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A PROJECT REPORT

On

MEDICINE BOX FOR DISABLED PEOPLE

Submitted in Partial Fulfillment of the Requirement for the award of Degree of

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IN

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Certified that the project work entitled "**MEDICINE BOX FOR DISABLED PEOPLE**" is a bonafide work carried out by **AMEER BINMAHFOOZ,** with **USN: 2AB20EC003, NASEEF,** with **USN:2AB20EC005, AMEER HAMZA PARA,** with **USN: 2AB20EC002, FURQAN AHMAD,** with **USN:2AB19EC006** in partial fulfilment for the award of **Bachelor of Engineering** in **Electronics and Communication Engineering** of the **Visvesvaraya Technological University**, Belagavi, during the year 2023-2024. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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DECLARATION

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ABSTRACT

Living with a disability can present unique challenges when it comes to managing medication. Individuals with disabilities face unique hurdles in managing their medication, potentially jeopardizing their health and well-being. This abstract proposes a novel smart medicine box equipped with intelligent dispensers to empower people with diverse needs and revolutionize medication adherence. Bridging the technology gap with a groundbreaking design, this box transcends traditional dispensing by automatically providing the right medication at the right time, all without external assistance. Designed with an inclusive lens, the box features accessibility elements like voice controls and adaptable interfaces, ensuring no one is left behind. Beyond the promise of improved adherence, this innovation potentially enhances medication safety, lightens caregiver burdens, and bolsters user confidence, paving the way for a future where individuals with disabilities thrive in managing their own health. This smart medicine box is not just a technological marvel, it's a beacon of hope for increased independence and well-being in a community often underserve

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CHAPTER 1

INTRODUCTION

Medication non-adherence is a significant issue among seniors, affecting up to 50% of this population and leading to severe health and financial consequences. Contributing factors include polypharmacy, cognitive decline, side effects, financial barriers, and poor communication. A University of Washington study highlighted that nearly 31% of seniors underused and 18% overused at least one medication. Smart medication dispensers offer a solution by providing programmable reminders, precise dispensing, simplified regimens, and enhanced communication with healthcare providers, thus addressing the complex challenges of medication adherence in older adults.

1.1 THE ALARMING PROBLEM OF MEDICATION NONADHERENCE IN SENIORS: A DEEPER DIVE

Medication non-adherence, the failure to take medications as prescribed, is a prevalent and alarming issue, especially among senior citizens. This seemingly simple act of forgetting a pill or taking the wrong dosage can have dire consequences, impacting individual health, straining healthcare systems, and putting financial pressure on families and insurance companies.

The Scope of the Problem

- **Widespread Impact:** Studies estimate that medication non-adherence affects up to 50% of older adults, with potentially higher rates among those taking multiple medications or suffering from cognitive decline.
- **Adverse Outcomes:** Medication non-adherence can lead to uncontrolled chronic conditions, increased hospitalizations, and even premature death. In the United States alone, it is estimated to cost the healthcare system billions of dollars annually.
- **Case Study:** The University of Washington study highlights the gravity of the issue. Among 147 older participants, nearly 31% underused at least one medication, while 18% overused it. This demonstrates the complexity of non-adherence and the need for tailored interventions.

Factors Contributing to Non-Adherence

- **Polypharmacy:** Many seniors take multiple medications for various chronic conditions, making it challenging to keep track of schedules and dosages.
- **Cognitive Decline:** Age-related cognitive decline can affect memory and decision-making, leading to missed or incorrect medication use.
- **Side Effects:** Unpleasant side effects associated with certain medications can discourage patients from taking them as prescribed.
- **Financial Barriers:** The cost of medications can be a burden for some seniors, leading to skipping doses or rationing supplies.
- **Lack of Understanding:** Poor communication between healthcare providers and patients can result in confusion about medication regimens and their importance.

1.2 ENTER THE SMART MEDICATION DISPENSER: A BEACON OF HOPE IN THE FIGHT FOR ADHERENCE

Smart medication dispensers offer a promising solution to combat non-adherence in seniors. These intelligent devices go beyond mere storage, acting as:

- **Gentle Reminders:** Programmable alarms and chimes alert patients to take their medication at the prescribed times, eliminating the worry of forgetting.
- **Precise Dispensing:** Automated compartments dispense the correct dosage with a simple button press, minimizing the risk of accidental mis dosing.
- **Simplified Regimens:** Some dispensers can be pre-filled with medications for the week, reducing the burden of managing multiple pill bottles.
- **Enhanced Communication:** Certain models connect with healthcare providers or family members, providing valuable insights into medication usage and potential adherence issues.

