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A Review on Smart Medication Reminder Systems and Automated Drug Dispensing Technologies

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ABSTRACT: The smart medicine box assists users in managing their medication schedule by providing timely reminders and automatically dispensing the correct pills. It helps prevent missed doses and minimizes errors, especially for elderly individuals. The system tracks adherence to the prescribed schedule and alerts caregivers if needed. Additionally, it automates medication refills by notifying a medical shop when stock is low. This solution enhances medication management, increases user independence, and improves healthcare efficiency.

KEYWORDS: Smart medicine Dispenser; Automated Medication Remainder System; Personal health Assistant, Confusion avoidance while taking medicines.

I. INTRODUCTION

In daily life, many people struggle to remember when to take their medications, especially when managing multiple prescriptions. Often, medicine packaging lacks clear instructions on timing, or patients may find it difficult to read labels, particularly if they are not in their native language. As a result, some individuals miss doses, leading to ineffective treatment or even expired medicines. This issue is especially significant for patients with chronic illnesses who require consistent medication intake to maintain their health.

To address this problem, our project introduces a Smart Medicine Reminder and Medical Dispensing Mechanism that helps patients take their medication on time. The system is designed to alert users with an alarm at preset times, ensuring they never miss a dose. Patients can initially set the medication schedule, and if needed, they can update it easily according to their requirements. This makes the system adaptable to different users, catering to their specific needs.

The project incorporates an LCD and keypad interface, making it user-friendly and accessible. These components allow patients to modify the medication schedule and track their intake. After taking a dose, the user must input the number of pills removed from the storage, ensuring accurate tracking of remaining medication. This feature helps in maintaining proper adherence to the prescribed regimen while also preventing accidental overdoses or skipped doses.

Additionally, the system includes an automated pill reordering feature. When the stock of a particular medication reaches a critical level, the system automatically sends an order request to a designated medical shop using a GSM communication module. This ensures that users receive timely refills without the need for manual tracking, reducing the risk of running out of essential medicines. Overall, this project offers an efficient solution to medication management by providing timely reminders, allowing easy schedule adjustments, tracking pill consumption, and automating medicine reordering. By integrating these features, the system enhances patient convenience, improves medication adherence, and minimizes confusion, ultimately contributing to better healthcare outcomes.

II. LITERATURE SURVEY

Diaa Salama Abdul Minaam et al. [1] (2018) proposed a smart pill box system utilizing IoT to ensure patients take the correct medication at the prescribed time. Their system integrates an automatic reminder mechanism that alerts patients



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through mobile notifications. The study emphasizes the importance of medication adherence, particularly for elderly patients with chronic diseases. By incorporating real-time monitoring, the system ensures that missed doses are promptly reported to caregivers. The IoT-based approach allows for remote access and scheduling of medications. This research highlights how technology can bridge gaps in patient care and medication management.

Huai-Kuei Wu et al. [2] (2015) developed a smart pill box with reminder and consumption confirmation functions to enhance medication adherence. The system includes electronic tracking that monitors medication intake and alerts patients about missed doses. A key feature is the confirmation mechanism, ensuring that the user actually consumes the medication rather than just removing it from the dispenser. Their research highlights the need for a reliable and automated system to assist elderly patients and individuals with memory-related disorders. By integrating sensors and GSM technology, the system can notify caregivers in real time. This approach reduces the risk of overdosing or missing doses, improving patient safety.

Mohammed Asad Fasahate [3] (2018) introduced a smart medicine box using IoT, focusing on real-time alerts and notifications to caregivers. The system is designed to remind users of their medication schedules through visual and audio alerts. It features an automated pill dispenser that ensures the right dosage is provided at the correct time. A mobile application is integrated for remote monitoring, allowing caregivers to track patient adherence. This study emphasizes how IoT can enhance medication management and reduce dependency on manual supervision. The implementation of cloud-based storage ensures that historical medication data is accessible for future reference.

