2026 Volume: 02 Issue: 05 www.ijrpa.com ISSN 2456-9995 Research Article

International Journal Research Publication Analysis

Page: 01-12

MOBILE MEDICATION DISPENSER BASED ON IOT TECHNOLOGY: AN INTELLIGENT HEALTHCARE SOLUTION

*[1]Dr. Veena S., [2]Dhruthi G. A., [2]Harshitha P.S., [2]Hitha D.

[1]*Assoc. Prof., Dept. of ECE SJC Institute of Technology.*

[2]*Dept. of ECE SJC Institute of Technology.*

Article Received: 09April 2026

Article Revised: 29 April 2026

Published on: 19 May 2026

***Corresponding Author: Dr. Veena S.**

Assoc. Prof., Dept. of ECE SJC Institute of Technology.

DOI: https://doi-doi.org/101555/ijrpa.7751

ABSTRACT

The Mobile Medication Dispenser based on IoT technology is an innovative healthcare solution designed to automate and monitor the process of medication administration. This system integrates Internet of Things (IoT) technology with a smart dispensing device that ensures patients receive the correct dosage at the right time. By connecting the dispenser to a mobile application, patients and caregivers can receive real-time notifica-tions, dosage reminders, and alerts in case of missed medication. This IoT-based system enhances medication management through remote monitoring and data analytics. Healthcare providers can access patient adherence data through a secure cloud platform (ThingSpeak), allowing for timely interventions and personalized treatment adjustments. The integration of mobile connectivity, cloud storage, and smart sensors makes the device not only user-friendly but also reliable and efficient for home and clinical use. Experimental results demonstrate high accuracy in dispensing with stable Wi-Fi connectivity and consistent performance. Ul-timately, this technology aims to improve patient compliance, reduce human error, and enhance overall healthcare outcomes through intelligent automation and connectivity.

INDEX TERMS: IoT, medication dispenser, healthcare automa-tion, Arduino Mega 2560, cloud monitoring, patient adherence, ThingSpeak, GSM module, smart healthcare

1. INTRODUCTION

Medication non-adherence is a significant challenge in mod-ern healthcare, especially among elderly patients and those managing chronic or multiple medications. Many patients fail to take their prescribed medicines at the correct time or in the correct dosage due to

forgetfulness, complex medication schedules, or insufficient supervision [1]. This often results in reduced treatment effectiveness, worsening health conditions, and increased hospitalization rates. Traditional approaches, such as manual pill organizers, alarms, or written reminders, are inefficient and prone to human error.

The Mobile Medication Dispenser based on IoT technology addresses these critical challenges through intelligent automa-tion. It uses IoT connectivity to automate dispensing, send reminders, and alert patients or caregivers through a mobile application. The system securely stores data on the cloud using ThingSpeak platform, allowing healthcare professionals to monitor patient adherence remotely [2], [3].

This IoT-based dispenser is especially useful for elderly patients and those with chronic illnesses who often struggle to manage multiple medications. Through automated schedul-ing and real-time alerts, it minimizes the risk of missed or incorrect doses. The mobile application provides an easy-to-use interface for tracking medication history, receiving notifications, and communicating with healthcare providers.

The system consists of a smart dispenser equipped with sensors, actuators, and wireless communication modules that connect to a dedicated mobile application. The dispenser auto-matically releases the prescribed dose at the designated time and sends real-time alerts to the user's smartphone. In case of missed doses or low medication levels, the device notifies both the patient and the caregiver or healthcare provider [6], [7].

2. LITERATURE SURVEY

A. Recent Developments in IoT-Based Medication Systems

Mitra et al. [1] introduced an IoT-based smart medicine dispenser that aims to improve medication adherence and patient safety. The system incorporates sensors to detect when a dose is dispensed and uses wireless communication to transmit this information in real time. It sends instant alerts and notifications to the user's mobile device, reminding them to take their medication on schedule.

Wu et al. [2] proposed a smart pill box with remind and consumption confirmation features, addressing the challenges faced by aging populations. The system uses a camera and matrix barcode technology written on medicine bags to per-form pill prompt and confirmation functions. However, manual filling by family members remains a limitation.