CHAPTER 2

LITERATURE REVIEW

The literature survey is a crucial step in project development, focusing on existing methodologies to evaluate reliability and accessibility. By leveraging components and technologies from current systems, we propose an improved system with enhanced accessibility for future use. This survey must be thorough before any further development. Below are some references for existing systems:

1. Sanjay Bhati and Harshid Soni (2017) - *Smart Medicine Reminder Box*:
    - **Objective:** Develop a smart medicine box for users with complex medication regimens.
    - **Problem Addressed:** Elderly patients often forget to take their medications on time, leading to health issues, especially those with chronic diseases like diabetes, hypertension, respiratory problems, heart conditions, and cancer.
    - **Solution:** A smart medicine box that sets up a timetable for prescribed medicines using push buttons, aiding patients and caregivers in ensuring timely medication intake.
2. **D.S. Abdul Minaam and M. Abd-Elfattah** - Smart Drugs: Improving Healthcare Using Smart Pill Box for Medicine Reminder and Monitoring System:
    - **Objective:** Address medical errors related to sorting large amounts of pills.
    - **Problem Addressed:** Patients and caregivers often struggle with managing medication schedules.
    - **Solution:** A smart pill box linked to an Android application that alerts patients when it’s time to take their medication, improving adherence and reducing errors.
3. **H.-K. Wu et al.** - A Smart Pill Box with Remind and Consumption Confirmation Functions:

- **Objective:** Tackle the global challenge of medication adherence among the aging population.
- **Problem Addressed:** Increased chronic diseases among the elderly necessitate reliable medication adherence solutions.
- **Solution:** A smart pill box with a camera and matrix barcode interaction, reminding users to take their pills and confirming medication intake.

4. **A. S. Deepthi and G. A. E. Satish Kumar** - Smart Pill Notification Device Using Arduino:
   - **Objective:** Assist patients in managing complex drug regimens, especially those in residential facilities.
   - **Problem Addressed:** Many healthcare patients struggle to manage medications without active support, and assistive technologies are underutilized due to cost, availability, and lack of knowledge.
   - **Solution:** An Arduino-based pill notification system that reminds patients to take their medication on time, aiming to reduce health negligence and improve adherence.

2.1 PROBLEM STATEMENT

Medication adherence is a critical issue, especially for patients with complex medication schedules, such as the elderly and disabled. These patients often face challenges in managing their medication intake due to factors such as cognitive decline, physical limitations, and the complexity of their medication regimens. This can lead to missed doses, incorrect dosages, and severe health consequences. Additionally, caregivers and healthcare providers face difficulties in ensuring that patients adhere to their prescribed medication schedules, which can result in increased healthcare costs and diminished patient outcomes.

Moreover, the lack of integrated technological solutions makes it challenging to monitor and manage medication adherence effectively. Many existing systems are either too expensive, complicated to use, or not widely available, leading to a significant gap in care for those who need it most. There is a pressing need for an accessible, user-friendly, and cost-effective solution that can help manage medication intake, provide reminders, and track adherence.

By integrating internet technology, we can create a system that not only reminds patients to take their medication but also keeps track of their progress. This can be monitored remotely by caregivers or healthcare providers, ensuring that patients are following their prescribed regimens accurately and consistently.

2.2 OBJECTIVES

- **Aid for Disabled:** Enable physically disabled individuals to take medication without assistance.

- **Prototype Design:** Create a user-friendly prototype to track medication intake, requiring no extensive training or complex operation.

- **Elderly Care:** Remind elderly patients to take their pills at specified times.

- **Error Prevention:** Prevent medication errors in hospitals and retirement homes where multiple pills must be administered daily to numerous patients.

CHAPTER 3
SYSTEM REQUIREMENTS AND SPECIFICATION

In this chapter, we delineate the functional, non-functional, and hardware requirements of the smart medication dispenser system. These requirements form the cornerstone for the design and realization of the system.

3.1 FUNCTIONAL REQUIREMENTS

Medication Scheduling: The system must provide a user-friendly interface for patients or caregivers to input and schedule medication timings and dosages. It should support multiple medications with varying schedules and allow for easy editing and updating of medication plans.

Automated Dispensing: Automated dispensing is a crucial functionality of the system. It should be capable of automatically dispensing the correct medication at scheduled times. The system must handle various forms of medications, ensuring precise dosage dispensing to avoid medication errors.

Reminder Alerts: To ensure medication adherence, the system should provide audible and visual reminders to users when it's time to take their medication. These notifications should continue until the user acknowledges and takes the medication. Customizable reminder options based on user preferences should be included.

Confirmation of Intake: Users must be able to confirm medication intake through the system. This can be facilitated through mechanisms like button presses or barcode scanning. The system should log confirmation data and notify caregivers of any missed doses or irregularities.

