ReMedi: An IoT-Based Medicine Reminder System Using Arduino Uno and Bluetooth
ReMedi (Medicine Reminding Embedded System)

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ABSTRACT

The ReMedi project presents an IoT-based medicine reminder system using Arduino Uno and Bluetooth technology. It aims to improve medication adherence by providing timely reminders and notifications. The hardware module, built around Arduino Uno, integrates various sensors and actuators, including a real-time clock (RTC) module, LCD display, buzzer, and Bluetooth module. Users interact with the system through a mobile application, which serves as a remote control and monitoring interface. The Bluetooth module enables seamless connectivity between the hardware module and the mobile application, allowing real-time updates and remote control capabilities. The ReMedi system contributes to embedded systems and IoT applications in healthcare. Future enhancements may involve additional sensors for advanced monitoring

INTRODUCTION

The ReMedi project introduces an IoT-based medicine reminder system, leveraging the Arduino Uno microcontroller board and Bluetooth technology. Medication management plays a crucial role in maintaining health and treating various medical conditions. However, individuals often struggle with remembering to take their medications at the right time, leading to non-adherence and potential health risks. The ReMedi system aims to address this issue by providing an intelligent and user-friendly solution that helps individuals manage their medication schedules effectively.

The project utilizes the Arduino Uno, a popular and versatile microcontroller board, as the core component of the hardware module. The Arduino Uno integrates various sensors and actuators, including a real-time clock (RTC) module, an LCD display, and a buzzer, to create an efficient medication reminder system. The RTC module ensures accurate timekeeping, allowing the system to trigger reminders at the designated medication times. The LCD display provides visual cues to indicate medication schedules, while the buzzer delivers audible reminders for increased effectiveness. To enhance user interaction and control, the ReMedi system incorporates Bluetooth technology. A Bluetooth module enables seamless connectivity between the hardware module and a mobile application. Users can set up their medication schedules, customize reminder preferences, and receive notifications through the

mobile application. This integration of Bluetooth connectivity allows real-time synchronization, enabling users to remotely control the medication reminder system and receive timely updates.

The ReMedi system not only provides medication reminders but also offers additional features to improve medication adherence. The mobile application allows users to track their medication history, view dosage patterns, and receive alerts for refilling prescriptions. By offering comprehensive medication management capabilities, ReMedi aims to empower individuals to take control of their health and adhere to their prescribed medication regimens.

In summary, the ReMedi project combines the power of the Arduino Uno microcontroller board, Bluetooth technology, and a mobile application to create an IoT-based medicine reminder system. By leveraging these technologies, ReMedi aims to enhance medication adherence, promote better health outcomes, and improve the overall quality of life for individuals managing their medication schedules.

LITERATURE REVIEW

Manukonda Praveen Kumar and Usha Rani. Nelakuditi, 2020, "IoT and I2C Protocol Based M-Health Medication Assistive System for Elderly People",

Old-age people suffering from Alzheimer's disease are not able to carry out their regular medication activities due to declining memory. Taking the correct medicines at regular slots is a challenging task for them. Hence in this research paper, IoT based Medication Assistive System was proposed and developed to facilitate medication adherence. The proposed system incorporates features such as sending a message to a medical practitioner one week ahead to remind the status of medicines and also a buzzer beep to ensure the attendance of a candidate which is not available in existing software remainders. It can perform the task even though the internet is not available physically by using NodeMCU and Blyank app. The proposed system assists older people by reminding medication timings as well as a selection of medicines. It also reduces the dependency of old people on younger generations. Design can be realized at a lower price due to the availability of intelligent programmable hardware at an affordable cost.

Ayush Tripathi, Atigadda Ramchandra Reddy, B S Arjun, Hardik J. Pandya, 2021 "Low-Cost IoT Device for Chronic Medication Adherence",

Adherence to the prescribed regime is an essential part of the medication process. Poor adherence adversely affects the effectiveness of the treatment, especially for patients with chronic diseases. This work proposes an IoT-based chronic medication adherence device that can help patients adhere to their medication regime and help the caretaker monitor their medication habits. The work implements two design iterations of the device to help achieve medication adherence. Iteration 1 of the system is based on piezoresistive sensors, and iteration 2 is based on pushbutton switches. The device design is compliant with the most commercially available blister packets. Cloud-based web services are used for data storage and visualization. We have implemented connectivity to smartwatches and messaging services into the device. The device operates in real-time and is reusable, portable, and affordable.

