Innovation & Entrepreneurship Hub for Educated Rural Youth (SURE Trust

SMART MEDICINE REMINDER SYSTEM

The domain of the Project

Embedded Systems and IoT

Mentor

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(Junior Engineer , ATFAAL Innovations)

By

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(B.Tech, 4th year pursuing)

Period of the project

July 2025 to August 2025

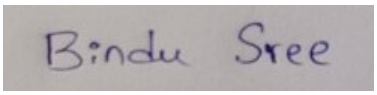
Innovation & Entrepreneurship Hub for Educated Rural Youth (SURE Trust

SURE ProEd

Declaration

The project titled "**SMART MEDICINE REMINDER SYSTEM**" has been mentored by **MEHAK MAJEED**, organised by SURE Trust, from March 2025 to August 2025, for the benefit of the educated unemployed rural youth for gaining hands-on experience in working on industry relevant projects that would take them closer to the prospective employer. I declare that to the best of my knowledge the members of the team mentioned below, have worked on it successfully and enhanced their practical knowledge in the domain.

Name | **Signature**

Ms.B.Bindu Sree | 

Mentor | **Signature**

MEHAK MAJEED | *mehak*

(Junior Engineer—ATFAAL innovations)

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Prof. Radhakumari
Executive Director & Founder
SURE Trust

Table of contents

Executive Summary

Medicine Reminder is an IoT-based healthcare project designed to help patients, especially the elderly and those with chronic illnesses, take their medicines on time. Missing or delaying doses often reduces treatment effectiveness and may lead to serious health risks. This system provides an affordable, reliable, and user-friendly solution to address this challenge.

The project uses an **ESP32 microcontroller** with an **RTC DS3231 module** for accurate timekeeping, a **16x2 I2C LCD** to display current time and medicine details, a **buzzer** for alerts, and **push buttons** to confirm intake or manage schedules. At each scheduled time, the LCD shows the medicine name and dosage, while the buzzer reminds the patient. If the patient confirms intake, the status is recorded; if not, an **automatic notification** is sent to the caretaker via **Telegram or SMS** using Wi-Fi.

A **web-based interface** enables patients or caregivers to easily **add, delete, or view medicines**. The complete schedule—medicine names, timings, types, and intake status—is accessible on the web. Additionally, the system sends a **daily summary report** at a specified time, highlighting medicines taken and missed, ensuring better monitoring and health tracking.

The solution ensures:

- Timely reminders with LCD and buzzer alerts.
- Remote caretaker notifications for missed doses.
- Daily medicine reports for record-keeping.
- Flexible web interface for schedule management.
- Reliable RTC-based time accuracy.

By integrating hardware and IoT, the **Medicine Reminder** improves healthcare outcomes through enhanced medication adherence. Its low cost, scalability, and simplicity make it suitable for **homes, hospitals, and elderly care centers**.

Introduction

1. Background and Context of the Project

In today's healthcare environment, **medication non-adherence** has become a major concern, particularly among elderly patients, individuals with chronic diseases, and those requiring long-term treatments. Studies show that a significant percentage of patients forget or skip their prescribed doses, which can lead to treatment failure, complications, or even hospitalization. Traditional solutions such as pill organizers or manual reminders often fail due to lack of automation and real-time monitoring.

The advancement of **Internet of Things (IoT)** and **embedded systems** has opened new possibilities in addressing this issue. Smart healthcare devices can now provide real-time tracking, automated alerts, and remote communication between patients and caregivers. The integration of microcontrollers, sensors, and wireless connectivity makes it possible to design low-cost, efficient, and user-friendly reminder systems.

The **Medicine Reminder System** was conceptualized in this context, combining an **ESP32 microcontroller** with **RTC DS3231** for accurate timekeeping, an **LCD display** for information output, and a **buzzer** for alert notifications. Through **Wi-Fi connectivity**, the system ensures that caregivers are informed instantly via **Telegram or SMS** if a medicine dose is missed. Additionally, the inclusion of a **web interface** for managing medicine schedules makes the system flexible and easy to use.

Thus, this project is rooted in the larger context of **digital healthcare transformation**, where technology is leveraged to improve patient compliance, reduce health risks, and enhance quality of life. It bridges the gap between conventional reminder methods and modern IoT-based smart healthcare solutions.

2. Problem Statement / Goals of the Project

One of the critical challenges in healthcare is ensuring that patients take their prescribed medicines on time and in the correct dosage. Elderly individuals, patients with chronic illnesses, and those undergoing long-term treatment often forget or delay their medication intake. This non-adherence can result in reduced treatment effectiveness, worsening of health conditions, and in severe cases, hospitalization.

Existing solutions such as manual alarms, pillboxes, or calendar reminders are often ineffective because they lack real-time monitoring, confirmation of medicine intake, and

communication with caregivers. Moreover, these traditional methods do not provide an automated record of medicine adherence.

Therefore, there is a strong need for a smart, automated, and connected system that not only reminds patients to take medicines but also tracks whether the medicine was taken and alerts caregivers immediately in case of a missed dose. This project aims to address this gap by designing an IoT-based Medicine Reminder System that ensures timely reminders, patient confirmation, and remote caregiver notifications.

3. Scope and Limitations of the Project

Scope

1. The system continuously tracks real-time using the RTC (Real Time Clock) to provide accurate medicine reminders.
2. LCD displays the current time on the first row and medicine details (name, type, time) on the second row for user clarity.
3. A buzzer alert ensures patients are immediately notified when it's time to take the medicine.
4. A confirmation button allows the patient to acknowledge intake, helping to maintain accurate logs.
5. If the medicine is not confirmed within a set period, an automatic SMS/Telegram notification is sent to the caregiver.
6. The web server hosted on ESP32 allows users to add, delete, and update medicines dynamically.
7. Medicine schedules (morning, afternoon, evening, custom times) are fully configurable.
8. The system stores medicine history and generates adherence reports that can be viewed online.
9. Scalable architecture allows integration of more sensors (e.g., pill box detection, weight sensors) in future versions.
10. Designed to work in low-resource environments with minimal hardware and no dependency on external servers.
11. Suitable for home use, hospitals, old-age homes, and clinics to assist in reliable healthcare management.
12. Provides flexibility to expand with IoT platforms like Blynk, MQTT, or cloud dashboards for remote monitoring.