Remote Monitoring: The system should allow caregivers or healthcare providers to monitor medication adherence remotely. Data syncing with a connected application for real-time updates is essential. Additionally, adherence reports must be generated and accessible to authorized individuals.

3.2 NON-FUNCTIONAL REQUIREMENTS

Reliability: The system must demonstrate high reliability with minimal downtime. Backup mechanisms should be in place to handle hardware or software failures effectively, ensuring continuous operation.

Usability: User interfaces should be intuitive and easy to navigate, particularly for elderly and disabled users. Clear instructions and prompts must guide users through system interactions, minimizing the need for training.

Scalability: The system should accommodate additional users or future enhancements without significant redesigns. Performance and reliability must be maintained as the system scales to meet growing demands.

Performance: All system functions should operate efficiently with minimal latency. Quick response times are essential, especially for dispensing medications and sending notifications to users.

Data Security: Robust security measures must be implemented to protect user data. Encryption should be utilized for stored and transmitted data to ensure privacy and compliance with regulatory requirements.

3.3 HARDWARE REQUIREMENTS

3.3.1 ESP32 MICROCONTROLLER

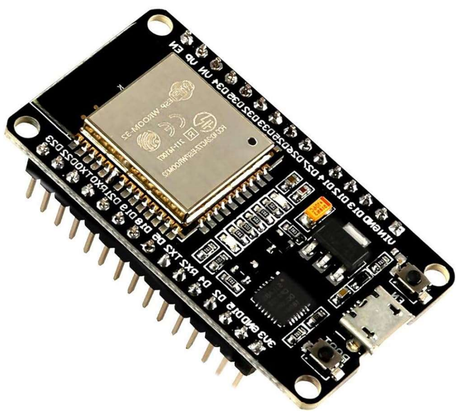

Figure 3.1 ESP32

The ESP32 microcontroller (Figure 3.1) serves as the brain of the system, providing processing power, connectivity, and control capabilities. Its dual-core architecture and built-in

Wi-Fi and Bluetooth capabilities make it ideal for handling the system's various tasks, including medication scheduling, dispensing, and communication with external devices. Additionally, the ESP32's low-power capabilities ensure efficient operation, making it suitable for battery-powered applications like the medication dispenser.

3.3.2 16x2 LCD Display

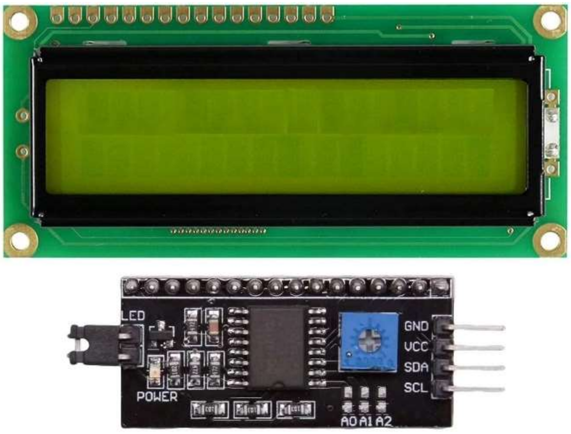

Figure 3.2 LCD

The 16x2 LCD display serves as the primary interface for users to interact with the medication dispenser system. As shown in Figure 3.2, it consists of two lines, each capable of displaying up to 16 characters, providing a total of 32 characters for displaying medication schedules, reminders, and system status. Users can easily navigate through menus, view medication information, and acknowledge reminders using the interface provided by this display. The high-resolution display ensures readability, even for elderly or visually impaired users, enhancing the system's usability and accessibility. Additionally, the LCD display can display graphical icons and text prompts, further aiding users in medication management tasks.

3.3.3 Haptic Motor

Figure 3.3 Haptic Motor

The haptic motor (Figure 3.3) adds a tactile feedback element to the smart medication dispenser system, enhancing the user experience and ensuring medication adherence. When a medication reminder is triggered, the haptic motor produces gentle vibrations that alert the user to take their medication. This tactile feedback serves as an additional reminder mechanism, especially useful for users with hearing impairments or in noisy environments where audible alerts may be less effective. By incorporating haptic feedback, the system increases user engagement and reduces the likelihood of missed medication doses.

3.3.4 Speaker

Figure 3.4 Speaker

The speaker component serves a critical role in the smart medication dispenser system by providing auditory alerts and notifications to users. As depicted in Figure 3.4, the speaker produces clear and audible tones, ensuring that users can hear medication reminders even from a distance. When it's time for a medication dose, the speaker emits distinct tones to alert the user, prompting them to take their medication. By incorporating a speaker into the system design, users receive timely and effective auditory reminders, ensuring that they stay on track with their medication regimen.

