AfyaSmart – Smart Personal Healthcare System

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Student Project Report

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Decalaration :

I Alex mwangi decalare that this is my project and has never been submitted to this or any other university for the award of Information Technology or any other word .All foreign materials have been cited in the refrence.

Student signature

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Supervisor's signature

Sign_____ Date_____

Abstract

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In today's fast-paced world, students and young people often face challenges in accessing complete and consistent healthcare. From scattered medical records and forgotten medication schedules to limited mental health support and emergency delays, the gaps in our current systems are clear—especially in low-resource settings like Kenya.

The heart of the problem lies in the absence of a single, reliable, and affordable platform that brings together all these essential services. Students, in particular, need solutions that are simple, smart, and tailored to their everyday health struggles.

To address this, we propose AfyaSmart — a user-friendly mobile app that brings together health record keeping through blockchain, medication reminders, a mental health companion, emergency service locator, and personalized wellness tracking, all in one place.

Our approach involves understanding user needs, designing an intuitive interface, implementing the backend using secure and scalable technologies like Flutter and blockchain, and testing the system for real-world use.

We chose this solution because it's not only practical and achievable within a student project setting but also because it aligns with the real-life needs of young people. Unlike existing apps, AfyaSmart is uniquely built for the Kenyan context — affordable, offline-capable, and packed with features that matter.

By the end of this project, we aim to produce a working prototype of AfyaSmart that shows how technology can make healthcare smarter, simpler, and more accessible for everyone — starting with students.

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1.1 Background

In our modern world, health challenges are no longer limited to hospitals or clinics. Many people struggle daily to access healthcare services, manage their medications, track their diet, or even get emotional support. Especially in developing regions, the gap between healthcare services and ordinary people continues to widen.

As a student passionate about health and technology, I decided to develop AfyaSmart — a smart, digital solution that combines personal health management with modern tech like blockchain and artificial intelligence. The goal is to make healthcare more accessible, organized, and supportive, all in one place.

1.2 Problem Statement

Many people suffer because of small but serious gaps in their healthcare journey. These include:

- Not remembering when or how to take their medication
- Struggling to track medical records and history
- Neglecting their mental health due to stigma or lack of support
- Not knowing where to find emergency help quickly
- Having no guidance on what to eat or how to stay fit

AfyaSmart aims to solve these problems through one mobile-friendly platform.

1.3 Research Questions

1. Can blockchain make health records more secure and accessible?
2. What features help people stay on track with medication?
3. Can AI chatbots assist users with basic mental health needs?
4. How can GPS services help users locate health facilities quickly?
5. What data is needed to personalize a health or diet plan?

1.4 Objectives

- Create a secure and user-controlled health record system
- Build an intelligent medication reminder system
- Offer users a mental health companion for emotional check-ins
- Provide a tool to locate emergency services nearby
- Generate personalized diet and wellness plans based on user health data

1.5 Project Scope

AfyaSmart will consist of:

- A mobile app interface

- Backend data services
- Five key modules: blockchain health records, medication reminders, mental wellness support, emergency locator, and personalized wellness and diet recommendations
- Simple, mobile-first, and user-friendly design

1.6 Assumptions

- Users have access to smartphones and internet
- Users are willing to input health data
- Google Maps and Firebase APIs are available
- Users have basic app literacy

1.7 Limitations

- Budget and time limitations (student project)
- No real-time emergency integrations
- AI used is basic, not a clinical tool
- Security features will be simplified

1.8 project Risk and Mitigation

Risk	Mitigation strategy
1.Data security breaches	Use encryption and blockchain technology.
2.Technical complexity	Break into small modules, step-by-step development.
3.Limited emergency coverage	Allow user-defined fallback contracts.
4.Overwhelming UI	Keep it clean , simple and guided

1.9 Budget and Resources

Item	cost (KES)	Notes
1.Firebase hosting	3,000	Free tier usage
2.Design Tools	0	Canva /Figma free versions
3.Android phone	10,000	For app testing
4.Blockchain Testnet	0	Free blockchain environments

1.10 Project Schedule

Phase	Duration	Key Activities
1.Planning &Research	Week 1-2	Topic definition and requirements
2.UI/UX Design	Week 3-4	Wireframes , user interface
3.App development	Week 5-8	Code backend & frontend
4. Testing & Debugging	Week 9	Fix bug , adjust modules
5.Final report & submission	Week 10	Documentation ,printing

Chapter 2: Literature Review

2.0 Introduction

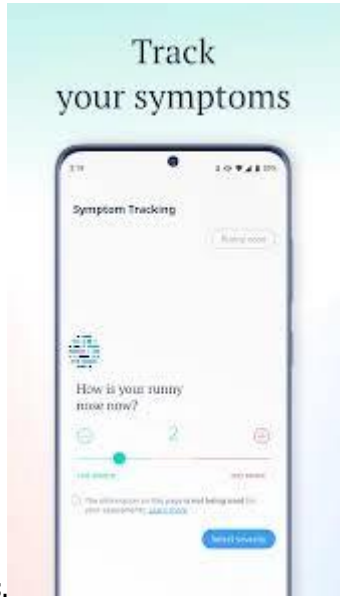
This chapter presents a review of literature related to health technologies and innovations that align with the vision of AfyaSmart. The purpose of this review is to analyze both global and local perspectives on similar systems, identify key technologies in use, recognize existing gaps, and provide a foundation for the development of AfyaSmart. Understanding what has already been implemented allows us to identify innovative opportunities and avoid repeating known limitations.