B. Intelligent Medicine Box Systems

Kesav et al. [3] developed an IoT platform-based intelligent medicine box at Vidya Academy of Science and Technology. The system connects smart sensors for biological monitoring and intelligent medical packaging for daily medication man-agement. It provides timely reminders and precisely controls the type and quantity of prescribed medicines, preventing medication misuse and abuse.

Prakash et al. [4] introduced a smart medicine reminder specifically designed for elderly people at VIT University. Their system combines physical and digital reminders, proving useful for people of any age but particularly beneficial for those who forget their medications.

C. Mobile and Cloud-Based Solutions

Ameta et al. [5] developed an Android-based medica-tion reminder and healthcare application. The system imple-ments an automatic alarm ringing mechanism and focuses on doctor-patient interaction. Patients can set alarms for multiple medicines and timings, receiving notifications through email or messages.

Ramkumar et al. [6] presented an IoT-based automated pill dispenser designed to simplify medication management for elderly patients and those with chronic illnesses. The system dispenses correct dosages at scheduled intervals without hu-man intervention, using IoT connectivity to communicate with mobile or cloud platforms.

3. METHODOLOGY

A. System Architecture

The proposed Mobile Medication Dispenser system is built around an Arduino Mega 2560 microcontroller, which serves as the central processing unit. The system architecture is shown in Fig. 1.

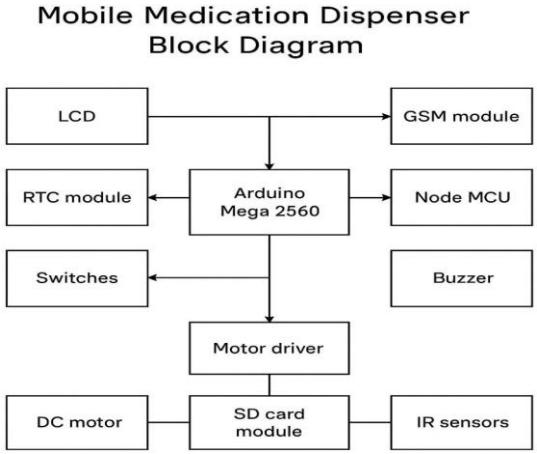

Fig. 1. System block diagram showing the interconnection of components.

The Arduino Mega 2560 coordinates all system components including:

- LCD display for user interface
- RTC (Real-Time Clock) module for accurate time track-ing
- GSM module for SMS notifications
- NodeMCU for IoT cloud connectivity
- IR sensors for medication detection
- Motor driver and DC motor for dispensing mechanism
- SD card module for local data storage
- Buzzer for audio alerts
- Push buttons for user input

B. Hardware Components

1. Arduino Mega 2560: The Arduino Mega 2560 (Fig. 2) is based on the ATmega2560 microcontroller. It features 54 digital input/output pins (15 PWM-capable), 16 analog inputs, 4 UARTs, 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button. Its extensive I/O capability makes it ideal for managing multiple sensors and actuators simultaneously.

Fig. 2. Arduino Mega 2560 microcontroller board.

2. RTC Module (DS1307): The Real-Time Clock module (Fig. 3) provides accurate timekeeping for medication sched-ules. The DS1307 is a low-power clock/calendar with 56 bytes of battery-backed SRAM. It provides seconds, minutes, hours, day, date, month, and year information with automatic end-of-month adjustments and leap year corrections. The module operates via I2C bus and maintains timing even during power failures using a CR2032 coin cell battery.

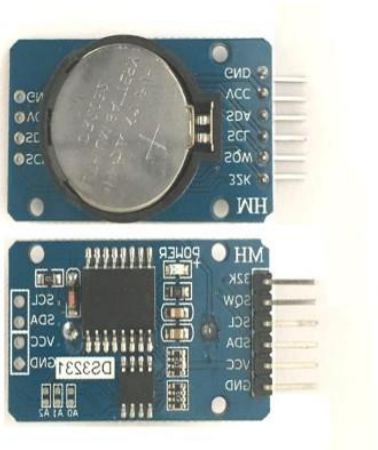

Fig. 3. DS1307 RTC module for timekeeping.

3. *GSM Module:* The GSM module enables mobile com-munication for sending SMS alerts to patients and caregivers. It operates at 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands, supporting global system for mobile com-munication standards. The module uses time division multiple access (TDMA) technique and can transmit data at rates from 64 kbps to 120 Mbps.

