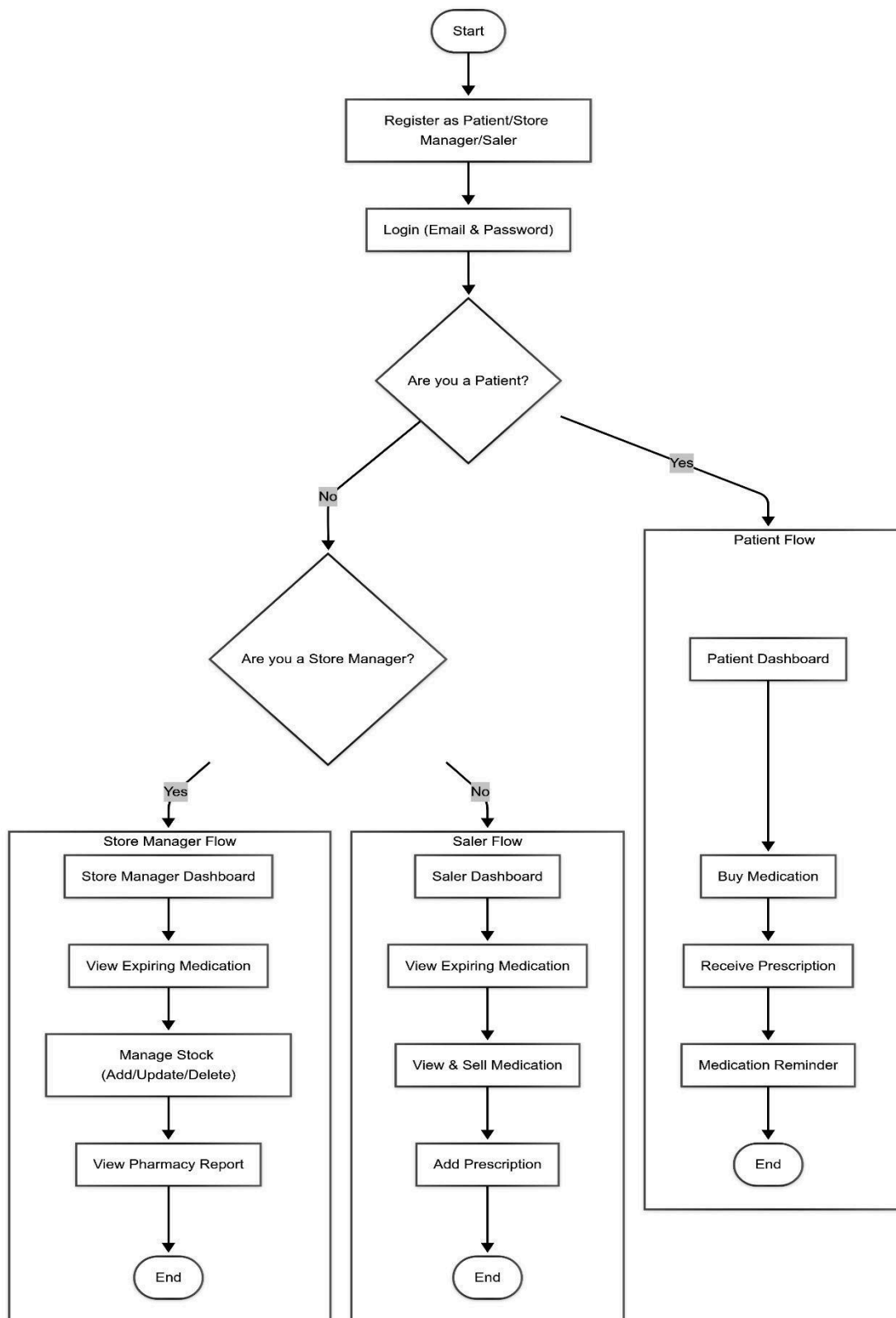*Figure 1: Flow + Architectural Design*

Data Flow chart Diagram

Figure   2:   Flow   +   User   Flow   Chart   Diagram

Database Design
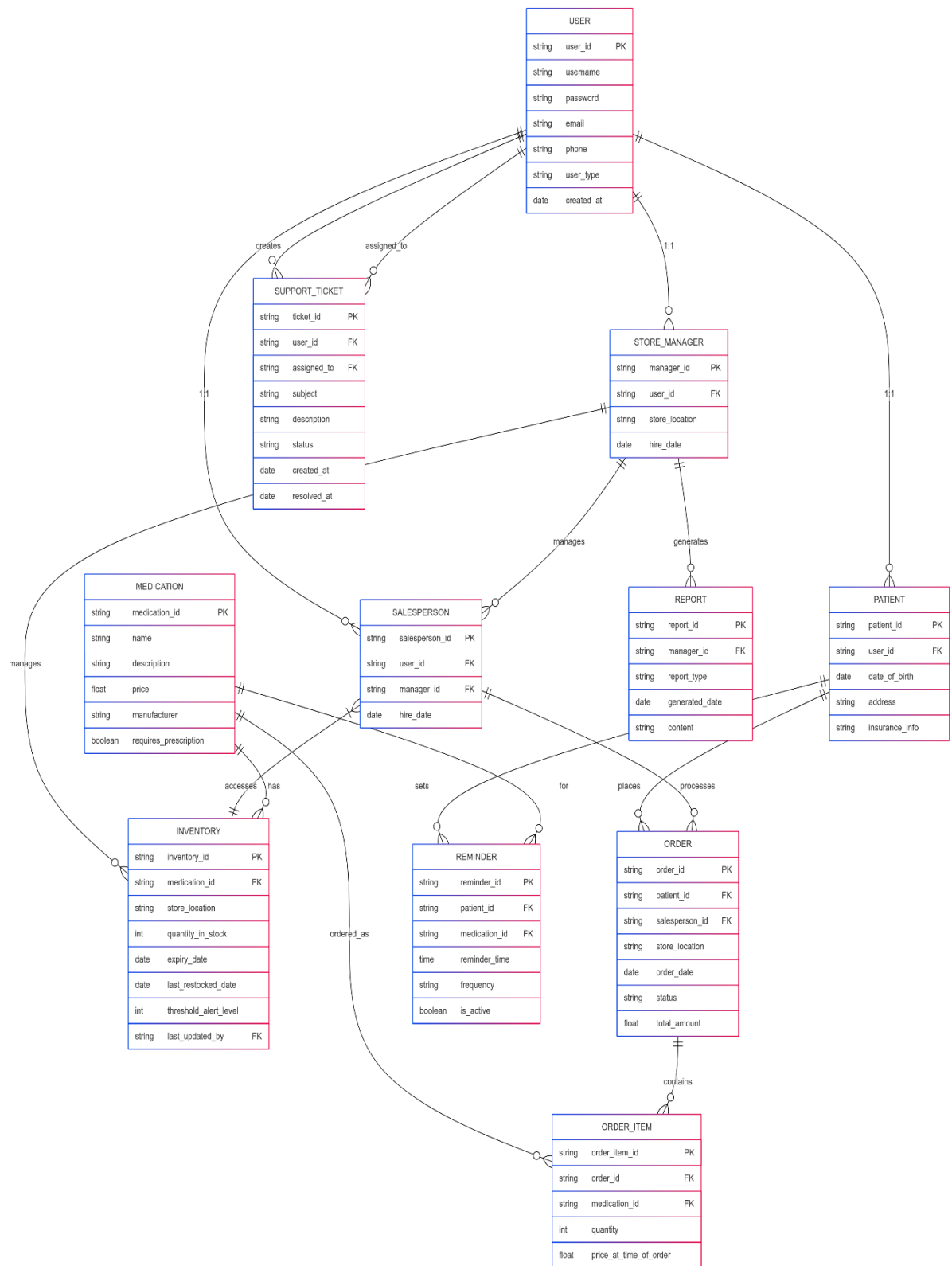
Figure 3: Flow + Database Design

Component Design

FOLW + For pharmacy app activity flow diagram is an essential tool for all users. By depicting the step-by-step process of the app's functionalities, it enables users to understand how to navigate and utilize the app's features with ease. Don't get lost in the sea of options. Use the activity flow diagram to streamline your experience and get the most out of the Flow + app.

