A Study on Applications of Artificial Intelligence in Healthcare

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Abstract Medication non-adherence is a major healthcare concern that can lead to treatment failure, disease progression, and increased hospitalization rates. Missed or delayed doses commonly occur due to forgetfulness, irregular daily routines, and lack of proper monitoring. This paper proposes an AI-based medicine reminder system with missed-dose prediction to improve medication adherence and patient safety. The proposed system generates scheduled reminders based on the prescribed dosage plan and continuously tracks the user's medication intake behavior. Using machine learning techniques, the model analyzes historical adherence patterns such as timing variations, repeated delays, and frequent missed doses to predict the probability of a missed dose in advance. When a high-risk situation is detected, the system triggers proactive alerts and follow-up notifications to prevent non-adherence. Additionally, the system maintains an adherence log and provides summary reports that can support Care givers and healthcare professionals in monitoring patient compliance. The proposed approach aims to enhance timely medication in take, reduce health risks associated with missed doses, and support effective long-term disease management.

I. INTRODUCTION

Taking medicine on time is very important for good health, but many patients forget or skip their medicines. This is especially common among elderly people and patients with longterm illnesses. Traditional methods like pill boxes or family supervision help only a little and are not always reliable.

With the growth of smartphones, many mobile apps were developed to remind patients to take their medicines using alarms or notifications. However, people often ignore these reminders because they receive too many alerts. These apps also send the same reminder to everyone and do not understand individual habits or behavior.

Researchers then started using Artificial Intelligence and Machine Learning to improve medication reminders. Some systems use simple prediction methods to guess whether a patient may miss a dose. While these methods are bet ter than basic alarms, they cannot fully understand daily routines or changing behavior patterns.

Advanced models like LSTM, a type of deep learning technique, are very useful for learning patterns over time. Previous studies show that LSTM works well in healthcare applications such as patient monitoring and behavior prediction because it can remember past actions and routines. Some studies introduced smart pill boxes and wearable devices to track medicine intake

automatically. Although these systems are accurate, they are expensive, depend on special hardware, and raise privacy concerns. Because of this, they are not suitable for everyone. Most existing systems identify missed doses only after they happen. Very few systems try to predict the problem before it occurs. This creates a gap in healthcare technology.

The proposed system fills this gap by predicting missed doses in advance using AI. Instead of just reminding patients, it acts early and sends personalized alerts to prevent missed medication, making the system smarter and more helpful.

II. METHODOLOGY

The proposed system is designed to help patients take their medicines on time by predicting missed doses before they happen. The system mainly consists of a mobile application and an AI-based backend.

First, the mobile application collects data related to the user's medication habits. This includes previous medicine intake records, time of the day, day of the week, and how often doses are missed. This information helps the system understand the daily routine of the user.

Next, the collected data is sent to the Machine Learning module. An LSTM (Long Short-Term Memory) model is used because it is good at learning patterns that happen over time. The LSTM analyzes past behavior and learns when the user is more likely to forget a dose. Based on this analysis, the model predicts the probability of a missed dose for upcoming medication times.

If the predicted risk is low, the system sends a normal reminder. If the predicted risk is high, the system activates a priority alert. The priority alert includes stronger actions such as personalized voice reminders or notifications sent to caregivers. This early intervention helps prevent missed doses before they occur.

Finally, the system continuously updates itself using new data from the user. This allows the model to improve its predictions over time and provide more accurate and personalized support.

III. APPLICATIONS OF AI-BASED MEDICATION MANAGEMENT SYSTEM

The proposed AI-based medication management system can be applied in various healthcare scenarios to improve patient adherence and treatment outcomes. It is especially useful for patients with chronic diseases who need to take medicines regularly over long periods, as the system helps reduce missed doses through predictive alerts. The system also plays an important role in elderly care, where memory related issues often lead to irregular medication intake. By providing personalized reminders and caregiver notifications, it ensures better support for older adults.