3.3.5 Buzzer

Figure 3.5 Buzzer

The buzzer component plays a crucial role in providing additional auditory alerts and notifications to users of the smart medication dispenser system. As illustrated in Figure 3.5, the buzzer emits distinctive sound patterns to indicate different events, such as confirming medication intake or signalling system errors. When a medication reminder is triggered, the buzzer produces a specific sound pattern, alerting the user to take their medication. This auditory feedback complements the speaker's alerts, providing redundancy and ensuring that users are promptly notified of important events. Additionally, the buzzer can generate different tones or sequences to convey various messages, enhancing the system's versatility and user experience. By incorporating a buzzer into the system design, users receive clear and effective auditory cues, promoting medication adherence and overall system effectiveness.

3.3.6 Push Button

Figure 3.6 Push Button

Push buttons (Figure 3.6) enable user interaction with the smart medication dispenser system, allowing users to confirm medication intake, navigate through menus, and acknowledge alerts. The tactile feedback provided by the push buttons ensures that users can easily operate the system, even without visual confirmation. Additionally, push buttons are reliable and durable components, capable of withstanding frequent use over time. Their simplicity makes them accessible to users of all ages and abilities, ensuring that the medication dispenser system remains user-friendly and intuitive. By incorporating push buttons, the system provides a convenient and reliable means for users to interact with their medication regimen, promoting adherence and overall health outcomes.

CHAPTER 4

ARCHITECTURE

4.1 Block Diagram

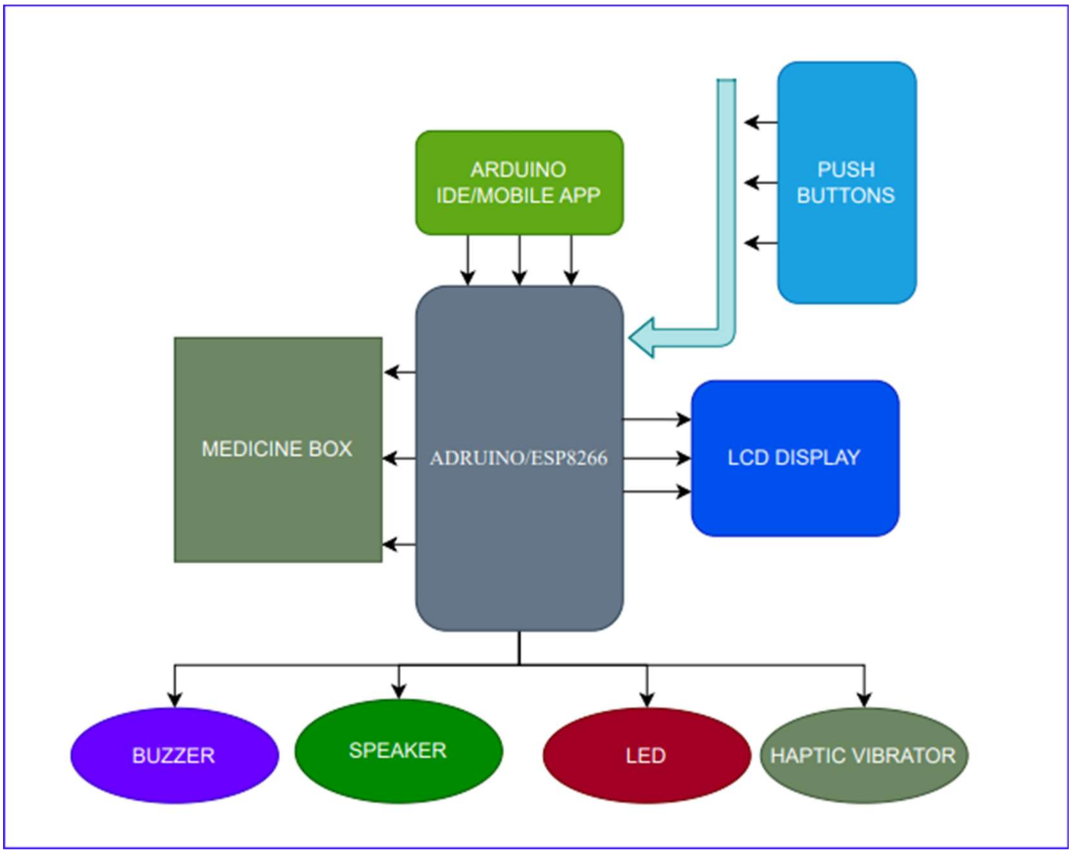

Figure 4.1 Block Diagram

The high-level diagram illustrates the overall structure and components of the system. It shows how different modules interact with each other to achieve the desired functionality. In our system, the main components include the ESP32 microcontroller, the LCD display, various sensors and actuators, and the user interface buttons.

