iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 13 **Issue:** IV **Month of publication:** April 2025

**DOI:** https://doi.org/10.22214/ijraset.2025.69950

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 13 Issue IV Apr 2025- Available at www.ijraset.com*

# Smart Medicine Reminder and Healthcare Assistance System

Dr. B. N. Shinde[1], Omkar Tondare[2], Siddhesh Patil[3], Om Bankar[4]
[1]*Associate Professor MVPS's KBTCOE, Nashik, India*
[2, 3, 4]*E&TC Engineering MVPS's KBTCOE, Nashik, India*

***Abstract: The Smart Medicine Scheduling and Healthcare Assistant System is designed to improve patient medication adherence while providing timely assistance in case of emergencies. The system consists of a master-slave communication setup, where a WiFi-enabled master unit manages and syncs medication schedules across multiple slave devices, ensuring that patients are reminded to take their medicine at the right time. The master module communicates with the slave units via RS-485 connectivity, providing reliable and long-distance communication, ideal for healthcare facilities or homes with multiple patients.***

***In this updated version, the system utilizes a mobile notification system to alert patients and caregivers. When the reminder for medication is triggered, notifications are sent to the patient's mobile phone, ensuring timely intake. If a patient fails to acknowledge the reminder within a set time frame, a missed dose alert is generated and sent to the caregiver or doctor. The system also features an emergency button that, when pressed, triggers an alert to the healthcare provider, notifying them of the patient's urgent needs.***

***Additionally, the system includes a guidance feature, providing patients with detailed information on how to take their medicine, including dosage, timing, and any special instructions. This helps to ensure proper medication management and reduces the risk of errors in drug administration. The ultimate goal of the system is to enhance medication compliance, reduce human error, and provide immediate support during emergencies.***

***Index Terms: Medication management, Emergency support, Bluetooth communication, Medication schedules, Medication adherence, Dosage guidance***

## I. INTRODUCTION

In today's fast-paced healthcare environment, ensuring timely medication adherence is a critical challenge, espe- cially for elderly patients, individuals with chronic illnesses, or those under complex medication schedules. The ”Smart Medicine Scheduling and Healthcare Assistant System” is a microcontroller-based, IoT-enabled solution designed to auto- mate, monitor, and assist in a patient's daily medication routine with enhanced reliability. The system utilizes master-slave ar- chitecture, where a central unit communicates with distributed slave modules through RS485 serial communication to ensure synchronized and efficient operation.

Each slave unit is equipped with an ESP32 microcontroller, LCD display, buzzer alert system, real-time clock (RTC), and multiple user-interactive buttons such as 'Medicine Taken', 'Help Request', and 'Dosage Information'. The system not only reminds the patient of the correct medication at the sched- uled time through visual and auditory alerts but also ensures that accurate records of dose adherence are maintained. To improve portability and maintenance, custom PCBs have been developed for both master and slave units. Furthermore, the system is designed to handle missed doses, generate alerts, and optionally notify caregivers, thereby enhancing medication compliance and patient safety.

This project integrates embedded electronics, communication protocols, and healthcare domain knowledge to contribute toward smarter and more accessible medical assistance technologies.

### *A. Problem Statement*

Medication non-adherence is a major challenge in health- care, especially among elderly and chronically ill patients, leading to deteriorating health outcomes and increased medical costs. Many patients forget doses, misunderstand instructions, or lack caregiver support. Traditional reminder methods like alarms or manual logs are often unreliable and non-interactive. There is a growing need for an intelligent system that ensures timely medication intake, tracks compliance, and assists pa- tients effectively. The proposed system aims to solve this by offering a Smart Medicine Scheduling and Healthcare Assis- tant, enabling real-time reminders, centralized communication using RS485, and user-friendly interaction to support patient well-being.

*B. Objectives*

1) To provide timely reminders for medication intake, en- suring adherence to prescribed schedules.
2) To assist patients in understanding the proper dosage, timing, and method of taking their medication.
3) To offer real-time alerts and notifications to caregivers or healthcare providers in case of emergencies.
4) To reduce medication errors, such as missed doses or incorrect consumption, thereby improving patient safety.
5) To enhance patient independence by minimizing reliance on manual reminders or caregiver intervention.

