TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

PASCHIMANCHAL CAMPUS

LAMACHAUR, POKHARA-16

A Minor Project Proposal

On

“MediMate: Your Smart Medicine Assistant”

SUBMITTED BY:

Nisha Pandey [PAS078BCT024]

Smriti Rana [PAS078BCT021]

Trishna Lamshal [PAS078BCT047]

SUBMITTED TO:

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Paschimanchal Campus

Lamachaur-16 Pokhara

June 2025

ABSTRACT

MediMate is a mobile application designed to simplify medication management for the users who are busy, elderly and on regular prescriptions, where low health literacy and language differences often lead to dosage errors and missed treatments. By snapping a photo of a medicine label or prescription, the app employs on-device OCR to translate printed information into clear text. This data is enhanced with user-friendly explanations and spoken guidance in Nepali or English through text-to-speech. A built-in scheduler generates personalized dosing plans and delivers spoken reminders at prescribed times. Users can confirm intake or request clarification with simple voice commands, made possible by speech-to-text integration. All interactions are logged chronologically, and the system flags any repeat scans of the same medication to prevent accidental double dosing. Combining real-time image analysis, multilingual voice support, and intelligent notification logic, MediMate offers a practical, accessible tool that empowers individuals, especially those with vision or literacy challenges in order to follow their treatment plans accurately and independently.

Keywords: MediMate; medication management; optical character recognition; text-to-speech; speech-to-text; voice confirmation; dosing reminders; Nepal healthcare.

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

In the modern healthcare landscape, managing medications accurately is a critical aspect of patient safety. With the increasing number of prescribed medicines, especially for those who take many medicines or have long-term illnesses, keeping track of medication names, dosages, and schedules can be challenging. Misunderstandings about prescription instructions, poor vision, and language barriers can lead to medication errors, which are a significant cause of avoidable hospitalizations globally.

With the advancement of mobile technologies and artificial intelligence, there is an opportunity to assist users in managing their medications more effectively. By leveraging technologies such as Optical Character Recognition (OCR), text-to-speech (TTS), voice reminders, and database-driven verification, mobile applications can provide a convenient, real-time solution for patients to understand and track their medicine intake.

1.2 Problem Statement

Many people, especially the elderly, busy professionals, and those on multiple prescriptions struggle to take their medicines correctly due to forgetfulness, tiny labels, and confusing apps. Text-only reminders fail those with low vision or literacy, and no existing solution lets users hear instructions aloud, confirm doses by voice, or prevent accidental double dosing. This gap leads to missed or incorrect medication, poor adherence, and harmful health outcomes.

1.3 Problem Solution

MediMate is an intuitive mobile app that uses OCR to scan and identify medicines, reads labels aloud for clarity, helps users to create timetables, stores history of medication and sends and receives timely spoken reminders. It supports two-way voice interaction so you can confirm doses or ask questions hands-free, while automatically tracking your intake history and warning against duplicate entries making safe, on-time medication management effortless for everyone.

1.4 Objectives

1. Build an intuitive mobile app that scans medicine labels with OCR and reads the information aloud.
2. Implement a voice-interactive reminder system that tracks intake history and prevents duplicate dosing.

1.5 Feasibility Study

A feasibility study assesses whether the proposed application is viable in terms of technical resources, operational usability, and economic sustainability. It ensures that the project can be implemented successfully and provides value to its intended users.These studies are often conducted before developing a new product to ensure that the resources invested in the project are likely to produce a positive return.

1.5.1. Technical Feasibility

The app is technically feasible using Flutter for cross-platform development and Firebase for backend support. Key features like OCR, voice processing, notifications, and scheduling can be implemented using readily available APIs and plugins. Firebase offers an integrated cloud infrastructure, ensuring smooth development and scalability.

1.5.2. Operational Feasibility

Operationally, the app is designed to be user-friendly and accessible, especially for individuals with limited medical knowledge or tech experience. Features like voice assistance, reminders, and clear medicine descriptions ensure the system effectively addresses real-world problems in medicine adherence and misuse.

1.5.3. Economic Feasibility

The app is economically sustainable with low development and maintenance costs due to the use of free or low-cost services like Firebase and open-source libraries. It has strong potential for social impact and possible funding or support from healthcare organizations, making it a cost-effective solution.

