

SMART MEDICINE REMINDER BOX



EMMBEDDED SYSTEMS AND DESIGN -EC6020 PROJECT PROPOSAL

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1.INTRODUCTION

The Smart Medicine Reminder Box is a helpful tool to assist patients in taking their medicines on time. It combines easy-to-use technology and reliable hardware to solve problems like missing doses, taking medicines at the wrong times, or wrong people accessing them. The system lets users set times to take their medicines, get reminders, and store medicines safely. The locking system makes sure medicines are only taken at the right times, preventing mistakes, especially in homes with children. This box helps patients follow their medicine schedules better and stay safe, leading to improved health.

2.PURPOSE

The Smart Medicine Reminder Box addresses the critical issue of missed or incorrect medication intake, a problem that can lead to severe health complications or reduced treatment efficacy. This innovative solution ensures patients take the right medicine at the right time while providing safety and convenience. It also helps caregivers monitor medication adherence effectively.

Problem

Patients often miss their medication schedules due to forgetfulness, lack of reminders, or difficulty in managing multiple prescriptions. Existing solutions lack real-time monitoring, secure storage, or integration with modern technology to track medication usage effectively. Furthermore, there is a need for a system that provides both visual and audible alerts while logging medication activity for better accountability.

Solution

The Smart Medicine Reminder Box integrates a mobile application, embedded system, and cloud-based database to ensure medication adherence through automated alerts, secure storage, and real-time monitoring.

3.FEATURES

Mobile Application

- **Add, Delete, and Update Medication Schedules:**

The mobile app allows users to create and manage their medication schedules easily. This feature enables patients or caregivers to ensure that the correct medication is scheduled at the right time.

- **Receive Notifications and Alerts for Upcoming Medications:**

The app sends real-time notifications to remind users when it is time to take their medicine, reducing the chances of missed doses.

- **Unlock the Medicine Box Remotely When Needed:**

The app includes functionality to unlock the medicine box securely via Wi-Fi, ensuring access only to authorized users when necessary.

Embedded System

- **OLED Display for Showing Current Time and Medicine Schedule:**

An OLED display on the medicine box provides visual feedback, showing the current time and the next scheduled medication, helping users stay informed.

- **Servo Motor Lock Mechanism for Secure Storage:**

The medicine box is equipped with a servo motor to control the locking mechanism, ensuring medicines are securely stored and accessible only when unlocked via the app.

Cloud Integration

- **Synchronization of Schedules Between Mobile App and Hardware Using Firebase:**

Firebase is used as the cloud database to synchronize medication schedules between the mobile app and the embedded system, ensuring seamless communication.

- **Real-Time Updates and Logs of Medicine Intake:**

The system logs medication intake events in real-time to Firebase, providing a detailed history that can be accessed by users or caregivers for monitoring and analysis.

4.ARCHITECTURE

The system is designed using a high-level architecture that ensures seamless communication between all components:

1) Hardware Components:

- **ESP32 Microcontroller:**

The core of the system that handles all processing, communication, and control tasks. It connects the hardware components and communicates with the mobile app via Wi-Fi.

- **OLED Display (128x64):**

Displays the current time, upcoming medication schedules, and real-time status updates, ensuring the user has visual feedback.

- **Servo Motor (standard size):**

Operates the locking mechanism of the medicine box, ensuring the medicine is securely stored and accessible only at scheduled times.

- **Magnetic Sensor:**

Detects whether the medicine box is open or closed and ensures safety by triggering alerts if opened at unauthorized times.

- **Push Button:**

Allows for manual override or user interaction (e.g., confirming medication intake or unlocking the box if the mobile app isn't accessible).

- **Resistors:**

Used for current limiting and protecting electronic components, ensuring the circuit operates safely and reliably.

- **Connecting Wires:**

Physically connect all components in the circuit to the ESP32 microcontroller for data transmission and power.

- **Enclosure:**

Encases all the hardware components to provide a secure, user-friendly, and aesthetic appearance while protecting the components from damage.

- **Battery:**

Powers the entire system, making it portable and functional even during power outages.