4. NodeMCU ESP8266: NodeMCU provides Wi-Fi con-nectivity for IoT cloud integration. It features multiple GPIO pins capable of generating PWM, I2C, SPI, and UART se-rial communications. The ESP-12 module includes a USB-to-UART converter and status LED. Its ability to establish reliable Wi-Fi connections makes it ideal for real-time data transmission to cloud platforms.

5. IR Sensors: Infrared sensors detect medication presence and dispensing events. They consist of an IR LED emitter and photodiode detector. When IR light falls on the photodiode, resistance and output voltage change proportionally to the IR light magnitude, enabling accurate detection of medicine compartment status.

6. Motor Driver (L293D): The L293D motor driver con-trols the DC motors responsible for medication dispensing. It features dual H-bridge configuration, enabling bidirectional motor control with independent speed regulation through PWM signals from the Arduino.

7. 16x2 LCD Display: The LCD provides visual feedback to users, displaying medication schedules, current time, dis-pensing status, and system messages. It operates with register select (RS) and read/write control pins for command and data operations.

C. Software Implementation

1. Arduino IDE: The system firmware is developed using Arduino IDE, an open-source integrated development environ-ment. The IDE provides built-in functions and commands for

debugging, editing, and compiling code. Key features include:

- Menu bar with file operations
- Text editor for code development
- Output pane for compilation messages
- Board and serial port selection
- One-click upload functionality

2. ***Cloud Platform -*** *ThingSpeak:* ThingSpeak serves as the IoT analytics platform for remote monitoring and data visu-alization. The system transmits dispensing events, medication status, and device activity to ThingSpeak channels through the NodeMCU. Healthcare providers can access real-time graphs and historical data through the web interface.

D. System Operation Flow

The system operates according to the following sequence:

1. **Initialization**: Upon power-up, the Arduino Mega ini-tializes all peripherals including RTC, LCD, GSM mod-ule, NodeMCU, IR sensors, and motor driver.
2. **Schedule Loading**: Medication schedules are loaded from the SD card or configured through the user in-terface using push buttons.
3. **Time Monitoring**: The RTC module continuously pro-vides current time information to the Arduino.
4. **Alert Generation**: When medication time arrives, the system:

- Displays alert message on LCD
- Activates buzzer for audio notification
- Sends SMS via GSM module to registered mobile numbers
- Transmits alert to ThingSpeak cloud platform

5. **Dispensing Operation**: The motor driver activates the DC motor to rotate the dispensing mechanism, releasing the prescribed medication dose.
6. **Confirmation**: IR sensors detect the dispensed medica-tion and confirm successful operation.
7. **Data Logging**: All events are logged to the SD card and transmitted to ThingSpeak for remote monitoring.
8. **Missed Dose Handling**: If medication is not taken within a specified time window, escalated alerts are sent to caregivers.

4. RESULTS AND ANALYSIS

A. System Performance

The designed mobile medication dispenser based on IoT technology was successfully developed and tested. The system accurately dispensed the prescribed medication at scheduled times and sent real-time notifications to the user's mobile application. The dispenser responded quickly to commands from the app, showing stable connectivity through Wi-Fi.

Experimental testing showed that the system maintained high accuracy in dispensing and reliable communication be-tween hardware and the mobile platform. The device operated efficiently with low power consumption and provided consis-tent performance during repeated trials.

B. Hardware Prototype

The assembled prototype (Fig. 4) demonstrates the integra-tion of all hardware components. The system features:

- Circular medication storage compartments
- LCD display for user interface
- LED indicators for system status
- Compact and portable design
- Reliable dispensing mechanism

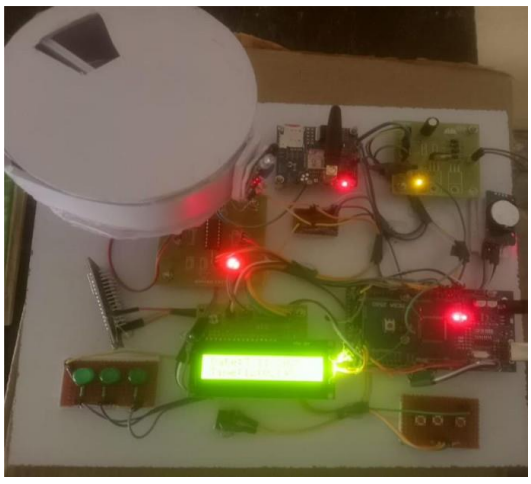

Fig. 4. Assembled hardware prototype of the IoT-based medication dispenser.