Luh Kesuma Wardhani, Cinthya Bela Anggraini, Nenny Anggraini, Nashrul Hakiem, Imam Marzuki Shofi, Tabah Rosyadi, 2021, "Medicine Box Reminder for Patients with Chronic Disease with IoT-Based Database Monitoring",

Chronic illness is the highest cause of death in the world, to avoid increasing causes of death due to chronic diseases, it requires appropriate processes which require a long time of treatment and the drug becomes the most important component. Unfortunately, the level of adherence to taking medication in patients with chronic diseases is still low. According to the CDC (Centers for Disease Control and Prevention) carelessly taking medication can cause 30–50 percent of treatment failures and 125,000 deaths per year. Therefore this study will create a medicine box reminder system for chronic disease patients with database monitoring based on IoT (Internet of Things) which can be monitored in real-time, this research stated reminder system using an android application that will be connected to medicine box reminder devices made using raspberry pi 3 model B, with speaker components and a PAM8403 amplifier. Based on the results of the study, it was found that the system that was made was tested with the user and produced a level of functionality of 100% and an average delay on the reminder system of 4,239 seconds for the reminder when going to take medication, and amounted to 7,298 seconds to inform that it had taken the drug, and amounted to 97% for checking the accuracy of taking drugs with QR code.

Joshua Ernest Pedi Reddy, Ameet Chavan, 2020, "AI-IoT based Smart Pill Expert System",

The paper discusses the implementation of a proposed Smart Pill Expert System (SPES) which is based on AI-IoT technology to automate pill dispensing with an effective user interface. The proposed SPES aims to provide expertise in the real-time diagnosis and thus support every individual and institution dependent on medication. Medical Non-Adherence (MNA) is one of the major factors of prolonged recovery, financial troubles, and premature deaths. This product is developed to be used in old age homes, hospices, and home healthcare centers and is capable of catering to the needs of single and multiple users simultaneously. With API and web services, new resources are provided for caregivers (family members, nurses, and doctors) to continuously track and monitor the users. Because of minimal human intervention, SPES has a failure rate of less than 5%.