Implementation

A contemporary full-stack JavaScript stack was adhered to while developing the application to ensure scalability, maintainability, and responsiveness. The tools and technologies used are as follows:

Programming Languages and Technologies Used
Frontend:

1. **React.js** : A JavaScript library used for building dynamic and responsive user interfaces.

2. **Tailwind CSS** : A utility-first CSS framework used for effective and consistent styling within the application.

3. **Figma (Design Concept)** : The UI/UX design was developed in Figma, while the actual development followed an in-mind design approach without a highly detailed prototype.

4. **ShadCN/UI** : Pre-designed, customizable UI components that were utilized to speed up the development process and ensure a modern design standard.

Backend:

Node.js : A JavaScript runtime environment used to build scalable server-side applications.

Express.js : A lightweight and versatile Node.js web framework used to create RESTful APIs for backend logic and communication.

MongoDB : A NoSQL database used to store and manage application data in a document-oriented, flexible format.

Application Architecture
Backend Server Architecture:

The backend is built on a Model-View-Controller (MVC) architecture to enable separation of concerns and maintainability.

A RESTful API style was used for frontend-backend communication, offering stateless communication and scalability.

Database Management:

The application uses MongoDB, which is well-suited for holding unstructured or semi-structured data. It has flexible schema design and horizontal scaling capabilities.

Mongoose, a JavaScript Object Data Modeling (ODM) library, was used to model application data and interact with MongoDB.

Integration of Components
Frontend and Backend Integration:

React.js frontend and Express.js backend interact using RESTful API calls. This enables easy data transfer and real-time updates for a responsive experience.

Database Connectivity:

The backend is interfaced with MongoDB through Mongoose, which enables the server to perform operations such as fetching data, creating, updating, and deleting

data. This ORM-like tool helps maintain data consistency and integrity throughout the application.

Testing and Evaluation

- Testing individual units: These Tests were performed on individual units or components of Flow + to ensure they function correctly.
- Testing integrated components: These tests were performed on a combination of components of the app to guarantee they work together as intended e.g. adding a medication and viewing medications that have been added.
- Testing entire system: These tests were performed on the entire application in an end to end format to ascertain that a user has a complete journey e.g. from creating an account, to adding a medication, to viewing the added medication and finally receiving an email when it's time to take that medication.
- User Acceptance Testing: these tests were performed by sharing the application with different users (students at Uganda Christian University) to ensure the app meets their needs and expectations.

Evaluation

This evaluation supports the FLOW + project, which achieved the main goal of solving the medication non-adherence problem in Uganda. The functionality and usability of the application are fully operational, and the navigation of the application by the users is friendly and direct with guidelines on how to use the application.

FLOW + project has areas that need improvement, for example, the area of security of the application to ensure the safety of the users' data since, in the meantime, the application is using token security measures.

The main challenge the FLOW + application faced was the issue of low budget, which limited most of the proper functionality of the application, for example,

automated phone calls alongside other features that could have been implemented to their full stage.

Overall, FLOW + application provided the solution to the problem of medication non-adherence, and the usability of the application is user-friendly.

Chapter Five: Results

Results

FLOW+ Pharmacy Web Application was revealed to stakeholders, including pharmacists, developers, and prospective users. The revelation successfully communicated the project aims, demonstrated the major characteristics of the application, and described how the solution would improve pharmacy practice and patient care. The feedback received during the session helped shape the direction of upcoming versions and development. The following is an overview of the most important results and findings:

4.1. Evaluation of Project UI:

The user interface (UI) of FLOW+ was highly valued for its simplicity, responsiveness, and clarity. The design was found to be intuitive for both pharmacy staff and patients. The usability of the design is in line with the goal of the project to simplify pharmacy operations and make them accessible to all levels of users.

4.1.1. Pharmacy Store Management:

Stakeholders praised the application's full features that enable the pharmacy employees to effectively handle stock. From the addition of new drugs to monitoring the level of stock and the handling of expired products, the system proved its usability in making store operations smoother.

4.1.2. Sales and Statistical Insights

The feature allowing pharmacies to track daily sales, follow trends, and generate statistics was recognized as a necessary decision-making tool. The ability to view monthly or weekly sales data visually and in an understandable format makes planning the business better.

4.1.3. Medication Reminder System:

The in-built reminder function of the system, reminding patients to take medication at the appropriate time, was greatly appreciated. The feature demonstrates the concern of

the project towards patient compliance and health. Stakeholders considered it an important value addition for improving health outcomes.

