MediMind: A Cross-Platform System for Automated Prescription Parsing and Multi-Channel Medication Reminders Using OCR and Large Language Models

Rayaprolu Karthik
CSE (AI & ML)
Gayatri Vidya Parishad College of Engineering (Autonomous)
Vishakapatnam, India.
323103382106@gvpce.ac.in

Islavath Raghu Naik
CSE (AI & ML)
Gayatri Vidya Parishad College of Engineering (Autonomous)
Vishakapatnam, India.
322103382018@gvpce.ac.in

Chereddy Venkata Karthik Reddy
CSE (AI & ML)
Gayatri Vidya Parishad College of Engineering (Autonomous)
Vishakapatnam, India.
322103382010@gvpce.ac.in

Chaparla Murari
CSE (AI & ML)
Gayatri Vidya Parishad College of Engineering (Autonomous)
Vishakapatnam, India.
322103382009@gvpce.ac.in

Dr. R. Seeta Sireesha
Associate Professor
Gayatri Vidya Parishad College of Engineering (Autonomous)
Vishakapatnam, India.
seetasireesha@gvpce.ac.in

ABSTRACT

Medication non-adherence remains a major public health challenge, contributing to adverse clinical outcomes and increased healthcare costs. This paper presents MediMind, a cross-platform healthcare application designed to improve medication adherence through automated prescription management and intelligent reminder delivery. The system allows users to upload prescription images, from which text is extracted using Optical Character Recognition (OCR). A Large Language Model (LLM) then parses the unstructured text into structured medication data, including medicine name, dosage, frequency, and administration timings. Based on this parsed information, personalized reminder schedules are automatically generated and stored. Timely reminders are delivered via multiple channels: email notifications and mobile push notifications facilitated by Firebase Cloud Messaging. MediMind is implemented as a full-stack application with a React-based frontend (deployed on web and wrapped for Android using Capacitor), a FastAPI backend, MongoDB for data persistence, and Redis for session management. The architecture supports secure user authentication, cross-device accessibility, and reliable background scheduling of reminders. Key innovations include the integration of EasyOCR for robust text extraction and prompt-engineered LLM parsing for accurate interpretation of complex prescription instructions.

By automating the interpretation of prescriptions and providing consistent, multi-modal reminders, MediMind reduces the cognitive burden on patients and minimizes errors associated with manual schedule management. The system offers a practical, user-friendly solution to enhance medication adherence in everyday clinical practice.

Keywords: medication adherence, prescription parsing, optical character recognition, large language models, medication reminders, push notifications, cross-platform application, digital health

I. INTRODUCTION:

Medication non-adherence represents a persistent and pervasive challenge in the management of chronic diseases, contributing to suboptimal clinical outcomes, increased morbidity and mortality, and a substantial economic burden on healthcare systems worldwide. Despite advancements in pharmacotherapy, adherence rates remain critically low. Systematic reviews and expert consensus indicate that only approximately 50% of patients with chronic conditions take their medications as prescribed. This figure, originally highlighted in the World Health Organization's 2003 report on adherence to long-term therapies, has been consistently reaffirmed in analyses spanning 2024 and 2025. The consequences of non-adherence are severe, leading to preventable complications such as disease progression, higher hospitalization rates, and elevated mortality risk across conditions including cardiovascular disease, diabetes, hypertension, and respiratory disorders. Economically, poor adherence is associated with hundreds of billions in avoidable healthcare costs annually, with estimates in the United States alone ranging from $100–300 billion, and global figures suggesting up to $500 billion when accounting for indirect impacts like lost productivity.

The rise in chronic disease prevalence, driven by aging populations and lifestyle factors, further exacerbates this issue. While digital health interventions such as mobile applications and automated reminders have shown promise in addressing behavioral and practical barriers to adherence, many existing solutions remain limited in scope. They often focus primarily on simple reminders without tackling upstream challenges, specifically the accurate interpretation of complex prescription data. Patients managing chronic medications encounter multiple barriers that hinder adherence, starting with the interpretation of prescriptions themselves. Handwritten or printed documents often contain technical terminology, Latin abbreviations (e.g., *b.i.d.*, *t.i.d.*), and ambiguous timing instructions, making manual transcription by patients prone to errors. Furthermore, translating these details into a daily routine requires significant cognitive effort, increasing the risk of mistakes in dosage or timing. Dependence on memory or basic alarms often fails to provide consistent reliability, and physical prescriptions are easily misplaced, leading to gaps in long-term management. These challenges collectively underscore the urgent need for intelligent, automated systems that reduce cognitive load and enhance reliability.