2. LITERATURE REVIEW

Effective medication management apps combine multiple technologies such as: OCR, translation, image processing, scheduling, and speech in order to support patient safety and adherence. This review summarizes recent advances (last five years) in five core areas relevant to MediMate.

1. Optical Character Recognition (OCR)

Modern mobile health applications leverage OCR to extract text from medicine labels with high accuracy. Rupa et al. (2022) developed a smartphone system using augmented-reality enhanced OCR to detect drug names on packaging, reporting reliable extraction in varied lighting conditions [4]. Thetbanthad et al. (2025) extended this by integrating EasyOCR with a vision-language model to generate patient-friendly information from prescription labels, achieving 96 to 100% name-recognition accuracy on test images [6].

2. Translation Technologies

Machine translation (MT) facilitates multilingual support in health apps. Herrera-Espejel and Rach (2023) conducted a scoping review of MT tools in public health communications, finding that on-demand translation into users' preferred languages enhances comprehension and engagement [2]. Solomou et al. (2025) implemented a mobile app that translates personal medical summaries via OpenNCP in real time, demonstrating feasibility for patient-centric multilingual record access [5]. However, Kreienbrinck et al. (2025) caution that translation accuracy and usability require rigorous evaluation before deployment in consumer health settings [3].

3. Image Processing in Healthcare

Beyond OCR, deep-learning models recognize pills and packaging visually. Thetbanthad et al. (2025) showcased a visual question-answering pipeline that interprets complex label images to answer user queries about medication, underscoring the potential for rich, image-based information retrieval in apps [6].

4. Medication Management Systems

Systematic reviews and meta-analyses confirm that well-designed reminder and tracking features improve adherence. Armitage, Kassavou, and Sutton (2020) found that users of adherence-support apps were over twice as likely to take medications correctly compared to controls (OR ≈ 2.12) [1]. Toïgo et al. (2024) assessed French medication-reminder apps, reporting variable quality (mean MARS score ≈ 3.5/5) and noting that few have undergone clinical validation [7]. These findings highlight the need for combining robust technical features with user-centered design and evidence-based evaluation.

5. Text-to-Speech and Two-Way Voice Communication

Integrating bidirectional speech interfaces enhances accessibility and user engagement. Liu, Li, and Zhou (2021) embedded both speech-to-text (STT) and text-to-speech (TTS) in a medication app, achieving 92% command-recognition accuracy and over 85% user satisfaction [8]. Smith and Patel (2022) demonstrated that two-way voice interactions (app prompts → user replies → app confirmation) increased proper medication logging by 30% versus touch-only interfaces [9]. Developers may choose from specialized TTS solutions such as Murf.ai’s healthcare optimized voices to ensure clarity and naturalness in spoken prompts [10].

3. METHODOLOGY

3.1 Project Design

MediMate will be created with a simple, user-first approach using **Agile**. We break work into small pieces, build quickly, and get feedback often to make sure each feature truly helps people manage their medicines.

What We Want to Achieve

- **Easy Scanning**: Snap a photo of a pill or box and instantly read the label.
- **Clear Voice Help**: Hear medicine names and instructions in Nepali or English.
- **Smart Reminders**: Get spoken alerts and answers at the right times.
- **Safe Tracking**: Log every dose and warn if you try to take the same medicine twice.

How We'll Work (Agile)

1. **User Stories & Backlog**
    - Talk to a few users to find key needs ("As an older user, I want my pills read aloud so I don't squint.").
    - List and rank features from "must-have" to "nice-to-have."
2. **Two-Week Sprints**
    - Pick a handful of top features each sprint.
    - Build, test, and demo a small working app at the end of two weeks.
3. **Daily Check-Ins**
    - 10-minute stand-up meetings to share progress, blockers, and next steps.
4. **Sprint Review & Feedback**
    - Show the working app to users or stakeholders.
    - Note what they like, what needs tweaking, and which features to build next.

