

# Smart Medicine Reminder Platform Using Image-Based Prescription Recognition

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**ABSTRACT:** *This study presents a smart and fully offline medicine reminder application designed to simplify the process of daily medication management through automated image recognition. Users can capture or upload a photograph of a medicine strip, from which the system automatically extracts essential details—such as the medicine name, manufacturing date, and expiry date—using Optical Character Recognition (OCR) technology.*

*Once the information is retrieved, the application allows users to define dosage details, including the duration of intake and daily frequency. The app then creates a corresponding reminder schedule linked to the stored medicine record. Each notification prompts the user to mark the dose as either taken or missed, with these responses logged for later tracking.*

*Designed to work without an internet connection, the system ensures accessibility even in low-connectivity or rural areas. By combining OCR-driven automation with customizable local scheduling, this platform promotes better medication adherence, reduces manual input, and provides a convenient, reliable tool for everyday health management.*

**Keywords:-***Medicine Reminder, OCR, Android, AlarmManager, Offline Notifications, Healthcare Adherence*

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## I. INTRODUCTION

Regular and timely medication intake plays a vital role in successful disease management, especially for individuals managing chronic health conditions. Yet, many patients fail to follow their prescribed schedules consistently. Reports from the World Health Organization (WHO) indicate that nearly half of chronic disease patients do not take their medication as directed. Common causes include forgetfulness, complex dosing regimens, or limited access to user-friendly digital tools.

While existing reminder applications attempt to address these challenges, many depend on manual data entry or stable internet connectivity, which limits their usefulness for elderly users or those living in remote regions. Additionally, most systems do not offer an automatic way to capture and extract information directly from physical medicine packaging.

Recent advances in Optical Character Recognition (OCR) and mobile computing have shown that these technologies can significantly reduce manual workload by automating data capture and improving accuracy. When combined with offline scheduling and local notification services, OCR-based systems provide a strong foundation for improving medication adherence in real-world conditions.

The proposed system builds on these principles. It enables users to capture a photo of a medicine strip, extract vital details such as the name and expiry date through OCR, and automatically schedule reminders using a structured dosage form. All data—including intake logs and user responses—is stored locally, ensuring privacy and offline operation. This makes the system a reliable, inclusive, and practical solution for individuals managing complex medication schedules, regardless of network availability.

## II. LITERATURE REVIEW

Purva Sarange et al. (2025) developed an Android-based medicine management application designed for visually impaired users. The system employs Tesseract OCR for extracting drug details and includes a voice-command interface for medication reminders and consultations. This approach enhances accessibility and promotes adherence by audibly delivering medication instructions, proving particularly useful for individuals with limited vision.

Eden Shaveet and Utkarsh Singh et al. (2024) expanded upon their earlier research by implementing YOLOv5 for real-time pill recognition through smartphone cameras. The solution integrates object detection with text-to-speech (TTS) feedback, providing instant audio identification. Their study demonstrates that deep learning models can be effectively deployed on mobile devices for healthcare accessibility.

M. M. Alazzam, J. Kaur, and K. Joshi (2024) leveraged no-code AutoML tools to develop a pill recognition system compatible with Android devices. Utilizing TensorFlow Lite for offline inference, their work highlights the feasibility of deploying high-accuracy recognition models in rural and low-connectivity environments.

Eden Shaveet et al. (2023) proposed *memorAIs*, a medication reminder application using OCR to read medicine labels and rule-based logic to generate local scheduling files (.ics format). This design avoids cloud dependency, ensuring usability in offline conditions. However, the study also noted the need for improved UI design and text parsing robustness .

R. Patil, N. Nair, J. Prakash, and R. Krishnan (2023) introduced *MediScan*, an application that processes prescription images using OCR and natural language processing (NLP) to extract dosage information. The data is automatically converted into medication alerts, reducing manual entry errors and enhancing adherence .

A. Kapoor, T. Chaurasia, and A. Behera (2023) proposed a hybrid CNN-RNN model for accurate pill classification and medication tracking. Their architecture maps recognized medicines to a backend database for automated scheduling, showing strong potential for real-time healthcare applications .

A. R. Agrawal, B. P. Jain, and R. Singh (2023) presented a CNN-based mobile solution for pharmaceutical package recognition. Their system performs reliably across various lighting and positioning conditions, enabling effective medicine identification in both clinical and at-home settings .

A. Singh and P. Tiwari et al. (2022) developed a voice-enabled drug recognition app for visually impaired users, integrating deep learning-based pill identification with real-time voice feedback. The inclusion of automated reminders improved medication adherence and user independence .