2) Software:

- **Mobile App:**

Acts as the user interface for scheduling medication, receiving alerts, and remotely controlling the medicine box. It provides convenience and enhances medication management.

- **Firebase:**

A cloud-based platform used for storing schedules, synchronizing data between the mobile app and hardware, and logging medication events for tracking and monitoring.

3) Communication Protocols:

- **I2C (Inter-Integrated Circuit):**

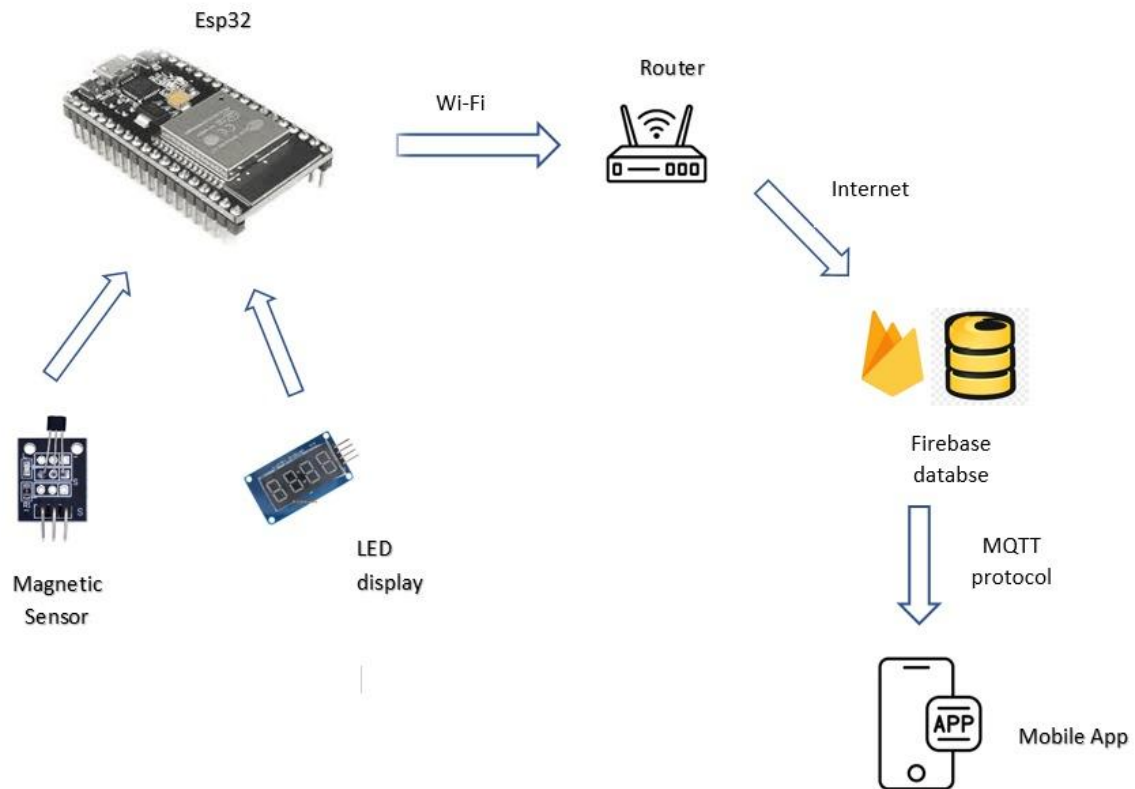
Used for communication between the ESP32 and peripherals like the OLED display and RTC module, allowing efficient, two-wire communication with multiple devices.

- **UART/SPI (Universal Asynchronous Receiver-Transmitter / Serial Peripheral Interface):**

Enables data transfer between the ESP32 and the weight sensor for precise measurement of medicine removal.

