IRO Journal on Sustainable Wireless Systems (ISSN: 2582-3167)
www.irojournals.com/irosws/

IoT based Kit for Medication Monitoring

Asha C N.[1], Yashawini P.[2], Pranathi M P.[3], Sneha N G.[4], Veerapureddy Akshaya[5]

Department of ECE, Acharya Institute of Technology, Bangalore, India

E-mail: [1]ashacn@acharya.ac.in, [2]yashuprakash05@gmail.com

Abstract

Medication non-adherence remains a significant challenge in healthcare, leading to suboptimal patient outcomes and increased medical expenditures. This study introduces an innovative Internet of Things (IoT)-based kit designed to monitor medication adherence. The proposed kit employs various sensors to ensure precise tracking and supervision of medication intake. Its seamless integration with a cloud platform facilitates remote access, real-time data processing, and storage. Through an intuitive mobile application or web interface, users receive personalized notifications and reminders to assist them in adhering to their medication schedules. Furthermore, the kit offers historical data tracking, enabling both users and healthcare professionals to assess adherence trends over time. This IoT-based medication monitoring kit provides a connected and intelligent approach to optimizing medication management in contemporary healthcare settings, thereby enhancing health outcomes and improving patient care. It represents a promising solution to the issue of medication non-adherence.

Keywords: IoT, IR Sensor, Arduino UNO, Telegram App.

1. Introduction

A whole condition of physical, mental, and social well-being—rather than just the absence of disease—is what is meant to be understood as health. People's desire for a better life is fundamentally based on their health. Unfortunately, a number of problems, including inadequate health services, significant inequalities between rural and urban areas, and the unavailability of doctors and nurses during the most difficult times, have contributed to the global health crisis.

DOI: https://doi.org/10.36548/jsws.2024.4.004
Received: 08.12.2024, received in revised form: 04.01.2025, accepted: 25.01.2025, published:07-02-2025

The healthcare sector has been deeply influenced by the increasing integration of mobile and smart devices,such as Fitbit, Mi-Fit, Realme-Fit, and others as well as the incorporation of Internet of Things (IoT) technologies, including GSM, Wi-Fi, and Bluetooth modules, for the monitoring of health parameters. Medical professionals are progressively incorporating these technologies into clinical patient care. The application of IoT in healthcare is proving to be increasingly advantageous, particularly for the elderly.

Elderly individuals and those with chronic disease must adhere to regular and timely medication schedules. Due to their demanding daily routines, caregivers may inadvertently miss administering medications at the prescribed times. Additionally, managing multiple patients can complicate the organization of medication schedules.

Numerous studies have been conducted in this area, leading to the development of various pill boxes. One such device, the Medico Box, utilizes IoT technology to provide users with real-time updates on medications prescribed by healthcare professionals. This approach aligns with the growing trend of relocating routine medical examinations and other healthcare services from hospitals to patients' homes. With the assistance of mobile applications, IoT is now integrated into medicine boxes, reducing the risk of health deterioration by ensuring that patients take the correct medications at the appropriate times, as indicated by updates from their doctors or physicians.

Utilizing a comprehensive sensor grid kit, this IoT-based medication kit assists patients in adhering to their prescribed medication schedules. While current medication kits feature an LCD display and a warning buzzer, they lack the capability to monitor the number of tablets consumed.

2. Literature Review

B. Ayshwarya et al [1] highlights a solution designed for elderly and chronically ill patients. This box can handle capsules of various sizes, dispensing up to six different medicines for a month. It features adjustable alerts to remind patients to take their medication, enhancing adherence and safety [1].

Nuqman Ahmad Fuad etal [2] developed an IoT-based Medication Monitoring System focusing on patient security and environment monitoring. The system uses fingerprint

authentication for access control and a DHT sensor to monitor the container's temperature, ensuring medicines are stored correctly and accessed only by authorized users.

The research study proposed a smart medicine box integrated with sensors and a server for regular health monitoring, facilitating remote communication between patients and doctors. This system sends email reminders to patients and monitors body temperature to ensure proper medication intake [3].

The authors'designed an IoT-based Medical Assistant for improving patient monitoring during the COVID-19 pandemic. It collects real-time data on vital signs using biomedical sensors and alerts medical staff during emergencies. The system also includes an Android app for bed control, medication reminders, and emergency calls, aiming to enhance patient care efficiency[4].

