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Automatic Medicine Reminder for Elder People Using Real Time Clock Module

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Abstract: As individuals age, their cognitive abilities diminish, leading to increased instances of forgetfulness, particularly in adhering to medication schedules. This poses significant health risks, including improper dosages or medication errors among the elderly. To address this issue, this study proposes an enhanced automatic medicine reminder system utilizing an RTC module integrated with an ESP32 microcontroller to facilitate precise medication timing and consistency. Furthermore, the inclusion of a GSM module enables caretakers to remotely monitor patients' adherence by receiving real-time notifications on their smartphones. This enhanced system offers a proactive approach to medication management, enhancing patient safety and caregiver oversight in geriatric healthcare settings.

Keywords: automatic medicine reminder, elderly care, RTC module, ESP32 microcontroller, medication adherence, GSM module, remote monitoring, caregiver supervision, patient safety, geriatric healthcare.

I. INTRODUCTION

The care and well-being of elderly individuals, particularly in managing their medication intake, pose significant challenges as they age. Observations within family settings often reveal the distress and potential health risks associated with missed doses or incorrect medication administration due to the decline in memory and cognitive abilities among the elderly. This issue becomes even more pronounced in the absence of regular supervision, highlighting the urgent need for reliable and effective solutions to support medication adherence in aging populations. Moreover, the challenges extend beyond familial environments to public healthcare systems, where lapses in supervision further exacerbate the situation. Instances of missed doses or improper medication use in public hospitals underscore the critical need for enhanced monitoring and intervention strategies to ensure the safety and well-being of elderly patients. In response to these pressing concerns, this paper proposes an innovative approach to medication management through the development of an automatic medicine reminder system. Leveraging advanced technologies such as RTC modules and ESP32 microcontrollers, this system aims to provide a reliable means of tracking medication schedules and promoting consistent intake among elderly individuals. Furthermore, the integration of GSM modules enables remote supervision by caregivers, addressing the need for enhanced oversight and intervention in both familial and public healthcare settings.

II. WORKING

Major Working of Enhanced Automatic Medicine Reminder System:

- 1) *Compartmentalized Medicine Storage:* The medicine box is divided into four compartments, each equipped with a lid controlled by a servo motor. This compartmentalization allows for the organized storage of different medications, simplifying the medication management process.
- 2) *Integration with Real-Time Clock (RTC) and ESP32 Microcontroller:* The medicine box is connected to a real-time clock and an ESP32 microcontroller. These components work in tandem to process the scheduled medication activities. The RTC ensures accurate timekeeping, while the ESP32 microcontroller manages the overall functionality of the system.
- 3) *Medication Alert System:* At the designated time for medication intake, the ESP32 microcontroller activates a buzzer and LED light to alert the patient. This auditory and visual cue serves as a reminder for the patient to take their medication from the specified compartment.
- 4) *Interaction with IR Sensors:* Each compartment is equipped with specific IR sensors. These sensors detect the movement of the patient as they access the medication. When the patient interacts with the compartment, the corresponding IR sensor triggers the servo motor to open the lid, granting access to the medication.

- 5) *Communication with Caretaker via GSM Module:* Upon accessing the medication, the IR sensor sends a signal to the ESP32 microcontroller, which in turn activates the GSM module. The GSM module sends a message to the designated caretaker, notifying them that the medication has been taken. This communication provides real-time updates to the caretaker, ensuring proactive monitoring of the patient's medication adherence.
- 6) *Disabling Alert System:* Once the medication has been accessed and the IR sensor detects movement, the buzzer and LED light are automatically turned off. This feature prevents unnecessary alerts and ensures a seamless user experience for the patient.

In summary, the enhanced automatic medicine reminder system utilizes a combination of compartmentalized storage, real-time clock integration, IR sensors, servo motors, ESP32 microcontroller, GSM module, and alert mechanisms to facilitate efficient medication management and remote monitoring for elderly individuals.