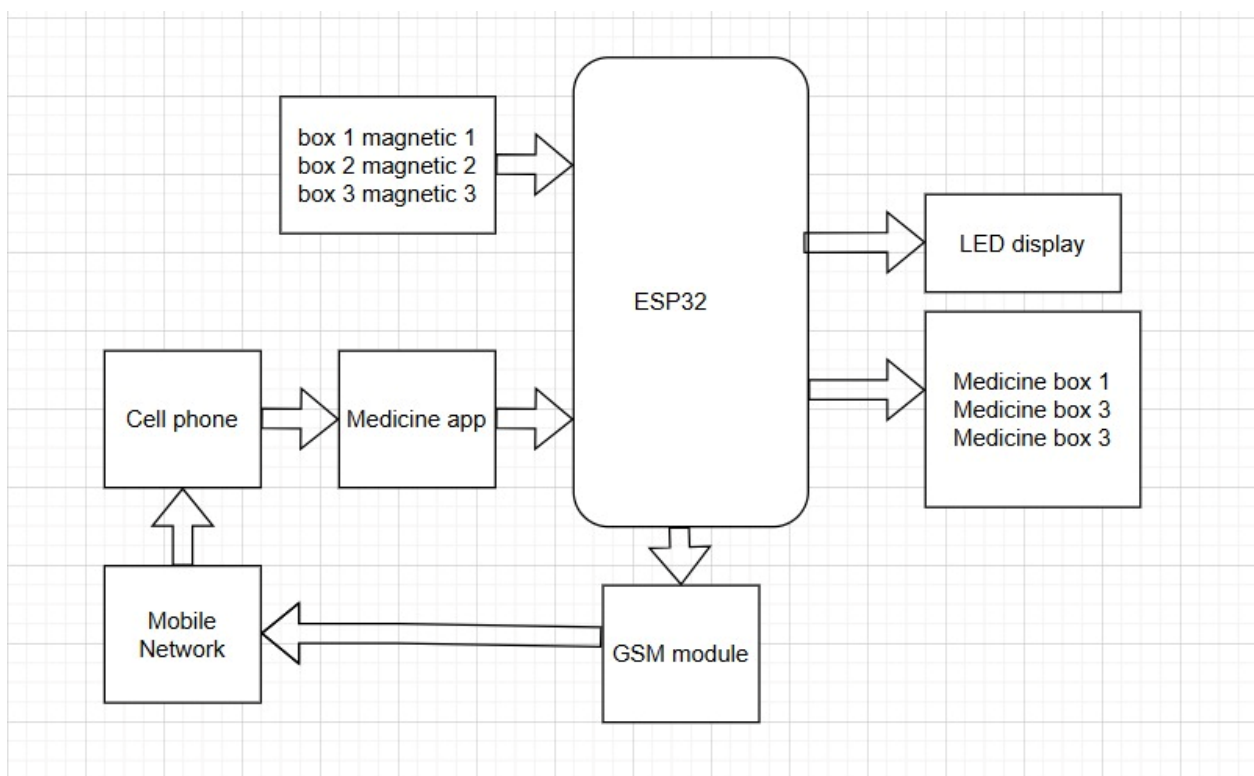
- **MQTT (Message Queuing Telemetry Transport) / HTTP (Hypertext Transfer Protocol):**

Facilitates communication between the ESP32 and the mobile app via Wi-Fi, ensuring real-time updates, alerts, and schedule synchronization.