Limitations

Despite its usefulness, the system has certain limitations. It requires stable Wi-Fi connectivity to send notifications, which may not be available in all areas. The memory capacity of the ESP32 restricts the number of medicine schedules that can be stored at once. The confirmation of medicine intake depends on manual button pressing, which means the system cannot physically verify whether the medicine was actually consumed. It is therefore less effective for patients with severe memory loss or mobility challenges who may forget or be unable to press the button. Furthermore, the system does not integrate advanced health monitoring sensors, which could otherwise improve its functionality for chronic or critical patients.

4. Innovation Component in the Project

The system combines hardware (ESP32, RTC, LCD, buzzer, push buttons) with IoT features (Wi-Fi, web server, Telegram/SMS alerts) for a complete medicine reminder solution.

1. Unlike conventional reminder systems, it provides **two-way interaction** — patients confirm intake via a push button, and caregivers get alerts if doses are missed.

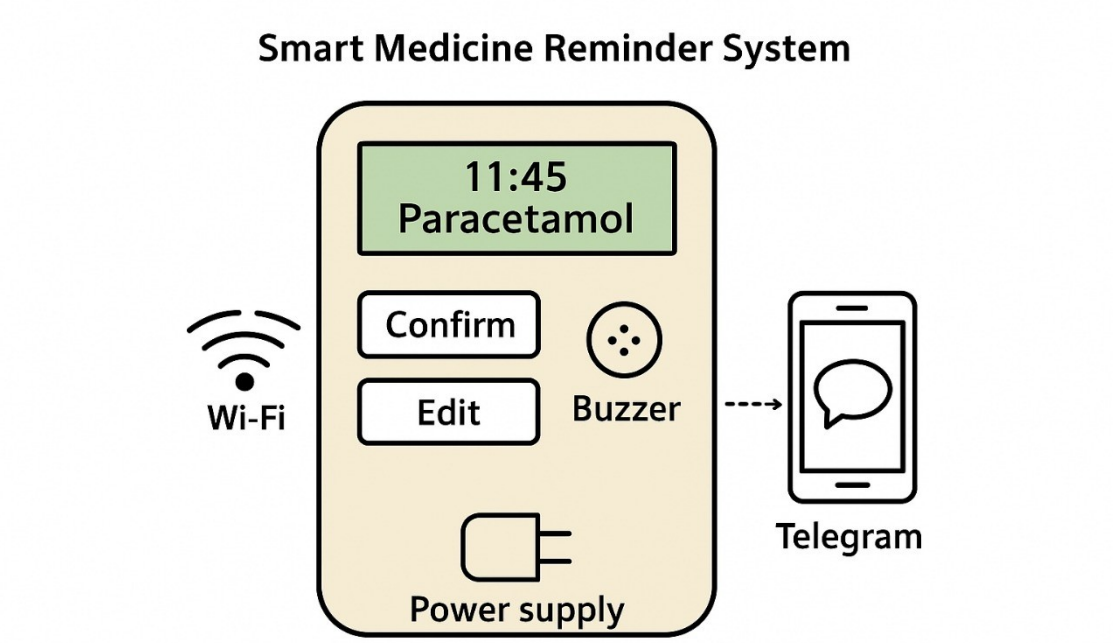
2. The integration of **real-time monitoring** with daily medicine reports offers both instant and long-term tracking of adherence.

3. The use of an **IoT-based web interface** enables remote management of medicine schedules without needing direct access to the device.

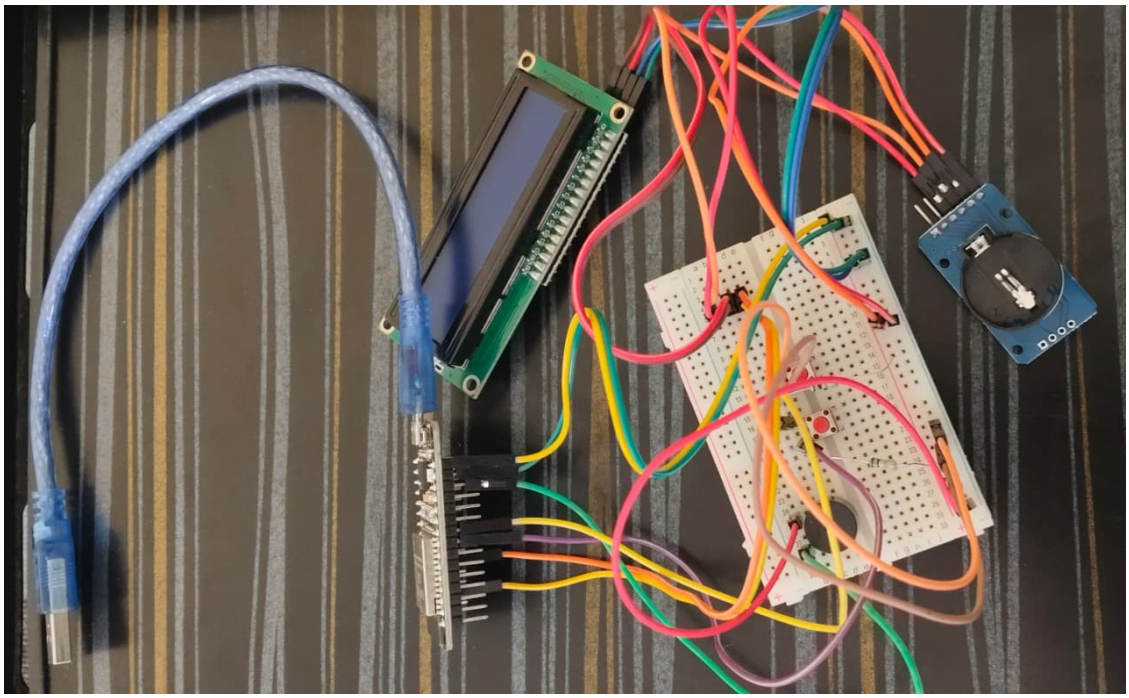
4. The modular architecture allows future expansion, such as connecting multiple patients’ devices to a central monitoring system.