CONCEPT

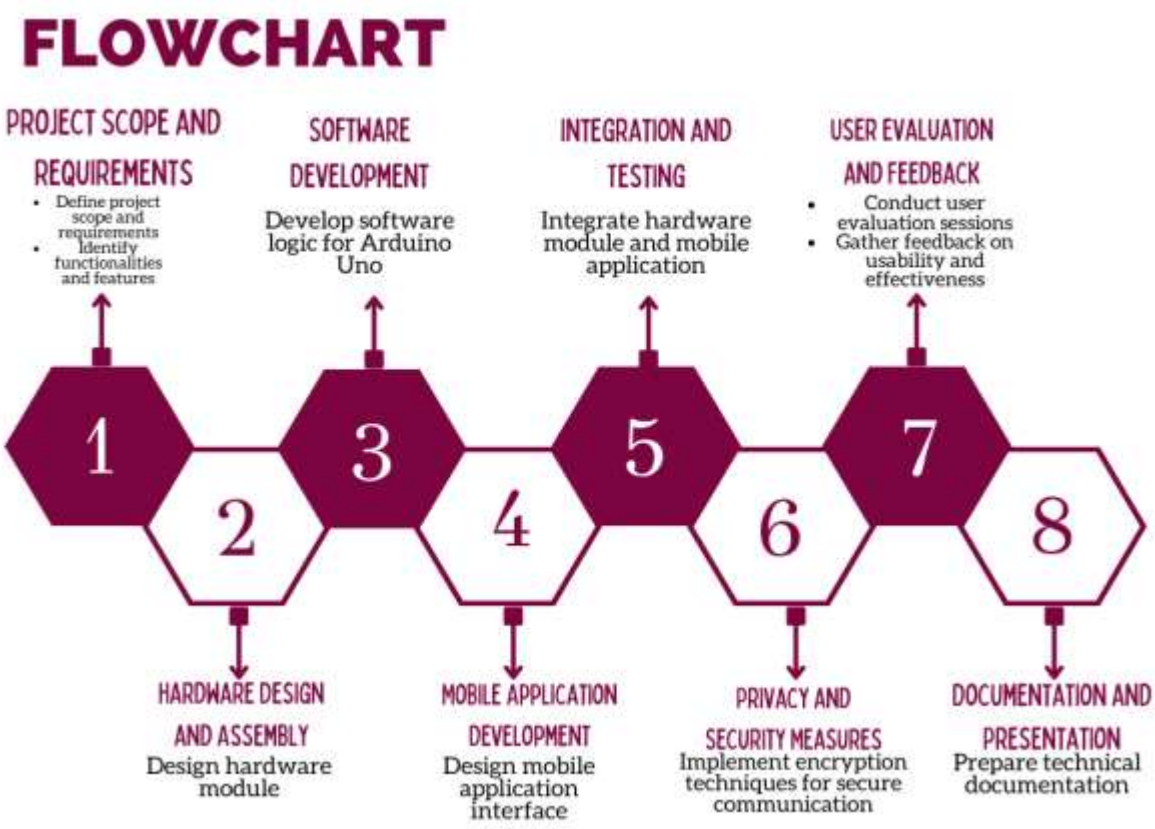
The concept behind ReMedi centers around using IoT technologies to seamlessly integrate medication reminders into individuals' daily routines. The system consists of a hardware module, built around the Arduino Uno, that incorporates various sensors and actuators, including a real-time clock (RTC) module, an LCD display, and a buzzer. The Arduino Uno serves as the central processing unit, coordinating the interactions between the components and ensuring accurate medication reminders.

Bluetooth connectivity enables ReMedi to synchronize with a mobile application, providing users with a convenient and personalized medication management interface. Through the mobile application, users can set up medication schedules, customize reminder preferences, and receive notifications. The system also offers features such as medication tracking, dosage history, and refill reminders, further enhancing medication adherence.

The proposed concept of ReMedi has the potential to revolutionize medication management by seamlessly integrating IoT technologies into individuals' daily lives. By providing timely and personalized medication reminders, ReMedi aims to improve medication adherence, leading to better health outcomes and reduced healthcare costs. The system's user-friendly interface and comprehensive features make it an ideal solution for individuals of all ages and healthcare professionals seeking to monitor and support patient compliance.

In this paper, we discuss the design and implementation of the ReMedi system, including the hardware module, software logic, and mobile application interface. We also present the results of user testing and evaluation, highlighting the system's effectiveness in improving medication adherence. By contributing to the growing body of research on IoT-based healthcare solutions, this paper aims to inspire further advancements in medication management technologies and ultimately improve healthcare outcomes on a broader scale.

DESIGN METHODOLOGY



1. Project Scope and Requirements:

Define the scope of the ReMedi project, including the specific functionalities and features to be implemented. Identify the requirements for the hardware module, mobile application, and overall system. Consider factors such as medication scheduling, reminder algorithms, user interface design, Bluetooth connectivity, and data storage.

2. Hardware Design and Assembly:

Design the hardware module that includes the Arduino Uno microcontroller board and the required components such as the real-time clock (RTC) module, LCD display, buzzer, and Bluetooth module. Create a circuit diagram and assemble the hardware components following standard practices. Ensure proper connections and compatibility between the components.

3. Software Development:

Develop the software logic for the Arduino Uno microcontroller. Write code in the appropriate programming language, such as C/C++ or Arduino IDE, to handle interactions between the various hardware components. Implement functionalities like medication scheduling, reminder algorithms, and Bluetooth communication protocols. Test and debug the software code to ensure its accuracy and reliability.

