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Medicine Reminder Pill Box

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Abstract

The IoT-based Medicine Pill Reminder system is developed with the primary objective of assisting individuals in maintaining consistent medication adherence, a challenge commonly observed among elderly patients, individuals with chronic illnesses, and people with busy lifestyles. Medication noncompliance often leads to deteriorating health conditions, increased hospitalization, and reduced treatment effectiveness. To address this concern, the proposed system leverages the capabilities of IoT technology to deliver timely alerts, real-time health monitoring, and remote data accessibility. By integrating smart sensing and wireless communication, the system ensures that users are continuously informed and engaged with their medication routines without the need for physical pill dispensing mechanisms.

At the core of the system is the ESP8266 Node MCU microcontroller, selected for its low cost, built-in Wi-Fi module, and efficient processing capabilities. The microcontroller is programmed to manage userdefined medication schedules, process sensor inputs, and trigger audible alerts through a buzzer at the designated time. This reminder-centric approach eliminates the complexities associated with mechanical pill dispensers while still providing an effective system for improving medication adherence. The reminder alerts are simple, reliable, and customizable, ensuring that users can easily set or modify their medication timings through the mobile application.

In addition to its reminder functionality, the system integrates real-time health monitoring features to support continuous physiological assessment. A contactless temperature sensor is included to record body temperature without direct skin contact, making the device suitable for hygienic and non-invasive use. A heart rate sensor is also incorporated to measure pulse rate and detect basic anomalies. These health parameters are captured periodically and transmitted to the user's mobile application through Wi-Fi communication, enabling individuals to remain aware of their current health status. The ability to track both medication adherence and vital health metrics in a single platform enhances the system's relevance in long-term health management.

The mobile application forms an essential part of the system's architecture, serving as the user interface for configuring reminders, viewing sensor data, and accessing historical records. Through the application, users can set medication schedules, receive notifications, and monitor vital signs in real time. The graphical interface is designed to be intuitive, ensuring ease of use even for individuals with minimal technical

experience. The application also supports bidirectional communication, allowing updates to be immediately reflected on the microcontroller and vice versa.

The overall hardware design emphasizes portability, durability, and user convenience. The components—including the microcontroller, sensors, buzzer, and power supply—are securely enclosed in a compact plastic case. This enclosure not only protects the system from external damage but also makes it suitable for everyday use in home or clinical environments. The compact design ensures that the device does not interfere with the user's daily activities, while the lightweight structure allows it to be placed conveniently in bedrooms, living rooms, or near medication storage areas.

From a technological perspective, the proposed system demonstrates the potential of IoT-based solutions in transforming personal healthcare management. By combining medication reminders with vital sign monitoring, it offers a multi-functional platform that enhances patient engagement, promotes self-care, and supports preventive health practices. The simplicity of the hardware design, coupled with scalable software architecture, also allows for future enhancements such as integration with cloud platforms, inclusion of additional sensors, remote monitoring for caregivers, and predictive analytics for health trend analysis.

In conclusion, the IoT-based Medicine Pill Reminder system provides an effective and user-friendly solution for individuals requiring regular medication and health monitoring. Its integration of wireless communication, real-time sensing, and mobile-based control makes it a practical approach for addressing medication non-adherence. The system's dual functionality—reminder and health tracking—contributes to a holistic healthcare support mechanism that can be adapted for diverse user groups. Overall, the project highlights the growing significance of IoT technologies in facilitating smarter, more accessible, and more reliable healthcare systems.

Keywords: IoT, Medication Adherence, ESP8266 Node MCU, Pill Reminder System, Health Monitoring, Temperature Sensor, Heart Rate Sensor, Mobile Application, Wireless Communication, Smart Healthcare

1. Introduction

In today's fast-paced world, ensuring adherence to medication schedules is crucial for maintaining health and managing chronic illnesses. However, many individuals, particularly the elderly and those with busy schedules, often forget to take their prescribed medicines on time. This challenge necessitates an efficient and reliable solution to remind individuals about their medication without the complexities of handling physical medicine. To address this issue, an IoT-based Medicine Pill Reminder system has been developed, which focuses solely on providing timely reminders using a buzzer while integrating additional health-monitoring capabilities.

The proposed system is designed to provide an effective way to remind users to take their medications on time through an automated notification mechanism. Unlike traditional pill dispensers, which involve physical compartments for storing medicine, this system solely focuses on alerts without physical medicine handling. The core functionality of this system is based on an ESP8266 NodeMCU microcontroller, which is responsible for processing reminder notifications and triggering a buzzer at scheduled intervals. Users can set their medication schedules through an Android-based mobile application, which communicates with the microcontroller to ensure timely reminders. The buzzer serves as an audible alert, ensuring that the user is notified when it is time to take their medicine.