Yash Sharma [4] (2017) designed a smart medicine reminder box that employs alarms and LED indicators for notifications. The system is built to assist patients in taking their prescribed medications without missing doses. A buzzer and LED notification system provide clear reminders at scheduled times, ensuring accessibility for elderly users. The research highlights the limitations of traditional pillboxes, which lack automated scheduling and tracking. By integrating a real-time clock and microcontroller, the system enhances accuracy in medicine dispensing. The study demonstrates how simple yet effective automation can significantly improve patient adherence to medical prescriptions.

R. Surender Reddy et al. [5] (2017) developed an intelligent patient medicine reminder system that sends alerts via mobile applications and SMS. The system enables caregivers to remotely monitor medication intake and receive notifications if a dose is missed. It incorporates a database that logs medication schedules, ensuring that patients receive the correct dosage on time. The study highlights the importance of an automated reminder system for individuals with cognitive impairments. The GSM module integrated into the system allows seamless communication between patients and healthcare providers. This innovation reduces medication errors and enhances patient safety.

Pallavi Prakash Ghogare et al. [6] (2018) emphasized the role of IoT in automating pill dispensing to minimize human error. Their system integrates sensors to detect when a pill is taken, ensuring adherence monitoring. A smartphone application is used to alert both patients and caregivers about upcoming doses. The study highlights the challenges faced by elderly patients in remembering medication schedules. By automating the pill-dispensing process, the system improves accuracy and reduces the risk of overdose. The implementation of GSM and Bluetooth technologies enhances real-time communication and monitoring.

Deepti Ameta et al. [7] (2015) created an Android-based application for medication reminders, allowing users to track their medicine schedules efficiently. The system provides real-time alerts and notifications to ensure timely medication intake. A key feature of this system is its user-friendly interface, designed specifically for elderly patients. The study highlights how mobile applications can serve as an effective tool in healthcare management. By integrating cloud storage, the application allows easy access to historical medication data. The research demonstrates the potential of mobile technology in improving patient adherence to prescriptions.

D. Jeya Priya [8] (2017) designed an automated medical reminder system using an Arduino kit for a cost-effective solution. The system uses an RTC (Real-Time Clock) module to schedule medication alerts accurately. A buzzer and LCD screen provide visual and auditory reminders for patients. The research emphasizes the importance of affordability in healthcare technology, making this solution accessible to a wider audience. The system's integration with a



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microcontroller ensures precise timing and reliable performance. This study highlights how simple automation can enhance medication adherence without requiring complex installations.

International Journal of Research in Innovative Technology [9] (2018) presented an automatic medicine reminder using Arduino, integrating GSM for remote caregiver notifications. The system is designed to assist elderly patients and individuals with memory impairments in maintaining their medication schedules. It features a microcontroller-based mechanism that automatically dispenses pills at predetermined times. The GSM module sends SMS alerts to caregivers when a dose is missed, ensuring continuous monitoring. The study emphasizes the importance of real-time communication in improving medication adherence. By utilizing Arduino technology, the system provides a cost-effective and scalable solution for healthcare applications.

Kunal Jagdale [10] (2017) proposed a microcontroller-based medicine dispenser and reminder to ensure a user-friendly approach to medication scheduling. The system is programmed to dispense the correct dosage at precise intervals, reducing the chances of missed or incorrect doses. It integrates a notification system that alerts patients through audio and visual cues. A key focus of the study is improving accessibility for elderly users who may struggle with complex technology. The research highlights the significance of automation in reducing human error in medicine intake. By combining microcontroller-based control with a simple interface, the system ensures efficient and reliable medication management.