System Diagram

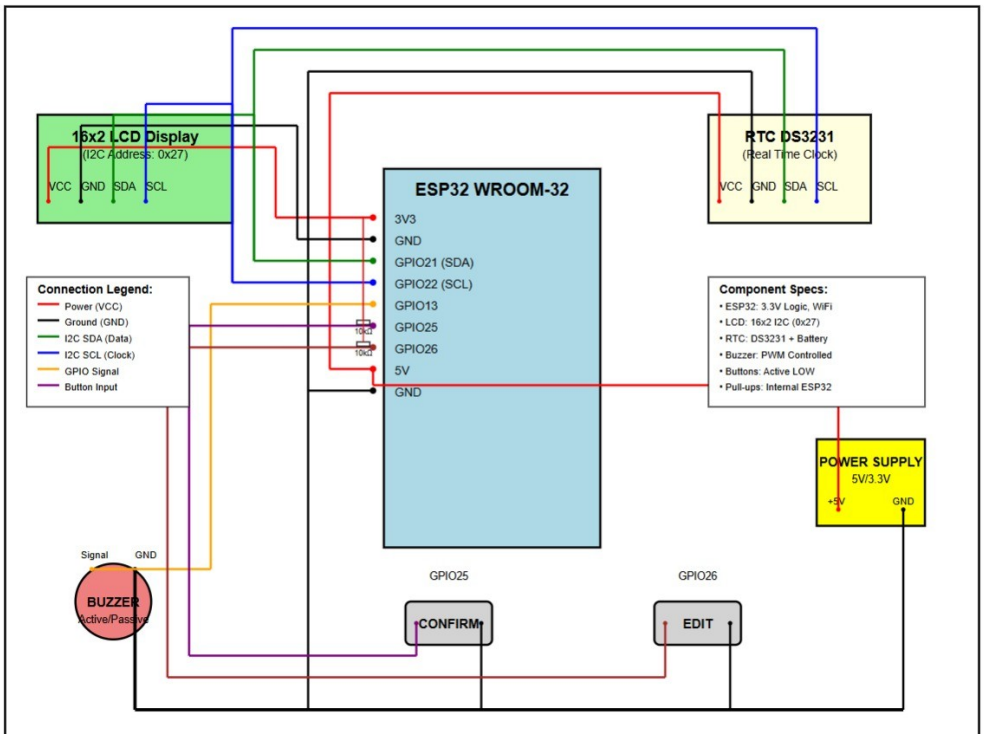
A. Mechanical Representation of Smart Medicine Reminder System



B. Electrical Representation of Smart Medicine Reminder System



C. Electronics Representation of Smart Medicine Reminder System



Project Objectives

1. Objectives and Goals

The key objectives of the **Smart Medicine Reminder System** are:

1. **Accurate Time Tracking**
   ◦ Use an RTC (DS3231) to maintain precise timing for medicine schedules.
2. **Medicine Schedule Management**
   ◦ Allow users/caretakers to add, delete, and update medicine reminders via a web interface.
3. **Real-Time Notifications**
   ◦ Trigger buzzer and LCD alerts at scheduled times to remind patients of medicine intake.
4. **User Confirmation Mechanism**
   ◦ Use a push button for patients to confirm that they have taken the medicine.
5. **Missed Dose Alerts**
   ◦ If the patient does not confirm, send SMS/Telegram notifications to the caretaker using Wi-Fi.
6. **LCD Display Updates**
   ◦ Continuously show current date/time on the first row and medicine details on the second row.
7. **IoT Connectivity**
   ◦ Provide web dashboard access to view medicine schedules, intake status, and generate reports.
8. **Scalable Design**
   ◦ Support multiple medicines and flexible scheduling (morning, afternoon, evening, night).
9. **Enhanced Patient Safety**
   ◦ Reduce missed doses, improve medication adherence, and ensure caretaker awareness.

2. Expected Outcomes

- **Reduced Missed Doses**
  ◦ Caretakers are notified via SMS/Telegram if the patient forgets to take the medicine.
- **Reliable Medicine Reminders**
  ◦ Patients receive timely alerts through buzzer and LCD to take

medicines without delays.

- **Improved Patient Compliance**
  ◦ Regular reminders and confirmations ensure higher adherence to prescribed schedules.
- **Real-Time Information Display**
  ◦ LCD continuously shows current time/date and medicine details, keeping patients informed.
- **Remote Monitoring**
  ◦ Caretakers can monitor medicine intake status and schedules via a web server.
- **Scalability & Flexibility**
  ◦ System can handle multiple medicines, customizable times, and easy addition of new schedules.
- **User-Friendly Interface**
  ◦ Simple push-button confirmation and web-based scheduling make it accessible to elderly users.
- **Enhanced Safety & Care**
  ◦ Early alerts and caretaker notifications reduce health risks caused by missed medications.

3. Deliverables

- **Embedded Software**
  ◦ Complete ESP32 firmware with Wi-Fi, web server, LCD display control, buzzer alerts, push-button logic, and API integration for SMS/Telegram notifications.
- **Hardware Prototype**
  ◦ Fully assembled Smart Medicine Reminder System using ESP32, RTC, LCD, buzzer, and push buttons.
- **Web Interface**
  ◦ Local server hosted on ESP32 to add, delete, and view medicine schedules with real- time updates.
- **Notification System**
  ◦ SMS/Telegram alert system for notifying caretakers when medicine intake is missed.
- **Demonstration**
  ◦ Working demo showing scheduling, reminder alerts, medicine intake confirmation, and caretaker notification in case of missed doses.

Methodology and Results

Hardware Setup

1. **ESP32 Microcontroller**
    - Acts as the central processing unit.
    - Handles scheduling, LCD updates, buzzer control, button inputs, and Wi-Fi connectivity.
2. **RTC DS3231 Module**
    - Provides accurate real-time clock for medicine scheduling.
    - Ensures reminders are triggered at correct times even if ESP32 restarts.
3. **16x2 LCD Display (I2C interface)**
    - Displays current time on the first row.
    - Shows medicine name and reminder details on the second row.
4. **Buzzer**
    - Generates an audio alert when it’s time to take medicine.
    - Stops ringing when the patient confirms intake using a push button.
5. **Push Buttons**
    - **Medicine Confirmation Button**: Patient presses after taking medicine to stop the alert.
    - **Add/Delete Button** (optional): Used to modify medicine schedules manually.
6. **Power Supply**
    - 5V regulated supply via USB adapter or battery backup for portability.
7. **Wi-Fi Module (inbuilt in ESP32)**
    - Connects system to the internet.
    - Sends SMS/Telegram notifications to caretaker if medicine is missed.

- Hosts a web server for adding/deleting medicines and viewing the schedule.