The study discusses about a medicine box reminder system for chronic disease patients, incorporating IoT-based database monitoring. This system uses a Raspberry Pi and an Android app to provide real-time medication reminders and monitoring, reducing treatment failures and improving health outcomes. [6]

3. Proposed System

The Medication Kit incorporates several key components to optimize medication management. The input interface, featuring a user-friendly keypad with tactile buttons, allows users to input medication schedules and navigate the system interface seamlessly. At the core of the kit is the NodeMCU control unit, based on the ESP8266 microcontroller, which controls the various functions and ensures smooth operation by managing input from the keypad and processing sensor data.

Integral to the kit's functionality are the IR sensors, which use infrared technology to accurately detect the presence of tablets within the kit, ensuring precise counting and organization. The NodeMCU facilitates connectivity to the IoT platform, enhancing the overall efficiency of the system. This connectivity allows for real-time updates and remote management, making the medication management process more convenient and reliable. Figure.1. illustrates the block diagram of medication monitoring system.

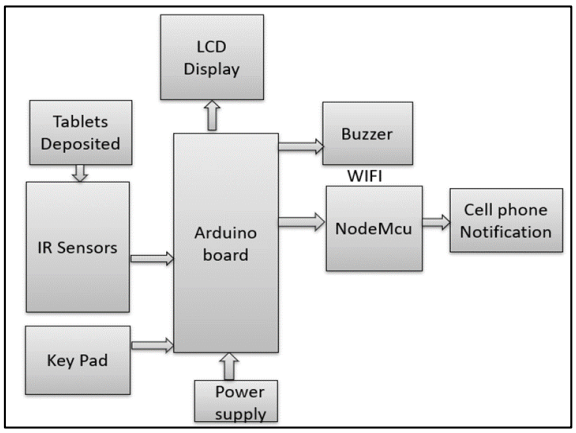

Figure 1. Block Diagram of Medication Monitoring System.

On the output side, the Medication Kit features an LCD display that utilizes high-resolution graphics to present detailed information on medication status, including total tablet count and daily intake details, providing users with immediate visibility into their medication details. Additionally, the kit is equipped with an alarm buzzer that emits audible alerts at scheduled medication times, serving as a reliable reminder for users to adhere to their prescribed medication schedules. Figure.2 illustrates the flow chart of system operation

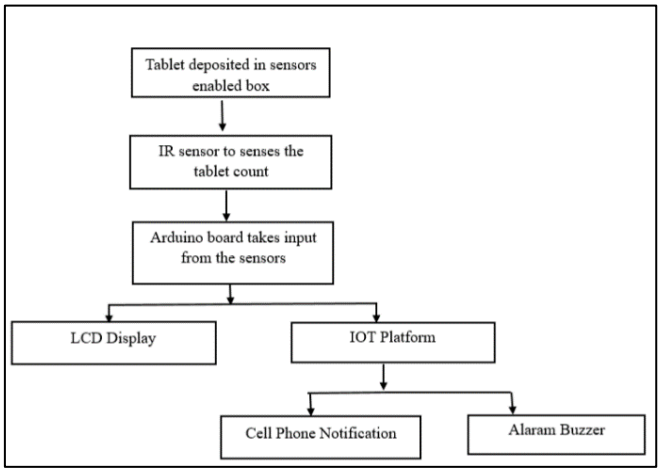

Figure 2. Flow Chart of System Operation.

The research integrates sensor technology, Arduino processing, an LCD display, IoT connectivity, and user-friendly notifications to provide a comprehensive and efficient tablet counting solution. Tablets placed on a sensor-enabled box trigger an IR sensor that captures and records the count, with data communicated to an Arduino board for processing and

displayed on an LCD. Advanced IoT capabilities ensure real-time data transfer to a cloud-based infrastructure for broader accessibility and analysis.

The system features a multi-faceted notification system, enabling mobile notifications and audible alerts for timely updates on tablet counts. A user-friendly interface accessible through the LCD display and mobile applications allows for real-time updates.

The proposed system can be customized for various operational environments such as pharmaceutical facilities, warehouses, or research laboratories, ensuring longevity and seamless integration with evolving technologies. The research prioritizes sustainability through optimized energy consumption and eco-friendly materials, contributing to sustainability initiatives and reducing ecological footprint. By addressing fundamental tablet counting challenges and incorporating advanced features, the proposed approach provides an innovative solution meeting the evolving needs of customers and stakeholders.

