

IoT-Based Smart Medicine Box with AR Holographic Caregiver and Automatic Liquid Tonic and Pill Dispensing System

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Abstract

Medication management is a major challenge for elderly individuals, chronic disease patients, and users who require multiple medicines at scheduled intervals. Missed doses, incorrect quantities, and improper medication handling can reduce treatment effectiveness and create health risks. This paper proposes an IoT-Based Smart Medicine Box with an AR Holographic Caregiver and Automatic Liquid Tonic & Pill Dispensing System to provide a reliable and intelligent medication management solution. The proposed system integrates Internet of Things (IoT) technology, sensors, wireless communication, automated dispensing mechanisms, and Augmented Reality (AR) to support accurate and timely medicine administration. Based on predefined schedules, the system automatically dispenses prescribed pills and measured quantities of liquid tonic. Sensors monitor medicine availability and confirm the dispensing process, improving system reliability. An AR holographic caregiver provides interactive medication reminders, dosage instructions, visual guidance, and supportive information to improve user understanding and adherence. IoT connectivity enables caregivers to remotely monitor medication status and receive notifications regarding scheduled doses and dispensing conditions. The proposed system aims to minimize medication errors, improve treatment adherence, reduce caregiver dependency, and enhance user safety. The paper presents the system architecture, working methodology, key components, benefits, and implementation challenges, including cost, reliability, connectivity, privacy, and scalability. The integration of IoT, automation, and AR offers an innovative approach to intelligent healthcare assistance and effective medication management.

Keywords: IoT, smart medicine box, medication management, augmented reality (AR), automatic pill dispensing, liquid tonic dispensing

INTRODUCTION

The increasing complexity of medication routines has created a need for safe, reliable, and convenient medication management solutions. Elderly patients and individuals taking multiple medications may forget doses or take incorrect quantities of tablets, capsules, and liquid tonics. These challenges can affect medication adherence and treatment effectiveness, highlighting the importance of intelligent healthcare technologies. IoT-based smart medicine boxes provide a promising solution by offering medication reminders, connected monitoring, and automated dispensing. The integration of automatic pill and liquid tonic dispensing mechanisms improves convenience and supports accurate medication administration. IoT connectivity also enables caregivers to monitor medication-related information remotely.

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The proposed IoT-based smart medicine box with AR holographic caregiver and automatic liquid tonic and pill dispensing system combines automated dispensing, IoT monitoring, and AR-based assistance. The system is designed to dispense tablets and liquid tonics according to predefined schedules and quantities. An AR holographic caregiver provides visual guidance, reminders, and user instructions to support elderly patients and improve medication adherence.

However, challenges such as dispensing accuracy, medication compatibility, system reliability, cost, and data privacy must be considered. Integrating solid and liquid medication dispensing mechanisms requires careful design to ensure proper dosage control and safe operation. This review paper examines the technologies, system architecture, dispensing mechanisms, and healthcare applications of IoT-based smart medicine boxes with AR holographic assistance. It also discusses their benefits, limitations, research gaps, and future developments to support safer and more reliable medication management.

RESEARCH SURVEY REPORTS

An automated medicine reminder system has been developed to assist patients in taking their medicines at scheduled times. The system is designed to minimize missed doses and improve medication adherence, particularly among elderly people and patients who require regular medication. Automated alerts based on predefined medicine schedules help users organize their medicines and remember the appropriate time for medication intake. Such an approach can reduce forgetfulness, improve convenience, and reduce the need for continuous caregiver supervision [1].

A smart medicine reminder system integrated with an Android application has been proposed to support patients in taking medicines at the appropriate time. The system uses a microcontroller-based approach to manage reminder operations and provide timely alerts to users. It helps patients organize their medicines and follow prescribed schedules through automated reminders. This approach provides a simple and cost-effective solution for improving daily medication management and reducing missed doses [2].

An IoT-enhanced medication management framework has been developed to support personalized medication management, particularly for elderly care. The system combines IoT connectivity with intelligent technologies to monitor medication-related activities and support personalized medication schedules. Such integration can assist users in maintaining regular medication routines while enabling remote monitoring and providing additional support for caregivers [3].