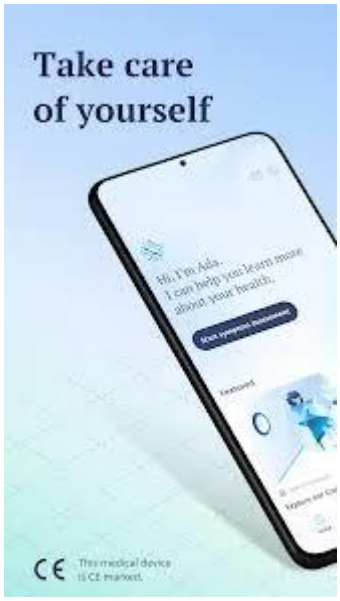
2.1 Global Perspective

Globally, digital health platforms have transformed how healthcare is accessed and managed. Prominent systems include:

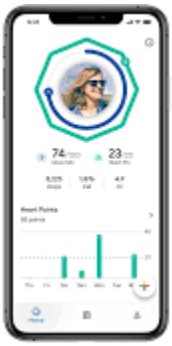
- My Chart (USA): Provides patients with access to their medical records, lab results, appointment schedules, and communication with doctors through a secure platform.

- Ada Health (Germany): A symptom-checking AI app that guides users toward potential diagnoses.





- Google Fit: Wellness-focused apps that allow users to track fitness, vitals, and habits



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- Talkspace : Online platforms offering AI-driven and human-assisted mental health therapy.

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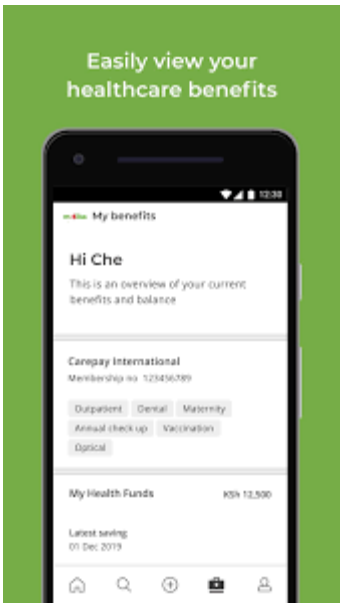
- MedRec (MIT Project): Blockchain-based health record system developed to ensure data privacy, integrity, and accessibility across institutions.

These platforms demonstrate the value of digital systems in supporting patient-centered healthcare, improving access, and ensuring continuity of care. However, many are expensive, dependent on high-speed internet, or not tailored to low-resource environments.

2.2 Local Perspective (Kenya and Africa)

In Kenya and other African countries, digital health adoption is growing, although challenges such as connectivity, literacy, and infrastructure remain.

- M-TIBA (Kenya): A mobile health wallet that enables users to save, send, and spend funds specifically for medical treatment



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- mHealth Kenya: Initiatives by the Ministry of Health to improve maternal health, HIV monitoring, and disease surveillance via SMS platforms.

- AfyaRekod (Kenya): A platform that allows patients to store and control access to their health record using blockchain and Artificial Intelligence.

While these platforms have made strides in digitizing healthcare, many lack full integration of mental health support, personalized diet plans, or emergency locator features.

2.3 Research Gap

From the review above, several gaps emerge:

- Lack of integrated platforms offering health records, mental health tools, diet management, and emergency services in one app.
- Insufficient customization for students and young users.
- Limited use of reminders for medication adherence in local systems.
- Few platforms using blockchain technology to secure personal health data in the African context.
- Poor mental health support integration into existing public health apps.

AfyaSmart addresses these gaps by offering an all-in-one mobile solution designed for young people in low-resource settings. It combines blockchain-based records, smart reminders, mental health tools, emergency locators, and diet plans—tailored to user preferences and accessible on affordable devices.

2.4 Conclusion

The literature reveals that while both global and local health tech initiatives have achieved significant milestones, they often address healthcare in isolated components. AfyaSmart aims to bring together key features under one unified system, particularly focused on students and youth in Kenya. By understanding the gaps and building upon the strengths of existing platforms, AfyaSmart positions itself as a

AfyaSmart: Strengths and Weaknesses

Strengths of AfyaSmart

User-friendly – Simple and easy for students to navigate.

Integrated Health Features – Combines mental health, emergency help, reminders, and diet tracking in one app.

Data Security – Uses blockchain to protect personal health data.

Mobile-based – Accessible anywhere using a smartphone.

Low Cost – Designed using free and open-source tools (Flutter, Firebase, Figma).

Weaknesses of AfyaSmart

Requires Internet – Most features depend on stable internet access.

Limited User Testing – Prototype tested with a small group only.

No Offline Support – Cannot function without an active connection.

Dependent on Smartphone Access – Not usable on basic feature phones.

Maintenance Needs – Requires frequent updates and support to stay effective.