4. Results

The smart medication kit enhances medication adherence through integrated technology, featuring components like an IR sensor, LCD, keypad, buzzer, Arduino Uno, and a power supply. The IR sensor detects pill dispensation, while the LCD, displays schedules and reminders. The keypad allows user input for setting medication times, and the buzzer provides auditory alerts. The Arduino Uno coordinates all these components, ensuring they work together seamlessly. The kit can be powered by batteries or an AC adapter, ensuring continuous operation. The hardware results and the alerts notified through the telegram are illustrated in Figures 3and 4

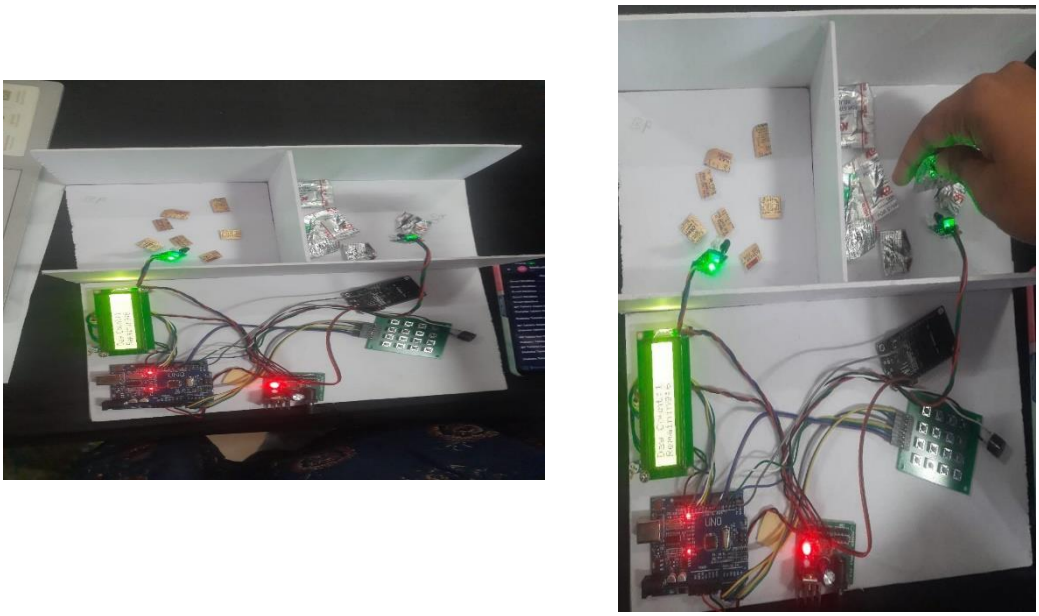

Figure 3. Hardware Prototype

Each component has a specific role: the IR sensor confirms pill consumption using infrared light, selected based on detection range and sensitivity. The LCD, displays crucial information, chosen for its size and compatibility with Arduino. The keypad facilitates user input and navigation, selected for its durability and user-friendliness. The buzzer gives audible feedback, with selection criteria including sound output and power needs.

Figure 4. Telegram App Interface.

Integrating these components involves connecting them to the Arduino Uno using appropriate interfaces and libraries. A stable power supply is crucial, calculated based on the

power needs of each part. The design includes a detailed circuit layout for compactness and ease of assembly. Testing ensures each component and the overall system function correctly, with user trials validating effectiveness. Challenges like component compatibility and user interface design are addressed to ensure the kit is user-friendly and reliable for better medication management.

This image shows a chat interface from a bot named "Medication kit." The bot is sending a series of notifications related to medication management. The alerts indicate two main issues: "Diabetic Tablets Count Is Less..." and "BP Tablet Not Taken..." These messages suggest that the bot is monitoring pill counts and reminding the user about missed or low stock of diabetic and blood pressure (BP) tablets. The timestamps indicate that the notifications are frequent and ongoing, highlighting a real-time tracking system for medication adherence.

To interface a Telegram app with a smart medication kit, you need to establish a communication system where the kit can send notifications and receive commands through Telegram. Start by creating a Telegram bot using BotFather in the Telegram app, which will provide you with a unique bot token. This bot will serve as the interface between the medication kit and the user. Next, set up a server that can handle HTTP requests and use this server to communicate with the Telegram bot through its API. The smart medication kit should be programmed to send data, such as medication reminders or alerts, to this server. When the kit detects an event, such as the time to take medication, it sends a notification to the server, which in turn uses the bot to send a message to the user on Telegram. This setup ensures that the user receives timely reminders and can also send commands back to the smart medication kit through the bot, enabling remote management and interaction.