A smart medicine storage and reminder system has been proposed to support elderly users in managing their medications. The system focuses on organizing medicine storage and providing reminders according to predefined medication schedules. Automated reminders can help reduce forgetfulness and support timely medicine intake, while connected functionality provides opportunities for monitoring medication-related activities [4].

An IoT-based smart medicine dispenser has been developed to provide automated medication dispensing and improve medication management. The system is designed to assist patients in taking medicines at the scheduled time while reducing missed doses and improving adherence. IoT technology provides connected monitoring capabilities, while automated dispensing reduces dependence on manual medication handling. The approach also provides a foundation for remote medication monitoring and improved caregiver support [5].

A smart medical emergency kit incorporating fingerprint-based authentication and Internet of Things (IoT) technology has been proposed to improve the security and accessibility of medical supplies. Biometric authentication can help restrict unauthorized access, while IoT connectivity provides opportunities for monitoring and managing medical information remotely. The integration of authentication and connected technologies can improve the safety and reliability of intelligent healthcare systems [6].

An IoT-based smart medicine dispenser model has been developed to support medication management and automated dispensing. The system focuses on providing medicines according to predefined schedules and reducing the possibility of missed doses. IoT connectivity enables monitoring of medication-related information and supports remote healthcare management. Automated dispensing can also reduce manual intervention and improve convenience for patients requiring regular medication [7].

An IoT-based smart medicine box has been developed to assist patients in managing their medicines and taking them according to prescribed schedules. The system uses IoT technology to provide medication reminders and support organized medicine management. Such a connected medicine box can reduce forgetfulness and provide a basis for monitoring medication activities, particularly for users who require regular medication [8].

An IoT-based smart medicine box has also been proposed to provide automated medication management and reminder functionality. The system assists users in organizing medicines and following prescribed medication schedules. IoT connectivity supports the monitoring of medication-related information, while automated reminders reduce dependence on manual supervision. This approach addresses several limitations of conventional medicine boxes, which mainly rely on manual handling and user memory [9].

An AI- and IoT-based smart medicine box has been proposed to combine intelligent healthcare technologies with medication management. The system supports medication reminders and connected monitoring to help users follow their prescribed schedules. The integration of artificial intelligence and IoT can provide a more intelligent approach to medication management, while connected monitoring can support caregivers and improve the management of regular medication activities [10].

An IoT-based smart medicine box designed for medication monitoring provides a connected solution for managing and tracking medicines. The system focuses on improving medication adherence by providing reminders and monitoring medication-related activities. IoT connectivity can enable remote access to medication information and provide additional support to caregivers, thereby reducing the requirement for continuous manual supervision [11].

An STM32-based smart medicine box reminder system was designed to provide multiple medication management functionalities. The STM32 microcontroller acts as the central control unit for managing the operations of the medicine box and providing reminders according to medication schedules. The system can assist users in following prescribed medication timings and provides a microcontroller-based foundation for developing intelligent medicine management systems [12].

An IoT-based medication management system combining a pill dispenser and smart cup has been proposed to improve medication adherence. The system integrates automated medication dispensing with connected monitoring capabilities, helping users take medicines according to their prescribed schedules. The combination of dispensing and monitoring provides a convenient approach to medication management and can support caregivers through connected healthcare functionality [13].

An IoT-integrated smart pill box has been developed for monitoring patient medication usage at home. The system connects the medicine box to an IoT-based monitoring environment, allowing medication-related activities to be tracked remotely. This approach helps users manage their medication schedules while providing caregivers with information about medication usage. Such remote monitoring can reduce the need for continuous manual supervision in home healthcare environments [14].

An IoT-enhanced medication management framework has been proposed to provide personalized support for elderly patients. The system integrates connected technologies with intelligent medication management to support regular medication intake and monitoring. Personalized medication management can help users follow their prescribed schedules, while remote monitoring capabilities can provide additional assistance to caregivers and improve the overall management of medication activities [15].