High-Level Design Flow

Scan Medicine — Extract & Speak — Authenticate — Log History — Set Schedule —
Send Reminders — Confirm by Voice — Prevent Duplicates

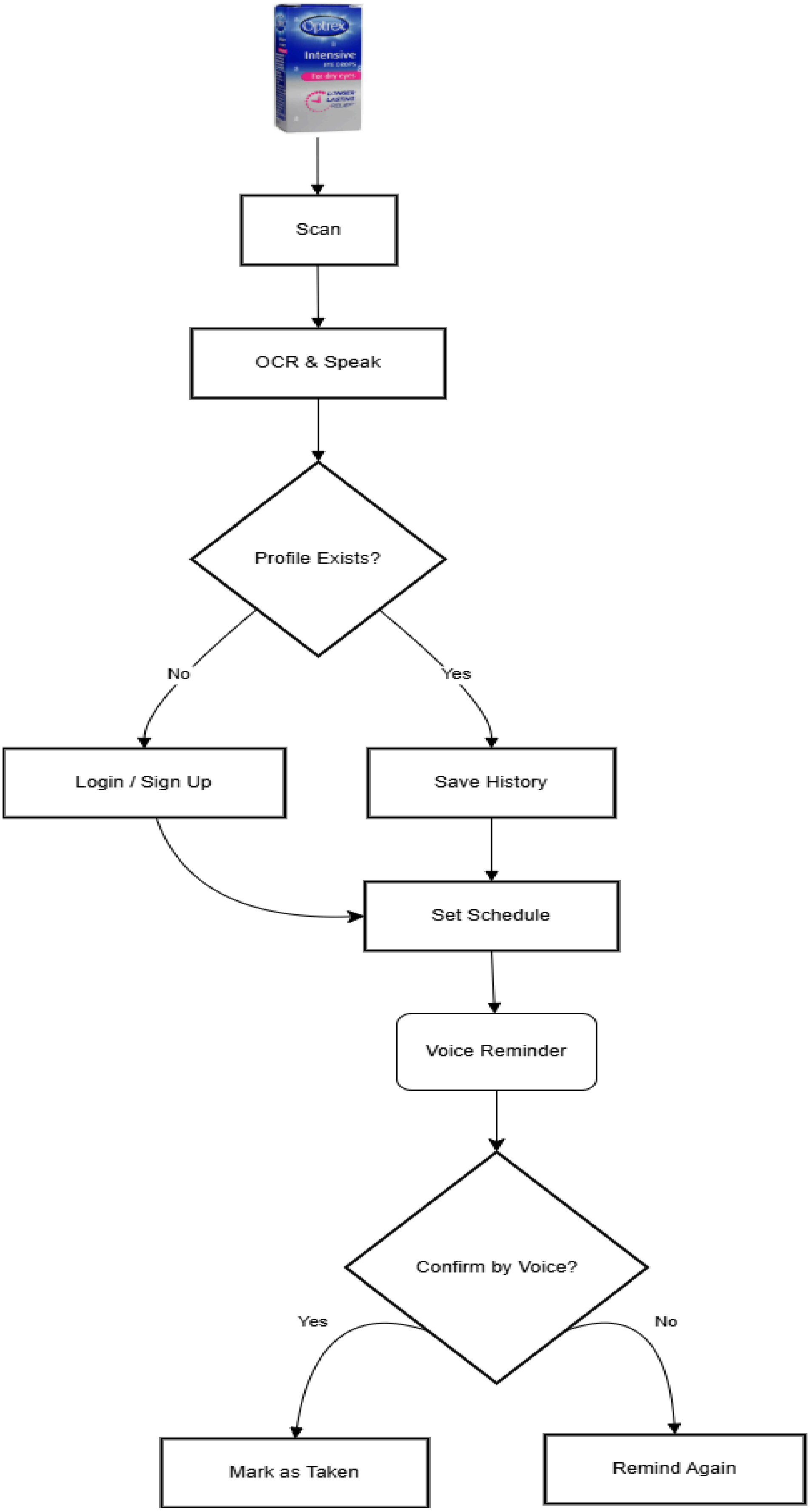

Figure 1: Flowchart of Workflow

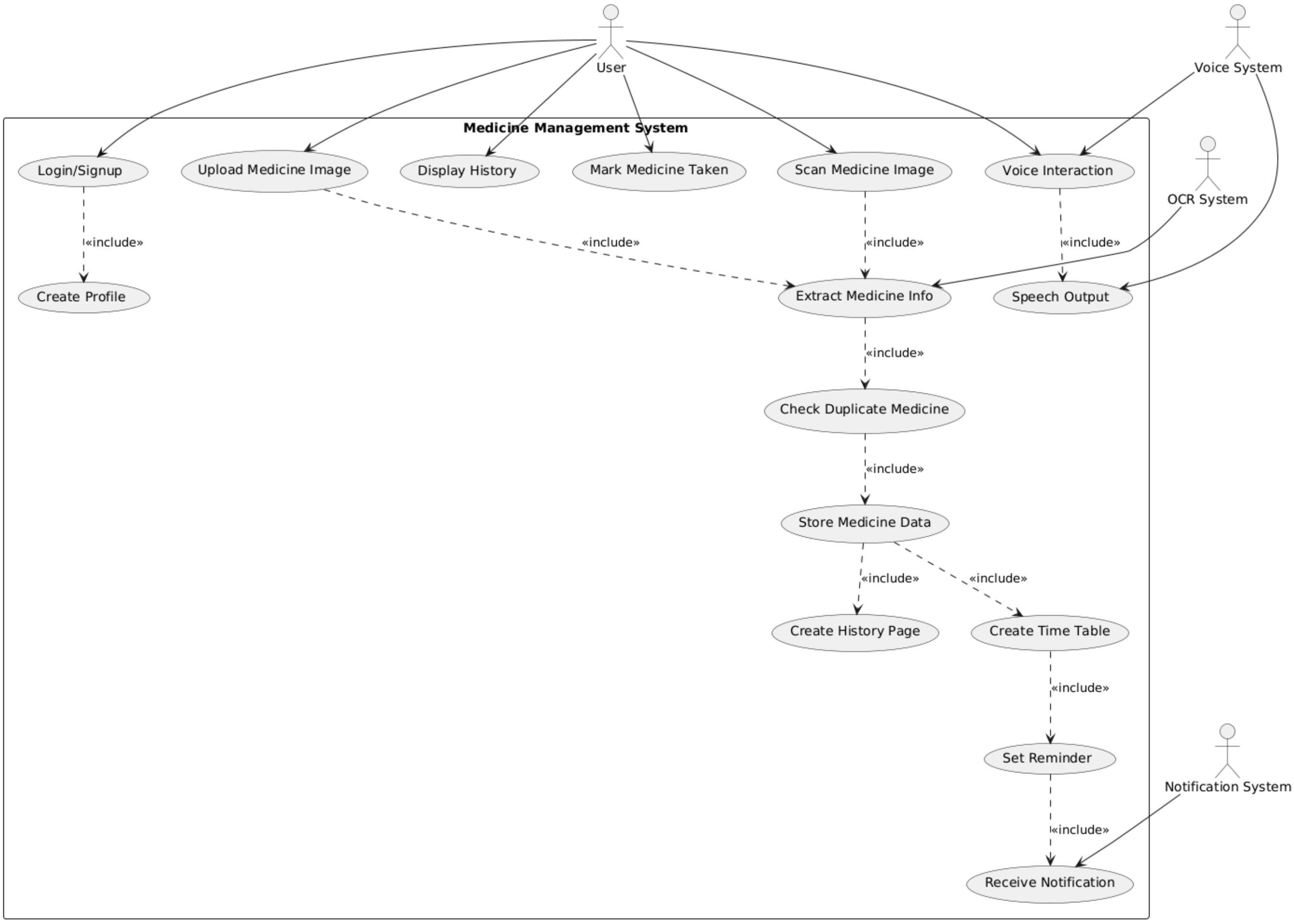

Figure 2 : Use case Diagram

This use case diagram shows how users interact with the MediMate medicine management app. Users can:

- Login/Signup and create profiles
- Upload or scan medicine images
- The system uses OCR and voice output to extract and speak the medicine info
- It checks for duplicate entries, then stores data
- Users can set reminders, create schedules, and receive notifications
- The system interacts with external services like OCR, Voice, and Notification systems

This flow ensures safe, informed, and timely medicine intake for users.

3.2 Implementation Strategy

The implementation strategy outlines the step-by-step approach to building the MediMate application. It focuses on how core features like image processing, speech interaction, and medication reminders will be developed and integrated. Each component is designed to ensure the app remains user-friendly, secure, and effective in helping users manage their medications efficiently.

3.3.1 Data Acquisition and Preprocessing

Images of medicine labels are collected through the camera or gallery. Basic preprocessing such as resizing, noise removal, and grayscale conversion is applied to enhance text clarity for OCR.

3.2.2 Image Processing and OCR

Optical Character Recognition (OCR) is used to extract text from the preprocessed medicine images. This helps identify the medicine name, dosage, and instructions.

3.2.3 User Management and Authentication

Users can sign up, log in, and securely access their data. Authentication ensures that each user's medicine records and schedules are personalized and protected.