5. Conclusion

IoT-based medication monitoring kits represent a significant advancement in healthcare, utilizing connected devices and sensors to enhance patient adherence, treatment outcomes, and process efficiency. By enabling real-time monitoring and data collection, these kits empower healthcare providers to remotely track medication adherence and treatment response, leading to a range of benefits. These include increased adherence rates, timely interventions for missed doses, personalized treatment plans, and prevention of health complications. Patients benefit from features such as medication reminders, dosage

information, and access to educational resources, which can improve their understanding of their treatment regimen and promote adherence. Healthcare professionals can optimize treatment plans and allocate resources more efficiently based on the data collected through remote monitoring. This proactive approach helps identify issues early, reducing the likelihood of hospital readmissions and emergencies. However, to realize the full potential of IoT-based medication monitoring kits, several challenges must be addressed. These include ensuring data security and privacy, establishing standardization across devices and platforms, providing user education to both patients and healthcare professionals, and ensuring accessibility for all users. Overcoming these challenges is essential for achieving widespread adoption and maximizing the benefits of this technology. In summary, IoT-based medication monitoring kits hold promise for revolutionizing healthcare delivery by improving patient outcomes, enhancing treatment adherence, and reducing costs. Ultimately, IoT-based medication monitoring kits have the potential to not only improve individual patient outcomes but also contribute to the overall efficiency and effectiveness of healthcare system. As part of future work, it can be implemented as a voice-alert notification system. This system will not only send notifications but also read the content of the alerts aloud to patients, ensuring they receive and understand important information. Currently, the research focuses only on two types of tablets, but the study is planned to expand support to a broader range of tablets in the future. This expansion will enable us to reach more customers, enhance user satisfaction, and maintain a competitive edge. Additionally, would incorporate fingerprint or keypad input to prevent unauthorized access, thereby enhancing security for the users. These advancements will contribute to a more secure, accessible, and user-friendly medication monitoring system.

References

[1] Ayshwarya, B., and R. Velmurugan. "Intelligent and safe medication box in health IoT platform for medication monitoring system with timely remainders." In 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), vol. 1, pp. IEEE, 2021.

[2] Fuad, Mohd Ady Nuqman Ahmad, Muhamad Naim Che Rosman, Nur Idawati Md Enzai, Mohd Amir Hamzah Ab Ghani, and Syazilawati Mohamed. "Design of an IoT-based Medication Monitoring System." In 2022 International Conference on Computer and Drone Applications (IConDA), IEEE, 2022. 91-94.

[3] Al-Mahmud, Obaidulla, Kausar Khan, Rajdeep Roy, and Fakir Mashuque Alamgir. "Internet of things (IoT) based smart health care medical box for elderly people." In 2020 International Conference for Emerging Technology (INCET), IEEE, 2020. 1-6.

[4] Bhardwaj, Vaneeta, Rajat Joshi, and Anshu Mli Gaur. "IoT-based smart health monitoring system for COVID-19." SN Computer Science 3, no. 2 (2022): 137.

[5] Bandyopadhyay, Saradwata, Akash Kumar Singh, Sunil Kumar Sharma, Rajrupa Das, Arju Kumari, Angira Halder, and Sandip Mandal. "MediFi: An IoT based Wireless and Portable System for Patient's Healthcare Monitoring." In 2022 Interdisciplinary Research in Technology and Management (IRTM), IEEE, 2022. 1-4.

[6] Wardhani, Luh Kesuma, Cinthya Bela Anggraini, Nenny Anggraini, Nashrul Hakiem, Imam Marzuki Shofi, and Tabah Rosyadi. "Medicine box reminder for patients with chronic disease with iot-based database monitoring." In 2021 9th International Conference on Cyber and IT Service Management (CITSM), IEEE, 2021. 1-7.

[7] Zanjal, Samir V., and Girish R. Talmale. "Medicine reminder and monitoring system for secure health using IOT." Procedia Computer Science 78 (2016): 471-476.

[8] Saha, Jayeeta, Arnab Kumar Saha, Aiswarya Chatterjee, Suyash Agrawal, Ankita Saha, Avirup Kar, and Himadri Nath Saha. "Advanced IOT based combined remote health monitoring, home automation and alarm system." In 2018 IEEE 8th annual computing and communication workshop and conference (CCWC), IEEE, 2018. 602-606.

[9] PillSense: Designing a medication adherence monitoring system using pill bottle-mounted wireless sensors

[10] Anan, Safayat Reza, Md Azizul Hossain, Md Zubayer Milky, Mohammad Monirujjaman Khan, Mehedi Masud, and Sultan Aljahdali. "[Retracted] Research and Development of an IoT-Based Remote Asthma Patient Monitoring System." Journal of Healthcare Engineering 2021, no. 1 (2021): 2192913