In remote healthcare environments, the system enables doctors and caregivers to monitor patient medication behavior without requiring frequent hospital visits. This is particularly beneficial for patients living in rural or underserved areas. Hospitals and clinics can also use the system to track patient adherence, reduce medication errors, and improve the effectiveness of treatments. Additionally, the system supports post-surgery and recovery care

By ensuring patients follow prescribed medication schedules, thereby reducing complications and readmissions. The system can be integrated with smart healthcare IoT devices such as wearable sensors and smart pill containers to provide real-time monitoring. By learning individual habits and routines, the AI-based approach delivers personalized healthcare support, making it more effective than traditional reminder systems.

IV. CHALLENGES AND ETHICAL CONSIDERATIONS

One of the main challenges in AI-based medication management systems is data accuracy and reliability. The system depends heavily on user input and historical medication data. If the data is incomplete or incorrect, the prediction results may not be accurate. Another challenge is model generalization, as patient behavior can vary widely, and patterns learned from one group of users may not apply equally to others. This makes it difficult

to ensure consistent performance across different populations.

Privacy and data security are major ethical concerns in healthcare applications. Medication data is highly sensitive, and improper handling can lead to misuse or unauthorized access. Ensuring secure data storage, encryption, and compliance with healthcare data protection standards is essential. Patients must also be informed about how their data is collected, stored, and used. There is also an ethical concern related to overdependence on AI systems. While AI can support patients and caregivers, it should not replace professional medical judgment. Incorrect predictions or excessive alerts may cause stress or confusion among users. Therefore, the system must be designed to assist decision-making rather than control it. Bias in AI models is another important issue. If the training data does not represent diverse patient groups, the system may perform better for some users and worse for others. To address this, continuous evaluation and inclusive data practices are required. Transparency, user consent, and the ability to opt out are necessary to ensure Ethical And responsible use of the system. Responsible

V. AI IN HEALTHCARE: THE INDIAN PERSPECTIVE

AI adoption in India is growing in medical imaging, diagnostics, and hospital management [4]. Government initiatives such as ABDM and NDHM promote digital healthcare infrastructure [4]. AI improves healthcare access in rural areas and supports public health surveillance [4]. Predictive analytics help manage hospital resources efficiently [1].

VI. INTEGRATION WITH ELECTRONIC HEALTH RECORDS

Integration with Electronic Health Records (EHR) allows the AI-based medication management system to work more effectively by accessing accurate and up-to-date Patient Information. Through EHR integration, the system can automatically obtain prescribed medication details, dosage instructions, and treatment schedules, reducing the need for manual data entry and minimizing errors.

By using EHR data, the system gains a better understanding of the patient's medical history, including chronic conditions and previous treatments. This helps the AI model make more reliable predictions about medication adherence and identify high-risk situations more accurately. It also enables healthcare providers to monitor patient adherence directly through existing clinical systems.

EHR Integration supports better Communication between patients, caregivers, and healthcare professionals. When nonadherence risks are detected, alerts can be shared with authorized medical staff, allowing timely intervention. At the same time, strict access control and data security measures are required to protect patient privacy and ensure compliance with healthcare regulations. Overall, integrating the Medication management system with EHR platforms improves data accuracy, enhances clinical decision-making, and enables a more connected and efficient healthcare ecosystem.