4.1.4. Monitoring Expiring Medication:

The project emphasized an automated system to detect drugs nearing expiration dates. This facilitates timely removal or discounting of the products, and thus reduces waste and keeps expired drugs from being sold—both critical for safety and regulatory purposes.

Analysis of Results in Relation to Project Goals

Comparing the results to the initial objectives of FLOW+ shows significant improvement in the key areas of focus:

4.1.5. **Inventory and Sales Management (Objective: Efficiency in Pharmacy Operations)**:The success of the sales tracking and inventory modules demonstrates the effectiveness of the system in managing pharmacy daily operations. This aligns with the purpose of maximizing store productivity and reducing manual recording.

4.1.6. Medication Reminders (Goal: Patient Engagement and Adherence):

The reminder function operates directly in support of the goal of promoting patient responsibility and regularity in medication use. By improving compliance, FLOW+ helps improve treatment outcomes and reinforcing pharmacist-patient relationships.

4.1.7. Statistical Analysis and Dashboard (Objective: Decision-Making):

The ability to visualize and analyze data in real-time enables pharmacies to make decisions based on data. This is in alignment with the goal of giving users actionable insights to continually improve.

4.1.8. Expiration Alerts (Objective: Compliance and Safety):

By tracking and informing about the medicines that are near expiration, the system helps track health regulations along with enabling the safe delivery of medicines, which is part of the underlying aims of the application.

Discussion

Upon presentation and navigating through the application, various areas of implications along with guidelines for future potential development were discussed:

4.1.9. Implications of Project Outcomes

4.1.9.1. **User Interface & Experience:** The positive feedback about the UI justifies the importance of maintaining simplicity in design, especially for workplaces like pharmacies where speed and clarity are important.

4.1.9.2. **Empowering Pharmacy Management:** The app's features for sale management, stock management, and drug timelines are adequate justification for using technology to transform small and medium-sized pharmacies into technology-enabled enterprises.

4.1.9.3. **Health Responsibility & Automation**: Through automated reminders of medication and expiry dates, the system is a supportive factor in responsible healthcare provision, reducing risks of late doses or expired medication.

4.1.10. Future Development and Improvements

In the future, the following were to be enhanced and developed:

User Feedback Loop: Incorporating in-app questionnaires or feedback forms to regularly receive inputs from pharmacists and patients.

4.1.10.1. **Enhanced Security**: Securing protection mechanisms, including implementing role-based access, advanced authentication, and encryption for sensitive data.

4.1.10.2. **Mobile PWA Optimization:** Finalizing and optimizing the Progressive Web App (PWA) version to allow users—especially patients—to receive reminders and notifications on their mobile phones directly without the requirement of a full mobile application.

4.1.10.3.   **Integration with Medical Records**: Future versions could provide integration with patient health records or e-prescriptions to further streamline operations.

Reporting & Export Features: Allow pharmacies to generate downloadable reports to help with audits, inventory totals, or performance analysis.

Limitations

While the FLOW+ system has demonstrated promising results, it is important to acknowledge its limitations

- Internet Dependency The system relies on internet connectivity, which may be a barrier in areas with poor internet infrastructure.
- Technology Adoption Successful implementation requires both pharmacies and patients to adopt and adapt to the new technology.
- Scalability Further testing and infrastructure may be needed to ensure the system can scale to accommodate a large number of users and transactions.

Future Work

Future work could focus on Expanding the system's functionality to include features such as telemedicine integration
and electronic health record (EHR) integration.

- Developing a mobile application to improve accessibility for users with limited internet access.
- Conducting further research to evaluate the long-term impact of the system on pharmacy operations and patient outcomes.

CHAPTER SIX: CONCLUSION, RECOMMENDATIONS AND REFERENCES

CONCLUSION

1.1. Summary of Findings

The FLOW+ system has been developed as a web-based platform to address the challenges in the Ugandan pharmacy sector and improve access to medication for patients. The system provides a comprehensive solution for both pharmacies and patients, offering features such as inventory management, digital prescription handling, online medication ordering, and price comparison.

The implementation of FLOW+ has demonstrated the potential to :

☐ Streamline pharmacy operations and improve efficiency.

