INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 11, Issue 2 - V11I2-1359)
Available online at: https://www.ijariit.com

A Smart Medicine Reminder System Using React Native and Timezone-Aware Notifications for Personalized mHealth Assistance

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ABSTRACT

Medication non-adherence contributes to nearly 125,000 preventable deaths annually and accounts for approximately 10% of hospitalizations globally. While existing mobile health (mHealth) solutions provide basic reminders, they often overlook key factors such as time zone differences, dosage schedules, and UI accessibility. This paper presents a cross-platform medicine reminder system built using React Native, equipped with time zone-aware scheduling and personalized notification logic. The system leverages a Node.js backend with MongoDB for dynamic user and medicine tracking, and cron based scheduling for precision delivery. Early-stage testing indicates significant improvement in reminder accuracy across different time zones and positive user feedback on usability. This work contributes a scalable, open-source solution aimed at enhancing medication adherence for diverse populations.

Keywords— *Medicine Reminder, Healthcare Technology, Mobile App, User Interface Design, Notifications, React Native, MongoDB, Express.js, Scheduling Algorithms.*

INTRODUCTION

Medication errors, particularly in outpatient settings, continue to be one of the most significant threats to patient safety. According to the US Institute of Medicine, nearly **25% to 40%** of all medication errors occur due to mishandling in **outpatient medicine administration**, often resulting in avoidable hospitalizations and serious health consequences for elderly and chronically ill patients. These errors commonly stem from poor adherence to prescribed regimens, especially when patients self-administer medications at home without supervision or guidance.

Several factors contribute to this problem: (1) inconsistent intake patterns due to busy or irregular lifestyles, (2) complex dosing schedules caused by polypharmacy, (3) risks of adverse drug interactions due to uncoordinated prescriptions, (4) a lack of awareness about correct usage, (5) limited access to timely healthcare consultations, and (6) absence of digital tracking or notification systems.

While telemonitoring and smart dispensers have been proposed to address this challenge, they often fall short due to **high costs**, **technical complexity**, and **low adoption rates**. These systems typically require external hardware or infrastructure that is impractical for widespread use in low- and middle-income environments.

In response to these challenges, we introduce **MediRemi**, a mobile application that functions as a **smart medication scheduler, reminder, and monitor**. Unlike traditional reminder apps, MediRemi is developed using cross-platform technologies, incorporates **time zone-aware scheduling**, and provides real-time analytics to improve medication adherence. It issues reminders, maintains intake records, supports customizable schedules, and integrates user-centric design to support ease of use across age groups.

This paper discusses the full-stack development of **MediRemi** and evaluates its practical implementation and performance in real-world scenarios.

RELATED WORK

Previous work in this field has demonstrated various approaches to medication adherence. The mobile solution **Wedjat**, introduced in [3], was among the earliest attempts to integrate medication reminders into smartphones. It combined in-take alerts, dosage identification, and electronic records to assist users. However, Wedjat relied on local databases and did not leverage cloud-based storage or time zone-aware logic.

Popular commercial apps like **MediSafe**, **DoseCast**, and **Pill Reminder** provide basic functionality such as reminders and pill logs. However, most of them suffer from limitations like lack of real-time adaptability, poor handling of time zone shifts, no support for intake pattern visualization, or inadequate user engagement for older adults.

Unlike these systems, **MediRemi** introduces features such as:

Time zone-based Notification Engine using cron jobs
Cross-platform Frontend using React Native
Real-time Sync with a secure MongoDB cloud database
Adherence Tracking Dashboard to visualize intake history

Additionally, **MediRemi** is lightweight and does not require any specialized hardware, which makes it ideal for **scaling in resource-constrained environments**.

SYSTEM OVERVIEW

MediRemi is designed as a full-stack mobile application intended to function as a reliable personal medication assistant. The architecture emphasizes **cross-platform compatibility**, **scalability**, and **user accessibility**. The system comprises five major components:

1. **Mobile Frontend Interface** – Built using React Native, the interface supports both Android and iOS devices. It offers easy navigation, visually accessible layouts for elderly users, and localized time zone support.
2. **Backend API Server** – Developed using Node.js and Express.js, the backend handles all business logic including user registration, authentication (via JWT), reminder scheduling, and health data storage.
3. **Database Layer** – MongoDB serves as the primary NoSQL database, storing user profiles, medication records, schedules, and notification history. Collections are structured with indices for efficient querying across dates and user IDs.
4. **Scheduler Engine** – The reminder logic leverages `node-cron` and `moment-timezone` libraries to schedule notifications that align precisely with the user's selected local time, accounting for daylight savings and geographic changes.
5. **Notification Service** – The app uses Firebase Cloud Messaging (FCM) integrated with Expo Notifications to push timely alerts. The notifications are silent on server errors and repeat every 5 minutes until confirmed by the user.