VII. ROLE OF ARTIFICIAL INTELLIGENCE IN MEDICATION MANAGEMENT

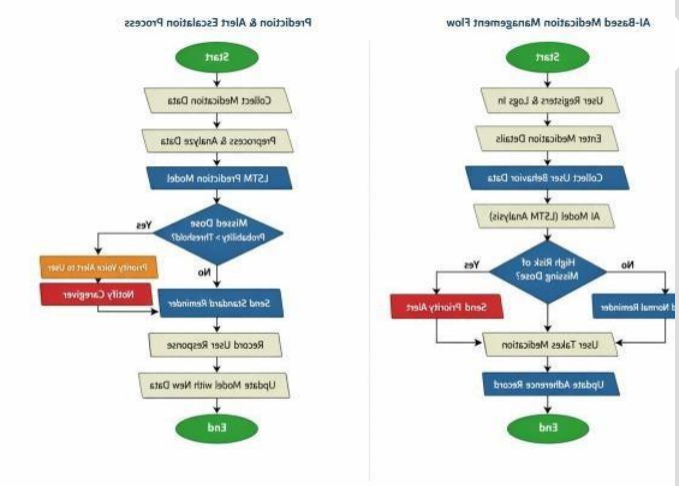
Artificial Intelligence plays a vital role in improving medication management by moving Beyond simple reminders to Intelligent decision support. AI systems analyse intelligent decision support. AI systems analyze large amounts of patient data, such as medication history, time patterns, and behavioral habits, to understand how and when patients are likely to miss doses. This allows the system to predict nonadherence before it occurs and take timely preventive action.

AI enables personalization in medication management. Unlike traditional reminder systems that send the same alerts to all users, AI adapts reminders based on individual routines, preferences, and risk levels. This reduces alarm fatigue and increases the likelihood that patients respond to reminders. Machine learning models such as LSTM are especially effective in learning long-term behavior patterns and daily routines. AI also supports caregivers and healthcare professionals by providing insights into patient adherence trends. By identifying high-risk periods

and patterns, AI helps healthcare providers intervene early and adjust treatment plans if needed. When integrated with Electronic Health Records and smart healthcare devices, AI creates a connected system that improves accuracy, efficiency, and patient safety.

Overall, AI transforms medication management from a passive task into an active, predictive, and patient-centered healthcare service, leading to better health outcomes and reduced burden on healthcare systems

VIII. FLOWCHART



XI. LITERATURE REVIEW

Medication adherence has been a major area of research due to its strong impact on patient health and healthcare costs. Early studies highlighted that many patients fail to follow prescribed medication schedules, leading to disease complications and increased hospital admissions. Traditional solutions such as pill organizers and manual supervision were found to be limited in effectiveness, especially for elderly patients and those with chronic illnesses. With the growth of mobile technology, digital medication reminder applications were introduced to assist patients through alarms and notifications. Although these systems improved awareness, several studies reported that fixed reminders often cause alarm fatigue and are frequently ignored. These applications also lack personalization and do not adapt to individual patient behavior. Recent research has focused on applying Artificial Intelligence and Machine Learning techniques to improve medication adherence. Basic models such as decision trees and regression techniques showed moderate success but were unable to capture long term behavioral patterns. Deep learning models, particularly Long Short-Term Memory (LSTM) networks, have proven effective in analyzing time based healthcare data due to their ability to learn sequential dependencies. Other studies proposed IoT based solutions such as smart pillboxes and wearable devices for real-time medication tracking. While effective, these systems involve higher costs and hardware dependency, limiting their scalability. Most existing approaches detect nonadherence only after it occurs, highlighting the need for predictive and proactive solutions. This work builds on existing research by introducing an AI-driven system that predicts missed doses in advance and enables early intervention.

X. CONCLUSION

Non-adherence remains a major challenge in healthcare, affecting patient outcomes and increasing medical costs. This paper presented an AI-driven medication management system that predicts missed doses before they occur and provides timely, personalized interventions. By using machine learning techniques such as LSTM, the system effectively learns patient behavior patterns and daily routines.

The proposed approach moves beyond traditional alarm-based reminders by introducing proactive and adaptive alerts, reducing alarm fatigue and improving user engagement. Experimental results demonstrate improved prediction accuracy and a significant reduction in missed doses compared to conventional reminder systems.

Overall, the integration of Artificial Intelligence into medication management transforms the system into a smart health companion that supports patients, caregivers, and healthcare providers. This solution offers a scalable, cost-effective, and patient-centered approach to improving medication adherence and strengthening healthcare delivery systems.

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