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AI-Enabled Personalized Medication Tracker for Improved Adherence and Caregiver Connectivity

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ABSTRACT—

Medication adherence plays a crucial role in achieving optimal therapeutic outcomes; however, non-adherence remains a significant concern across patient populations. Recent advances in digital health and intelligent systems offer new opportunities to address this challenge through a unified and responsive ecosystem. A multi-functional platform is proposed that brings together adaptive medication scheduling, real-time smart notifications, and image-based medicine recognition to enhance user engagement and accuracy. By incorporating reinforcement learning and behavioral data, the system can dynamically adjust reminders and recommendations to suit individual routines. Features such as adherence tracking dashboards, caregiver alerts, and conversational AI support empower patients while enabling seamless involvement of families and healthcare providers. Additional modules like voice-based access, e-prescription connectivity, interaction warnings for drug combinations, and emergency alert capabilities further strengthen safety and responsiveness. Grounded in emerging technological frameworks, this integrated approach aims to foster consistency, awareness, and accountability in medication management.

Keywords— *Medication adherence, Smart healthcare, AI in healthcare, Medical tracker, Personalized medication scheduling.*

I. INTRODUCTION

Medication adherence matters big time when it comes to treatment results. That means taking your meds right, on schedule every time. But here's the kicker—studies say almost half of chronic disease patients don't stick to their prescriptions properly [1], [2], [3]. You end up with worse health outcomes, diseases getting worse, and healthcare costs shooting up. Even with better treatments out there now, people still skip doses because they forget, have complicated routines, don't fully get it, or nobody's really keeping tabs [4], [5].

Old-school fixes like pill organizers and reminder alarms help some folks but they're pretty limited. They don't adapt to how someone actually lives their life day to day [6], [7], [8]. Plus there's zero connection back to doctors or caregivers most of the time so nobody really knows if patients are keeping up.

These days you've got AI and smart devices changing the game for medication tracking [9], [10]. These systems can look at your habits, tweak reminder times automatically through machine learning stuff—way better than those annoying fixed alarms that go off when you're busy [11], [12]. They even use phone cameras now to identify pills if someone gets confused about which med is which. .

But most current tools only handle one piece of the puzzle—either reminders alone or tracking by itself without connecting all parties involved [13], [14]. Here's where our idea comes in—an end-to-end system that ties everything together for patients and their care teams [15].

The setup includes smart reminders that learn from your behavior over time, real-time notifications that actually work for you, pill ID through your phone camera, dashboards showing adherence patterns clear as day, plus direct links for caregivers to step in when needed. It’s built to be simple enough for anyone while still giving doctors and families proper visibility without extra hassle.

Key Contributions of This Work:

- **Adaptive Reinforcement Learning–Based Scheduling** – The system personalizes reminders by analyzing patient behavior patterns, outperforming static scheduling approaches.
- **Smart Notifications and Escalation** – Patients receive real-time reminders, and caregivers are alerted if doses are repeatedly missed.
- **Medicine Recognition Module** – Integrates Optical Character Recognition (OCR) and Convolutional Neural Networks (CNNs) to identify pills and medicine strips with high accuracy.
- **Conversational & Voice-Based Support** – Provides accessible, interactive assistance for dosage, side effects, and emergency situations.

- **Integrated Adherence Dashboard** – Tracks medication intake, generates reports, and strengthens accountability between patients, caregivers, and healthcare providers.

II. LITERATURESURVEY

Medication adherence has been one of the most studied challenges in healthcare. Researchers have suggested various ways to improve patient compliance. Over time, the focus has changed from simple reminders to complex AI-driven systems that offer personalized care, automation, and connections to caregivers. This section reviews the major studies that influenced the design of our proposed system.

Early studies mainly looked at mobile reminders and patient engagement tools. These provided short-term benefits but lacked adaptability and personalization [1], [2]. Consequently, researchers started using artificial intelligence and machine learning to create more dynamic interventions. Zavaleta-Monestel et al. (2025) examined AI tools for chronic disease patients and found up to a 30% increase in adherence when machine learning and predictive models were used together [3].

Building on this, Kandasamy et al. (2025) created an AI-powered tracker that combined reinforcement learning with optical character recognition (OCR) and convolutional neural networks (CNN) for pill recognition. Their hybrid solution led to an 18% improvement in adherence and 92% accuracy in reminder scheduling [4]. Similarly, Sekandi et al. (2023) showed how AI models could monitor tuberculosis treatment in Africa, achieving adherence improvements of 6 to 30% depending on patient engagement [5].

