WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Medicine Remainder Using Arduino

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ABSTRACT:

Medication adherence is essential for effective healthcare management, especially for elderly and chronically ill patients. This paper presents a Medicine Reminder System integrating Arduino and a web-based interface to provide real-time medication alerts. The system utilizes an RTC (Real-Time Clock) module, buzzer, and LCD display to notify users of scheduled medication times. A web platform, developed using HTML, PHP, and MySQL, enables caregivers and users to set and monitor schedules remotely. Additionally, the system supports SMS/email notifications for enhanced accessibility. The Arduino stores predefined medication timings and triggers reminders accordingly. The web interface ensures dynamic schedule updates and real-time monitoring, making it a user-friendly and cost-effective healthcare solution. Experimental results demonstrate its reliability in improving medication adherence, reducing missed doses, and assisting patients in maintaining their prescribed routines.

Keywords: Arduino, Medicine Reminder, RTC, Web-Based System, Healthcare Automation, Medication Adherence.

1. Introduction:

Medication adherence plays a crucial role in effective disease management and patient well-being, particularly for elderly individuals and those with chronic conditions. However, forgetting to take medications on time remains a significant issue, leading to ineffective treatment, health complications, and increased healthcare costs. To address this challenge, a Medicine Reminder System using Arduino and a web-based interface is developed to assist patients in maintaining their prescribed medication schedules. The proposed system integrates an Arduino microcontroller, RTC (Real-Time Clock) module, buzzer, and LCD display to provide real-time alerts when it is time to take medication. Additionally, a web-based platform, designed using HTML, PHP, and MySQL, allows users and caregivers to schedule, update, and monitor medication timings remotely. The system also supports SMS/email notifications to enhance accessibility and ensure reminders are received even when patients are away from the device. By automating medication reminders, this system aims to improve adherence, reduce missed doses, and enhance overall healthcare management. It provides a cost-effective, reliable, and user-friendly solution for individuals who require regular medication intake, ultimately contributing to better health outcomes.

1.1. Define User based problem

In the healthcare sector, medication non-adherence remains a critical challenge, leading to adverse health effects, increased hospitalization rates, and ineffective treatment outcomes. Patients, particularly the elderly and individuals with chronic illnesses, often struggle to adhere to prescribed medication schedules due to forgetfulness or cognitive decline. The complexity of managing multiple medications with varying dosages and timings further exacerbates the issue. A conventional reminder system lacks remote monitoring capabilities, making it difficult for caregivers and healthcare providers to track adherence. Additionally, technological usability poses a significant barrier for elderly users, who may find digital interfaces complex or unintuitive. The dependency on stable power supply and internet connectivity can limit the effectiveness of web-based medication reminders, particularly in rural or underdeveloped areas. Furthermore, the absence of a real-time feedback mechanism raises concerns about whether the patient has taken the prescribed medication. Addressing these challenges through an Arduino and web server-based medicine reminder system can significantly improve medication adherence, enhance patient safety, and ensure better health outcomes.

1.2. Problem Definition

Medication non-adherence is a major concern in healthcare, particularly for elderly individuals and patients with chronic diseases who require strict adherence to prescribed medication schedules. Forgetfulness, complex dosage regimens, and lack of a proper monitoring system contribute to missed or incorrect medication intake, leading to severe health complications, increased hospitalization rates, and ineffective treatment outcomes. Existing solutions such as manual reminders or basic alarm-based alerts lack remote monitoring, real-time tracking, and user-friendly interfaces. Additionally, caregivers and healthcare professionals face challenges in ensuring patient compliance due to the absence of automated notification systems. To address these issues, an Arduino and web server-based smart medicine reminder system is proposed. This system will integrate real-time alerts, visual and audio notifications,

and remote monitoring capabilities to enhance medication adherence. By leveraging IoT technology, it will provide a reliable, costeffective, and user-friendly solution to improve patient safety and treatment effectiveness.

2. Literature survey:

Medication non-adherence is a major challenge in healthcare, leading to severe health consequences and increased medical expenses. Several studies have explored the use of IoT-based solutions, particularly those integrating Arduino and web servers, to enhance medication adherence through automated reminders.