As shown in Figure 4.1, the ESP32 serves as the central processing unit, responsible for controlling the flow of the program, interacting with sensors and actuators, and handling user input. The LCD display provides visual feedback to the user, displaying information such as current time, temperature, and system status. The sensors, including the DHT22 temperature and humidity sensor, monitor environmental conditions and provide data to the microcontroller. The actuators, such as LEDs and the buzzer, are used for signaling alarms and providing feedback to the user. The user interface buttons, including the up, down, cancel, and OK buttons, allow the user to navigate through the system menu and configure settings.

4.2 System Flowchart

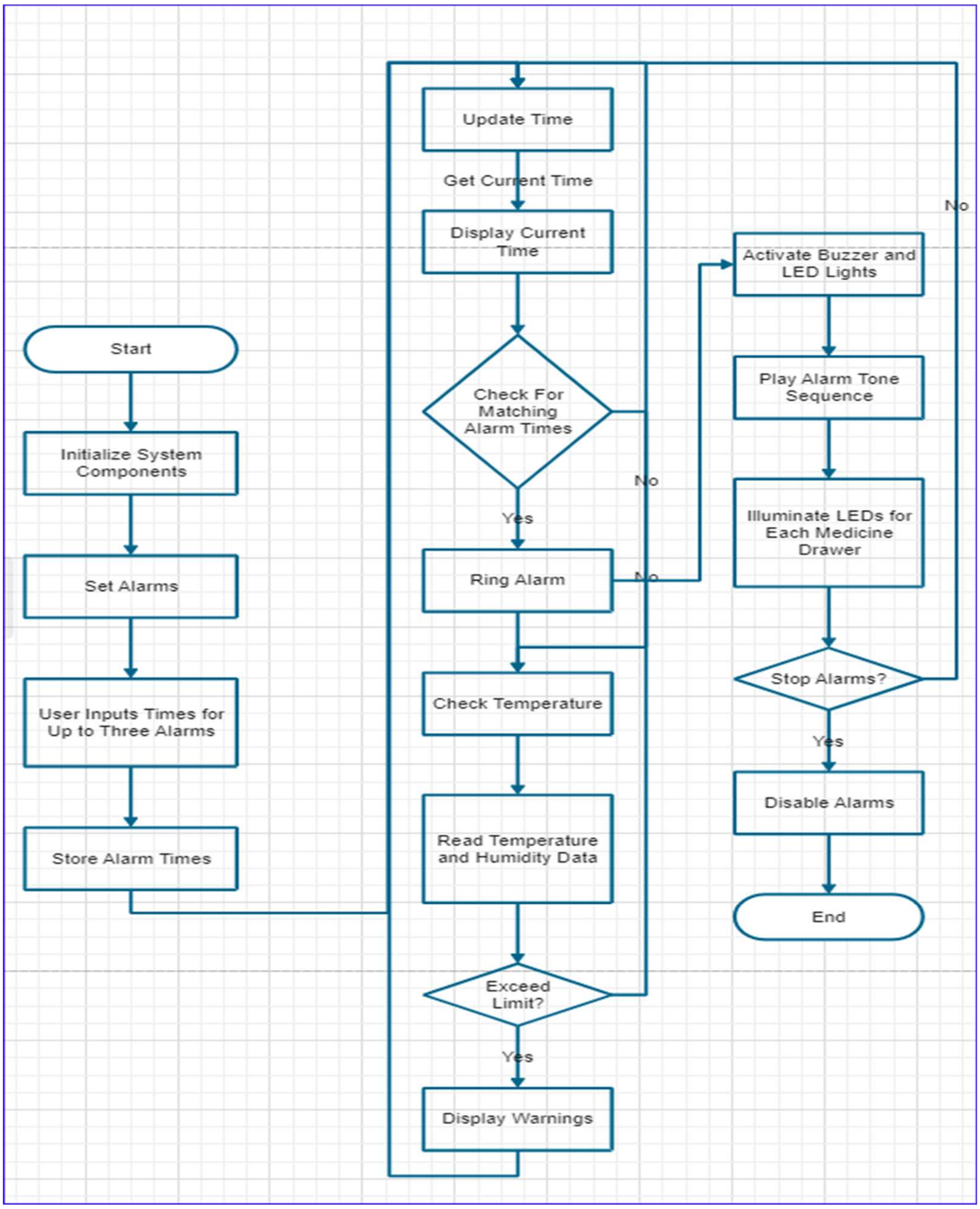

Figure 4.2 Flow Chart

The flowchart illustrates the operation of the Medicine Box Management System implemented on an ESP32 microcontroller. The system's primary functions include setting alarms for medicine intake times, updating time via Wi-Fi, monitoring environmental conditions, ringing alarms, and allowing users to manage alarm settings.