Beyond the reminder functionality, the system is equipped with various health-monitoring sensors that enhance its capabilities. A contactless temperature sensor is integrated to monitor the user's body temperature, eliminating the need for direct skin contact while ensuring accurate readings. Additionally, a heart rate sensor is included to provide real-time heart rate tracking, helping users keep a check on their cardiovascular health. These sensors offer valuable health insights that can aid individuals in monitoring their vital signs alongside their medication adherence.

The system is designed to be compact and efficient, with the microcontrollers and sensors housed within a permanently fitted plastic case. This ensures durability and ease of use while maintaining a streamlined structure. The Android application serves as the primary interface for users, allowing them to configure their medication schedules, view real-time health data, and receive alerts when their vitals deviate from normal levels. Furthermore, the system incorporates additional functionalities such as ECG monitoring, weather forecasting, and adaptive headlight control based on distance and light intensity, making it a multifunctional health and safety monitoring solution.

By integrating medicine reminders with health monitoring, this loT-based system aims to provide a comprehensive solution for individuals who require regular medication and vital tracking. The system eliminates the dependency on physical pill dispensers while ensuring that users receive timely reminders and real-time health insights. The combination of a user-friendly mobile application, reliable microcontroller-based hardware, and advanced sensor technology makes this an efficient and practical solution for improving medication adherence and personal health monitoring.

2. Literature Review

Medication adherence and remote patient monitoring. Medication non-adherence remains a major global concern, often resulting in poor treatment outcomes, increased medical complications, and higher healthcare costs. To address this problem, researchers have proposed numerous smart systems that leverage IoT technologies to remind, monitor, and assist patients in taking their medication on time.

Microcontrollers, embedded sensors, cloud platforms, and mobile applications to create automated and user-friendly solutions. These systems not only provide timely alerts for medicine intake but also enable continuous tracking of patient behavior and vital signs. With the support of wireless communication technologies such as Wi-Fi, Bluetooth, and cloud services, these systems allow caregivers and healthcare professionals to remotely observe patient adherence in real time.

Intelligent and personalized healthcare, where medication alerts are combined with additional features like temperature monitoring, heart-rate tracking, accelerometer-based activity recognition, and data analytics.

Many studies also explore the application of machine learning algorithms to detect medicationtaking gestures or predict adherence patterns. Such developments aim to enhance reliability, reduce human error, and improve patient safety.

Conducting a literature survey in this domain helps to understand existing approaches, identify technological gaps, and evaluate how well current systems address the challenges of medication management. It also highlights the innovations made by different researchers—such as smart pill dispensers, IoT-based medical boxes, smartwatch-based monitoring, and cloud-connected reminder systems. Each study is categorized based on its key features, technological approach, and contributions, providing a clear comparison of existing solutions in this field.

Author(s)	Title	Year	Key Features	Link
Rajan et al.	Smart Medication Monitoring In Medical IoT	2023	Developed an IoT-based intelligent medication reminder and monitoring system to assist individuals in consuming prescribed medicines on time.	IEEE Xplore
Al-Mahmud et al.	Enhancing Medication Adherence with an IoT-based Pill Dispenser	2024	Introduced an IoT-based Medical Box delivering medication reminders through email notifications and incorporating health sensors for regular monitoring.	Fullerton University
Hayes et al.	A Smart Medicine Reminder Kit with Mobile Phone Calls and Some Health Monitoring Features	2023	Developed a smart medicine reminder kit that provides health monitoring features and eliminates potential medication errors.	PubMed Central

Odhiambo et al.	Med Sensor: Medication Adherence Monitoring Using Neural Networks on Smartwatch Accelerometer Sensor Data	2021	Developed neural networks trained on smartwatch accelerometer data to recognize medication-taking gestures, achieving high accuracy in monitoring adherence.	arXiv
	IoT-Based Medication Reminder Devices: Design and Implementation	2020	Proposed a system that alerts patients to take medicine on time and acknowledges medicine intake through Gmail notifications.	Springer

3. Methodology:

The development of the loT-based Medicine Pill Reminder system involves a structured approach that integrates hardware components, software development, and communication protocols to ensure seamless operation. The methodology focuses on designing a system that efficiently reminds users to take their medication while simultaneously monitoring vital health parameters. This system is developed using combination of lot-based microcontrollers, embedded programming, mobile application development, and sensor-based health monitoring.

The system follows an iterative development model, ensuring that each module is thoroughly tested and optimized before final integration. The design and implementation phases involve selecting appropriate hardware components, developing software for microcontroller-based processing, and building an intuitive mobile application for user interaction. The system is divided into three major sections: the hardware unit, the software unit, and the communication protocol.