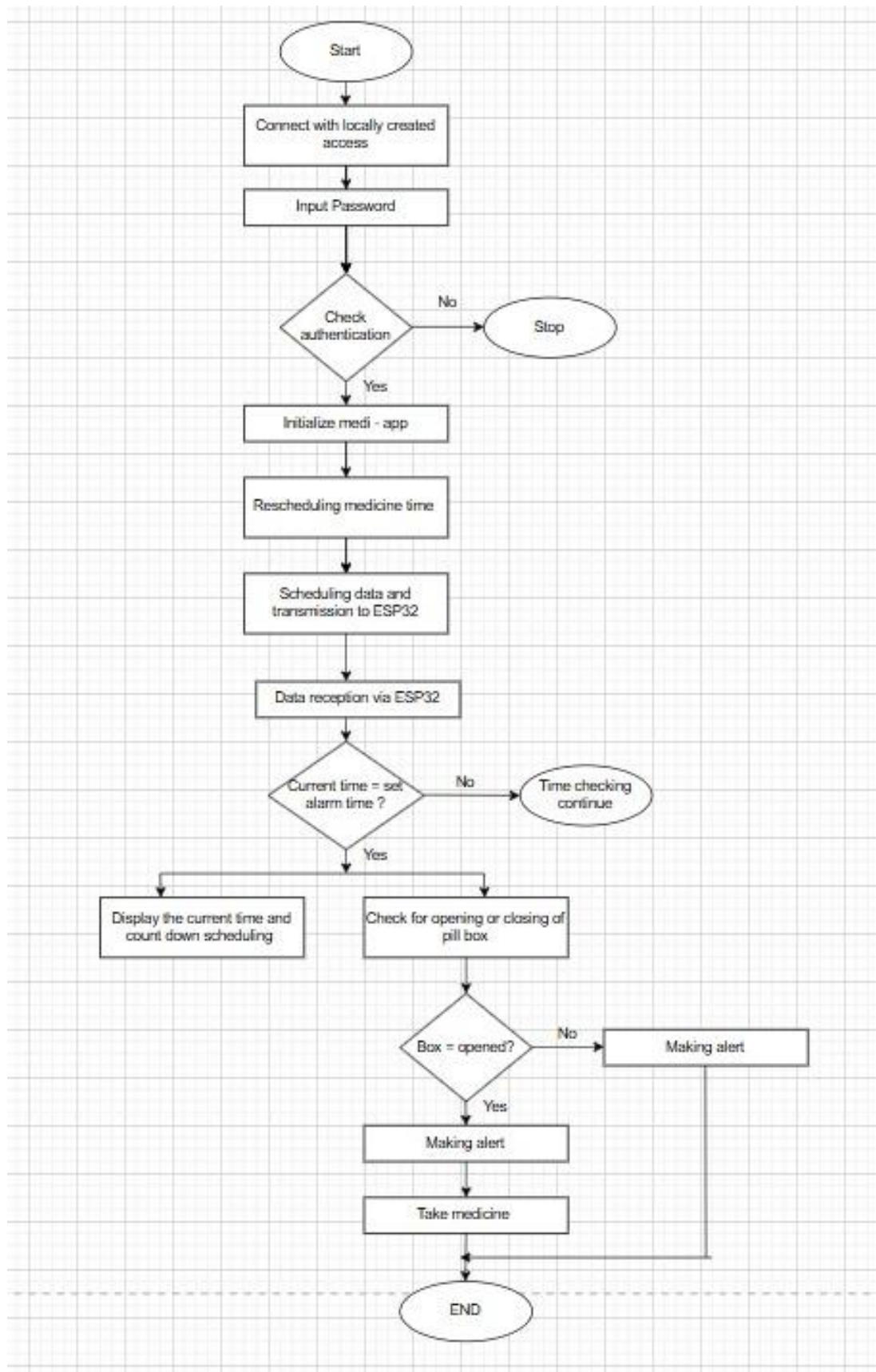


5.SOLUTION ARCHITECTURE

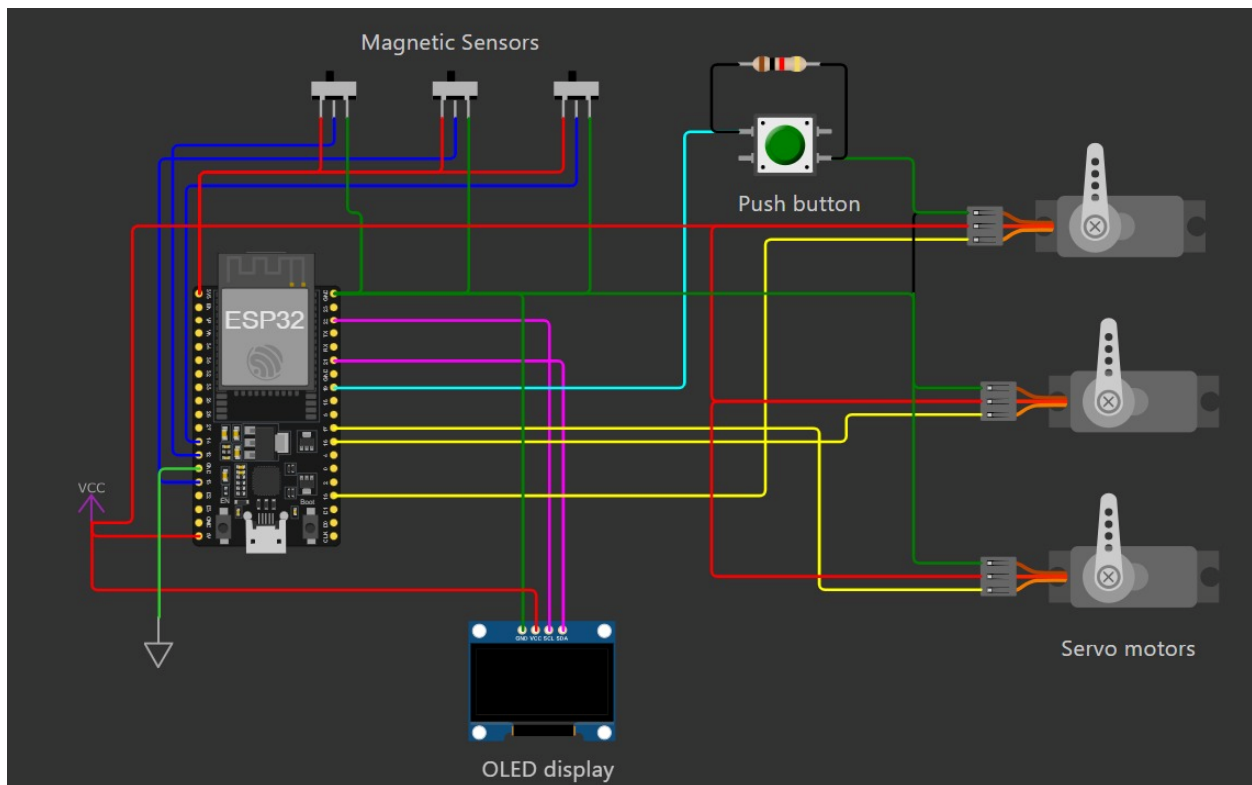
Block Diagram



Flow Chart



Prototype Design



6.INNOVATIVE FEATURES OF OUR MEDICAL BOX

1. Customized Medicine Scheduling via Mobile App:

- The box integrates with a mobile app that allows users to set and adjust medicine schedules in real-time.
- Users can schedule alarms for up to five medicine cups, each with its own unique timing.

2. ESP32-Based Hardware Integration:

- The hardware uses an ESP32 microcontroller, which communicates with the mobile app and a Firebase database via Wi-Fi using MQTT protocols.
- The system includes hardware components like LEDs, a buzzer, and an LCD display to provide real-time notifications and feedback.

3. Secure Storage with Locking Mechanism:

- Each medicine cup has a secure locking system controlled electronically via the ESP32. This ensures that users can only access the required medicine at the right time.

4. Real-Time Notifications:

- The mobile app sends notifications when it's time to take medicine, ensuring timely intake.
- If a medicine cup is not accessed within the designated time, the app generates an alert.

5. Minimal Wiring Design:

- The internal design is optimized to reduce wiring complexity, providing a cleaner and more reliable structure.

6. Portability and User-Friendly Interface:

- The box is designed to be compact and portable, suitable for both home and travel use.
- The app interface is simple and intuitive, making it accessible for users of all age groups.

7.COMPARISON BETWEEN OUR PROJECT AND EXISTING MEDICAL BOXES

Feature	Existing Medical Boxes	Our Smart Medical Box
Medicine Scheduling	Predefined schedules; limited or no customization.	Fully customizable scheduling via mobile app.
Connectivity	Often lacks connectivity or uses basic Bluetooth.	Wi-Fi enabled with MQTT protocol and Firebase integration.
Notifications	May have simple alarms (buzzers or lights).	Real-time app notifications, buzzer, and LED reminders.
Locking Mechanism	Typically no locking system; relies on user discipline.	Secure locking mechanism controlled electronically.
Portability	Often bulky or inconvenient for travel.	Compact and lightweight design, ideal for portability.
Multi-Cup Support	Limited to a single compartment or manual sorting.	Supports three separate medicine cups with individual timers.
Data Logging	Rarely logs data or provides usage analytics.	Logs medicine intake data on Firebase for tracking and analysis.
Ease of Use	Basic functionality; may not cater to elderly or tech-averse users.	Simple mobile app interface; LED and buzzer for easy understanding.