K. Shah, P. Bhatt, and N. Parmar et al. (2022) designed an IoT-based pill reminder and monitoring system integrating physical sensors with a mobile interface. The system issues alerts for missed doses and logs medication activity in a backend database, assisting patients with chronic conditions through caregiver supervision .

Finally, R. K. Agrawal and S. Yadav et al. (2020) introduced an Android application that uses OCR to identify medicines directly from packaging. The system automatically configures pill reminders via Android alert APIs, offering an intuitive interface tailored for elderly users with memory impairments .

### III. MATERIAL AND METHODS

The Smart Medicine Reminder Platform (PillMate) was developed as an Android application using Android Studio as the primary development environment. The app was coded in Kotlin and designed for API Level 36, while maintaining backward compatibility for devices running Android 7.0 and above, ensuring broad accessibility across both new and legacy Android phones.

The application integrates several key Android components:

- TensorFlow Lite for on-device machine-learning inference
- Google ML Kit Text Recognition API for Optical Character Recognition (OCR)
- Room Persistence Library for secure, local data management
- AlarmManager for precise, time-based medicine reminders

Local storage was implemented using the Room Database, optimized with custom Data Access Objects (DAOs) to ensure fast read/write performance for medicine details, user profiles, and intake logs. The user interface (UI) was designed with Jetpack Compose, following Material Design 3 principles to provide a clean, accessible, and intuitive navigation flow between app modules.

#### System Architecture

The system follows a modular, layered architecture based on the Model–View–ViewModel (MVVM) pattern, ensuring clarity, scalability, and ease of maintenance. It is organized into five functional layers:

1. **Presentation Layer:** Handles user interaction and interface logic through Jetpack Compose components. Multiple screens guide users through medicine recognition, dosage scheduling, tracking, and settings, with consistent navigation implemented via Compose Navigation.
2. **Business Logic Layer:** Coordinates medicine management operations including image processing, OCR handling, fuzzy text matching, reminder scheduling, and database transactions. Each module functions independently but interacts seamlessly with others to maintain stability and reliability.
3. **Data Access Layer:** Manages persistent data using Room, structured into three entities—User, Medicine, and MedicineLog—to store profile details, dosage data, and medication history. Android’s security features protect all stored information to maintain user privacy.
4. **System Integration Layer:** Connects the app with device hardware and system services such as the camera for image capture, sensors for image quality optimization, network modules for optional cloud features, and notification systems for reminder delivery. Background operations are handled by WorkManager and AlarmManager to ensure timely alerts and resource efficiency.
5. **Machine Learning Layer:** Combines TensorFlow Lite for medicine image classification and Google ML Kit for OCR. Additional Python-based post-processing is performed through Chaquopy, using the RapidFuzz library for enhanced text similarity matching. The ML models are quantized for faster inference on mobile devices without compromising accuracy.

#### Medicine Identification Techniques

To enhance flexibility and accessibility, the system supports several medicine identification and entry methods:

- **Camera-Based Recognition:** Captures medicine packaging using the device camera. Images are resized to  $224 \times 224$  pixels, normalized, and processed through a TensorFlow Lite model. The model distinguishes between medicine and non-medicine objects. If confidence exceeds a set threshold, OCR extraction begins automatically using ML Kit.
- **Manual Entry:** Enables users to input medicine details such as name, manufacturing date, expiry date, and dosage instructions manually. Input validation ensures data completeness and accuracy before saving to the local database.
- **Barcode Scanning:** Allows rapid identification of medicines through barcode or QR-code scanning. This method supplements the recognition system, providing quick access to standardized product information.
- **Voice-Based Search:** Lets users search medicines through spoken commands—an accessibility feature useful for visually impaired or elderly users. Speech input is processed via Android’s speech-to-text API and matched with entries in the local database.

All four methods are seamlessly unified in the platform, ensuring consistent performance and a convenient, reliable experience for all users.

## IV. RESULTS

The PillMate application was tested on multiple Android devices ranging from Android 7.0 (Nougat) to Android 14, ensuring consistent performance and compatibility across diverse hardware configurations.

#### Medicine Identification Performance

Testing was conducted using a dataset of 1,200 medicine bottle images and 800 text samples extracted from packaging.

- **Camera-Based Recognition:** The TensorFlow Lite classifier achieved 92.3 % accuracy in differentiating medicines from other objects, with an average inference time of 280 milliseconds, delivering near-instant user feedback.
- **OCR Performance:** The ML Kit module reached 89.7 % character-level accuracy, 85.2 % word accuracy, and 91.3 % line accuracy, completing full image-to-text conversion in under 2 seconds on modern devices.
- **Text Matching:** The fuzzy-matching algorithm accurately linked OCR text with reference medicine names, attaining a 94.1 % lookup success rate even when data contained minor errors.
- **Manual Entry:** Extensive testing verified 98.7 % prevention of incomplete entries, with average input time of 45 seconds per medicine, improving over traditional manual methods.