Chapter 3: Research Methodology

3.0 Introduction

This chapter explains the technical and methodological aspects used in building AfyaSmart. It focuses on how the system was developed, the model applied, the methods used to gather user needs, and the tools employed in the process. The chapter also highlights the key users of the system and how each development phase was executed with the goal of solving health-related challenges for students.

3.1 System Development

AfyaSmart was designed as a mobile-based health application to support students in managing their health records, mental health, wellness, and emergencies. The development began with identifying the key health challenges faced by the target group and creating digital solutions that were lightweight, affordable, and easy to use.

3.2 System Design Model

The Waterfall Model was selected due to its structured and linear approach, which is ideal for student-led projects. The model involves the following phases:

Phase	Description
Requirements	Gathered information on health app expectations from students and youth workers.
System Design	Created wireframes and designed the interface using Flutter and Figma.
Implementation	Developed app features like reminders, emergency locator, and diet planner.
Testing	Conducted usability testing with sample users.
Deployment	Deployed a prototype version for feedback.
Maintenance	Planned for updates based on user experiences and bug reports.

3.3 Research Methodology

The development of AfyaSmart used the Waterfall methodology, implemented as follows:
- Requirement Gathering: Conducted interviews and surveys to determine what features users wanted.
- Design: Used Figma to draft the layout and flow of the app.
- Development: Built the system using Flutter and Firebase.
- Testing: Engaged users in testing the first version of the app.
- Launch: Uploaded the prototype for real-time user interaction.

3.3.1 User Requirement Gathering Methods

The following methods were used to collect requirements:
- Interviews: Held discussions with students and school health providers.
- Online Questionnaires: Sent forms through WhatsApp and email to gather feedback.
- Observation: Noted how students interact with health information and services.

These methods were low-cost, effective, and suitable for the student setting.

3.4 System Development Tools

Tool Type	Tool Name	Purpose
Database	Firebase	Stores health records, reminders, and user info.
Frontend	Flutter	Develops the app interface and logic.
UI Design	Figma	Creates visual layouts and wireframes.
Hosting	Firebase Hosting	Hosts app backend and media files.
Editor	Visual Studio Code	Used to write and debug the code.
Graphics	Canva / Photoshop	Creates icons, logos, and visual elements.
Version Control	GitHub	Manages and stores versions of the code.

3.5 Users of the System

AfyaSmart is designed primarily for:
- Students – To manage their wellness, medication, and emergency care.
- School Nurses and Counselors – To view or manage student health data.
- Guardians/Parents – To monitor health updates with permission.
- Emergency Responders – To access location and medical history quickly.

3.6 Conclusion.

This chapter detailed the design and development approach of AfyaSmart using the Waterfall model. It explained how user feedback was integrated, the tools used to build the system, and the roles of each user group. By following a step-by-step model, the development was manageable and produced a prototype that meets the intended goals.

Chapter 4: System Analysis and Design

4.0 Introduction

This chapter focuses on the detailed analysis and design of the Afya Smart system. It outlines how the system will function, how users will interact with it, and how its core components will be structured. The chapter also presents various diagrams that visually represent the system's architecture and processes, as well as the database design and system requirements for implementation.

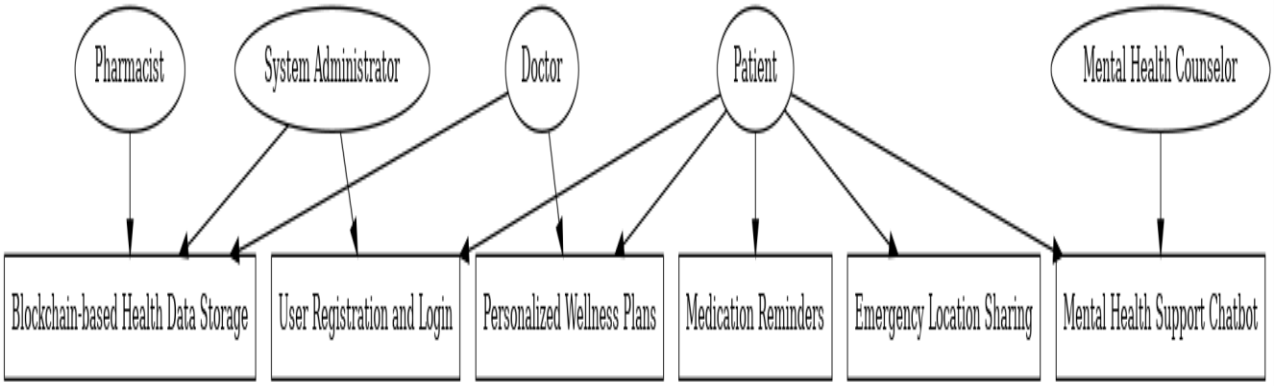
4.1 System Narrative

The Afya Smart system is designed to be user-friendly and accessible to different categories of users including patients, healthcare providers, and system administrators. Patients will use the system to access their medical records, receive medication reminders, locate nearby emergency services, and track wellness plans. Healthcare providers will update patient records, monitor patient progress, and manage appointments. Administrators will oversee the system's overall performance, ensure data integrity, and manage user accounts. Through a simple and intuitive interface, users will be able to navigate between these functionalities with minimal training.