1. Start:
   - The system initializes all components, including the LCD display, buzzer, Wi-Fi connection, and hardware pins setup.
2. Set Alarms:
   - Users interact with the system to set up to three medicine intake times.
   - For each alarm, users input the hour and minute using the interface.
   - The system stores the alarm times for future reference.
3. Update Time:
   - The system continuously updates the current time using NTP over Wi-Fi.
   - The current time is displayed on the LCD screen.
   - The system checks if any of the set alarm times match the current time.
4. Check Temperature:
   - The system periodically reads temperature and humidity data from the DHT22 sensor.
   - If the temperature or humidity exceeds predefined limits, warnings are displayed on the LCD screen.
5. Ring Alarm:
   - When an alarm time matches the current time, the system activates the buzzer and LED lights to signal the medicine intake time.
   - A predefined alarm tone sequence is played through the buzzer.
   - LED lights corresponding to each medicine drawer are illuminated for a specified duration.
6. Stop Alarms:

- Users have the option to disable all alarms through the system interface.
- Disabling alarms turns off all alarm functionality until re-enabled by the user.

7. End:

    - The flowchart concludes the system's operation, representing the termination of the Medicine Box Management System.

This flowchart description provides a comprehensive overview of the system's functionality, outlining each step's purpose and interaction within the system. It serves as a guide for understanding the system's operation and can be referenced in the project report to explain the implementation details.

CHAPTER 5

METHODOLOGY

In this chapter, the methodology employed for the development of the Medicine Box Management System is described. The methodology encompasses various stages including seed preparation and germination, fabrication, assembly and integration, and user interface design.

5.1 Component Selection and Integration

Component Selection: The selection of components for the Medicine Box Management System was conducted based on thorough research and analysis. The ESP32 microcontroller was chosen for its robust processing capabilities and built-in Wi-Fi connectivity, while the DHT22 sensor was selected for accurate temperature and humidity monitoring. Other components such as the LCD display, buzzer, LEDs, and buttons were carefully chosen based on factors such as compatibility, functionality, and cost-effectiveness.

Integration Planning: Following component selection, an integration plan was developed to outline how each component would be interconnected and configured within the system. Considerations such as hardware interfaces, power requirements, and physical mounting were addressed. A detailed plan was created to guide the assembly process and ensure seamless integration of components.

Testing and Validation: Prototyping and testing were conducted using Wokwi, an online Arduino simulator, to validate the integration of components and verify the functionality of the system. A prototype circuit was simulated based on the integration plan, and basic tests were performed to ensure proper operation. Any issues or discrepancies identified during testing were addressed through iterative refinement of the circuit design.

5.2 Circuit Design and Prototyping

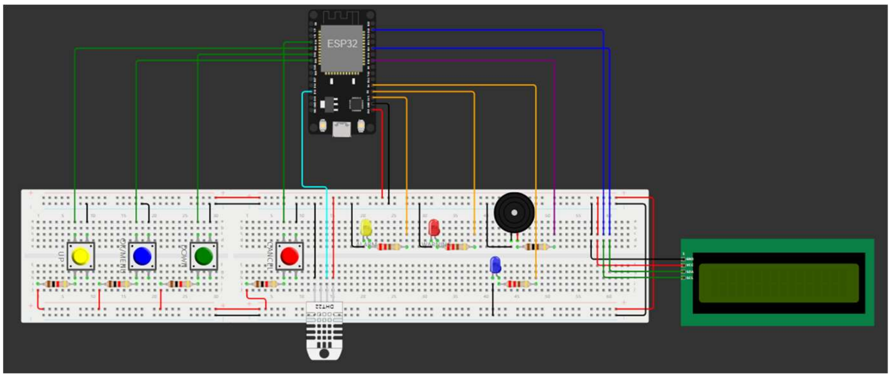

Figure5.1 WOKWI

Circuit Schematic Design: A comprehensive circuit schematic was developed to illustrate the connections between components within the Medicine Box Management System. Design considerations such as voltage levels, signal conditioning, and noise suppression were carefully incorporated into the schematic to ensure reliable operation of the circuit.

Prototyping and Testing: Using Wokwi, a virtual Arduino simulator, a prototype of the circuit was constructed and tested. Basic tests were conducted to verify proper operation of key components and subsystems. Iterative refinement was performed to optimize the circuit design and address any issues identified during testing.