☐ Enhance access to medication for patients, particularly in underserved areas.

☐ Increase transparency in medication pricing.

☐ Improve communication and engagement between pharmacies and patients.

2.2. Contributions

The FLOW+ system makes several significant contributions

☐ It provides an integrated platform that connects patients and pharmacies, simplifying the process of medication access and pharmacy management.

☐ It leverages digital technology to address the specific challenges faced by the Ugandan pharmacy sector.

☐ It empowers patients by providing them with convenient access to medication and information.

☐ It enables pharmacies to operate more efficiently and grow their business in the digital age.

2.3. Future Work

While FLOW+ offers a comprehensive solution, there are opportunities for future development
and enhancement

- Further development could focus on integrating additional healthcare services, such as medicine or electronic health records (EHRs).
- Expanding the platform's reach to more pharmacies and patients across Uganda would maximize its impact.
- Exploring partnerships with other healthcare providers and organizations could create a more integrated healthcare ecosystem.

An existing solution to improving pharmacy management and patient treatment in Uganda is the FLOW+ Pharmacy Web Application. It offers an array of core tools including inventory management, sales tracking of medicines, reminder systems, expiration reminders, and real-time statistical dashboards all created to help pharmacies work better and patients keep up with their treatments.

Key Benefits

Works Meets an Essential Requirement:
FLOW+ addresses some of the most important problems that pharmacies face, such as mismanaged inventories, expired drugs, and non-compliant patients, providing an electronic platform for modern, efficient pharmacy operations.

Ease of Use: The platform is intuitive and easy to use, so it is available to pharmacy staff with all technical abilities.

Extended Functionality: Apart from simple stock management, FLOW+ also has features like patient medication reminders, sales reports, and drug expiry reminders—making it a strong end-to-end solution.

Support towards Better Health Outcomes: By reminding patients to take medication and allowing pharmacies to stay organized, FLOW+ is directly involved in promoting medication adherence as well as improved dispensing practices.

Areas for Improvement

Security:When simple authentication and token-based access are in place, the system is further secured through more secure encryption, role-based access control, and regular security audits to ensure data security.

Offline Functionality: Presently internet-dependent, the app could be restricted to rural or low-connectivity areas. Future editions could include offline syncing or mobile slim versions.

Accessibility: To extend reach to more customers, FLOW+ may include USSD-based functionalities or SMS integration for small pharmacies or rural customers who do not have smartphones.

Data Accuracy and Integration: To work efficiently for features such as reminders, sales analysis, and expiry tracking, there will be a need for ongoing update of the medicine database and potential integration with other healthcare systems or medical vendors.

Final Thoughts

Overall, FLOW+ provides a sound foundation for an innovative, efficient pharmacy management system. Through fixing its current shortcomings and by tapping into stakeholder feedback, the platform can transform pharmacy workflows and improve health outcomes in Uganda and globally. Its user-based design, functional features, and flexibility make it ripe for use across the healthcare value chain on a large scale.

REFERENCES

1.   Bagonza, J., et al. (2023) 'Digital health solutions for medication access in Uganda', Journal of African Medical Informatics, 14(2), pp. 45-58.

2.   Kim, S. K., Park, S. Y., Hwang, H. R., & Park, J. W. (2023). Effectiveness of mobile health intervention in medication adherence: A systematic review and meta-analysis. ResearchGate. https://doi.org/10.21203/rs.3.rs-3440357/v1

3.   Katende, D. & Nakitende, J. (2023) 'Inventory optimization in Ugandan pharmacies', East African Health Review, 7(1), pp. 112-125.

4.   Ministry of Health Uganda (2023) National Pharmaceutical Sector Report. Kampala: Government Press.

5.   Mugisha, R., et al. (2023) 'Digital transformation of Ugandan pharmacies', African Journal of Health Informatics, 4(3), pp. 78-92.

6.   Nabukenya, J., et al. (2022) 'Technology adoption in Ugandan healthcare', Uganda Medical Journal, 16(4), pp. 33-47.

7.   National Information Technology Authority (2023) Uganda Digital Transformation Report. Kampala: NITA.

Appendix

Appendix A : Link to live version of the application:
https://flow-udwe.onrender.com/