J. E. P. Reddy, Dr. A. Chavan [11] (2020) and Dr. A. Chavan developed an AI-IoT-based smart pill expert system to enhance medication adherence. Their system featured a user-friendly interface and an intelligent chat assistant to assist users in troubleshooting and managing their medication schedules. They addressed the critical issue of non-adherence, which often leads to severe health consequences, by enabling live tracking and analysis of a patient's medication history. The system ensures accurate dosage timing through automation, reducing the risk of overdose or missed doses. It incorporates alert mechanisms, including notifications and buzzer alarms, to remind users about their medications. The study also highlights the integration of microcontrollers for automating pill dispensing. Their approach aims to improve patient safety by eliminating human errors in dosage management. By leveraging IoT technology, they provided real-time monitoring of medication consumption. This system significantly reduces the chances of medication errors and enhances the efficiency of home healthcare solutions.

A. J. Al-Haider, S. M. Al-Sharshani, H. S. Al-Sheraim, N. Subramanian, S. Al-Máadeed, M. Z. Chaari [12] (2020) team focused on developing a smart medicine planner specifically designed for elderly and visually impaired individuals. Their study emphasized the importance of assistive technologies in healthcare, particularly for those who struggle with managing their medication schedules independently. The system was designed to help users maintain an organized medicine intake routine by sorting their daily medication cycle. It featured an automated notification system that provided alerts when it was time for medication, ensuring adherence to prescriptions. The researchers incorporated voice assistance and large-font displays to accommodate users with vision impairments. Additionally, their system aimed to prevent accidental overdoses by verifying medicine intake and sending alerts to caregivers. A key feature of their design was the real-time tracking of medication consumption, which allowed remote monitoring by family members or healthcare professionals. Their work demonstrated how IoT-enabled smart medicine dispensers could improve the quality of life for dependent individuals.

A. Rao, Pranathi B. S, Adapa Shivani, Rajasekar Mohan [13] (2020) and colleagues proposed a system that incorporated advanced buzzer notifications and LED light alerts to remind patients of their scheduled medication times. They recognized the growing issue of non-adherence to prescribed medications, particularly among the elderly. Their smart pill dispenser was equipped with a simple yet effective interface that required minimal user interaction. The device ensured that patients received their medication at the correct times and in the right dosages. By integrating IoT technology, the system allowed caregivers to remotely monitor medicine intake and receive real-time updates. The authors focused on enhancing medication adherence through automated reminders while also implementing security measures to prevent accidental ingestion of the wrong pills. The system was designed to be portable and easy to operate, making it accessible to a wide range of users. Their research contributed to the development of efficient, low-cost, and reliable smart medicine dispensers.



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O. Al-Mahmud, Md. Kausar Khan, R. Roy, F. M. Alamgir [14] (2020) and team developed an IoT-based smart medicine container that integrated multiple sensors for health monitoring. Their system aimed to assist both patients and caregivers in managing medication routines more effectively. A notable feature of their model was the inclusion of a temperature sensor, which helped track patient health along with medicine consumption. The system employed wireless communication, allowing caretakers and doctors to remotely supervise patients' medication adherence. The authors highlighted the importance of real-time alerts, which were sent via SMS or app notifications, ensuring that patients did not miss their doses. The smart container also featured an emergency alert function that notified caregivers in case of a medical emergency. Their study demonstrated how IoT applications in healthcare could enhance patient safety and medication management. The integration of automation reduced the chances of human errors, making their model a significant advancement in smart medicine dispensers.

T. Sangvanloy, K. Sookhanaphibarn [15] (2020) introduced an automated medicine dispenser based on an IoT-enabled pet food dispenser concept. Their research was inspired by the precision and scheduling efficiency of automated pet feeders, which dispense food at fixed intervals. Applying this idea to healthcare, they developed a smart pill dispenser that allowed users to pre-load medications, which were then dispensed at pre-set times. Their system included a mobile application that enabled users to customize their medication schedules and receive reminders. The dispenser was designed to be user-friendly, requiring minimal manual intervention. Additionally, the system could be controlled remotely, making it a valuable tool for caretakers and individuals with memory impairments. The study emphasized the potential of IoT technology in improving medication adherence through automation and remote monitoring.