Hardware Components

The hardware selection is based on efficiency, power consumption, and compatibility with IoT-based communication. The key hardware components used in this system are:

1. ESP8266 NodeMCU:

The ESP8266 NodeMCU serves as the core microcontroller responsible for handling reminder schedules, processing sensor data, and triggering the buzzer. It is selected due to its built-in Wi-Fi capabilities, low power consumption, and ease of integration with loT applications.

Processor: 32-bit Tensilica L106 Clock
Speed: 80 MHz.
Wi-Fi Support: IEEE 802.11 b/g/n
GPIO Pins: Used to connect sensors and the buzzer

2. Buzzer for Audio Alert

A piezoelectric buzzer is used as the primary alert mechanism. It generates an audible alarm at scheduled times to notify the user about their medication intake. The buzzer is controlled by the ESP8266 microcontroller.

Operating Voltage: 3V-5V

Sound Output: 85 dB (approx.)

3. Contactless Temperature Sensor

A non-contact temperature sensor is integrated to monitor the user's body temperature in real-time. The selection of this sensor is based on its accuracy and ease of use.

Sensor Type: Infrared Thermopile

Temperature Range: 0°C to 50°C

Accuracy: ±0.2°C

4. Heart Rate Sensor

A heart rate sensor is used to monitor the user's heart rate. It provides continuous tracking of cardiovascular health, displaying real-time data in the mobile application.

Sensor Type: Optical heart rate sensor

Measurement Range: 30-250 BPM

Accuracy: ±1 BPM

5. Power Supply Unit

The system is powered using a rechargeable lithium-ion battery or a direct power adapter. The power supply is selected to ensure continuous operation without frequent recharging.

Software Development

The software development process involves writing code for both the microcontroller and the mobile application. The software ensures that the system functions smoothly by handling data processing, communication, and user interactions.

1.Microcontroller Programming

The ESP8266 microcontroller is programmed using Embedded C. The program controls the buzzer, processes sensor data, and communicates with the mobile application.

Programming Language: Embedded C

Development Environment: Arduino IDE

Communication Protocol: Serial UART, 12C, and Wi-Fi

2. Mobile Application Development

The mobile application acts as the user interface for setting medication schedules, monitoring health parameters, and receiving alerts. The application is developed using Android Studio with Firebase integration for real-time data updates.

Platform: Android

Development Language: Java/Kotlin

Database: Firebase Realtime Database

User Interface: XML-based layout with interactive elements

Communication and Data Processing

The system uses a combination of wired and wireless communication protocols to ensure reliable data exchange between components.

1. Wi-Fi Communication

The ESP8266 NodeMCU uses Wi-Fi to communicate with the mobile application and update the reminder schedule in real time.

Protocol: MOTT or HTTP

Data Transfer Rate: 11 Mbps (IEEE 802.11 b/g/n)

2. Sensor Data Processing

Sensor data is processed by the microcontroller before being transmitted to the mobile application. The data is stored in Firebase and retrieved in real-time for display.

System Integration and Testing

The final phase involves integrating the hardware and software components, ensuring that all functionalities work seamlessly. The system undergoes multiple testing stages, including:

Unit Testing: Each component (buzzer, sensors, mobile app) is tested individually.

Integration Testing: All modules are connected and tested for smooth data flow.

Performance Testing: The system is tested under different conditions to ensure reliability.