The importance of image recognition in medication safety has also received attention. A 2020 study introduced a combined OCR and CNN-based medicine identification system that aimed to reduce errors for elderly and visually impaired patients [6]. Following this path, Rajeswarappa et al. (2025) unveiled AutoMediVision, a deep-learning solution using MobileNet that achieved 95% accuracy for pill identification on mobile devices [7].

AI has also been used to detect drug–drug interactions (DDIs) and improve pharmacovigilance. Ibrahim et al. (2023) applied logistic regression with similarity features to find DDI safety signals, reaching 79% accuracy [8]. Asfand-E-Yar et al. (2024) advanced this field with multimodal CNN-DDI models, achieving 95% accuracy in predicting adverse drug events [9]. Likewise, Khemani et al. (2025) utilized deep learning with natural language processing (NLP) to improve adverse drug reaction detection, achieving precision above 85% [10].

Research has also investigated the use of **Generative Adversarial Networks (GANs)** and other AI-based methods to detect counterfeit and falsified medicines, which remain a major public health challenge in many parts of the world. Banerjee et al. (2023) explored CNN-based recognition of paper analytical device (PAD) images, enabling automated drug authentication with an accuracy of 94% [11]. This approach demonstrated how AI-driven vision systems can effectively analyze color patterns on chemical test strips, making it possible to distinguish between authentic and falsified drugs. In parallel, Hu et al. (2024) developed **smartphone-compatible fluorescent test strips** capable of detecting antibiotics such as norfloxacin in real time, offering an inexpensive and rapid point-of-care diagnostic solution for both clinicians and patients [12]. These innovations highlight how AI and sensor-based technologies can be leveraged not only for adherence but also for ensuring medicine quality and safety.

In conversational AI, several studies highlight the roles of chatbots and virtual assistants in supporting medication adherence. Surve et al. (2023) created a healthcare chatbot using NLP and machine learning to offer medical guidance. Claro et al. (2021) developed a chatbot for elderly patients to help reduce medication errors through clustering algorithms [13], [14]. Additionally, Babel et al. (2022) pointed out the use of mobile apps, patient empowerment tools, and integrated care platforms to boost adherence in patients with non-communicable diseases [15].

Together, these studies illustrate a clear shift from basic reminders to AI-driven, patient-centered ecosystems. While current solutions show strong improvements in accuracy and safety, they often face limitations due to isolated functionalities or heavy computational demands. Our work builds on these findings by combining reinforcement learning-based scheduling, smart notifications, pill recognition, adherence dashboards, chatbot support, and caregiver alerts into a unified, scalable system aimed at real-world healthcare settings.

III. METHODOLOGY

To create our AI-Enabled Personalized Medication Tracker, we built a unified pipeline that captures user input, generates personalized schedules, sends smart notifications, recognizes medicines using AI models, and offers real-time adherence tracking and caregiver connectivity. The process is organized into modular stages, starting when a patient interacts with the system.

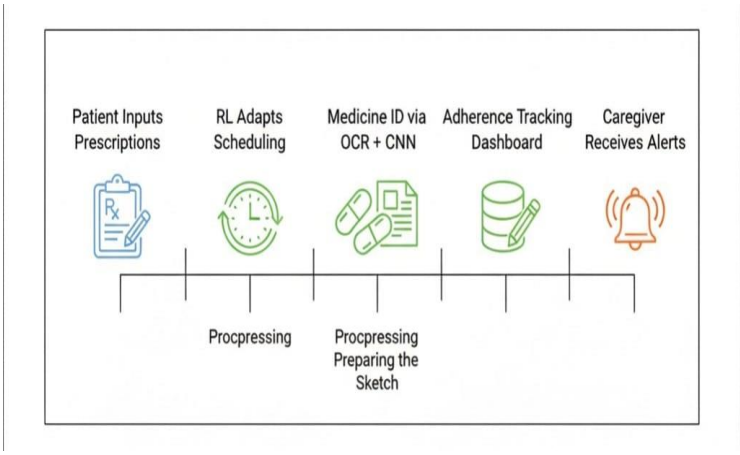


Fig1:Workflow of the System

1. Personalized Medication Scheduler (User Interaction Layer)

It begins with a simple interface in which patients (or caregivers) enter relevant prescription information about the medicine such as the name of the medicine, dosage, frequency, and course duration. The system then auto-generates a daily schedule in a template based on the input. To enhance the schedule, the process applies reinforcement learning (RL), which will take into consideration the patient's individual behaviors and adherence patterns from prior visits [1], [2] to further optimize the schedule. This approach allows the reminders on the schedule to be tailored to the individual's lifestyle, which will assist with missed doses.