M. V. Moise, P. M. Svasta, A. G. Mazăre [16] (2020) and his team designed a programmable IoT-based pill dispenser aimed at improving medication adherence. Their system allowed users to pre-set medication schedules, which were then automatically executed by the dispenser. The device was integrated with a GSM module that sent SMS alerts to patients and caregivers, ensuring that medication was taken at the right time. The authors emphasized the importance of real-time tracking and automated reminders in reducing missed doses. The system also featured an interactive display that provided information on upcoming dosages. Additionally, the dispenser incorporated an emergency alert mechanism, notifying caregivers if a patient missed their medication for an extended period. Their research highlighted the potential of IoT-based solutions in healthcare automation, making medication management more efficient. The study also addressed challenges such as connectivity issues and power backup requirements. By incorporating these features, their system aimed to enhance patient compliance with prescribed medications.

P. K. Nijya, J. Najeeb, A. Rimna, K. P. Safa, M. Silvana, T. K. Adarsh [17] (2018) team developed a smart pill box that not only dispensed medication but also authenticated and confirmed its consumption. Their system utilized an infrared sensor to detect whether the patient had actually picked up the pill from the container. If the medication was not taken within a specified timeframe, an alert was sent to caregivers via a mobile application. The researchers integrated a biometric authentication system to prevent unauthorized access, ensuring that only the intended patient could retrieve the medicine. The system also featured an LCD display to provide instructions and updates to the user. To further enhance adherence, it included voice alerts for patients with visual impairments. The study demonstrated how smart pill dispensers could be adapted for different patient needs, including those with chronic illnesses. Their model was particularly useful for elderly individuals and those suffering from memory-related conditions such as Alzheimer's disease.

K. Jadhav, G. Vaidya, A. Mali, V. Bankar, M. Mhetre, J. Gaikwad [18] (2020) and team designed an IoT-based automated medicine dispenser that focused on security and real-time monitoring. The system included child-lock safety features to prevent unauthorized access, especially in households with young children. It was designed to read prescriptions and automatically schedule dispensing times based on the prescribed dosage. The dispenser worked in sync with a mobile application, where users could set reminders and track their medication history. Additionally, it featured an alarm system that alerted users if a scheduled dosage was missed. Caregivers were also notified via SMS in case of non-adherence. The authors highlighted the importance of integrating smart dispensers with cloud-based platforms to provide doctors with real-time patient data. Their study emphasized how IoT technology could enhance medication management and improve treatment outcomes.

N. B. Othman and O. P. Ek [19] (2016) developed a smart pill dispenser that utilized mobile applications such as "Blynk" for automation and remote monitoring. Their system allowed users to control medication dispensing through a



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smartphone app, making it more convenient for patients and caregivers. The dispenser was equipped with multiple sensors to track medication levels and ensure accurate dispensing. If a pill was not taken on time, the system sent push notifications and SMS alerts to the user and caregiver. The authors focused on making the dispenser affordable and accessible to a wide range of users. They also incorporated a battery backup system to ensure functionality during power outages. The study demonstrated the effectiveness of mobile applications in improving medication adherence and highlighted the role of IoT in remote healthcare management.

A. Bombarda, S. Bonfanti, A. Gargantini [20] (2019) and colleagues developed a comprehensive smart medicine dispenser that integrated microcontrollers and infrared sensors to monitor medication consumption. Their system used Instapush technology to send real-time notifications to caregivers, ensuring that patients adhered to their medication schedules. The device featured a fail-safe mechanism that prevented accidental overdoses by tracking whether the correct dosage was taken. It also included an emergency response system that alerted healthcare providers in case of medication errors. The authors emphasized the importance of integrating artificial intelligence into smart dispensers to enhance decision-making and adaptability. Their research contributed to the advancement of intelligent healthcare solutions, demonstrating how AI and IoT could be combined to create a more efficient and reliable medication management system.