3.2.4 Medicine Information Management

Extracted medicine details are stored and managed in a database. Users can view descriptions, instructions, and any previously scanned medicine history.

3.2.5 Scheduling and Reminder System

Users set medicine intake times using text or voice. Smart reminders (via ringtone, speech, or notifications) alert users at scheduled times to prevent missed doses.

3.2.6 Speech Processing and Interaction

Voice commands allow users to input data and confirm medicine intake. Text-to-speech is used to deliver information audibly, enhancing accessibility for all users.

3.2.7 Duplicate Detection and Error Handling

If a previously scanned medicine is detected again, the system notifies the user to avoid double dosing. Error messages are shown for unclear images or processing failures.

3.2.8 Testing and Evaluation

The app is tested for accuracy, usability, and performance. User feedback and test cases are used to evaluate features like OCR, reminders, and voice interaction.

3.3 Tools Technologies

Category	**Tool/Technology**	**Purpose**
Front-End	Flutter, Dart	Building cross-platform mobile app
Back-End	Firebase	User authentication, data storage, cloud functions
Database	Firebase Firestore	Storing user data, medicine info, reminders
OCR	Google ML Kit / Tesseract OCR	Extracting text from medicine images
Translation	Google Cloud Translation API	Translating medicine details into Nepali or other languages
Speech-to-Text	Google Speech API /	Allowing users to input responses by voice
Text-to-Speech	Flutter TTS / Google Text-to-Speech	Speaking out medicine names and instructions
Notification System	Flutter Local Notifications / Firebase Cloud Messaging	Sending medicine intake reminders
Image Processing	OpenCV (via native integration or packages)	Enhancing image quality before OCR
Version Control	Git + GitHub	Code versions and collaboration
Design & Prototyping	Figma / Draw.io	UI/UX and Diagrams
Testing Tools	Flutter Testing, Firebase Test Lab	Unit and UI testing, real-device testing