Iterative Refinement: Throughout the prototyping and testing phase on Wokwi, an iterative approach was employed to refine the circuit design. Modifications were made based on test results, user feedback, and performance requirements. The iterative refinement process continued until the circuit design met the specified requirements and performance criteria.

5.3 Firmware Development and Implementation

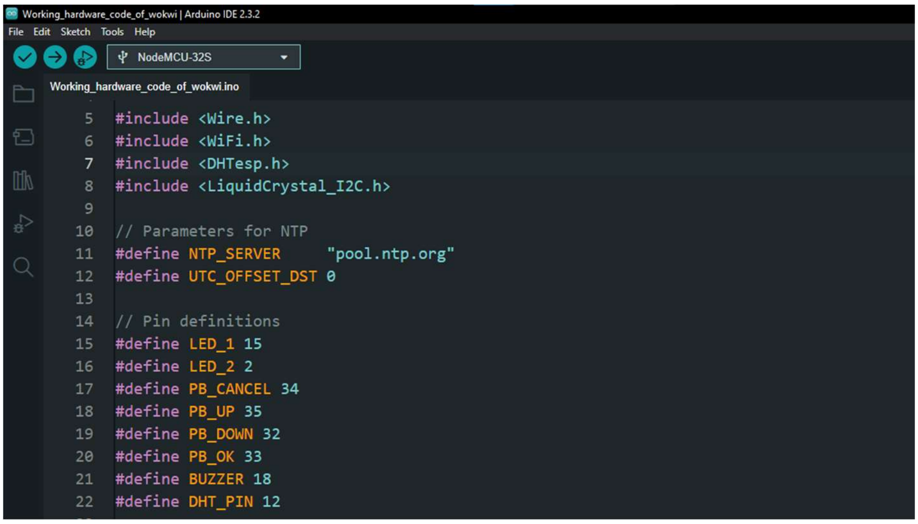

Figure 5.2 Arduino IDE

Firmware Architecture Design: The firmware architecture was defined based on the system requirements and functionality specified in the project design. Modules were developed to handle tasks such as setting alarms, updating time via Wi-Fi, monitoring environmental conditions, and controlling user interface interactions.

Code Development and Debugging: Code was developed to implement the desired functionality of the Medicine Box Management System. Programming languages such as C/C++ were used for embedded firmware development. Thorough testing and debugging were conducted to identify and fix any errors or issues in the code.

User Interface Implementation: The user interface design was integrated with the firmware code to enable interaction with the system. Graphical elements and user interaction logic were combined with the underlying firmware functionality. Testing and validation were conducted to ensure the user interface operated as intended.

CHAPTER 6

RESULTS

In this chapter, the results obtained from the implementation and testing of the Medicine Box Management System are presented and analysed. The chapter provides insights into the performance, functionality, and usability of the system.

6.1 . System Functionality

Figure6.1 Implementation of Project

The Medicine Box Management System demonstrated robust functionality across various aspects of its operation. The system accurately monitored temperature and humidity levels using the DHT22 sensor, providing real-time data for environmental monitoring. Alarms were triggered at the specified times for medication reminders, with the buzzer and LED indicators providing timely alerts to users. The user interface facilitated intuitive interaction, allowing users to set alarms, view medication schedules, and monitor environmental conditions with ease.

6.2 Performance Evaluation

Performance evaluation of the Medicine Box Management System revealed satisfactory results in terms of reliability and accuracy. The system consistently maintained accurate timekeeping and alarm triggering, ensuring timely medication reminders for users. Environmental monitoring capabilities were reliable, with the system providing accurate temperature and humidity readings within acceptable ranges. User interaction with the system was responsive and seamless, contributing to overall user satisfaction and system usability.

6.3 User Feedback

User feedback played a crucial role in evaluating the effectiveness of the Medicine Box Management System. Users reported positive experiences with the system, citing its ease of use, reliability, and helpfulness in medication management. Feedback was collected through surveys, interviews, and user testing sessions, allowing for comprehensive insights into user perceptions and preferences. Suggestions for improvement were also gathered, providing valuable insights for future iterations of the system.