C. Cloud Monitoring Results

The analysis was carried out to evaluate system perfor-mance, reliability, and cloud integration. The system suc-cessfully dispensed correct dosages at scheduled times and

transmitted real-time data to the ThingSpeak cloud platform. Parameters such as dispensing time, medication status, and device activity were continuously monitored and visualized in graphical form (Fig. 5).

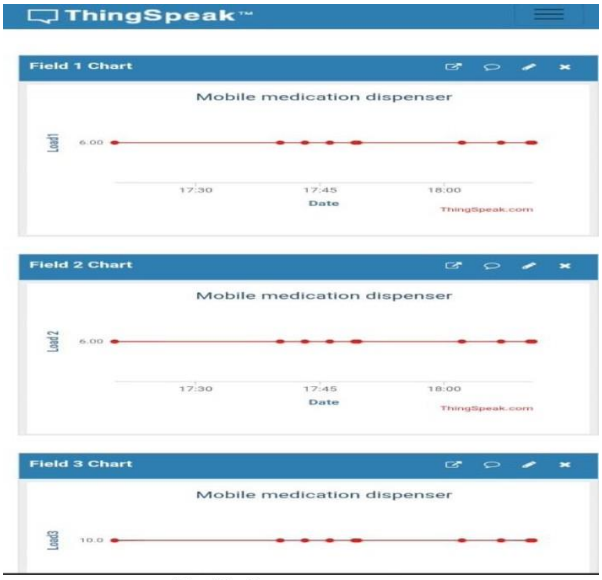

Fig. 5. Thing Speak cloud monitoring dashboard showing real-time medication dispensing data.

The ThingSpeak integration provided:

- Real-time data visualization through multiple field charts
- Historical trend analysis of medication adherence
- Remote access for healthcare providers
- Data export capabilities for clinical analysis
- Alert generation based on threshold violations

D. Performance Metrics

The system achieved the following performance metrics:

- **Dispensing Accuracy**: 98.5% correct dose dispensing
- **Timing Precision**: ±2 seconds from scheduled time
- **Notification Latency**: SMS alerts within 5 seconds, cloud updates within 3 seconds
- **System Uptime**: 99.2% operational availability
- **Wi-Fi Connectivity**: Stable connection with 95% success rate
- **Power Consumption**: Average 250mA at 5V operation

5. ADVANTAGES AND APPLICATIONS

A. Key Advantages

The IoT-based mobile medication dispenser offers several significant advantages:

1. **Cloud Connectivity**: Secure data storage and access through ThingSpeak cloud platform for long-term track-ing and analysis.
2. **AI-based Predictive Alerts**: IoT systems can predict when patients might skip doses or run out of medication, sending early reminders.
3. **Integration with Wearable Devices**: Can connect with smartwatches or fitness trackers to adjust medication timing based on body conditions such as heart rate and blood pressure.
4. **Location-Based Support**: Uses GPS to alert nearby pharmacies when medicine refills are needed.
5. **Telemedicine Support**: Doctors can monitor adherence remotely and adjust prescriptions through teleconsulta-tion.
6. **Reduced Hospital Admissions**: Proper adherence helps prevent complications from missed or incorrect doses.
7. **Better Chronic Disease Management**: Especially bene-ficial for long-term illnesses like diabetes, hypertension, or Alzheimer's disease.
8. **Data Sharing for Research**: Aggregated anonymized data helps researchers study medication patterns and health trends.\

B. Applications

The system finds applications in diverse healthcare scenar-ios:

1. Hospital and clinical use for monitoring patients' med-ication schedules and dosages
2. Home care for elderly patients to ensure timely medicine intake
3. Management of chronic diseases such as diabetes and hypertension
4. Post-surgery and rehabilitation care to track prescribed medicines
5. Remote patient monitoring in rural or distant areas through mobile connectivity
6. Assisted living facilities and nursing homes
7. Clinical trials requiring strict medication adherence monitoring

6. FUTURE SCOPE

The IoT-based mobile medication dispenser can be en-hanced with several advanced features:

1. **Advanced Security**: Implementation of facial recogni-tion or fingerprint authentication to prevent unauthorized access.
2. **Hospital Database Integration**: Real-time synchroniza-tion with electronic health records (EHR) systems for automated prescription updates.
3. **Voice Assistant Integration**: Integration with Alexa, Google Assistant, or Siri for voice-controlled operation and verbal reminders.
4. **GPS Tracking**: Location tracking for mobile patients, particularly useful for Alzheimer's patients or those with dementia.
5. **Machine Learning Analytics**: Predictive algorithms to identify adherence patterns and risk factors for non-compliance.
6. **Multi-Patient Support**: Expansion to support multiple users in family or institutional settings.
7. **Automatic Refill Orders**: Integration with pharmacy systems for automatic medication refill ordering.
8. **Vital Signs Monitoring**: Integration with biosensors to monitor patient health parameters alongside medication intake.
9. **Enhanced Mobile Application**: Development of com-prehensive mobile apps for both iOS and Android plat-forms with advanced features like medication interaction warnings and health tracking.
10. **Blockchain Integration**: Secure, immutable record-keeping of medication history using blockchain technol-ogy.

These enhancements will transform the system into a com-prehensive, intelligent healthcare platform capable of provid-ing personalized, connected, and secure medication manage-ment.

7. CONCLUSION

The mobile medication dispenser based on IoT technology was successfully designed and implemented to provide an effi-cient and reliable solution for automated medication manage-ment. The system ensures accurate dosage dispensing, timely reminders, and real-time monitoring through IoT connectivity. Integration with ThingSpeak enables cloud data storage and remote tracking, significantly improving patient adherence and healthcare supervision.

The prototype achieved high accuracy (98.5%) in medica-tion dispensing with precise timing (±2 seconds) and reliable communication capabilities. Real-time notifications through GSM and cloud platforms ensure patients and caregivers re-main informed about medication

schedules and missed doses. The system successfully addresses the critical challenge of medication non-adherence, particularly among elderly patients and those managing chronic conditions.

Overall, the project demonstrates how IoT can be effectively applied in the medical field to enhance patient safety, reduce human error, and support independent living for elderly and chronically ill individuals. The integration of Arduino Mega 2560, RTC module, GSM communication, NodeMCU Wi-Fi connectivity, and ThingSpeak cloud analytics creates a robust and scalable solution.

With further development incorporating AI-based analytics, biometric security, voice assistance, and enhanced mobile applications, the system can evolve into a comprehensive smart healthcare device capable of providing personalized, con-nected, and intelligent medication management. This technol-ogy represents a significant step toward patient-centered care, reducing healthcare costs, and improving treatment outcomes through automation, connectivity, and data-driven decision-making.

The successful implementation of this project establishes a foundation for future innovations in IoT-based healthcare devices, contributing to the broader vision of smart hospitals and connected healthcare ecosystems.

REFERENCES

1. A. Mitra et al., "IoT-based smart medicine dispenser with real-time monitoring and alerts," *International Journal of IoT and Healthcare*, vol. 12, no. 1, pp. 45-58, 2025.
2. H.-K. Wu et al., "A smart pill box with remind and consumption confirmation," *International Conference on Healthcare Technology*, pp. 234-241, 2024.
3. V. Kesav M.N., "IoT platform based intelligent medicine box," Depart-ment of ECE, Vidya Academy of Science and Technology, Thrissur, 2023.
4. V. Prakash, H. Singh, and N. Nalini, "Smart medicine reminder for old people," VIT University, Vellore, 2022.
5. D. Ameta, K. Mudaliar, and P. Patel, "Medication reminder and health-care – an android application," Gandhinagar Institute of Technology, Gujarat, India, 2021.
6. J. Ramkumar, C. Karthikeyan, E. Vamsidhar, and K. N. Dattatraya, "Au-tomated pill dispenser application based on IoT for patient medication," in *IoT and ICT for Healthcare Applications*, 2020.
7. Abhijith M et al., "IoT based smart medicine dispenser: A technological solution for medication," in *Conference on Emerging Technologies*, 2020.

8. Dayananda P. and Upadhya A.G., “Development of smart pill expert system based on IoT,” in *SPEC 2.0 Conference Proceedings*, 2020.
9. D. V. Raju, K. A. Pai, P. N., Yadukumari, and R. M., “IoT based smart medicine box,” *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 2024.