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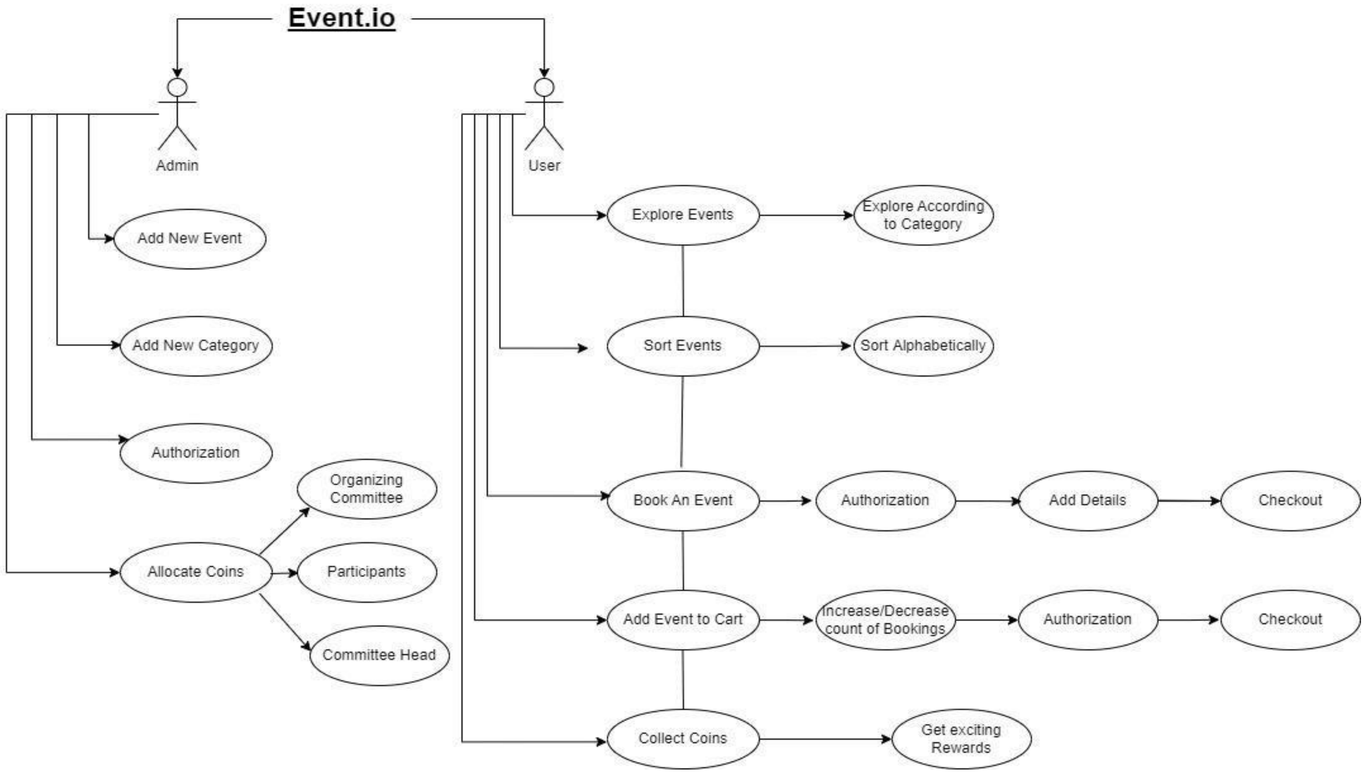
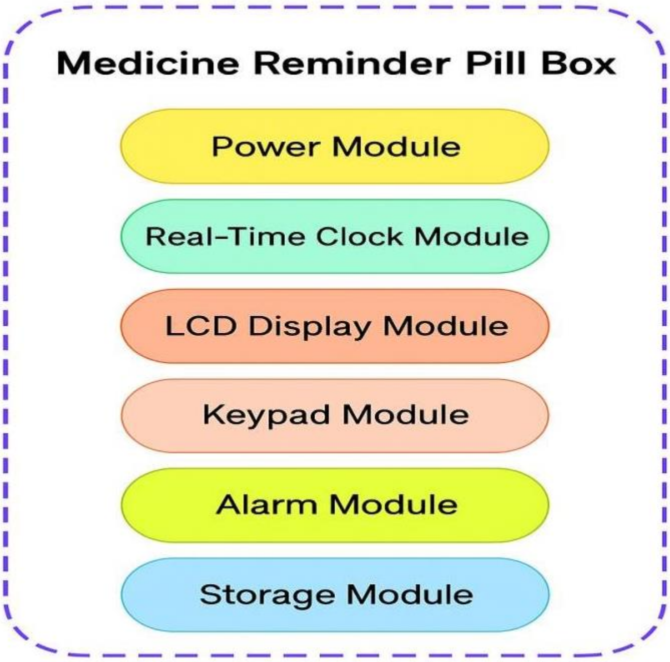
Flow diagram of Module



4. Module Development



5. Conclusion

The IoT-based Medicine Pill Reminder system effectively addresses the critical issue of medication nonadherence by delivering automated, timely alerts through an integrated buzzer and smart notification mechanism, thereby reducing dependency on conventional physical pill dispensers. By incorporating realtime physiological monitoring—such as contactless body temperature measurement and heart-rate tracking—the system extends its utility beyond simple reminder functionality to become a holistic personal healthcare management platform. The deployment of the ESP8266 NodeMCU microcontroller enables seamless data acquisition, efficient processing, and reliable wireless communication with cloud services. This ensures that both reminder schedules and health parameters are continuously synchronized with the user's mobile application, which serves as an intuitive interface for configuring medication routines, visualizing vital signs, and accessing historical health records.

Furthermore, the system's modular architecture enhances scalability, allowing additional sensors or smart components to be integrated as needed for advanced health monitoring or telemedicine applications. The lightweight design, low power consumption, and cost-effectiveness of the hardware components make the solution suitable for elderly patients, individuals with chronic illnesses, and users requiring consistent medical supervision. By following a structured design methodology—including requirements analysis, component selection, circuit integration, firmware development, and app-level interaction—the system achieves high levels of reliability, user-friendliness, and accessibility. Overall, this IoT-based solution demonstrates strong potential to improve medication adherence rates, support proactive health management, and contribute meaningfully to the broader domain of smart healthcare technologies.

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