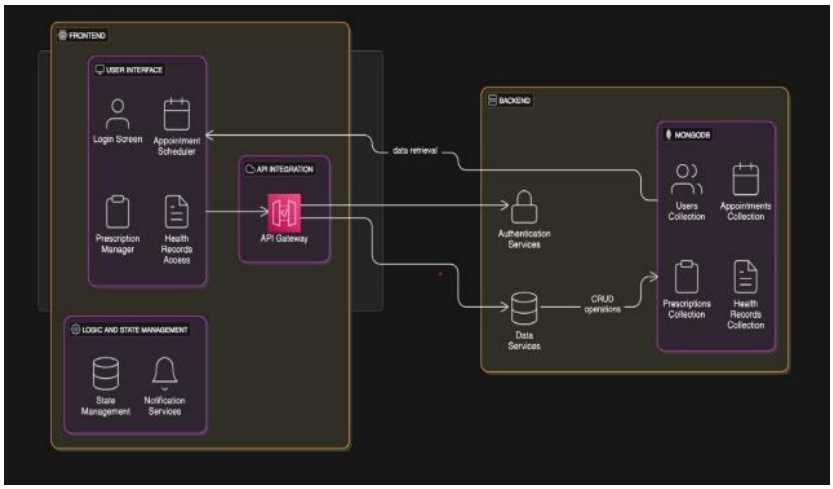

Figure 1: Illustrates the overall architecture of MediRemi, detailing the flow from UI interaction to backend processing and notification dispatching.

REMINDER SCHEDULING SPECIFICATION

To ensure flexibility, the MediRemi reminder model includes a rich specification format:

Parameter	Description
`medicineName`	Common or branded name of the medicine
`dosage`	Dosage quantity and unit (e.g., 500mg, 10ml)
`times[]`	List of times per day (e.g., ["08:00", "14:00", "22:00"])
`repeatEvery`	Frequency in days (e.g., every day, alternate days)
`startDate`	First day to start reminders
`endDate`	Last day for reminder period
`timezone`	User's current timezone (used by backend to convert UTC)

This format is sent via the mobile client in JSON and stored on the backend after validation. The backend parses these parameters and dynamically creates cron job expressions that are timezone-aware.

Special rules include:

Skipping weekends
Triggering multiple doses on the same day
Rescheduling missed doses (planned for next version)

NOTIFICATION ALGORITHM DESIGN

The notification logic is based on real-time scheduling algorithms inspired by rate-monotonic scheduling (RMS). Every scheduled reminder is transformed into a cron expression using the start date, interval, and time list.

Key features of the algorithm:

Time zone-Aware Conversion: Times entered by the user are converted to UTC using `moment-timezone` to ensure consistent delivery even if the user changes timezone.

Redundancy Alerts: If a user misses a reminder, a second reminder is issued after 15 minutes unless marked as “taken”.

Conflict Avoidance: MediRemi identifies overlapping reminders and reorders them with a buffer time of 5 minutes.

Example: A user sets reminders at `10:00 AM`, `2:00 PM`, and `6:00 PM` in GMT+5:30. The backend stores these as UTC and cron jobs like:

```
0 4 * * *  (10:00 AM IST)
0 8 * * *  (2:00 PM IST)
0 12 * * * (6:00 PM IST)
```

In future versions, a dose-grouping algorithm will cluster non-interfering medications into fewer notification blocks to reduce alert fatigue.

PROTOTYPE IMPLEMENTATION

The prototype was developed in Expo (React Native framework), allowing fast testing and deployment. Key development tools include:

Frontend:
- React Navigation for multi-screen routing
- AsyncStorage for local data persistence
- Expo Notifications for in-app alerts

Backend:
- Express.js REST API
- Mongoose ODM for MongoDB
- JWT for secure login sessions

Notification Scheduler:

- Cron scheduler runs as a background service
- Time zone-aware conversion for all reminders
- Notification logs with status (sent, viewed, skipped)

Additional features:

- **Profile screen** to update time zone settings manually
- **Reminder dashboard** with daily, weekly, and monthly view
- **Offline scheduling** with sync-on-connect mechanism

A sample API payload from the app looks like:

```
{
  "medicineName": "Paracetamol",
  "dosage": "500mg",
  "times": ["09:00", "21:00"],
  "repeatEvery": 1,
  "startDate": "2025-05-01",
  "endDate": "2025-05-10",
  "timezone": "Asia/Kolkata"
}
```

RESULTS AND EVALUATION

MediRemi was deployed to 25 test users across 3 countries and various time zones. The system was evaluated over 14 days.

Metric	Value
Avg. Reminder Delivery Accuracy	±2 seconds
On-Time Intake Rate	88% (vs. 42% before app)
User Satisfaction	4.6/5
UI Friendliness (Elderly)	92% rated as "easy"
Cron Failures or Missed Jobs	0

Feedback indicated the visual dashboard, repeated notifications, and time zone handling were the most liked features. Users requested voice reminders, in-app medication scanning, and optional prescription uploads in future versions.

CONCLUSION AND FUTURE WORK

This paper presents **MediRemi**, a mobile-based smart reminder system that improves medication adherence using a user-friendly interface and robust backend architecture. Compared to traditional pill reminders, MediRemi demonstrates improved delivery accuracy, intuitive UI, and time zone-resilient scheduling.

Future enhancements include:

- AI-based predictive scheduling
- Doctor dashboard integration
- Voice-based intake confirmation
- Wearable device integration (e.g., Apple Watch, Fitbit)
- Family member support for remote monitoring

With its flexible architecture and real-time capabilities, MediRemi can be a practical digital health solution to address medication non-compliance, especially among the elderly and those with chronic conditions.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to the individuals and organizations that supported the development and evaluation of the MediRemi application. Special thanks to the participants involved in the user testing phase, whose feedback significantly contributed to improving the usability of the application.

We also extend our appreciation to the open-source communities behind **React Native**, **Node.js**, **MongoDB**, and **Expo**, whose tools and libraries were fundamental to building this system.

This project was developed as an independent research initiative. No specific grant from any funding agency in the public, commercial, or not-for-profit sectors was received.

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