To address these gaps, this paper introduces MediMind, a cross-platform application designed to improve medication adherence through the integration of advanced computational techniques. The primary objective of this work is to automate the entire workflow of medication management: from prescription parsing to the generation of personalized schedules and the delivery of multi-channel reminders. The proposed system introduces a hybrid pipeline that combines Optical Character Recognition (OCR) for extracting text from prescription images with Large Language Model (LLM) parsing to structurally interpret unstructured medical text. This allows for the automatic generation of reminder schedules with fixed daily triggers for morning, afternoon, evening, and night. Additionally, the system ensures reliability through multi-modal notification delivery via email and mobile push notifications using Firebase Cloud Messaging. Built upon a secure, full-stack architecture supporting both web and native mobile deployment, MediMind aims to provide a practical, scalable solution that minimizes user effort while maximizing adherence support in real-world settings.

II. LITERATURE SURVEY

Medication non-adherence remains a critical barrier to effective chronic disease management, with adherence rates persistently hovering around 50% across various conditions, as established in the World Health Organization's 2003 report and corroborated by recent systematic reviews through 2025. Digital health interventions, particularly mobile applications delivering reminders and tracking features, have demonstrated moderate improvements in adherence. Randomized controlled trials and meta-analyses have shown that multimodal reminder systems, such as those combining push notifications with SMS, can significantly enhance compliance in populations with hypertension, diabetes, and cardiovascular diseases, often achieving adherence rates above 80% in targeted interventions. However, the efficacy of these solutions is frequently compromised by their dependence on the manual entry of medication details. This reliance introduces risks of transcription errors and user fatigue, which ultimately limit long-term engagement and system utility.

To address the bottleneck of manual data entry, Optical Character Recognition (OCR) has emerged as a foundational technology for automating prescription digitization. Ponnuru (2024) explored image-based extraction of prescription information using OCR, achieving reliable retrieval of key details such as drug names and dosages from scanned documents, though performance degraded notably with handwritten text or poor image quality. Similarly, Khod et al. (2024) developed an OCR model focused on pharmaceutical data extraction, reporting high accuracy for structured elements like dosages but highlighting persistent challenges with complex prescription layouts and multilingual content. Building on these foundations, artificial intelligence techniques have been increasingly applied to prescription analysis for greater semantic understanding. Mayur et al. (2023) provided a comprehensive review of AI applications in prescription processing, emphasizing the capacity to automate validation and support clinical decision-making. Likewise, Iancu (2023) and Allam (2025) underscored the potential of machine learning to improve predictive accuracy and pharmacy workflow automation, while cautioning that issues related to data privacy, model interpretability, and regulatory hurdles continue to impede full clinical adoption.

Despite these advancements, a significant gap remains in the integration of these technologies. Recent works have begun employing large language models (LLMs) alongside OCR pipelines to address limitations in handling noisy text; however, most existing systems remain fragmented—focusing either on extraction accuracy or basic reminder functionality—without offering an end-to-end solution. In contrast, MediMind advances the field by proposing a hybrid pipeline that seamlessly integrates EasyOCR for initial text extraction with prompt-engineered LLM parsing to produce reliable structured medication data, including frequency and timing interpretations. By coupling this automated extraction with consistent multi-modal notifications via email and Firebase Cloud Messaging, MediMind addresses both the interpretive challenges of prescriptions and the behavioral aspects of adherence within a unified, cross-platform architecture.

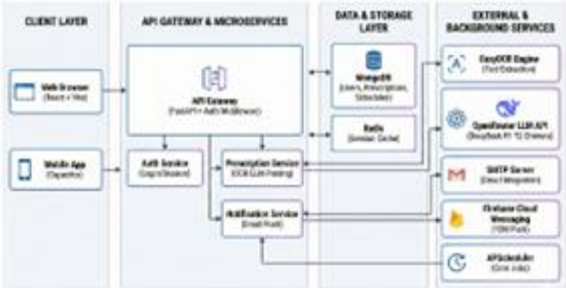
III. PROPOSED SYSTEM

MediMind is developed as a comprehensive, cross-platform digital health application designed to address medication non-adherence by automating the entire workflow from prescription digitization to personalized reminder delivery. The system eliminates the error-prone process of manual data entry by enabling users to upload images of medical prescriptions, which are then automatically extracted, interpreted, and converted into structured medication schedules. The primary objectives of the platform are to reduce the cognitive burden on patients by accurately parsing complex dosing instructions and to improve adherence through reliable, multi-modal notifications. Designed for accessibility, the application supports both web browsers and native Android environments, ensuring a seamless user experience whether the patient is at home or mobile, while adhering to strict security standards for health-related data.