Software and Tools

1. **Arduino IDE**
   - Used for coding and uploading programs to the ESP32.
   - Provides serial monitor for debugging.
2. **ESP32 Board Package**
   - Installed in Arduino IDE to support ESP32 programming.
   - Contains necessary drivers and libraries.
3. **Required Libraries**
   - **WiFi.h** → Enables Wi-Fi connectivity.
   - **HTTPClient.h** → For sending HTTP requests (SMS/Telegram API).
   - **Wire.h** → For I2C communication with RTC and LCD.
   - **LiquidCrystal_I2C.h** → To interface 16x2 LCD with ESP32.
   - **RTClib.h** → To access and manage time from DS3231 RTC.
   - **WebServer.h** → For hosting a local web server to add/delete medicines.
4. **APIs and Online Tools**
   - **Telegram Bot API** → For sending missed-medicine alerts to caretaker.

Methodology:

1. System Initialization

• ESP32 connects to Wi-Fi
• RTC initializes and provides current time
• LCD displays current time on the first row and Medicine name on the second row

2. Medicine Scheduling

• Each medicine entry has:
  ◦ Name
  ◦ Time
  ◦ Type (Morning / Afternoon / Evening)
• User can add or delete medicines using the webpage (via second push button activation)

3. Reminder Alert

• At the scheduled time, the system checks RTC
• If a medicine is due:
  ◦ LCD shows medicine name on the second row
  ◦ Buzzer rings until Button 1 (confirm button) is pressed
  ◦ Timer starts to wait for confirmation for 30sec

4. Medicine Confirmation

• If user presses Button 1:
  ◦ Status changes to *Taken*
  ◦ Telegram bot sends a message: Medicine taken :Name and Time
• If user does not press Button 1 within timeout:
  ◦ Status changes to *Missed*
  ◦ Telegram bot sends a message: Medicine Missed : Name and time

5. Web Page Interface (Button 2)

• When user presses Button 2, ESP32 starts web server interface
• From webpage:
  ◦ User can add a new medicine (name, time, type) by pressing push button >2sec
  ◦ User can delete a medicine from the schedule by pressing push button once

6. Telegram Reporting

• Each event (Taken/Missed) is immediately reported
• At the end of the day, the bot sends a daily report summary

7. Continuous Monitoring

• Loop continuously checks RTC and medicine schedule
• Updates LCD every second with current time
• Alerts only when medicine event occurs

Project Architecture

The Smart Medicine Reminder System is built around the ESP32 microcontroller, which integrates hardware modules and software logic to provide medicine reminders, alerts, and reporting. The architecture can be divided into four layers:

1. Input Layer

- **RTC Module (DS3231):** Provides accurate real-time clock and date information.

- **Push Buttons:**
    - **Confirm Button:** Patient confirms medicine intake.
    - **Add/Delete Button:** Allows modification of medicine schedules.

2. Processing Layer

- **ESP32 Microcontroller:**
    - Reads current time from RTC.
    - Compares with stored medicine schedule.
    - Controls LCD, buzzer, and communication interfaces.
    - Connects to Wi-Fi for IoT functionalities.
    - Handles web interface and data storage.

3. Output Layer

- **LCD (16x2 I2C):** Displays current time and upcoming/pending medicines.
- **Buzzer:** Generates audio alerts at medicine time.
- **LED Indicators (optional):** Visual indication of alerts.

4. Communication & IoT Layer

- **Wi-Fi Module (ESP32 inbuilt):** Enables internet connectivity.
- **Web Server:** Shows full medicine schedule (name, time, status).
- **Telegram/SMS API (Textbelt/Fast2SMS):** Sends alerts to caretaker if medicine is missed.
- **IoT Dashboard (optional):** Logs medicine adherence reports.

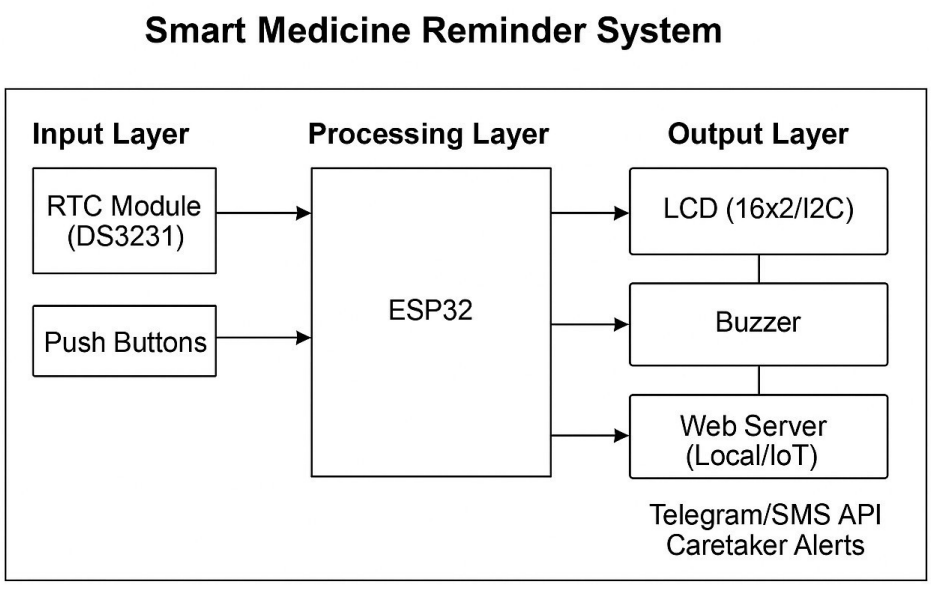
Results

1. **Accurate Medicine Alerts**
    - The system successfully generated reminders at the scheduled times using the **RTC module (DS3231)**.
    - The buzzer and LCD worked together to notify the patient.
2. **Medicine Intake Confirmation**
    - The **push button** mechanism allowed the patient to confirm medicine intake.
    - Confirmation status was updated on the LCD and stored in the ESP32.
3. **Missed Dose Alerts**

- If the patient failed to press the confirmation button, the system automatically sent an **SMS/Telegram alert** to the caretaker.
- This ensured timely notification to prevent missed medication.

4. **Web Dashboard Functionality**
    - The ESP32 hosted a **web interface** that displayed the complete medicine schedule, including:
        - Medicine name
        - Scheduled time
        - Status (Taken / Missed)
5. **Real-Time Clock Synchronization**
    - The RTC maintained precise timing even after power resets.
    - ESP32 successfully synchronized with RTC for scheduling.
6. **IoT Integration**
    - Wi-Fi connectivity allowed the system to send data to external platforms (SMS API / Telegram bot / IoT dashboard).
    - Remote monitoring was achieved.
7. **System Reliability**
    - The device was tested for multiple medicine schedules (morning, afternoon, evening).
    - Alerts and reporting worked consistently without failure.