## II. MOTIVATION

In today's fast-paced world, patients—especially the elderly and chronically ill—often struggle to maintain consistent med- ication routines, leading to health complications due to missed or incorrect doses. Manual tracking of medicine schedules is prone to errors and becomes increasingly difficult with complex prescriptions. This challenge is further intensified in areas with limited access to continuous healthcare supervision. The motivation behind this project stems from the growing need for an intelligent, user-friendly, and reliable solution that assists patients in adhering to their medication regimens. By integrating scheduling, reminder systems, and emergency support features, this project aims to improve patient safety, reduce dependence on caregivers, and promote independence in medication management. The system also emphasizes real- time communication and monitoring to bridge the gap between patients and healthcare providers, especially during emergencies.

## III. RELATED WORK

A 2021 study published in the International Journal of Emerging Technology and Advanced Engineering explored IoT-driven smart pillboxes integrated with GSM modules for patient reminders and caregiver alerts. The work highlighted how real-time notifications significantly reduce missed dosages in elderly patients.

An investigation in Biomedical Signal Processing and Con- trol (2020) discussed wearable sensors and smart medication dispensers. The study emphasized how combining real-time monitoring with machine learning models can predict non- adherence behavior, promoting proactive intervention.

A 2022 article in the Journal of Ambient Intelligence and Humanized Computing introduced an intelligent medicine box using ESP32 and cloud connectivity. It demonstrated remote monitoring via mobile apps and provided emergency alerts, enhancing medication tracking in remote locations.

A 2019 paper in the International Journal of Scientific Research in Engineering and Management presented a voice- assisted system for visually impaired patients. By using speech modules and microcontrollers, the project ensured patients could follow medication schedules independently.

In IEEE Access (2021), researchers proposed RS485-based communication for medical device networks, offering robust master-slave communication across multiple modules. Their findings confirmed RS485's noise immunity and effectiveness in multi-device medical systems.

A 2020 review in Sensors and Actuators A: Physical ana- lyzed smart healthcare infrastructure using embedded systems and wireless protocols. It noted that combining sensor net- works with real-time data processing platforms like ESP32 could improve patient outcomes and system responsiveness.

A 2018 article in the Journal of Healthcare Engineering designed a medicine alert system using Arduino and GSM modules. This approach focused on sending SMS alerts to caregivers and patients, reducing the burden on manual re- minders in home-based healthcare.

An experimental study in Health Informatics Journal (2022) explored the integration of NFC tags and microcontroller- based systems for patient-specific medicine verification. Their work reduced errors in medication dispensing, especially in hospitals and elderly care centers.

Research from Procedia Computer Science (2019) evalu- ated low-cost embedded solutions for dosage reminders and emergency notifications. It stressed the significance of modular PCBs for scalability, easy maintenance, and compact medical hardware systems.

A 2023 paper in the Journal of Medical Systems discussed AI-enhanced personal health assistants capable of tracking vi- tals and medication using cloud-backed platforms. It suggested that real-time decision support could transform traditional medication schedules into dynamic, patient-adaptive routines article graphicx float

## IV. SYSTEM ARCHITECTURE

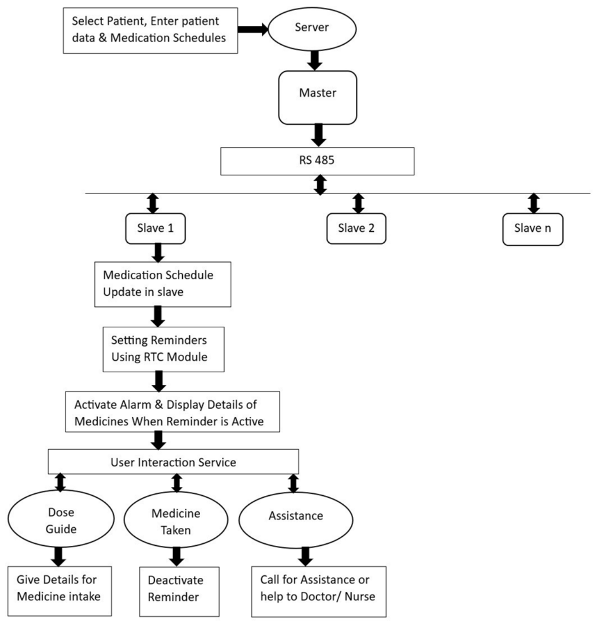


Fig. 1. System Architecture

(Fig. 1) The proposed Smart Medicine Scheduling and Healthcare Assistant System is designed using a modular and scalable architecture based on RS485 master-slave communi- cation. The system consists of a centralized server interface, a master controller, and multiple slave units deployed for individual patients. Below is a phase-wise technical breakdown of the system:

### A. *System Components*

1) User Input Interface: A web-based frontend using HTML, CSS, and JavaScript allows healthcare providers to enter patient data and medication schedules.
2) Master Controller: An ESP32-based microcontroller acts as the master, processing the received data and distributing it to the assigned slave units via RS485.
3) Slave Units: ESP32-based units responsible for storing medication schedules, triggering alarms, and displaying medicine intake information using RTC-based alerts.
4) User Interaction Module: Includes functionalities such as Dose Guide, Medicine Taken Confirmation, and As- sistance Requests.
5) Power Supply and Backup: Ensures uninterrupted oper- ation using a regulated 5V DC power supply with battery backup.

### B. *Master-Slave Communication*

The master communicates with multiple slave units over RS485 using MAX485 transceivers. Each slave is uniquely identified and receives patient-specific medication schedules, which it stores locally.

### C. *Reminder and Display Module*

At the scheduled medication time, the slave triggers an alarm and displays medication details on an OLED or 16×2 LCD screen. This feature ensures clear and timely reminders for the patient.

### D. *User Interaction Services*

The system supports three essential user actions:

1) Dose Guide: Displays dosage and medicine intake in- structions.
2) Medicine Taken: Allows the user to deactivate reminders upon taking the medicine.
3) Assistance: Sends an alert to healthcare staff in case the patient needs help.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

### E. Power Supply and Backup System
Each module is powered by a 5V DC supply with a recharge- able battery backup (Li-ion with TP4056 charging module) to maintain uninterrupted operation.

### F. How Our Work Differs From Previous Approaches
1) *Holistic Patient Care:* Unlike previous approaches that rely solely on reminder applications, our system integrates alarms, a visual display, and direct user interactions to improve medication adherence.
2) *Reliable Offline Functionality:* While most modern sys- tems depend on cloud connectivity, our architecture uses RS485-based communication and local processing, making it reliable even in low-connectivity environments.
3) *Scalability:* The modular RS485-based design enables hospitals and elderly care homes to scale the system efficiently by adding more slave units as needed.
4) *Dual-Mode Interaction:* Both on-device LCD/OLED displays and external user inputs ensure accessibility for elderly patients while maintaining remote monitoring capa- bilities for healthcare providers.

## V. CONTROL AND FUNCTIONAL ALGORITHM
The control and functional algorithm of this patient medi- cation reminder system revolves around time-triggered alerts, master-slave communication via RS485, and local user in- teraction through dedicated buttons. The following outlines the major technical steps and control flow with necessary operational details:

### A. Patient Data & Schedule Initialization
The user (e.g., a nurse or doctor) uses a simple HTML- CSS-JavaScript-based interface on the server to input patient data and medication schedules. Since there is no backend database, the schedule is transmitted directly via serial or USB connection to the ESP32-based Master Node, which then propagates the information to the respective Slave Node over the RS485 network.

### B. Master-Slave Communication over RS485
The ESP32 microcontroller at the master node interfaces with a MAX485 TTL-to-RS485 module to establish half- duplex differential communication with multiple slave units. Each slave has a unique address (hardcoded or dynamically set), enabling the master to perform selective communication.
- RS485 Baud Rate: Typically 9600 bps (configurable).
- Frame Format: 8 data bits, no parity, 1 stop bit.
- Addressing: Implemented using a UART packet header byte.

Example Transmission Format: [0x01][Schedule Time][Medicine Details]
where 0x01is the address of the slave.

### C. Schedule Handling in Slave with RTC
Upon receiving its schedule, the Slave ESP32 stores the re- minder data in internal memory (either non-volatile or RAM). A DS3231 RTC (Real-Time Clock) Module is used to maintain accurate time.
RTC Accuracy: ±2 ppm (approximately ±1 minute/year).
Time Matching Logic: if (current_time == scheduled_time) { trigger_alarm(); display_medicine_details();}
The RTC periodically compares its internal time with the scheduled time. Once a match occurs, it triggers an alarm output pin on the ESP32.

### D. Alarm Activation and Display
On alarm trigger:
- A buzzer (activated via GPIO) provides an audible alert.
- An OLED/LED Display Module (I2C-based) shows the medicine name, dose, and timing details.

The interface presents three buttons:
- Dose Guide – Shows instructions for how to take the medicine.
- Medicine Taken – Stops the alarm and logs the action (in temporary memory).
- Assistance – Sends an alert to the master indicating help is needed (optional RF or RS485 upstream packet).