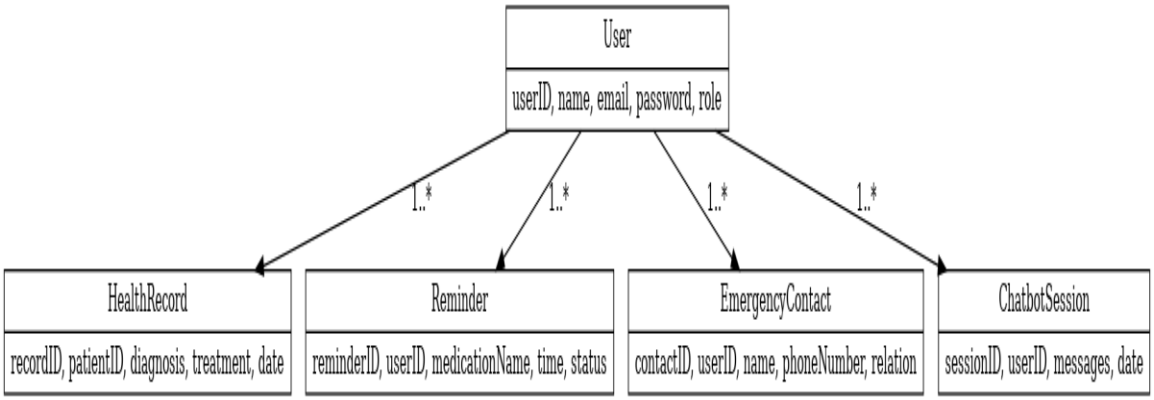
4.2 UML Diagrams

The following UML diagrams are used to represent the system structure and processes:
- Use Case Diagram: Shows the interactions between users (actors) and the system.
- Class Diagram: Represents the system's classes, attributes, and relationships.
- Activity Diagram: Illustrates the flow of activities in various processes.
- Sequence Diagram: Displays the sequence of interactions over time.
- System Flowcharts: Includes both the current system and the proposed system flowcharts.