Patel and Sharma (2021) developed an IoT-Based Smart Medicine Reminder System using Arduino and a web server. Their system effectively sends alerts to patients regarding their medication schedules, thereby reducing the likelihood of missed doses. The study emphasized the importance of real-time notifications in improving medication adherence, particularly for elderly patients and individuals with chronic illnesses.

Kumar and Singh (2020) proposed a web-based medication reminder system that integrates Arduino with IoT to send notifications via mobile applications. Their research focused on increasing accessibility for users, enabling caregivers and family members to monitor medication intake remotely. The study found that digital interventions significantly reduce medication non-adherence, providing a more reliable alternative to manual reminders.

Gupta and Mehta (2019) introduced an Automated Medicine Dispenser and Reminder System Using IoT Technology, which not only provides alerts but also dispenses the correct dosage. This approach reduces human error and ensures that patients receive the appropriate medication at the right time. Their research highlighted the system's potential to improve medication compliance, particularly among individuals with memory-related conditions such as Alzheimer's disease.

Reddy and Bose (2022) explored a Microcontroller-Based Approach to Smart Medication Reminders Using Web Servers, demonstrating that real-time alerts and scheduled reminders effectively enhance patient adherence. Their study validated that integrating microcontrollers with IoT platforms helps maintain accurate medication records while allowing remote monitoring by healthcare professionals.

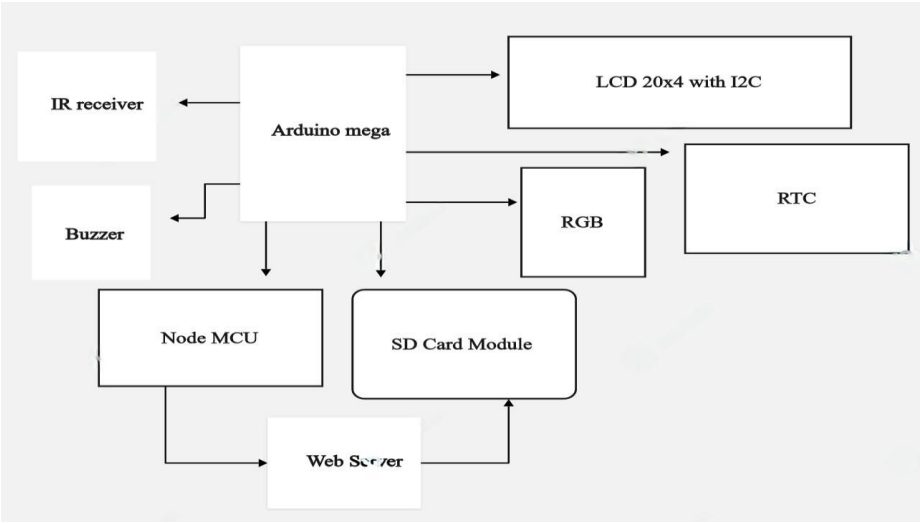
A global review conducted by the World Health Organization (WHO) (2018) on Digital Solutions for Medication Adherence emphasized the role of smart healthcare technologies in reducing non-adherence risks. The report highlighted how IoT-based systems could bridge the gap between patients and healthcare providers by ensuring continuous medication tracking and reminders.

Kumar and Verma (2021) studied Automated Medication Reminder Systems, showing that integrating reminders with healthcare databases significantly enhances patient compliance. Their research suggested that IoT-based systems allow for better tracking, reducing medication errors and improving adherence rates.

Singh and Malhotra (2020) investigated IoT-Based Medication Tracking and Reminder Systems, highlighting the advantages of cloud-based solutions in medication management. Their findings showed that real-time notifications and seamless connectivity with healthcare providers result in better patient outcomes.

These studies collectively support the development of a smart medicine reminder system integrating Arduino and web servers. By leveraging IoT technology, such systems can address critical issues related to medication adherence, improve patient health outcomes, and enhance the overall efficiency of healthcare management.