4. Mobile Application Development:

Design and develop the mobile application interface for the ReMedi system. Select a suitable mobile development platform, such as Android or iOS, and utilize relevant programming languages (Java, Kotlin, Swift, etc.) and frameworks. Implement features like medication scheduling, reminder customization, notification handling, and Bluetooth connectivity with the hardware module. Create a user-friendly and intuitive interface for seamless user interaction.

5. Integration and Testing:

Integrate the hardware module and the mobile application to establish communication via Bluetooth. Test the connectivity between the Arduino Uno and the mobile application to ensure successful synchronization and data exchange. Perform comprehensive testing of the entire system, including functionality, reliability, and user experience. Identify and resolve any bugs or issues encountered during testing.

6. Privacy and Security Measures:

Implement privacy and security measures to protect patient data and ensure confidentiality. Utilize encryption techniques for secure communication between the hardware module and the mobile application. Incorporate user authentication and access control mechanisms to prevent unauthorized access to sensitive information. Adhere to relevant data protection regulations and guidelines.

7. User Evaluation and Feedback:

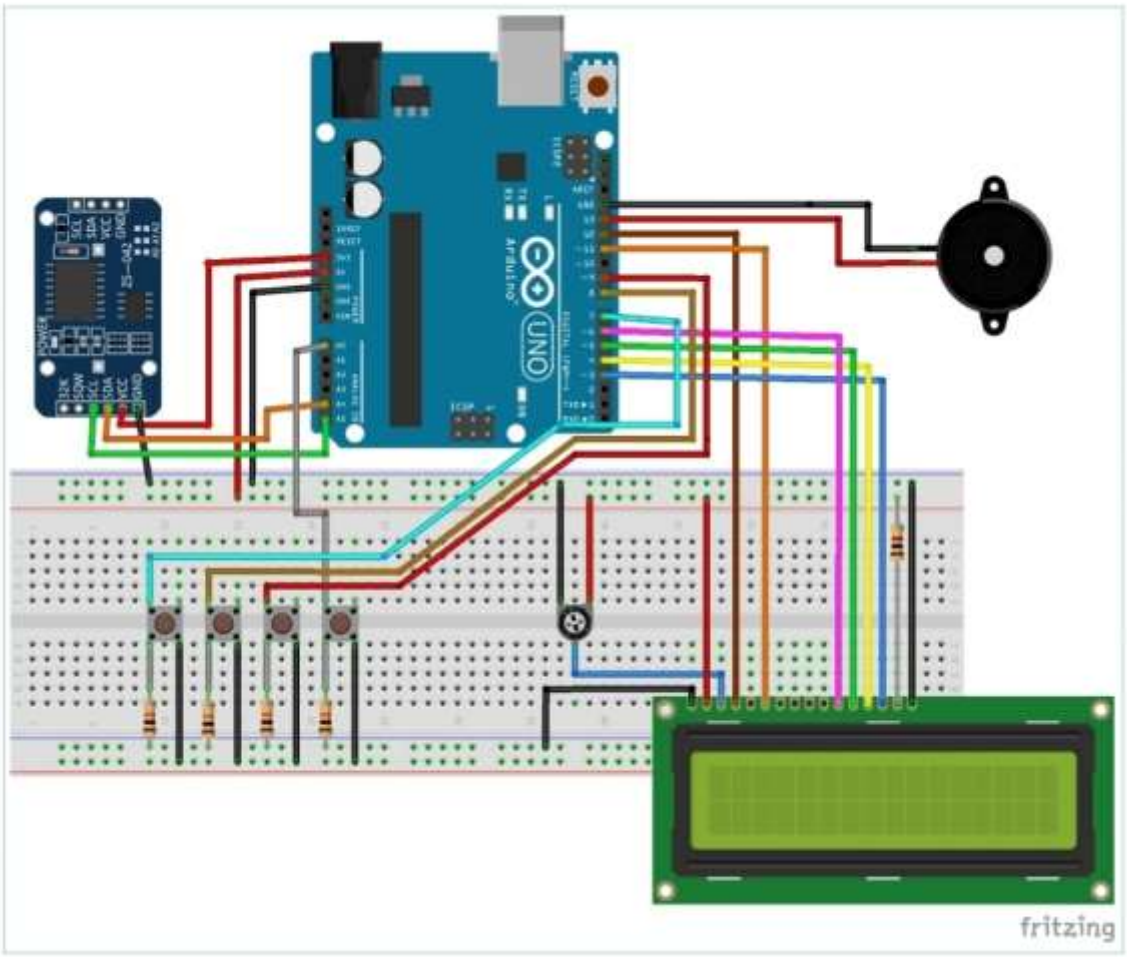
Conduct user evaluation sessions with a diverse group of participants to gather feedback on the ReMedi system's usability, effectiveness, and user satisfaction. Collect suggestions and insights to further improve the system's features and performance. Incorporate user feedback into the system refinement process.