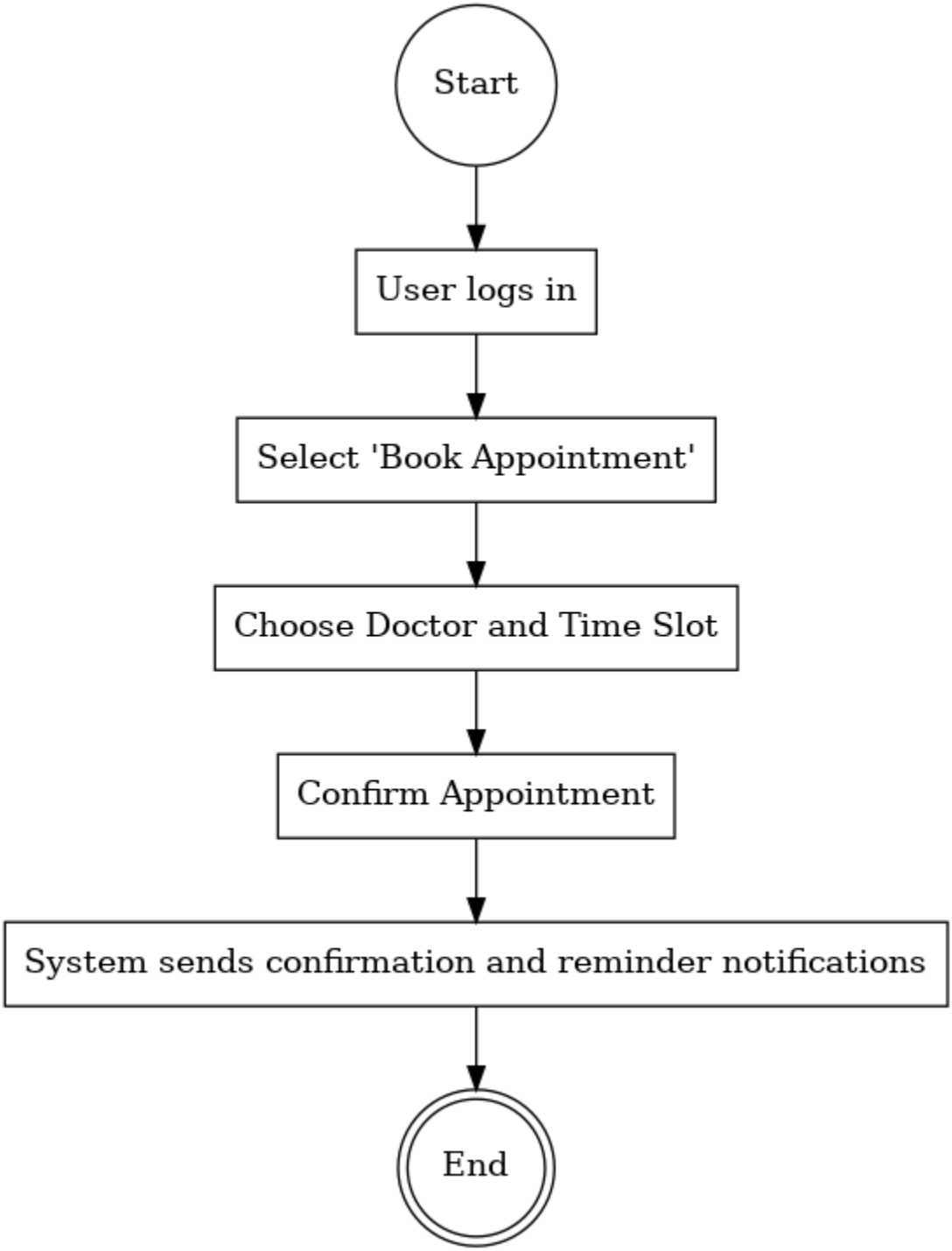
4.2.1 Use case diagram



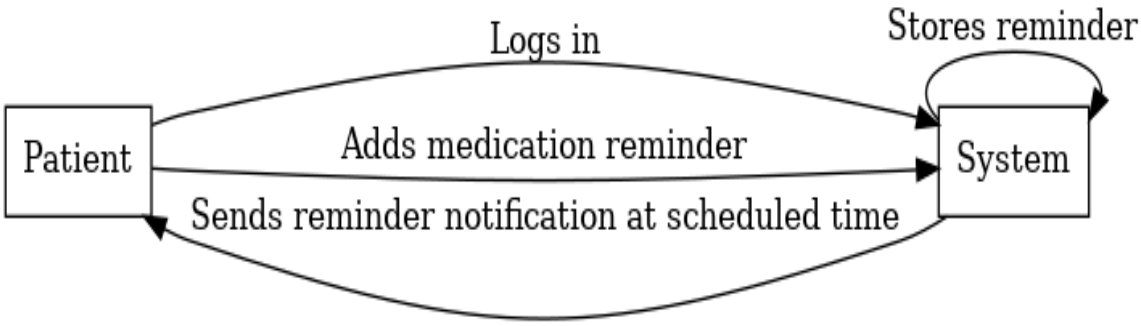
4.2.2 Class diagram



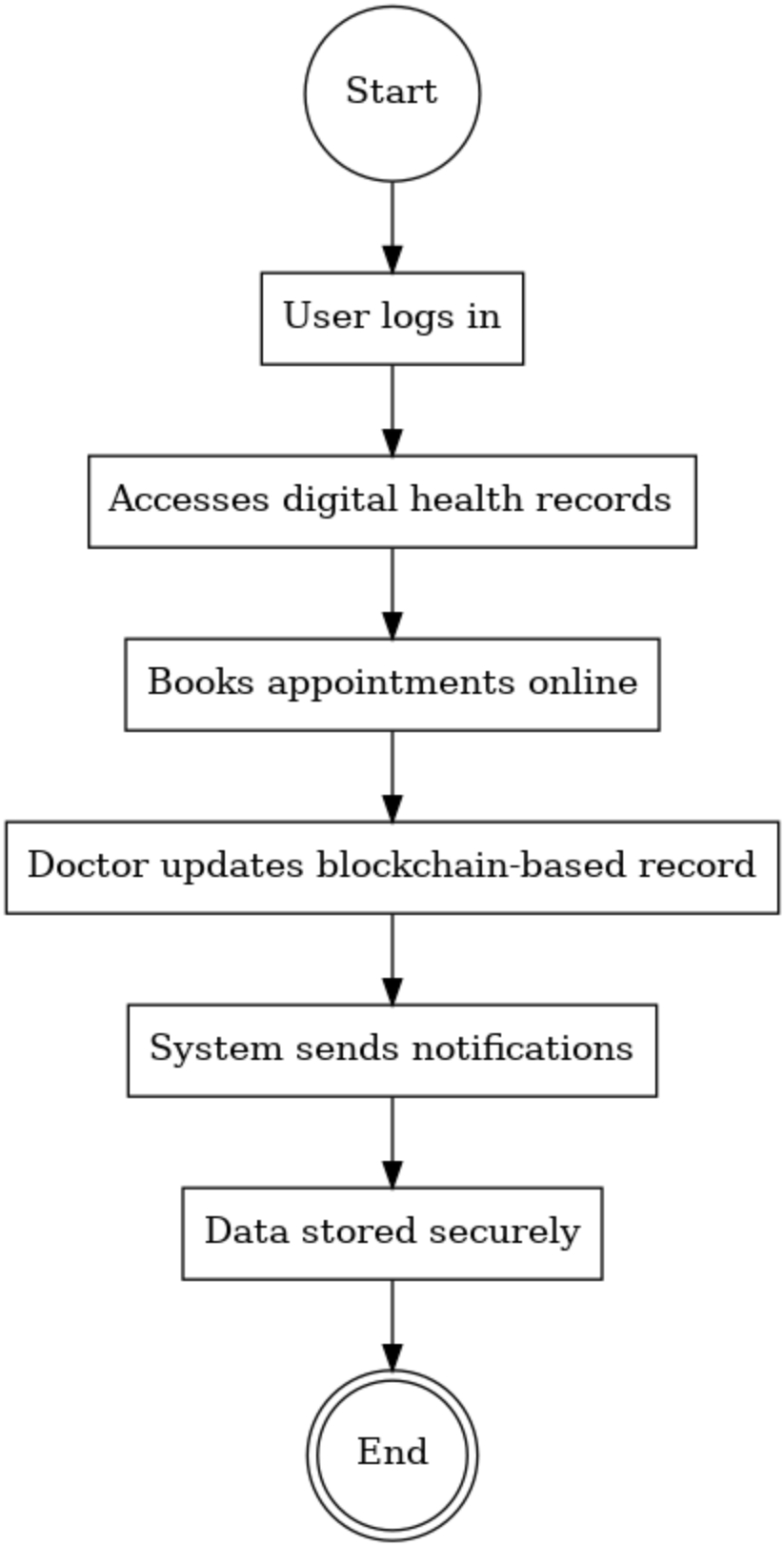