A smart messaging approach for medication adherence has been developed to provide medication-related communication and reminders to users. The system focuses on supporting patients in following their medication schedules through timely messages and notifications. Such communication-based assistance can reduce forgetfulness and encourage regular medication intake, providing an additional layer of support within intelligent medication management systems [16].

A smart pill box with reminder and consumption monitoring capabilities has been proposed using IoT technology. The system is designed to remind users about scheduled medicines and monitor medication consumption. IoT connectivity provides opportunities for tracking medication activities and supporting caregivers, while automated reminders can help reduce missed doses and improve regular medication management [17].

An IoT-based smart pill box using an Arduino microcontroller has been developed to provide an automated and cost-effective approach to medication management. The Arduino acts as the primary controller for managing the operations of the pill box and supporting scheduled medication reminders. IoT integration enables connected healthcare functionality and can support remote monitoring of medication-related information by caregivers [18].

A smart robotic pill dispenser has been proposed as assistive technology for elderly users. The system incorporates robotic functionality to automate pill dispensing and support medication management. Automated dispensing can reduce manual intervention and improve convenience for elderly individuals, whereas intelligent robotic functionality provides opportunities for developing more advanced medication assistance systems [19].

A health Internet of Things (IoT) platform integrating intelligent packaging, biosensors, and an intelligent medicine box has been developed to support connected healthcare and medication management. The integration of sensing and intelligent medicine management technologies enables medication-related information to be monitored and processed within a connected healthcare environment. Such integration provides a foundation for more comprehensive medication monitoring and personalized healthcare assistance [20].

A smart medicine box using Internet of Things (IoT) and computer vision techniques has been developed to support visually impaired users in managing their medicines. Computer vision can assist with identifying medicine-related information, while IoT technology enables connected medication management and monitoring. The system provides an accessible approach to medication management by assisting users with medicine identification and scheduled medication intake. It can also provide opportunities for remote caregiver support and improved medication safety for visually impaired users [21].

CONCLUSION

The IoT-based smart medicine box with AR holographic caregiver and automatic liquid tonic and pill dispensing system represents an innovative approach to addressing the growing challenges of medication management and patient safety. This review highlights how the integration of advanced technologies, such as the Internet of Things (IoT), automated dispensing mechanisms, augmented reality, and remote monitoring, enables more efficient and convenient medication management. By

dispensing tablets and liquid tonics according to predefined schedules and quantities, these systems can reduce manual intervention, support medication adherence, and improve the overall medication experience. The integration of AR holographic caregiver assistance further enhances user interaction by providing visual guidance, reminders, and medication instructions. These features are particularly valuable for elderly individuals and patients managing multiple medications, while IoT connectivity enables caregivers to monitor medication-related information and provide timely support.

However, despite these potential benefits, several challenges remain, including dispensing accuracy, medication compatibility, system reliability, high implementation costs, and concerns related to data security and privacy. The integration of solid and liquid medication dispensing mechanisms within a single system requires careful design to ensure accurate dosage control and prevent medication errors. In addition, AR-based assistance and IoT monitoring must be developed with accessibility, ease of operation, and user requirements in mind. Addressing these challenges is essential for improving the reliability and practical adoption of smart medicine box systems, particularly in homes and healthcare environments.

Future research should focus on developing cost-effective, user-friendly, and reliable medication management systems that can support different medication types and patient needs. The incorporation of improved sensors, intelligent dosage control, secure IoT communication, and advanced AR interaction can further enhance system performance and patient support. In addition, greater emphasis on caregiver awareness, user training, data privacy, and real-world testing will play a vital role in improving the effectiveness of these technologies. The development of portable and adaptable systems can also increase accessibility for elderly patients and individuals requiring regular medication. In conclusion, IoT-based smart medicine box systems with AR holographic caregivers and automatic liquid tonic and pill dispensing hold significant potential to improve medication management by promoting timely medication intake, accurate dispensing, and better caregiver support. Their continued development and implementation can contribute to safer medication practices, improved medication adherence, and enhanced patient well-being. By addressing existing technical and practical limitations, these intelligent healthcare solutions can support the future of personalized and connected medication management.

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