BLOCK DIAGRAM:



5.Pictures

FIGURE 1: ESP32 MICRO CONTROLLER

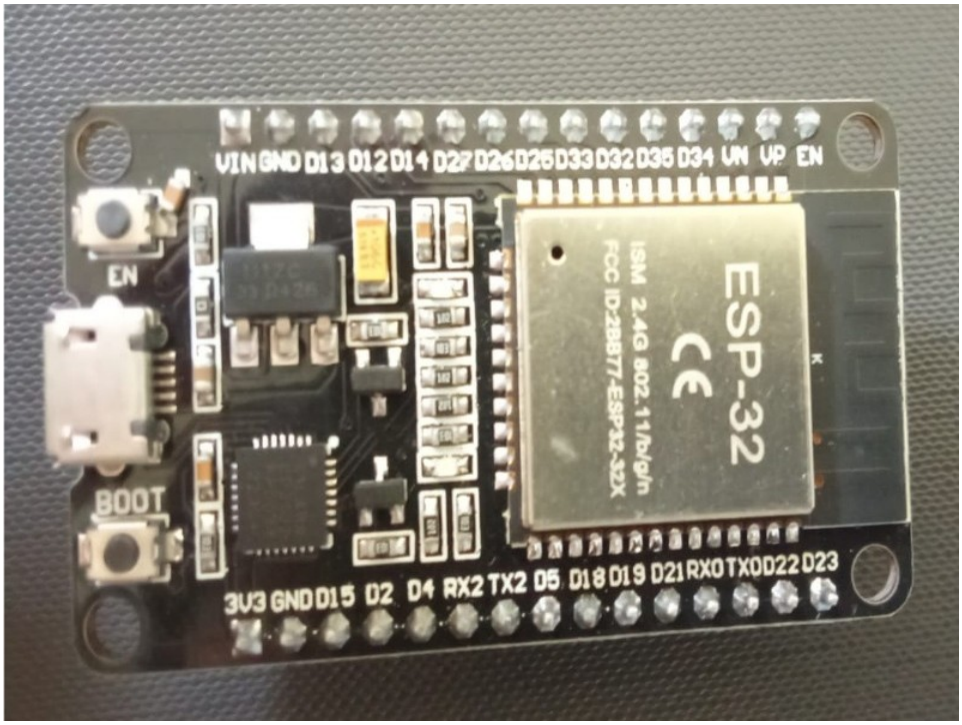


FIGURE 2: I2C LCD DISPLAY

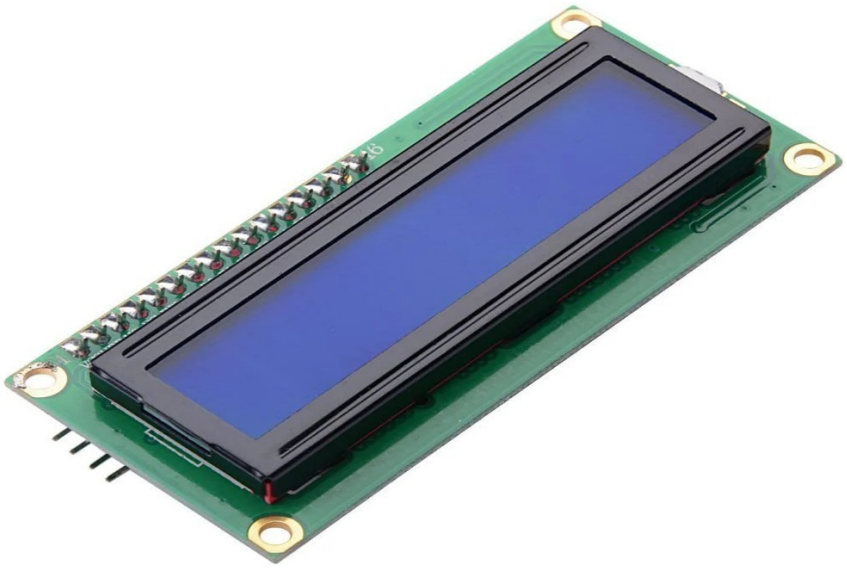


FIGURE 3: RTC MODULE (DS3231)