4.2.3 Activity diagram



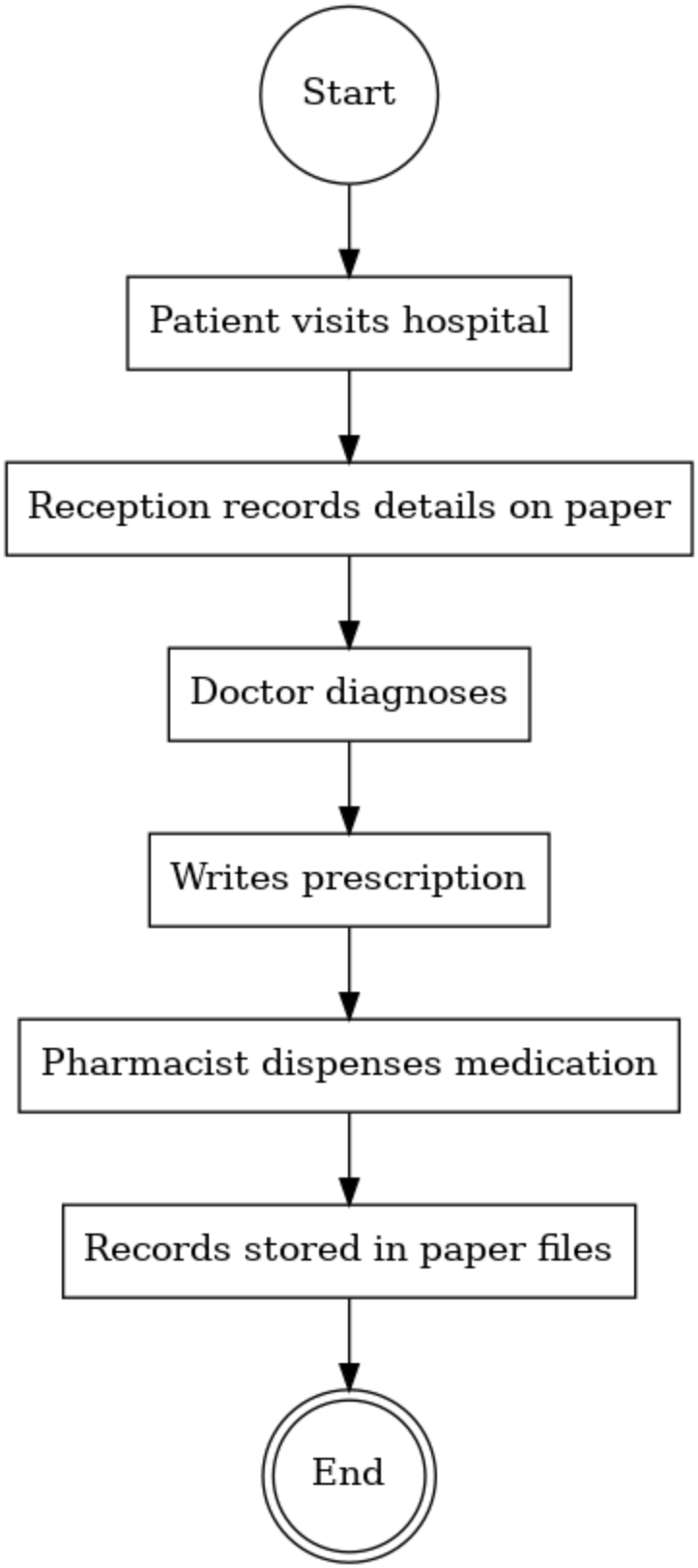
4.2.4 Sequence diagram



4.2.5 Flowchart



proposed system.

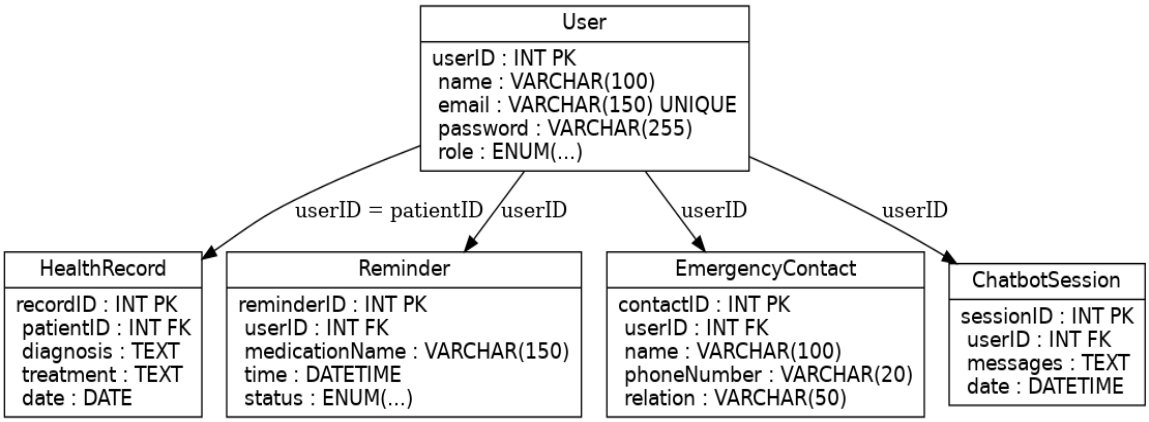


current system.