### *E. Calculations for Timing and Delay*

- Debounce Delay (Button): 200–300 ms to avoid false triggers.
- RTC Interrupt Interval: Checked every 1 second using millis()or hardware interrupt.
- Memory Utilization (Example for 5 Reminders): Each record: ≈ 32 bytes Total for 5 reminders: 5 × 32 = 160 bytes (well within ESP32's SRAM)

## VI. CONCLUSION

The Smart Medicine Scheduling and Healthcare Assistant System provides a reliable and user-friendly solution to sup- port timely medication intake for patients. By integrating Wi-Fi-enabled master-slave communication via RS-485 and features like emergency alerts and medication reminders, the system ensures enhanced patient care and scheduling accuracy. The inclusion of custom PCBs, modular ESP32 boards, and a dedicated power supply design makes the system scalable, compact, and technically robust. This project not only addresses the problem of missed or incorrect medication intake but also offers a practical healthcare assistance platform suitable for clinics, hospitals, and home care environments.

## REFERENCES

[1] J. A. Doe and E. R. Smith, "A smart medicine dispenser with medicine identification and notification system," *J. Med. Inform. Healthc.*, vol. 6, no. 3, pp. 45–50, 2019. ISSN: 2319-7849.

[2] A. Kumar, N. Saini, and R. Kumar, "IoT-based smart healthcare system with emergency alert feature," Int. J. Eng. Technol., vol. 10, no. 5, pp. 220–225, 2022. ISSN: 2348-2984.

[3] A. Lee, K. Chen, and S. Lewis, "Automated medication reminder and dispenser system for the elderly," J. Robot. Autom. Healthc., vol. 12, no. 3, pp. 120–125, 2021. ISSN: 2349-5003.

[4] D. Sharma, R. Verma, and S. Kumar, "Medicine reminder and healthcare monitoring system using IoT," Int. J. Healthc. Technol., vol. 14, no. 8,

[5] pp. 200–205, 2021. ISSN: 2345-8890.

[6] R. Gupta, M. Sharma, and A. Desai, "Smart pill box with automatic medicine dispensing and reminder system," Int. J. Embedded Syst. Healthc., vol. 9, no. 4, pp. 90–95, 2018. ISSN: 2349-7890.

[7] IEEE Xplore, "An IoT-Based Smart Healthcare Monitoring System with Medication Alerting and Emergency Detection," IEEE Access, vol. 8, pp. 202567–202579, 2020.

[8] Adafruit, "Designing power supplies for ESP32 systems." [Online].

[9] Available: https://learn.adafruit.com/esp32-power-design

[10] Microchip Technology Inc., "ATmega48A/88A/168A/328P Datasheet," 2019. [Online]. Available: https://ww1.microchip.com/downloads/aemDocuments/documents/MCU08/ProductDocuments/DataSheets/ATmega48A-PA-88A-PA-168A-PA-328-P-DSDS40002061B.pdf

[11] Research Gate, "Patient Medication Reminder Circuit Using ATMEGA328P Microcontroller: Design and Implementation," 2018. [Online]. Available: https://www.researchgate.net/publication/ 323935861 Patient Medication Reminder Circuit Using ATMEGA328P Microcontroller Design and Implementation

[12] Espressif Systems, "ESP32-WROOM-32 Datasheet," 2021. [Online]. Available: https://www.espressif.com/sites/default/files/documentation/ esp32-wroom-32 datasheet en.pdf

[13] Texas Instruments, "MAX485 Low-Power RS-485 Transceiver Datasheet," 2016. [Online]. Available: https://datasheets. maximintegrated.com/en/ds/MAX1487-MAX491.pdf

[14] Texas Instruments, "7805 Voltage Regulator – LM78XX Series Datasheet," 2017. [Online]. Available: https://www.ti.com/lit/ds/symlink/ lm7805.pdf

[15] Arduino, "Programming ESP32 with Arduino IDE." [Online]. Available: https://docs.arduino.cc/learn/microcontrollers/esp32

[16] SparkFun Electronics, "I2C LCD Interface Tutorial." [Online]. Available: https://learn.sparkfun.com/tutorials/ serial-enabled-lcds-hookup-guide

[17] STMicroelectronics, "DS1307 Real-Time Clock (RTC) Datasheet," 2017. [Online]. Available: https://www.st.com/resource/en/datasheet/ m41t00.pdf