- **Barcode Scanning:** When barcodes were present, recognition succeeded 99.2 % of the time, completing in < 0.5 seconds.
- **Voice Search:** Averaged 91.8 % accuracy, performing reliably except in environments with heavy background noise.

#### **Database Performance**

The Room implementation delivered strong efficiency:

- Insert operations: ~ 45 ms
- Read operations: < 30 ms
- Update operations: < 25 milliseconds are used here to handle that operations when they run. It smoothly handled up to 500 medicine records per user without noticeable delay. Query optimization within DAOs ensured responsive filtering and sorting, even under high data loads.

#### **Reminder System Evaluation**

The AlarmManager-based reminder module achieved 99.6 % scheduling accuracy, with most notifications appearing within one minute of the programmed time. The app supported simultaneous reminders for multiple medicines, correctly updating statuses (taken, missed, or pending) in real time. Alerts triggered reliably even when the app was closed or the device was in low-power mode.

#### **Context Awareness and Adaptability**

The system automatically adjusted to environmental and hardware conditions. Image-quality assessment algorithms advised users when lighting or focus was poor. For older devices, the processing pipeline dynamically reduced computational load. When internet access was unavailable, the system defaulted to fully offline operation without data loss.

#### **User Interface and Experience**

The Jetpack Compose interface maintained >60 frames per second during navigation and animations, ensuring a smooth experience. Layouts scaled responsively across screen sizes and orientations. The Material Design 3 theme ensured clear visual hierarchy and accessibility. Proper memory management kept usage stable during prolonged operation.

#### **System Reliability and Usability**

Background reminder services consumed minimal power—around 2.3 % battery usage over 24 hours during active operation. During extensive testing, no crashes or data loss were observed. Beta users praised the clean design, responsive reminders, and variety of medicine identification options. The application handled edge scenarios such as device restarts, time-zone shifts, and daylight-saving changes seamlessly, maintaining complete schedule integrity.

## **V. DISCUSSION AND CONCLUSION**

The design and testing of the Smart Medicine Reminder Platform (PillMate) demonstrate how mobile technology can meaningfully improve medication adherence through intelligent integration of machine learning and Optical Character Recognition (OCR). The use of TensorFlow Lite for on-device image classification proved both accurate and efficient, performing reliably under various lighting and packaging conditions. This ensured that medicine details were captured correctly and stored securely, enhancing the precision and dependability of the overall system.

One of the platform's major strengths lies in its multi-mode identification system. By combining camera-based recognition, manual entry, barcode scanning, and voice-based search, users are provided with multiple convenient options for managing their prescriptions. These features were extensively tested, showing high responsiveness and stability in real-time usage. In particular, the machine-learning-driven image recognition significantly reduced manual data entry, saving time and minimizing the possibility of user error.

From a design perspective, the modular MVVM architecture offered superior maintainability and scalability, simplifying debugging and enabling smooth integration of new features. Secure local data handling using the Room database and Android's permission controls strengthened the privacy framework, ensuring that all medical information remained confidential. This adherence to Android security standards highlights the project's suitability for real-world healthcare environments.

User evaluations emphasized that the interface was simple, responsive, and visually intuitive. Performance assessments indicated minimal impact on battery usage, while on-device processing through TensorFlow Lite and ML Kit ensured compatibility across a wide range of Android hardware without the need for server connectivity. This offline capability not only preserved privacy but also made the system accessible to users in areas with limited or unreliable internet connections.

The reminder system, implemented through Android AlarmManager, demonstrated excellent accuracy, delivering notifications with 99.6% precision. The integrated tracking module enabled users to review and manage their adherence patterns effectively. Complex scheduling scenarios—such as multiple daily reminders or overlapping medicine plans—were handled seamlessly without data loss or missed alerts, confirming the robustness of the reminder engine.

In conclusion, the project successfully achieved its primary objective: developing a reliable, efficient, and user-friendly medication management system. By merging machine learning-based medicine recognition, OCR-driven data extraction, and a robust local reminder mechanism, the system provides a comprehensive, practical solution for patients and caregivers.

Future improvements could include integration with electronic health record (EHR) systems, advanced analytics for medical professionals, and cloud synchronization for multi-device access. The use of Chaquopy for Python integration demonstrated the value of hybrid mobile development, enabling powerful text-processing through the RapidFuzz library. Overall, the PillMate system illustrates how thoughtfully engineered mobile applications can play a crucial role in promoting consistent medication adherence, reducing user workload, and improving long-term health outcomes for individuals managing chronic or complex medication regimens.

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