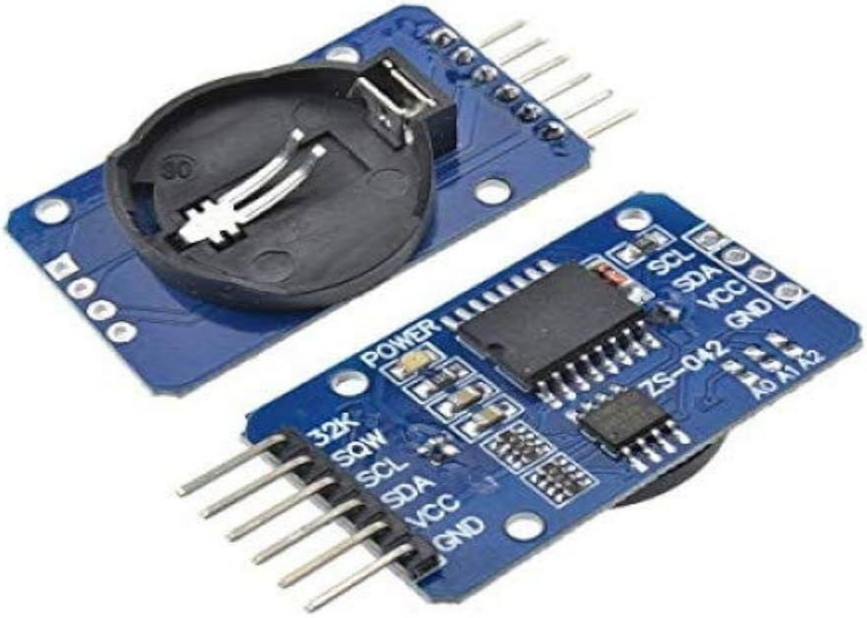
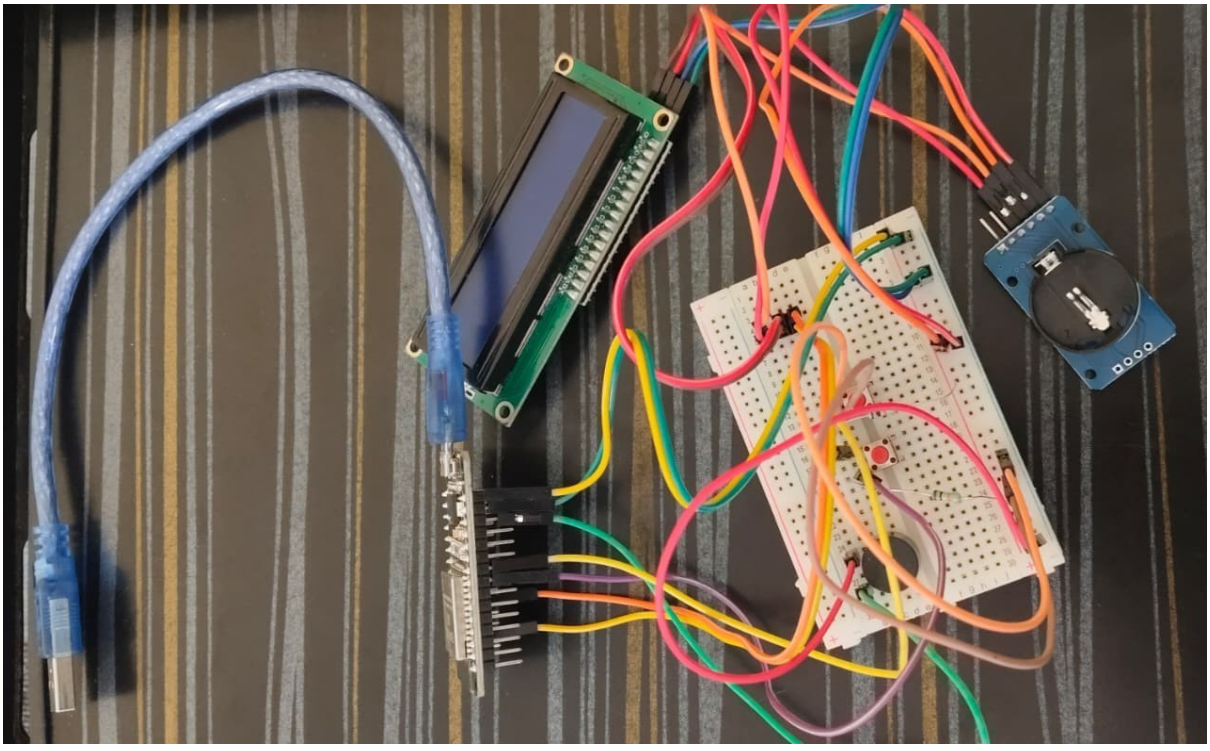


FIGURE 4: HARDWARE CONNECTION



RESULT:

FIGURE 5: OUTPUT ON LCD

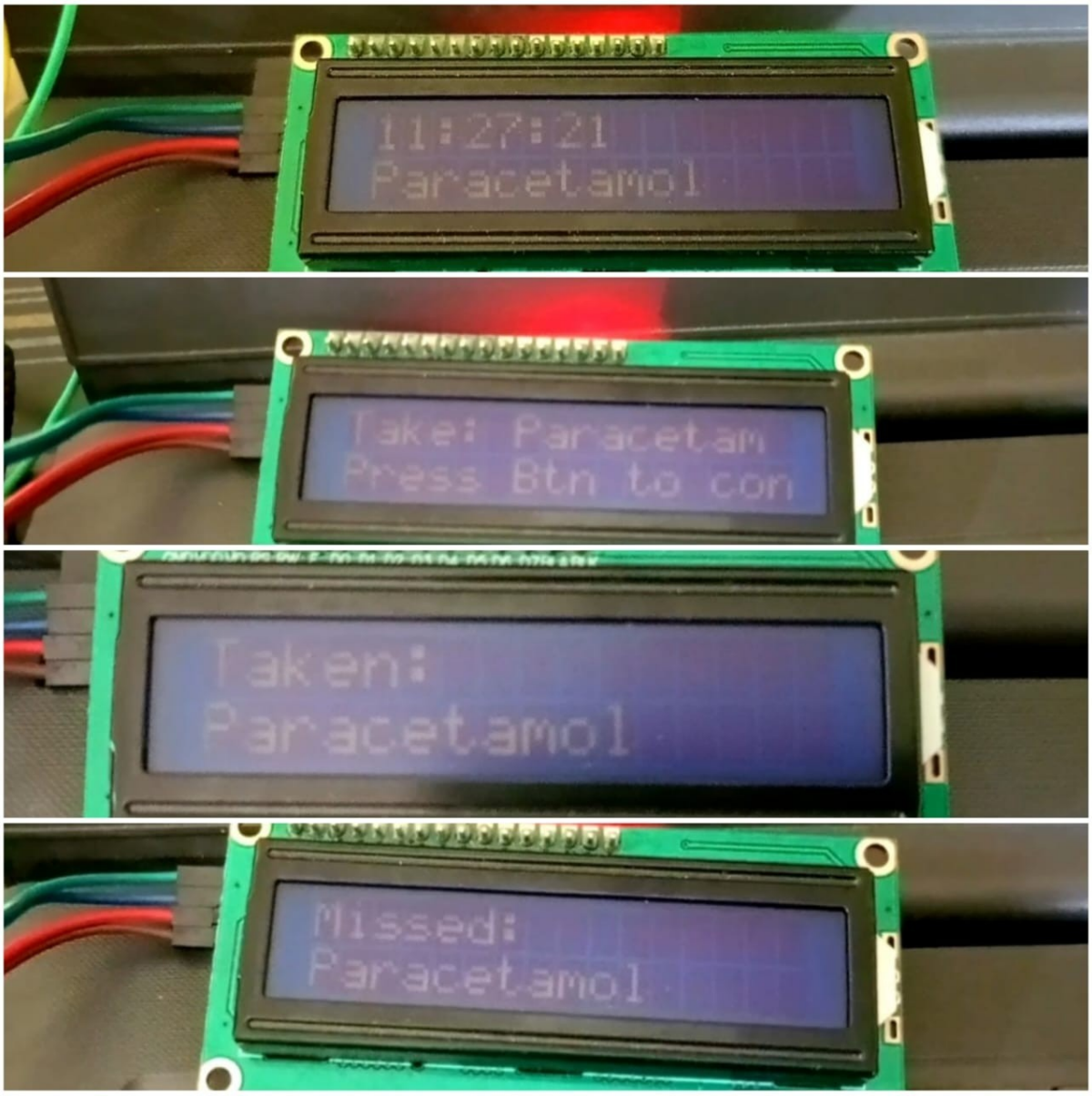


FIGURE 6:WEB PAGE

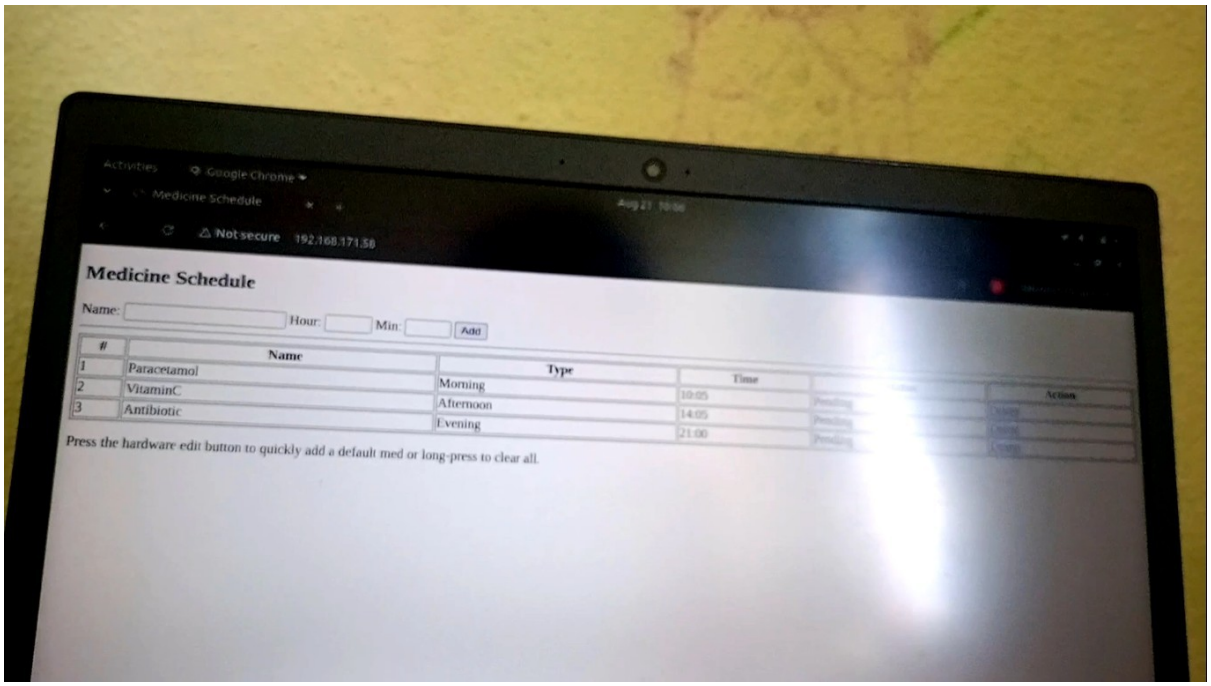


FIGURE 7: SERIAL MONITOR

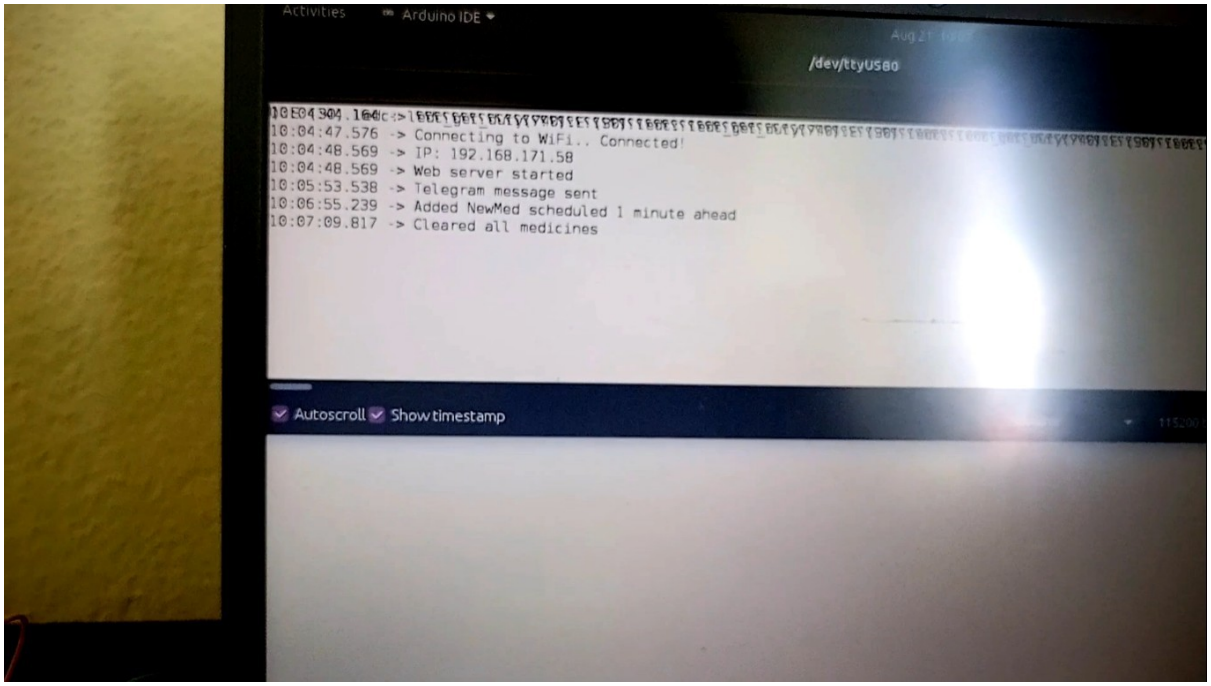


FIGURE 8: TELEGRAM MESSAGE

Social/Industry Relevance

The Smart Medicine Reminder System addresses a major social challenge: ensuring patients take their medicines on time, especially elderly individuals, people with chronic illnesses, and those with complex medication schedules. Non-adherence to prescribed medication can result in health deterioration, complications, and even life-threatening conditions, in addition to increased healthcare costs and frequent hospital visits. By providing timely audible and visual alerts, along with a confirmation mechanism via a push button, the system encourages patients to follow their medicine schedule accurately. Moreover, if a dose is missed, instant notifications are sent to caregivers via Telegram, ensuring remote monitoring and prompt intervention.

From a social perspective, this system promotes **better patient compliance, reduces caregiver burden, and enhances overall health outcomes**. It empowers patients to take responsibility for their health while providing peace of mind to family members and healthcare providers. The system is also user-friendly, cost-effective, and suitable for **home care environments**, making it accessible to a wide range of users in rural or urban areas.