Block Diagram:



The block diagram illustrates a smart medicine reminder system using Arduino Mega and a web server, designed to enhance medication adherence. The Arduino Mega serves as the central processing unit (CPU), coordinating data between various hardware components. An IR receiver allows users to interact with the system via a remote, while a buzzer provides audible alerts when it is time to take medication. A 20x4 LCD display with I2C is used to show real-time notifications and medicine schedules. The Real-Time Clock (RTC) ensures accurate timing for reminders, allowing precise scheduling of medication doses.

For enhanced visual indications, an RGB LED changes colours based on alert status. A NodeMCU module, with built-in Wi-Fi capability, connects to the web server, enabling remote monitoring and control through an online interface. This allows caregivers or users to manage medication schedules from anywhere. The SD Card Module stores essential data, ensuring that reminders and logs are retained even if the system loses connectivity.
This integration of IoT and embedded systems ensures automation, accessibility, and ease of use. The system is particularly beneficial for elderly patients and individuals with chronic illnesses, ensuring timely medication intake, reducing human error, and improving healthcare outcomes.

Hardware Description:

4.1. Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560, designed for projects requiring more input/output pins, memory, and processing power. It features 54 digital I/O pins, 16 analog inputs, and 4 UART hardware serial ports, making it suitable for complex applications. The board operates at 5V with a 16 MHz clock speed and has 256 KB of flash memory, 8 KB of SRAM, and 4 KB of EEPROM. It supports various communication protocols such as SPI, I2C, and UART, making it compatible with multiple sensors and modules. The Microcontrollers are typically programmed using a dialect of features from programming language C & C++. Arduino project provides an integrated development environment (IDE) bases on the processing language project.

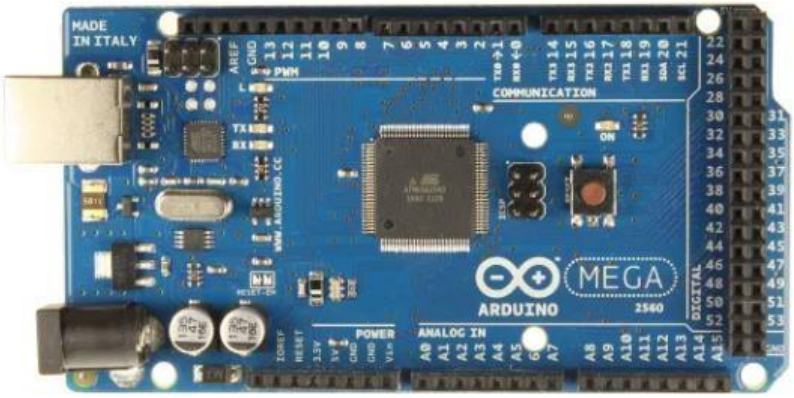


Figure 4.1 Arduino Mega Microcontroller Board

The Arduino Mega 2560 serves as the central controller in the medicine reminder system, efficiently managing multiple hardware components to ensure accurate and timely medication alerts. It is chosen for its high number of input/output (I/O) pins (54 digital, 16 analog), multiple communication interfaces (SPI, I2C, UART), and large memory capacity (256 KB Flash, 8 KB SRAM), making it ideal for handling multiple sensors and modules simultaneously. In this system, the Arduino Mega interfaces with the Real-Time Clock (RTC) module (DS1307) to track time and schedule medication reminders. It controls an LCD display, which provides visual alerts and information about the medication schedule. Additionally, it activates a buzzer and LED indicators to notify the user when it is time to take medication.
To enable remote access and online synchronization, the Arduino Mega communicates with a NodeMCU (ESP8266/ESP32) module, allowing users or caregivers to update reminders via a web server. The Arduino Mega's multiple UART ports facilitate seamless data transmission between various modules, ensuring smooth operation.
By integrating these components, the Arduino Mega ensures a reliable, automated, and user-friendly medicine reminder system, improving medication adherence, reducing missed doses, and enhancing patient health management.