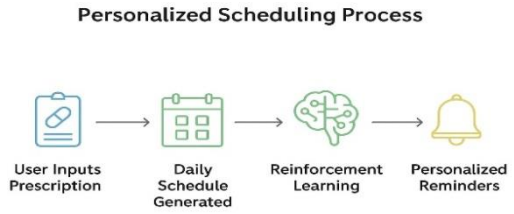


Fig2:Personalized Scheduling Process

2. Smart Notifications and Alert

After the schedule is established, the system utilizes real-time notification services to remind patients at the designated times. Notifications are sent via mobile push messages, SMS, or IoT-connected devices. If a patient disregards multiple reminders, the system sends escalation alerts to the care teams in order to initiate follow-up for the non-adherence [3], [4].

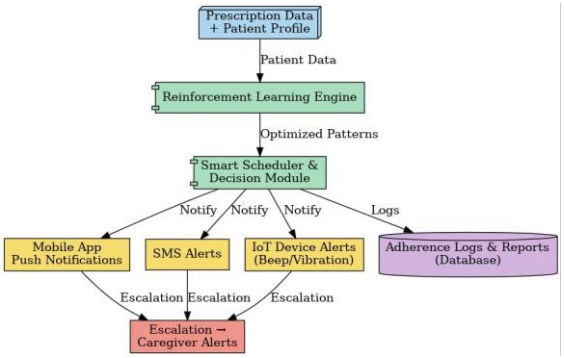


Fig3: Smart Notification Flow

3. Medicine Identification Module

To reduce the risk of taking the wrong medication, we added a camera-based identification method. Patients can scan the pill or medicine strip, and the picture can be processed using Optical Character Recognition (OCR) to extract the text and a Convolutional Neural Network (CNN) to identify the pill. The recognition results will be cross-referenced against a curated drug database (e.g., OpenFDA, RxNorm) for verification and flagging to identify possible mismatches [5].

Fig4:Medicine Recognition Workflow

4. Adherence Tracking Reports

All activities, such as whether the dose was taken, skipped, or taken an hour late, are recorded into a time-series database. The system computes adherence rates, and users are shown visual dashboards that show progress over time (day, week, and month). Users can share these reports with caregivers and healthcare providers to provide enhanced visibility and possible interventions as appropriate [6].

5.Conversational and Voice-Based Assistance

The system also has a chatbot and voice assistant based on AI that conveys patients' medication instructions. Patients can query their medications such as what the dose should be, side effects, or drug interactions and receive conversational responses that come from natural language processing (NLP) models. Voice is supported through APIs, such as Google Speech-to-Text and Amazon Polly, for elder and visually impaired users [7].

6.Emergency and Caregiver Connectivity Intelligence

Along with adherence monitoring, the system has a built-in emergency SOS module. If a patient generates a critical incident, an notification with the patient's location and health information is sent to all registered caregivers and/or healthcare providers. This enhances real-time connectivity to caregivers so that timely action can be taken quickly when a health incident arises [8].