From an industry perspective, the project demonstrates the practical application of **IoT and embedded systems in healthcare technology**. By integrating **ESP32 microcontroller, RTC DS3231, I2C LCD, buzzer, buttons, Wi-Fi connectivity, and cloud notifications**, it highlights the feasibility of **smart health monitoring solutions**. Such solutions are relevant for **hospitals, assisted living facilities, nursing homes, and telemedicine platforms**, where patient adherence and real-time monitoring are critical. The project can be **scaled and customized** to support multiple users, cloud-based data logging, predictive analytics, and even integration with **automated medicine dispensers**.

Overall, the Smart Medicine Reminder System is highly relevant both socially and industrially. It addresses a **real-world healthcare problem** with a practical, cost-effective solution while showcasing the potential of **IoT-driven healthcare innovations** to improve quality of life, patient safety, and operational efficiency in the healthcare sector

Learning and Reflection

1. New Learnings

- Gained experience integrating RTC DS3231 for accurate timekeeping and implementing time-based scheduling logic for daily medicine reminders.
- Developed skills in hardware interfacing with 16x2 I2C LCD, buzzer alerts, and push buttons (short and long press actions with debouncing).
- Learned Wi-Fi connectivity and IoT integration, including sending Telegram notifications and hosting a web server for adding, deleting, and viewing medicines remotely.
- Improved software design skills, including structuring data with C++ structs and arrays, handling scheduling logic, flag management, and error handling.
- Learned system integration and problem-solving, combining hardware, software, and cloud notifications into a cohesive, user-friendly healthcare solution.
- Developed practical skills in debugging, testing, deployment, and designing user-centric IoT applications for real-world healthcare problems.
- Learned programming ESP32 for real-time embedded applications, handling multiple tasks like LCD updates, button inputs, buzzer alerts, and web server simultaneously.

2. Overall Experience

Working on the Smart Medicine Reminder System was a highly enriching and practical experience. It provided hands-on exposure to embedded systems programming, IoT integration, and hardware-software interfacing. I gained practical skills in ESP32 programming, RTC management, LCD display, button handling, and buzzer alerts, as well as implementing web-based controls and cloud notifications via Telegram.

The project strengthened my abilities in system design, problem-solving, debugging, and real-time scheduling, and taught me how to integrate multiple components into a cohesive,user-friendly healthcare solution.

Libraries and Functions Used

A. Libraries Used:

```
#include <WiFi.h>
#include <HTTPClient.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <RTClib.h>
#include <WebServer.h>
```

B. Functions from your code:

- void sendTelegramMessage(String message)
- void sendDailyReport()
- void connectToWiFi()
- void setupMedicines()
- void handleRoot()
- void handleAdd()
- void handleDelete()
- void setup()
- void loop()

C. Functions from libraries:

- WiFi.begin(ssid, password) – connects to Wi-Fi
- WiFi.status() – gets Wi-Fi connection status
- WiFi.localIP() – gets ESP32's IP address
- HTTPClient.begin(url) – starts HTTP connection
- HTTPClient.GET() – sends HTTP GET request
- HTTPClient.end() – closes HTTP connection

- Wire.begin() – starts I²C communication
- rtc.begin() – initializes RTC
- rtc.adjust(DateTime) – sets RTC time
- rtc.now() – gets current date and time from RTC
- lcd.begin() – initializes LCD
- lcd.backlight() – turns on LCD backlight
- lcd.clear() – clears LCD display
- lcd.setCursor(x, y) – sets cursor position on LCD
- lcd.print(text) – prints text on LCD
- server.on(path, method, handler) – sets up web page route
- server.begin() – starts web server
- server.handleClient() – processes incoming requests
- server.send(code, type, message) – sends HTTP response
- server.hasArg(name) – checks if parameter exists
- server.arg(name) – gets value of a parameter
- ledcSetup(channel, freq, resolution) – configures PWM for buzzer
- ledcAttachPin(pin, channel) – attaches pin for PWM output
- ledcWriteTone(channel, frequency) – produces sound with buzzer
- pinMode(pin, mode) – sets pin mode
- digitalRead(pin) – reads digital input from pin
- delay(milliseconds) – pauses program for a given time

Conclusion and Future Scope

Conclusion

The Smart Medicine Reminder System effectively demonstrates the integration of **embedded systems, IoT technologies, and real-time hardware interfacing** to address a real-world healthcare problem. By combining **ESP32 microcontroller, RTC DS3231, I2C LCD, buzzer, push buttons, and Wi-Fi connectivity**, the system provides accurate **time-based medicine reminders**, allows **user confirmation**, and sends **automatic notifications via Telegram** in case of missed doses.

Through this project, I gained valuable experience in **system design, programming, and debugging**, as well as skills in **hardware-software integration, time scheduling, web server implementation, and cloud communication**. The project also taught me the importance of **user-friendly design**, practical problem-solving, and **reliable alert mechanisms** for healthcare applications.

Overall, this project not only reinforced my technical knowledge in **embedded IoT systems** but also demonstrated the potential for creating **smart healthcare solutions** that can improve patient adherence and safety. It serves as a solid foundation for developing **more advanced and scalable IoT-based health monitoring systems** in the future.

Future Scope

The Smart Medicine Reminder System has significant potential for **enhancement and expansion** in future developments:

1. **Mobile App Integration**
    - Develop a companion **mobile app** to receive alerts, confirm medicine intake, and manage schedules remotely.
2. **Advanced Notifications**
    - Integrate **SMS, email, or push notifications** in addition to Telegram for better accessibility.

3. **Cloud Data Logging & Analytics**
    - Store **medicine intake records in the cloud** for tracking adherence over time.
    - Generate **reports and statistics** for patients or caregivers.

4. **Multiple User Support**
    - Extend the system to handle **multiple patients** with personalized schedules.
5. **Voice Alerts & Assistants**
    - Integrate **voice notifications** using speakers or smart assistants like Alexa or Google Assistant.
6. **Automated Medicine Dispensing**
    - Combine with **servo-controlled pill dispensers** for automatic delivery of the correct medicine at the scheduled time.
7. **Machine Learning & Predictive Alerts**
    - Analyze adherence patterns and provide **predictive reminders** or alerts for missed doses.
8. **Scalable IoT Platform**
    - Connect multiple devices to a **central IoT platform** for hospitals or nursing homes to monitor patient adherence remotely.