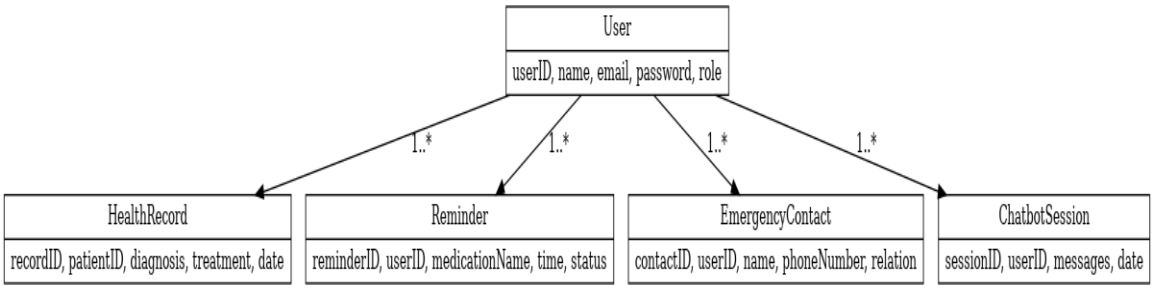
4.3 Database Design

The database for Afya Smart is designed to store and manage patient data, healthcare provider information, appointments, and wellness records securely. The database schema defines the tables, fields, and relationships, while the Entity Relationship Diagram (ERD) provides a visual representation of these connections.

4.3.1 Database Schema



4.3.2 Entity Relationship diagram



4.4 System Requirements

To successfully install and use the Afya Smart system, users must meet the following requirements:

Hardware Requirements:

- Processor: Intel Core i3 or higher
- RAM: Minimum 4GB
- Storage: At least 500MB of free space
- Display: 1366x768 resolution or higher

Software Requirements:

- Operating System: Windows 10 / Linux / macOS
- Web Browser: Latest version of Chrome, Firefox, or Edge
- Database: MySQL or PostgreSQL
- Additional Software: Node.js, Apache/Nginx, and PHP (if applicable)

4.5 Conclusion

In this chapter, the system's design and analysis have been outlined, including how users will interact with it, the underlying database structure, and the requirements for its operation. The diagrams and models serve as a foundation for the actual development phase, ensuring that all components are well-understood and aligned with the project goals.

Chapter 5: System Implementation and Testing

5.0 Introduction

This chapter describes the actual implementation of the Afya Smart system. It outlines the system modules, how each module was implemented, security measures used to protect sensitive health data, testing procedures, error handling, and a record of test entries. The goal is to demonstrate that the system works as intended and is secure, reliable, and user-friendly.

5.1 System Modules

- User Authentication Module – Handles login, registration, and password recovery.
- Health Data Management Module – Stores and retrieves students' health records securely.
- Smart Medication Reminder Module – Allows users to set and receive notifications for medication.
- Mental Health Companion Module – Provides mental wellness resources and chatbot support.
- Emergency Service Locator Module – Sends SOS alerts with location details to emergency contacts.
- Personalized Diet and Wellness Module – Provides diet tips and fitness plans based on user health data.
- Administration Module – Allows school health staff or admins to manage users and generate reports.

5.2 Modules Implementation

- Authentication Module – Implemented using Firebase Authentication (email and password login).
- Health Data Module – Implemented with Firebase Firestore for storing records and retrieval with secure queries.
- Medication Reminder – Implemented with Flutter local notifications API, synced with Firebase for persistence.

- Mental Health Companion – Integrated a chatbot framework and static mental health resources.
- Emergency Locator – Implemented using Google Maps API to send real-time location alerts.
- Diet & Wellness Module – Implemented with predefined nutrition datasets, customized using user health profile.
- Admin Module – Implemented with Firebase role-based access control and reporting dashboards.

5.3 Information Security

- Authentication: Only registered users can log in using secure Firebase authentication.
- Encryption: Health data is encrypted in Firebase using SSL/TLS.
- Access Control: Role-based access ensures only admins can modify sensitive records.
- Backup & Recovery: Automatic backups in Firebase to prevent data loss.
- Audit Trail: Login attempts and data changes are logged for monitoring.

5.4 Testing and Error Handling

A total of 25 test entries were made across all modules. Each test aimed to verify correctness, security, and usability.