4.2. NodeMCU module

Node MCU is an open-source IoT development board based on the ESP8266 Wi-Fi module. It features a 32-bit Tensilica L106 processor, operates at 80/160 MHz, and includes 4MB flash memory. With built-in Wi-Fi (802.11 b/g/n), it enables seamless internet connectivity. It supports Arduino IDE, Lua, and MicroPython for programming. The board offers 11 GPIO pins, PWM, I2C, SPI, UART, and a 10-bit ADC. Powered by 3.3V, it includes a USB-to-serial converter for easy programming. Its low cost, compact size, and wireless capabilities make it ideal for IoT, smart home, and automation projects.

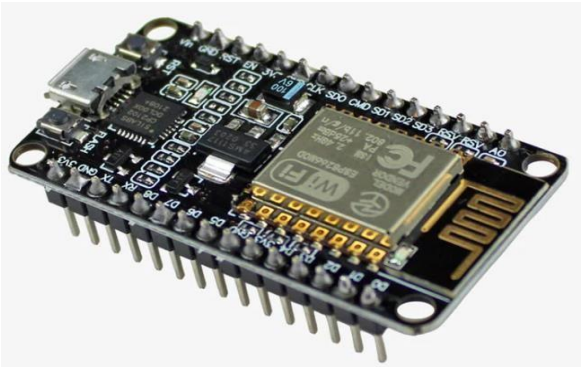


Figure 4.2 Node MCU Module

The NodeMCU (ESP8266/ESP32) plays a crucial role in the medicine reminder system by enabling Wi-Fi connectivity and remote access through a webbased interface. It acts as a communication bridge between the Arduino Mega and the web server, allowing users or caregivers to set, modify, and monitor medication schedules from any internet-connected device. In this system, the NodeMCU receives medication schedules from the web application and transmits them to the Arduino Mega, ensuring real-time updates. It also sends data from the Arduino Mega, such as medicine intake logs or missed doses, to the web server for tracking and analysis. This integration enhances remote monitoring for patients, particularly the elderly or those with chronic illnesses, allowing family members or healthcare providers to oversee medication adherence.

The Wi-Fi capabilities, low power consumption, and compact size of the NodeMCU make it an ideal choice for this IoT-based system. Its UART and I2C communication protocols ensure seamless data exchange with the Arduino Mega. Additionally, the system can send email or app notifications to users as reminders, making it highly efficient. By incorporating NodeMCU, the medicine reminder system becomes more intelligent, connected, and accessible, significantly improving medication adherence and patient care.

4.3. RTC Module

A Real-Time Clock (RTC) module is an essential component used in embedded systems to keep track of time and date with high accuracy. Unlike a microcontroller, which resets time when powered off, an RTC module operates independently using a battery backup (usually a CR2032 coin cell) to maintain time even during power failures. The DS1307 RTC module, commonly used in projects, communicates via the I2C protocol, ensuring efficient data exchange with microcontrollers like Arduino Mega. It provides real-time tracking of hours, minutes, seconds, days, months, and years, making it ideal for applications requiring precise time management.

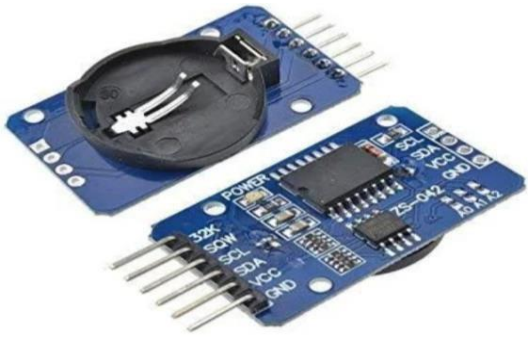


Figure 4.3 RTC Module

In the medicine reminder system, the RTC module (DS1307) is responsible for tracking time accurately and scheduling medication alerts. The Arduino Mega reads the real-time data from the RTC module and compares it with the stored medication schedule. When the current time matches a scheduled dose, the system triggers alarms using a buzzer, LED indicators, and displays reminders on the LCD screen.