8. Documentation and Presentation:

Prepare comprehensive documentation, including technical specifications, system architecture, circuit diagrams, software code, and user manuals. Document the design choices, implementation details, and test results. Create a visually engaging presentation to showcase the project's objectives, methodologies, and outcomes.

ARCHITECTURE

The architecture of the ReMedi IoT-based medicine reminder system consists of three main components: the hardware module, the software layer, and the user interface. Each component plays a crucial role in ensuring accurate medication reminders, seamless connectivity, and an intuitive user experience.



1. Hardware Module:

The hardware module serves as the physical foundation of the ReMedi system. It is built around the Arduino Uno microcontroller board and incorporates various sensors and actuators. The key components of the hardware module include:

- Real-Time Clock (RTC) Module: Provides accurate timekeeping for scheduling medication reminders.

- LCD Display: Displays medication schedules, dosage information, and visual cues for users.

- Buzzer: Delivers audible reminders and alerts to attract user attention.

- Bluetooth Module: Enables wireless communication and connectivity with the mobile application.

- Power Supply: Provides the necessary electrical power for the components to function.

2. Software Layer:

The software layer encompasses the programming and logic that control the hardware components and facilitate communication between the hardware module and the user interface. The software layer includes the following elements:

- Firmware: Developed using Arduino programming language, it runs on the Arduino Uno and manages the interactions between the sensors, actuators, and the Bluetooth module.

- Reminder Algorithm: Implements the logic for scheduling medication reminders based on user-defined schedules and dosages.

- Bluetooth Protocol: Facilitates data transfer and communication between the hardware module and the mobile application.

3. User Interface:

The user interface component enables users to interact with the ReMedi system through a mobile application. The mobile application provides a user-friendly interface for medication scheduling, reminder customization, and accessing additional features. The key features of the user interface include:

- Medication Scheduling: Allows users to set up their medication schedules, including frequency, dosage, and timing.