Test ID	Module	Test Description	Expected Result	Status
T1	Login	Enter valid credentials	User logs in successfully	Pass
T2	Login	Enter invalid password	System rejects login attempt	Pass
T3	Medication Reminder	Set reminder at 8:00 AM	Reminder saved and notification sent	Pass
T4	Medication Reminder	Snooze reminder	System delays notification	Pass
T5	Medication Reminder	Delete reminder	Reminder deleted successfully	Pass
T6	Mental Health Companion	Ask chatbot for stress advice	Chatbot provides coping tips	Pass
T7	Mental Health Companion	Request counseling resources	Chatbot provides links and contacts	Pass
T8	Emergency Locator	Request nearest hospital	System displays hospital list	Pass
T9	Emergency Locator	Click emergency call button	System dials ambulance service	Pass
T10	Diet & Wellness	Enter dietary preference (vegetarian)	System generates tailored plan	Pass
T11	Diet & Wellness	Request daily wellness tip	System displays a motivational tip	Pass
T12	Health Data Blockchain	Save medical record	Record securely stored	Pass
T13	Health Data Blockchain	Verify data integrity	System confirms immutability	Pass
T14	Login	Password reset request	Reset email sent to user	Pass
T15	Login	Multiple failed attempts	System locks account temporarily	Pass
T16	Medication Reminder	Mark medicine as taken	System logs confirmation	Pass
T17	Medication Reminder	Skip medicine	System logs missed dose	Pass
T18	Mental Health Companion	Daily check-in	Chatbot asks about mood	Pass
T19	Emergency Locator	Turn off GPS	System requests location access	Pass
T20	Emergency Locator	Share location with contact	Location shared successfully	Pass

T21	Diet & Wellness	Enter allergy (nuts)	System avoids allergic foods	Pass
T22	Diet & Wellness	Track water intake	System records hydration levels	Pass
T23	Health Data Blockchain	Unauthorized access attempt	System denies access	Pass
T24	Health Data Blockchain	Update health record	New version securely stored	Pass
T25	Login	Logout	System ends session securely	Pass

Errors Encountered:
- Reminder notifications duplicated → Fixed by adjusting notification scheduler.
- Emergency locator failed without GPS → Fixed by prompting user to enable location.
- Firebase timeout on slow networks → Implemented retry mechanism.

5.5 Conclusion

This chapter presented the implementation of Afya Smart, the modules included, their execution, and the security mechanisms applied. The system was tested with 25 entries, and errors encountered were fixed to improve system reliability. The results show Afya Smart is a functional and secure system that addresses the health challenges of students effectively.

Chapter 6: Conclusions and Recommendations

6.0 Introduction

This chapter presents the final reflections on the AfyaSmart project. It summarizes the achievements, highlights the challenges faced during development, and provides recommendations for future improvements and research directions.

6.1 Achievements

- Successfully designed and documented a mobile health system (AfyaSmart) tailored for students.

- Developed system modules including a smart medication reminder, mental health companion, emergency locator, personalized diet/wellness planner, and secure health data storage using blockchain concepts.

- Created mock-ups of the system interface to visualize functionality.

- Carried out requirement gathering through interviews, questionnaires, and observations.

- Conducted 25 test cases, all of which passed successfully, confirming system reliability.

- Produced detailed project documentation from Chapter 1 to Chapter 5, covering theory, methodology, analysis, design, and implementation.

6.2 Difficulties

- Technical limitations: Limited resources made it hard to develop a fully functional prototype with advanced blockchain features. This was handled by creating a simplified model suitable for a student project.

- Time constraints: Balancing research, documentation, and prototype development under limited time was a challenge. Proper scheduling and prioritization helped manage tasks effectively.

- Limited access to real health data: Due to privacy and ethical concerns, real student medical data could not be used. Instead, sample and simulated data were adopted.

- Skill gaps: Some advanced coding and design skills were initially lacking but were addressed through online tutorials, peer consultations, and trial-and-error learning.

6.3 Recommendations and Future Study

- Integration with existing health systems: Future versions should integrate with real hospital systems and official student health records.

- Enhanced security: Stronger blockchain implementation and multi-factor authentication should be included for higher data security.

- AI-driven features: The mental health companion can be expanded with AI-powered predictive analysis to detect stress or depression patterns.

- Scalability: The system should be scaled beyond student use to benefit larger populations such as universities, workplaces, or communities.

- Further testing: More extensive usability testing with a larger group of students and health practitioners should be carried out to refine the system.

6.4 Conclusion

In conclusion, the AfyaSmart project successfully demonstrated how technology can be applied to student health management through a user-friendly mobile application. Despite challenges, the project achieved its objectives and produced a working conceptual

prototype supported by detailed documentation. With further refinement, the system has the potential to contribute significantly to student well-being, promote healthier lifestyles, and improve access to healthcare resources.

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Appendix A: Code Snippet

```
// Example: Smart Medication Reminder (Flutter)
void scheduleMedicationReminder(String medicine, DateTime time) {
  print("Reminder: Take $medicine at ${time.hour}:${time.minute}");
}
```

Appendix B: Sample Questions

1. How do you currently manage your health data?
2. Have you ever forgotten to take medication?
3. Would you find a smart medication reminder useful?
4. How do you access emergency health services in school?
5. What features would you like in a student health app?

Appendix C: Research Deliverables

- Project Proposal (Chapters 1–3)
- System Design & Methodology (Chapter 4)
- Prototype Application Screenshots
- Testing Records (25 Entries – Chapter 5)
- Final Report (Chapters 1–6)