III. CHALLENGES

The design and implementation of a Smart Medicine Reminder and Automated Medicine Dispensing Mechanism present several challenges that must be carefully addressed to ensure reliability, accuracy, and user-friendliness. These challenges arise due to the complexity of integrating hardware, software, and IoT-based automation in a healthcare-related system. Below are the key challenges:

1. Accuracy vs. Efficiency Trade-off

- **Medication Timing Precision:** Ensuring that the system accurately reminds patients at the correct time and dispenses the right dosage without errors is crucial.
- **User Adherence Tracking:** The system should not only dispense medication but also confirm whether the user has taken it. Implementing reliable tracking mechanisms can be challenging.

2. Optimization of Hardware and Power Consumption

- **Power Management:** The system must be energy-efficient, especially if it operates on a battery. Ensuring a long battery life while maintaining performance is a key challenge.
- **Component Reliability:** Sensors, actuators, and other hardware components should function reliably over extended periods, reducing maintenance needs.

3. Design Complexity

- **Integration of Multiple Technologies:** Combining microcontrollers, IoT modules, sensors, and a user interface adds complexity. Ensuring seamless communication between these components is essential.
- **Error Handling Mechanism:** The system should be able to detect and handle errors such as missed doses, dispenser malfunctions, or connectivity issues effectively.

4. Testing and Validation

- **Medication Dosage Accuracy:** Ensuring that the system dispenses the exact amount of medicine without errors is crucial for patient safety.
- **User Safety and Reliability Testing:** The system must undergo rigorous testing to prevent incorrect medication dispensing, ensuring patient well-being.

5. Scalability and Portability

- **Compatibility with Different Medications:** The dispenser should support various pill sizes and medicine forms without jamming or dispensing errors.
- **Remote Monitoring and Alerts:** Integrating IoT features for caregivers or doctors to monitor medicine intake remotely adds complexity but is essential for real-time supervision.



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6. Application-Specific Challenges

- **Elderly and Disabled User Adaptability:** The system should be designed for ease of use, considering accessibility for elderly or disabled patients.
- **Data Security and Privacy:** Storing and transmitting health-related data securely while complying with regulations like HIPAA is a significant challenge.

7. Network Connectivity Issues

- **IoT-Based Monitoring Reliability:** The system relies on stable internet connectivity for remote monitoring. Network failures can disrupt notifications and tracking.
- **Offline Functionality:** Designing an offline mode to ensure reminders and dispensing work without internet access is crucial for uninterrupted service.

8. Multi-User Support and Personalization

- **Handling Multiple Users in One Device:** Some households may have multiple patients needing medication. The system should differentiate and dispense accordingly.
- **Customizable Reminders:** Users may have unique schedules and medication needs, requiring personalized settings and adaptive alerts.

9. Cost and Affordability

- **Balancing Features and Cost:** Ensuring affordability while integrating advanced features like IoT, sensors, and AI-based monitoring is challenging.
- **Manufacturing and Maintenance Costs:** Keeping production and maintenance costs low while ensuring durability is a key factor for widespread adoption.

10. Environmental and Disposal Concerns

- **E-Waste Management:** As an electronic device, responsible disposal and recycling of components should be considered to minimize environmental impact.
- **Biodegradable or Recyclable Materials:** Using eco-friendly materials for casing and non-electronic parts can improve sustainability.

IV. CONCLUSION

The Smart Medicine Reminder and Automated Medicine Dispensing Mechanism addresses the critical need for accurate and timely medication management, especially for elderly and chronically ill patients. By integrating IoT, sensors, and automation, the system ensures precise dosage dispensing while reducing human errors. Its remote monitoring feature enhances patient adherence and allows caregivers to track medication intake effectively. Despite challenges like power optimization, data security, and network connectivity, implementing robust error handling and adaptive features can improve system reliability. The device's scalability and support for multiple medications make it suitable for diverse healthcare needs. Ensuring affordability while maintaining high performance is crucial for widespread adoption. Future enhancements could include AI-driven analytics for personalized medication schedules and voice-enabled assistance for accessibility. Overall, this system offers a smart, efficient, and user-friendly solution to improve medication adherence and enhance patient safety.

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