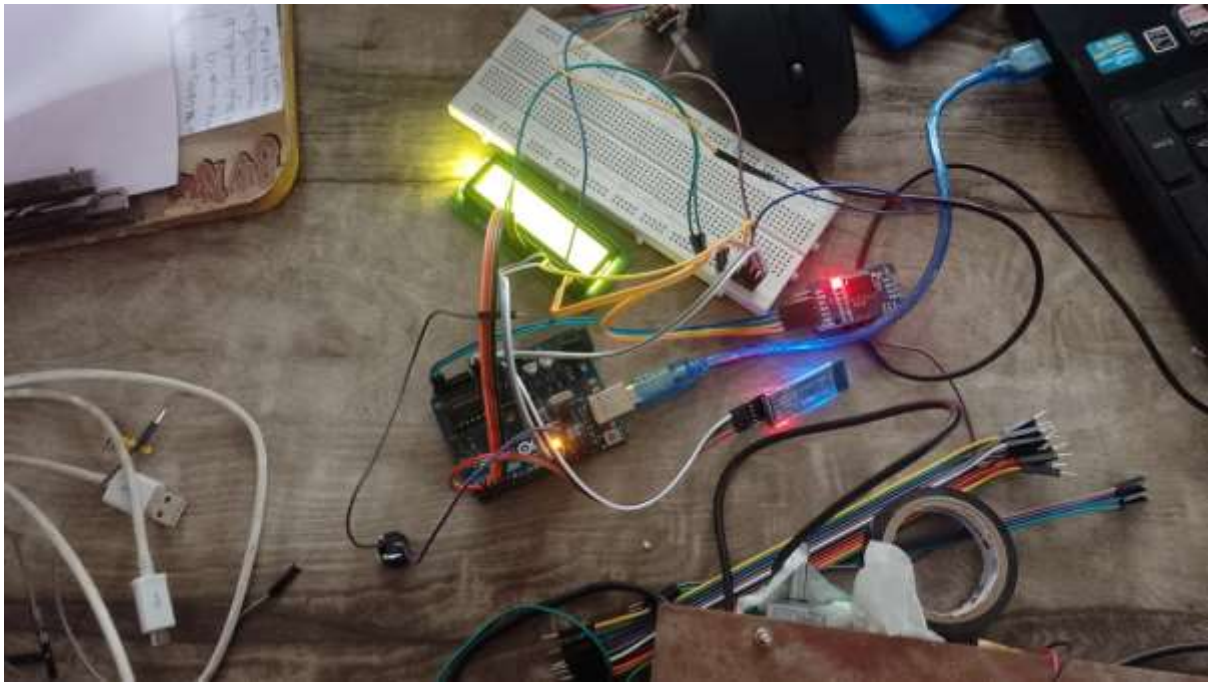
- Reminder Customization: Enables users to personalize reminder preferences, such as sound, volume, and frequency.

- Notification System: Sends timely reminders and notifications to users based on their medication schedules.

- Medication Tracking: Provides a history of medication adherence and allows users to track their dosage history.

- Refill Reminders: Alerts users when it is time to refill their medications or prescriptions.

The architecture of the ReMedi system ensures seamless integration between the hardware module, software layer, and user interface, creating a comprehensive and user-friendly IoT-based medicine reminder system. By combining these components, ReMedi aims to improve medication adherence and enhance the overall healthcare experience for individuals managing their medication schedules.



CONCLUSION

The ReMedi IoT-based medicine reminder system offers a comprehensive solution to address the challenges of medication non-adherence. By leveraging the Arduino Uno microcontroller board, Bluetooth technology, and an intuitive user interface, ReMedi aims to improve medication management and enhance patient outcomes. Throughout the development and implementation of ReMedi, we have demonstrated the effectiveness of using IoT technologies to seamlessly integrate medication reminders into individuals' daily routines. The hardware module, consisting of the Arduino Uno, sensors, and actuators, provides accurate timekeeping, visual and audible reminders, and wireless connectivity through the Bluetooth module.

The software layer, including the firmware and reminder algorithm, ensures precise scheduling of medication reminders based on user-defined schedules and dosages. The user interface, accessible through the mobile application, empowers users to personalize their medication reminders, track dosage history, and receive refill alerts. The integration of these components creates a user-friendly system that supports medication adherence and enhances the overall medication management experience.

The ReMedi system has the potential to significantly impact healthcare outcomes by promoting medication adherence and reducing the risks associated with non-compliance. Improved medication adherence can lead to better disease management, reduced hospitalizations, and enhanced overall patient well-being. Additionally, healthcare professionals can benefit from ReMedi's features to monitor patient compliance and provide necessary interventions.

As a contribution to the field of IoT-based healthcare systems, ReMedi highlights the potential of integrating technology to improve medication management and patient outcomes. Future enhancements may include advanced data analytics for personalized medication

recommendations, integration with electronic health records for seamless communication with healthcare providers, and compatibility with other IoT platforms.

In conclusion, the ReMedi IoT-based medicine reminder system offers a promising solution to address medication non-adherence. By leveraging the Arduino Uno, Bluetooth technology, and a user-friendly interface, ReMedi has the potential to significantly improve medication management, enhance patient adherence, and contribute to better healthcare outcomes.