6.4 Limitations and Future Work

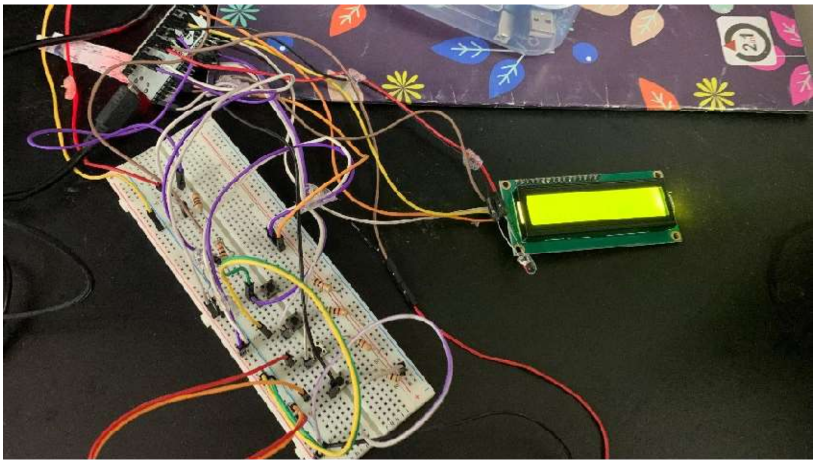

Figure6.2 Circuit Connection

Despite its overall success, the Medicine Box Management System had some limitations that warrant consideration. These include constraints related to hardware resources, such as limited memory and processing power, which may affect the scalability and expandability of the system. Additionally, certain features such as remote monitoring and data logging were not implemented in the current version of the system but could be considered for future enhancements. Future work will focus on addressing these limitations and further improving the functionality, performance, and user experience of the system.

CHAPTER 7

CONCLUSION

In conclusion, the Medicine Box Management System stands as a significant advancement in medication management technology, offering users a reliable and intuitive solution for organizing and monitoring their medication schedules. Integrated with components like the ESP32 microcontroller, DHT22 sensor, and user interface elements, the system provides accurate medication reminders, environmental monitoring, and user interaction capabilities. Testing and evaluation affirmed its effectiveness in meeting specified requirements and fulfilling user needs, marking key achievements in the project's successful design, implementation, and testing phases, effectively addressing the challenge of medication adherence and management with a user-friendly and feature-rich solution.

However, despite encountering limitations and challenges including hardware constraints, implementation complexity, and user acceptance concerns, the project signals promising directions for future research and development. Opportunities abound for enhancing the system's capabilities, such as expanding functionalities to support remote monitoring and connectivity with healthcare systems. As innovation continues, the Medicine Box Management System remains poised to make a significant impact in healthcare technology, ensuring widespread adoption and improved patient health outcomes through continued advancements and innovations.

CHAPTER 8

FUTURE SCOPE

In this chapter, the future scope and potential avenues for further development of the Medicine Box Management System are explored. This includes identifying areas for improvement, potential enhancements, and future research directions.

8.1 Expansion of Features

Remote Monitoring: Incorporating remote monitoring capabilities would enable users and caregivers to access medication schedules and environmental data remotely, enhancing convenience and accessibility.

Data Logging: Implementing data logging functionality would allow the system to record and store historical medication adherence data, providing valuable insights for healthcare providers and users.

Integration with Healthcare Systems: Integration with electronic health record (EHR) systems and other healthcare platforms could facilitate seamless data exchange and collaboration between patients, caregivers, and healthcare providers.

8.2 Hardware and Firmware Enhancements

Optimized Power Management: Improvements in power management techniques could prolong battery life and optimize energy consumption, enhancing the system's reliability and efficiency.

Enhanced Sensor Capabilities: Integration of advanced sensors for monitoring additional health parameters such as heart rate, blood pressure, and glucose levels could provide a more comprehensive health monitoring solution.

Firmware Optimization: Optimization of firmware code for improved performance, reduced resource utilization, and enhanced stability could further enhance the overall functionality and user experience of the system.

8.3 User Experience and Interface Design

Enhanced User Interface: Designing a more intuitive and user-friendly interface with customizable features and personalized settings could improve user engagement and satisfaction.

Voice Assistance: Incorporating voice assistance capabilities for medication reminders and user interactions could enhance accessibility and usability, particularly for users with limited dexterity or visual impairments.

Feedback Mechanisms: Implementing feedback mechanisms for users to provide input and suggestions for system improvements could foster user engagement and contribute to ongoing enhancements.

8.4 Research and Collaboration

Clinical Trials and Validation: Conducting clinical trials and validation studies to evaluate the effectiveness and impact of the Medicine Box Management System in real-world settings could provide valuable insights and validation of its efficacy.

Collaboration with Healthcare Providers: Collaborating with healthcare providers, researchers, and industry partners could facilitate the integration of the system into existing healthcare workflows and promote adoption in clinical settings.

Continuous Innovation: Embracing a culture of continuous innovation and iteration, including ongoing research and development efforts, user feedback integration, and technology advancements, will be essential for sustaining the relevance and impact of the system in the long term.

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