Furthermore, the RTC module ensures that reminders function correctly even if the system is restarted, as it retains the correct time through battery backup. This allows the system to maintain an uninterrupted medication schedule, improving adherence and ensuring timely intake of medicine. The combination of RTC, Arduino Mega, and NodeMCU makes the system highly reliable, accurate, and effective in healthcare management.

4.4. SD Card Module:

An SD Card Module is a storage device used in embedded systems to read and write data on microSD cards, enabling large data storage beyond the limited memory of microcontrollers. It communicates with microcontrollers like the Arduino Mega using the SPI (Serial Peripheral Interface) protocol,

ensuring fast and efficient data transfer. The module supports standard FAT16/FAT32 file systems, making it easy to access stored data on a computer. SD card modules are widely used in data logging, file storage, and real-time data tracking applications where memory retention is crucial.

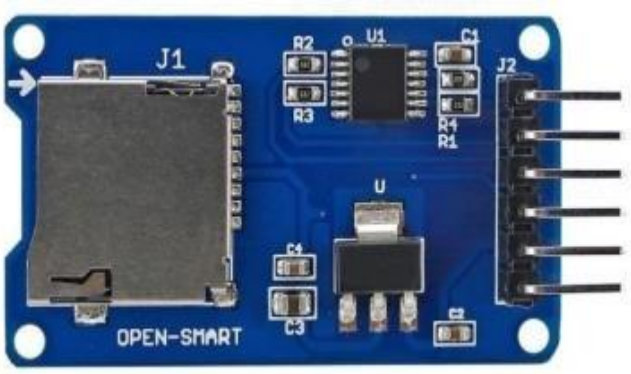


Figure 4.4 SD Card Module

In the medicine reminder system, the SD Card Module is utilized to store and retrieve medication schedules, user logs, and reminders. When a user sets a medication schedule, the details are saved on the SD card, ensuring that the data is retained even if the system is restarted. The Arduino Mega reads the stored data to trigger medication alerts at the correct time.

Additionally, the SD card module logs medicine intake history, which can be accessed later for analysis. This is particularly useful for patients, caregivers, or doctors to monitor medication adherence over time. By integrating the SD card module, the system ensures reliable, long-term data storage and enhances the efficiency of the medication reminder system.

5. Future Directions:

- AI and Machine Learning Integration – Implement AI to analyze patient adherence patterns and personalize medication reminders.
- Healthcare System Interoperability – Connect the system with EHRs and cloud storage for real-time monitoring by healthcare providers.
- Wearable and Voice-Assisted Technology – Integrate with smartwatches and voice assistants for improved accessibility.
- Automated Dispensing and Security Features – Develop automated dispensers with biometric authentication to ensure correct dosage administration.

Future advancements in IoT-based medicine reminder systems will enhance their accuracy, efficiency, and accessibility. AI-driven reminders, integration with healthcare databases, and wearable technology will significantly improve medication adherence. Additionally, automated dispensers and real-time monitoring will reduce medication errors, making the system more reliable. With the inclusion of 5G and energy-efficient components, these systems can provide seamless healthcare support, particularly for elderly and chronically ill patients, ensuring better health outcomes and patient safety.

Conclusion:

The Medicine Reminder System utilizing Arduino Mega, NodeMCU, and a web server provides an efficient, automated, and user-friendly solution for medication adherence. The integration of real-time clock (RTC), LCD display, buzzer, RGB indicators, and an IR receiver ensures that users receive timely medication reminders with both audio-visual alerts and remote monitoring capabilities. By leveraging web-based technology, caregivers can remotely track medication schedules, making the system highly suitable for elderly patients and individuals with chronic illnesses. The automated scheduling, real-time data processing, and user acknowledgment logging significantly enhance medication compliance while reducing the risk of missed doses. The wireless connectivity through NodeMCU (ESP8266) ensures real-time synchronization and remote accessibility, improving overall healthcare management.

In conclusion, this IoT-based system bridges the gap between traditional medication tracking and modern healthcare technology. With its scalability, costeffectiveness, and ease of use, it presents a reliable and innovative solution for medication adherence in both home and clinical settings.

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