The system utilizes a robust full-stack architecture comprising a responsive frontend, a high-performance asynchronous backend, and persistent storage layers. The frontend is engineered using React 18 with TypeScript and styled with Tailwind CSS, utilizing Capacitor to wrap the web application for native Android deployment. This approach ensures feature parity across platforms, facilitating capabilities such as drag-and-drop image uploads and real-time schedule management. The backend is implemented using FastAPI, a modern Python framework selected for its efficiency in handling asynchronous file uploads and external API integrations. Data persistence is managed through MongoDB, which stores user profiles, prescription records, and schedules, while Redis is employed for high-speed, distributed session management with automatic expiration to enhance security.

A key innovation of MediMind is its hybrid data processing pipeline, which integrates Optical Character Recognition (OCR) with Large Language Model (LLM) parsing. The system employs EasyOCR to extract raw text from prescription images, utilizing a model optimized for English text and medical documents. This unstructured output is subsequently processed by the DeepSeek R1-T2 Chimera model via the OpenRouter API. Through carefully engineered prompts, the LLM semantically interprets the raw text, resolving medical abbreviations and complex instructions into structured JSON data. This process maps specific dosage timings to four fixed daily periods—morning, afternoon, evening, and night—thereby standardizing diverse prescription formats into actionable schedules without requiring user intervention.

Upon successful parsing, the system automatically generates active schedule entries in the database. A background scheduler, implemented using APScheduler, executes jobs at four fixed daily intervals (08:00, 13:00, 18:00, and 21:00). When a job triggers, the system queries the database for active schedules matching the current time period and dispatches notifications. To ensure delivery reliability, MediMind employs a multi-channel approach: HTML-formatted emails are sent via SMTP, and push notifications are delivered to mobile devices using Firebase Cloud Messaging (FCM). Security is enforced throughout the architecture using bcrypt for password hashing and a dual authentication mechanism that supports both session cookies for web users and Bearer tokens for mobile clients. By combining these technologies, MediMind offers a scalable, end-to-end solution that directly addresses both the interpretive challenges of reading prescriptions and the behavioral challenges of maintaining a medication routine.



IV. METHODOLOGIES

The development of MediMind followed an iterative, prototype-driven methodology grounded in user-centered design and agile practices. This process emphasized continuous testing of core components, specifically OCR accuracy, LLM parsing reliability, and notification delivery, allowing for the early mitigation of challenges like variable image quality. The system was implemented as a full-stack application with clear separation of concerns, prioritizing scalability, security, and cross-platform compatibility.

The frontend architecture utilizes React 18 with TypeScript for type safety and Vite for optimized production builds. A component-based design strategy leveraged shadcn-ui and Tailwind CSS to create a responsive interface, while Capacitor wrapped the application for native Android deployment. This approach enabled access to device-specific features like push notifications without separate codebases. User experience remained central, incorporating drag-and-drop interactions and real-time feedback mechanisms during processing.

The backend was developed using FastAPI for its asynchronous capabilities and Pydantic type validation, ensuring non-blocking performance for I/O operations. Data modeling employed a document-oriented approach with MongoDB, using strategic indexing to optimize reminder queries. Session management relied on Redis for stateless scaling, while authentication middleware accommodated both cookie-based web sessions and Bearer token-based mobile authentication to address WebView limitations.

Prescription interpretation relies on a sequential pipeline where uploaded images are processed by EasyOCR (v1.7.2) for text recognition. The raw text is then passed to the DeepSeek R1-T2 Chimera model via the OpenRouter API. A carefully engineered prompt enforces strict JSON output, guiding the model to resolve medical abbreviations and interpret timing instructions with a deterministic temperature of 0.1. Successfully parsed data is validated and stored, with timings automatically mapped to fixed daily intervals.

Reminder delivery employs APScheduler's BackgroundScheduler with Cron triggers executing at 08:00, 13:00, 18:00, and 21:00 daily. The system identifies the current period, queries active schedules, and dispatches parallel notifications: HTML emails via SMTP and push messages via the Firebase Admin SDK. Security is integrated throughout using defense-in-depth principles, including bcrypt hashing, automatic session expiration, and strict environment variable isolation to protect sensitive health data.