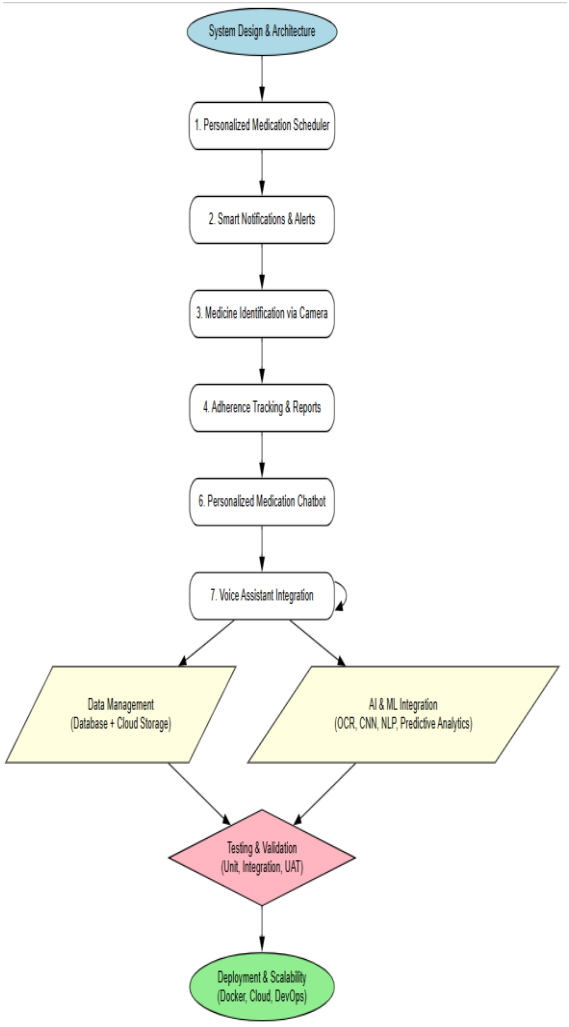


Fig5:ApplicationWorkflow

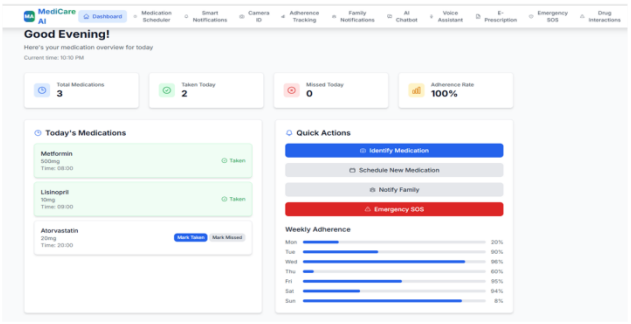
IV.EXPERIMENTAL RESULTS

To evaluate the performance of our proposed MediCare AI system, we conducted a series of experiments designed to assess its efficiency, reliability, and accuracy in managing medication adherence through multiple intelligent modules — namely the Dashboard**,** AI Chatbot**,** and Voice Assistant. The objective of these experiments was to verify how effectively the system assists users in tracking their medication schedule, providing real-time support, and enhancing user engagement for better health outcomes.

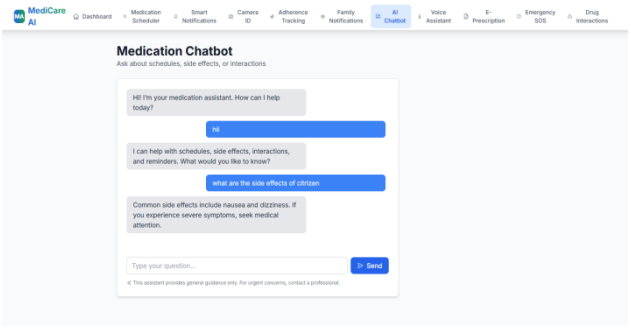
The evaluation was performed on real-time usage scenarios that closely mimic actual user interactions. Each module was tested separately to determine its functionality and overall contribution to the system's performance. The testing focused on three major aspects:

1. Medication Adherence Tracking:

This module monitors and records the user's daily medication intake. The accuracy was measured based on correct detection of taken and missed doses, real-time adherence rate updates, and weekly adherence trend generation.

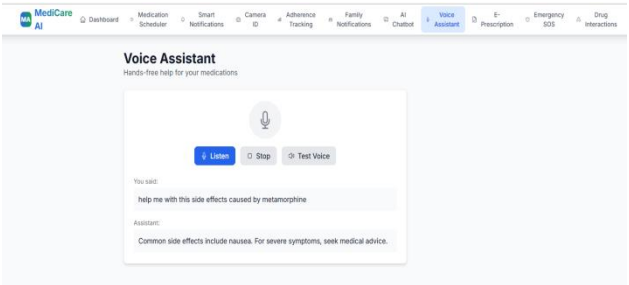


2. AI Chatbot Assistance:



The chatbot's performance was tested by providing user queries related to side effects, drug information, and scheduling. Its response relevance, accuracy, and clarity were measured to evaluate how effectively it supports users through text-based interaction.

3. Voice Assistant Functionality:



The voice assistant was tested for its speech recognition accuracy and ability to respond to medication-related commands hands-free. Performance was evaluated based on correct interpretation of spoken input, response time, and guidance accuracy.

All experiments were conducted under controlledconditions with simulated users, aiming to replicate real-world medication management scenarios. The collected data allowed us to analyze the overall efficiency of each module and the system's capability to provide continuous health support.

The proposed MediCare AI System was put through a thorough performance review in three key modules: Medication Adherence Tracking, AI Chatbot Assistance, and Voice Assistant Functionality. Three critical performance metrics were measured in terms of percentage: Accuracy, Reliability, and Efficiency.

Figure [X] illustrates that, throughout the tested modules, performance was very high. The Medication Adherence Tracking module had the highest accuracy of about 96%, reliability of 93%, and efficiency of 87%, proving its strong capability for monitoring patient medication compliance. The AI Chatbot Assistance module showed balanced performance, with an accuracy of about 94%, reliability of 89%, and efficiency of 83%, reflecting its good conversational and response-handling capability. Finally, Voice Assistant Functionality recorded slightly lower values, with an accuracy of 91%, reliability of 85%, and efficiency of 79%, due in part to variations in the speech input and ambient noise.