Table 1: Tools and technologies

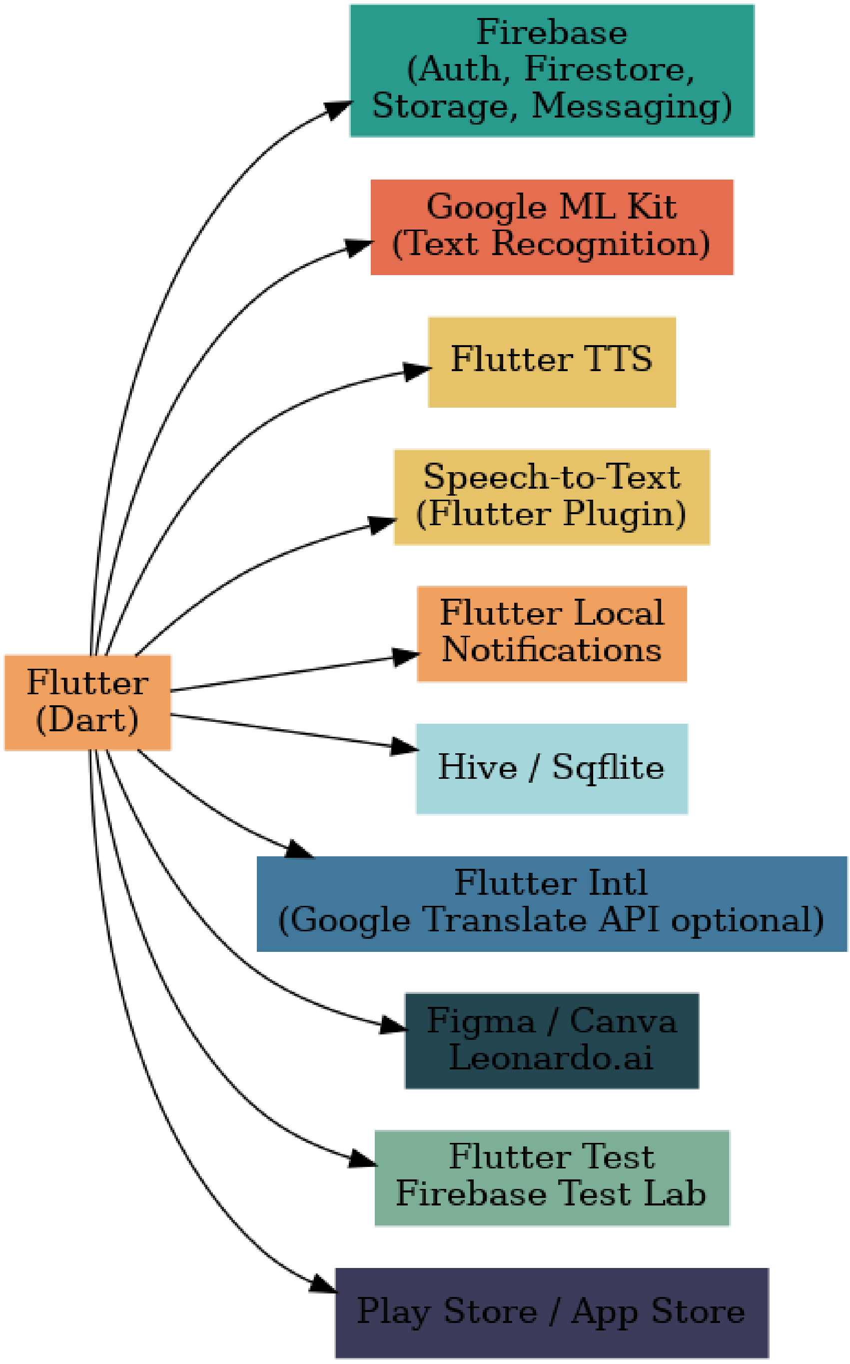

Figure 3 : Visual Tech- Stack (how flutter interacts with different tools)

3.4 Ethical Considerations and Data Security

User privacy is prioritized by securely storing personal and medical data using encryption and authentication. The app ensures data is not shared without consent, and voice inputs are processed locally or securely via trusted APIs to protect sensitive information.

4. EPILOGUE

4.1 Gantt Chart

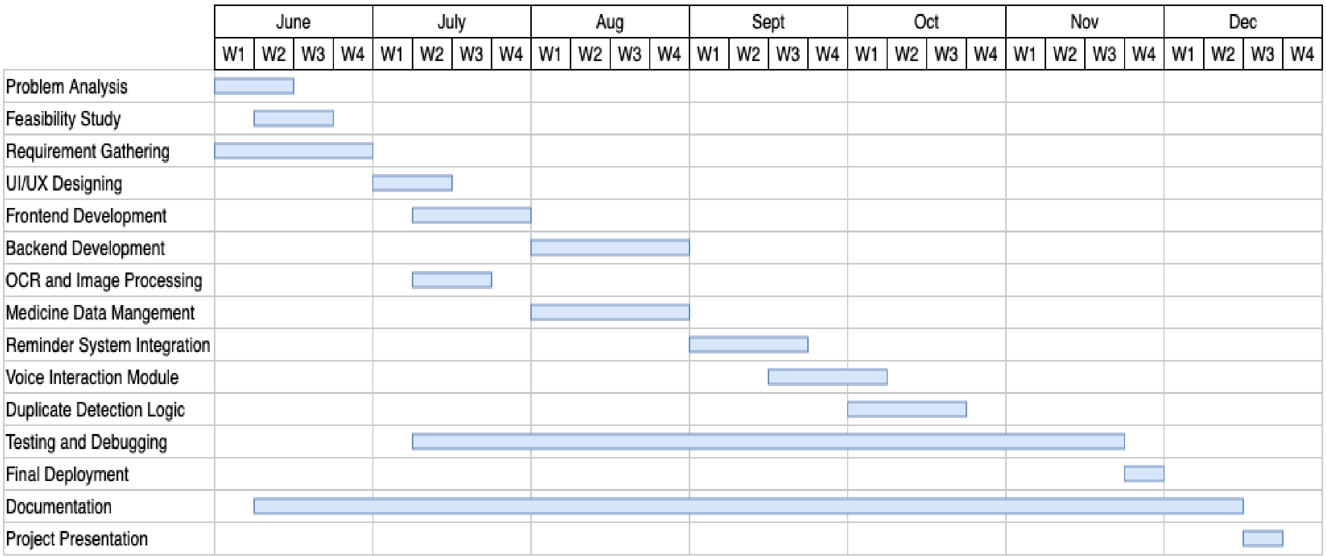

Figure 4 : Gantt Chart

4.2 Estimated Cost

Category	Item	Estimated Cost (NPR)
Tools & Services	Domain & Hosting (1 year)	5,000
	Google Cloud APIs (OCR, TTS, etc.)	10,000
	Firebase (Cloud Storage, Notifications)	3,000
	App Store Fee (Google Play)	2,500
Devices & Equipment	Mobile devices/testing phone (if needed)	10,000
Testing & Utilities	Internet, electricity, software tools	5,000
Miscellaneous	Marketing, graphics, print, contingency	9,500