8.WHY OUR PROJECT STANDS OUT

1. Enhanced Patient Compliance:

- The combination of app notifications, buzzer alerts, and secure storage ensures users never miss their medications.

2. Data-Driven Insights:

- With Firebase integration, healthcare providers can access real-time data on patient adherence, enabling better monitoring and personalized care.

3. Cost-Effective and Scalable:

- By leveraging widely available components (e.g., ESP32), our design is cost-effective and can be scaled for mass production.

4. User-Centric Design:

- Our focus on a simple app interface and visual/audible alerts makes the system accessible to elderly users or those unfamiliar with technology.

5. Versatility:

- The ability to update schedules remotely and integrate with IoT systems makes our box future-proof and adaptable to various user needs.

9.Potential Impact

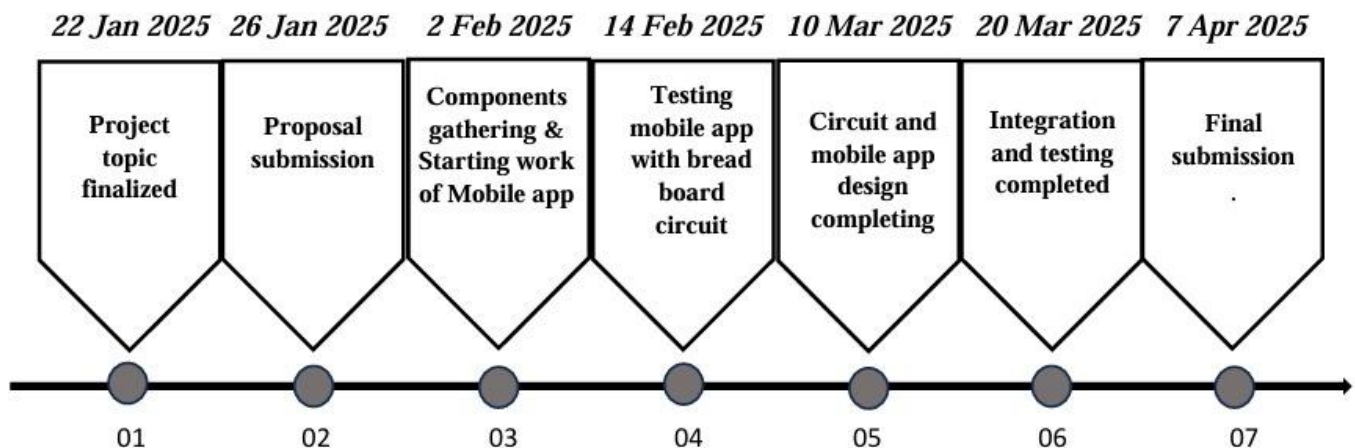
Our Smart Medical Box can significantly improve medication adherence rates, especially among elderly individuals and patients with chronic illnesses. By bridging the gap between technology and healthcare, our project has the potential to:

- Reduce medication errors.
- Improve health outcomes.
- Empower users to take control of their health in a convenient and reliable way.

6.ESTIMATED COST

Basic product	Estimated Price (Rs:)
ESP32 Microcontroller	1800.00
OLED Display (128x64)	600.00
Servo Motors (standard size)	1650.00
Magnetic Sensor	750.00
Connecting Wires	100.00
Resistors	10.00
Push button	50.00
Enclosure	700.00
Power supply 5v	500.00
Total Product Price (Estd..)	6160.00

7.TIME LINE



GITHUB REPOSITORY LINK:

<https://github.com/BuddhiniNavoda/smart-medical-reminder-box-EC6020>