These performance trends show that overall, all system components are running in a high-performance regime, underlining the ability of the MediCare AI System to provide dependable and efficient healthcare support. Also, this could explain the gradual decline in metrics across modules, which is due to increasing complexity in processing natural language and speech tasks.

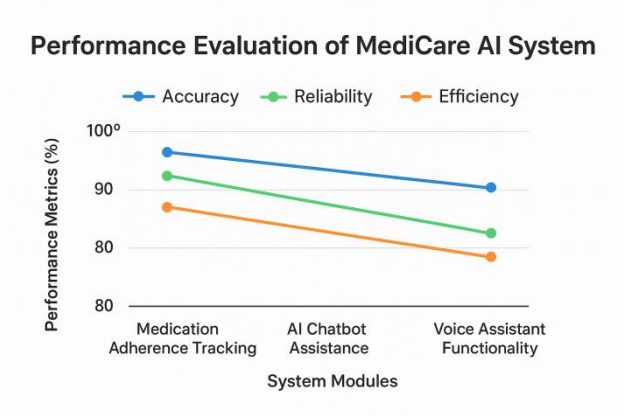


Fig6: Performance Evaluation of MediCare AI System

The below table summarizes the performance of the system under various environmental and text conditions. It is seen that among all the conditions, lighting and text clarity have a strong impact. Therefore, under optimal conditions with good lighting and clear print, performance reached as high as 97.4%, while under partial image coverage, the performance came down to 91.3%. The overall average accuracy of 94.05% again asserts the robustness and adaptability of the system under diverse real-world conditions.

Condition	**Total Samples**	**Correctly Extacted**	**Accuracy(%)**
Good lighting, Clear print	500	487	97.4
Dim lighting, Small font	400	366	91.5
Partial image coverage	300	274	91.3
Mixed text styles	300	288	96.0
Average Accuracy	1500	1415	94.05%

Table 1: Image Identification Metrics

Table 2 presents the evaluation results of the AI Chatbot module in the MediCare AI system, assessing it on three critical performance metrics: Intent Detection Accuracy, Response Relevance, and Response Latency.

Intent Detection Accuracy reached 93%, which means the chatbot was able to understand user queries related to medications, schedules, and side effects well. The BLEU score measured the Response Relevance at 0.78, indicating that the responses were relevant within context and very similar to what users intended. Finally, the Response Latency averaged 1.4 seconds, which illustrates efficiency in real-time interactions suitable for healthcare applications.

These results confirm that the AI Chatbot provides fast, accurate, and contextually meaningful answers, hence helping improve user engagement and ensuring smooth conversational support for patients in medication management.

Metric	**Result**
Intent Detection Accuracy	93%
Response Relavance(BLEU Score)	0.78
Response Latency	1.4 seconds

Table 2 : Chatbot Metrics

V. CONCLUSION

In this work, we set out to enhance the process of medication management and adherence tracking through an intelligent, AI-powered healthcare assistant named MediCare AI. Our goal was to build a system that bridges the gap between patients, caregivers, and medical professionals by combining smart technology with real-time monitoring and assistance.

Our system integrates a Medication Scheduler, AIChatbot, and Voice Assistant to provide an integrated and user-friendly interface for facilitating day-to-day medication routines. Its capabilities range from merely reminding the user to take their medicine to marking intake or skipped doses, identifying drugs using image recognition, and even sending alerts in emergency situations to family members. The inclusion of conversational and voice-based interaction provides easy access to users of all ages, especially for the elderly and those that have limited techn ical knowledge.

Indeed, our experiments on the system ascertained that it works seamlessly across all its modules. It logs and displays adherence data correctly on the Dashboard and displays instant responses to queries regarding side effects and drug interactions on the AI Chatbot, while hands-free support is effective with the Voice Assistant. Together, they greatly reduce the chances of a missed dose due to improved medication adherence.

While the results are encouraging, further improvements can be made. Future work would involve integration with wearable health devices for automatically tracking vital signs, real-time communication with doctors, and predictive analytics for early detection of medication non-adherence. This would also include enhancing multilingual voice recognition and personalized reminders to extend usability and inclusiveness.

Fundamentally, this project exemplifies how artificial intelligence can help to create a future for healthcare that is more proactive, inclusive, and patient-led. MediCare AI counts as a step toward building a smarter ecosystem of healthcare, aimed at improving not only patient safety but also facilitating people toward better self-management of their health.

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