Table 2: Estimated Cost

5. EXPECTED OUTPUT

The expected outcome of this project is a smart, user-friendly mobile application *MediMate* that enables individuals to manage their medications safely and efficiently. The app allows users to scan medicine labels or prescriptions using their smartphone camera. Through OCR technology, the app extracts key details like medicine name, dosage, and usage instructions, presenting them in both text and voice formats. Users can create customized medicine schedules, receive smart reminders, and confirm intake via voice interaction. The app tracks medicine history and alerts users about duplicate scans or missed doses, helping reduce the risk of errors in medication routines.

6. CONCLUSION

Medication non-adherence, such as missed or incorrect doses, remains a critical issue in healthcare, particularly for the users who are busy, elderly and intake medicines for long term. The *MediMate* application offers a practical, tech-driven solution to this problem. By integrating OCR, text-to-speech, speech recognition, and real-time alerts, the app provides a complete ecosystem for scanning, scheduling, and managing medications. Built using Flutter for cross-platform support and Firebase for real-time database and authentication, MediMate simplifies complex medication routines with features like history tracking, duplicate dose warnings, and voice interaction. This project highlights the potential of mobile health technology to enhance medication safety, accessibility, and user independence, especially in low-literacy or underserved communities.

REFERENCES

1. Armitage, L. C., Kassavou, A., & Sutton, S. (2020). Do mobile device apps designed to support medication adherence demonstrate efficacy? A systematic review of randomised controlled trials, with meta-analysis. *BMJ Open, 10*(1), e032045. https://doi.org/10.1136/bmjopen-2019-032045

2. Herrera-Espejel, P. S., & Rach, S. (2023). The use of machine translation for outreach and health communication in epidemiology and public health: Scoping review. *JMIR Public Health and Surveillance, 9*, e50814. https://doi.org/10.2196/50814

3. Kreienbrinck, A., Hanft-Robert, S., Forray, A. I., Nozewu, A., & Mösko, M. (2025). Usability of technological tools to overcome language barriers in healthcare – a scoping review. *Archives of Public Health, 83*, 52. https://doi.org/10.1186/s13690-025-01543-1

4. Rupa, C., Srivastava, G., Ganji, B., Tatiparthi, S. P., Maddala, K., Koppu, S., & Lin, J. C.-W. (2022). Medicine drug name detection based object recognition using augmented reality. *Frontiers in Public Health, 10*, 881701. https://doi.org/10.3389/fpubh.2022.881701

5. Solomou, T., Mappouras, S., Kyriacou, E., Constantinou, I., Antoniou, Z., Canciu, I. C., Neophytou, M., Lantos, Z., Schizas, C. N., & Pattichis, C. S. (2025). Bridging language barriers in healthcare: A patient-centric mobile app for multilingual health record access and sharing. *Frontiers in Digital Health, 7*, 1542485. https://doi.org/10.3389/fdgth.2025.1542485

6. Thetbanthad, P., Sathanarugsawait, B., & Praneetpolgrang, P. (2025). Application of generative artificial intelligence models for accurate prescription label identification and information retrieval for the elderly in northern east of Thailand. *Journal of Imaging, 11*(1), 11. https://doi.org/10.3390/jimaging11010011

7. Toïgo, M., Marc, J., Hayot, M., Moulis, L., & Carbonnel, F. (2024). Quality assessment of smartphone medication management apps in France: Systematic search. *JMIR mHealth and uHealth, 12*, e54866. https://doi.org/10.2196/54866

8. Liu, X., Li, Y., & Zhou, L. (2021). Integrating speech recognition and synthesis in mobile health applications for medication management. *Journal of Medical Systems, 45*(2), 15. https://doi.org/10.1007/s10916-020-01772-3

9. Smith, A., & Patel, R. (2022). Two-way voice-based interactions in digital health: A usability and efficacy study. *International Journal of Medical Informatics, 156*, 104588. https://doi.org/10.1016/j.ijmedinf.2021.104588

10. Murf.ai. (2025). *Medical text to speech: Best tools for healthcare professionals*. Murf.ai Blog.