III. METHODS AND EXPERIMENTAL DETAILS

A. Hardware Requirements for the Module

- 1) ESP 32 Microcontroller
- 2) DS1307 Real Time Clock (RTC) Module
- 3) IR Sensors
- 4) Buzzer
- 5) Servo motors
- 6) LED Lights, LCD (Liquid Crystal Display) Module
- 7) GSM (Global System for Mobile communication)

B. Software Requirements

Arduino IDE & Embedded C language Hardware

1) ESP 32

This microcontroller offers 36 GPIO ports for versatile digital interfacing, 14 ADC ports for precise analog-to-digital conversion, and 2 DAC ports for generating analog signals. With a clock rate of 240MHz, it delivers high computational performance. Its 16MB flash memory and 250KB SRAM provide ample storage and efficient data handling capabilities, making it suitable for a variety of embedded applications and IoT projects.



Figure 1.0 ESP 32

2) Buzzer

The device in question serves as an audio signaling device, specifically designed to emit audible alerts or notifications. Operating within a voltage range of 3.3 to 5 volts DC, it functions as an active buzzer module, capable of producing sound when powered. Its active nature implies that it generates sound without needing an external oscillation circuit. This makes it suitable for various applications requiring audible alerts or indications, such as alarms, timers, and user interface feedback systems.

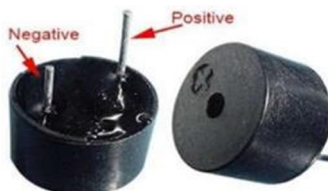


Figure 2.0 Buzzer

3) DS1307 RTC (Real Time Clock) Module

The described device serves as a real-time clock (RTC), retaining accurate time and date information even when the main system is powered down. It utilizes an I2C serial interface, a two-wire communication protocol, enabling seamless integration with a wide range of microcontrollers and systems. With an operating voltage spanning from 3.3 volts to 5 volts, it offers flexibility in powering options, ensuring compatibility with various electronic setups. This RTC module is invaluable for applications requiring precise timekeeping, such as datalogging, scheduling, and event triggering, even in scenarios where power may be intermittent or unavailable.



Figure 3.0 DS1307 RTC

4) GSM (Global System For Mobile Communications) Module

The described technology is a digital cellular system offering both voice and mobile data services across various devices. Operating within the frequency range of 850 to 1900MHz, it ensures widespread coverage and compatibility with cellular networks. Its communication interfaces include UART, SPI, I2C, and USB, facilitating seamless integration with different types of hardware and systems. Typically powered at 3.3 volts or 5 volts, it adapts well to common voltage standards in electronic devices. Reference to Figure 4.0 in the GSM (Global System for Mobile Communication) documentation provides further details or illustrations related to the system's architecture or functionality. Reference of GSM (Global System For mobile Communication) Figure 4.0



Figure 4.0 (GSM Module)

5) IR Sensor

The infrared sensor, also known as an IR sensor, serves as a radiation-sensitive optoelectronic component, detecting infrared wavelengths within the range of 780 nanometers to 50 micrometers. Operating efficiently within an electrical range of 3.3 volts to 5 volts, it offers compatibility with a variety of electronic systems. These sensors find widespread use in applications such as proximity sensing, object detection, and temperature measurement, where they leverage the characteristics of infrared radiation to provide accurate and reliable detection capabilities. With their versatility and adaptability to different voltage requirements, IR sensors play a vital role in various industrial, automotive, and consumer electronics applications.



Figure 5.0 IR sensor

6) Servo Motors

Servo motors represent a specialized category of rotary actuators engineered to deliver precise control over angular position, velocity, and acceleration. Operating effectively within a voltage range of 5 volts to 12 volts, they offer flexibility in powering options for diverse applications. These motors typically provide rotational angles spanning from 0 to 180 degrees, making them ideal for tasks requiring specific angular movements. Servo motors find extensive use in robotics, automation, and model control systems, where their ability to accurately position objects or mechanisms enhances operational efficiency and performance. Their reliability and versatility make them indispensable components across various industries, contributing to advancements in precision control and motion automation.



Figure 6.0 Servo motors

7) 16x2 LCD (Liquid Crystal Display) Display

A 16x2 LCD display, a type of liquid crystal display, presents 16 characters across each of its two rows, offering a combined display capacity of 32 characters. With an operational voltage range of 3.3 volts to 5 volts, it ensures compatibility with various electronic systems, making it widely used for text-based information presentation.

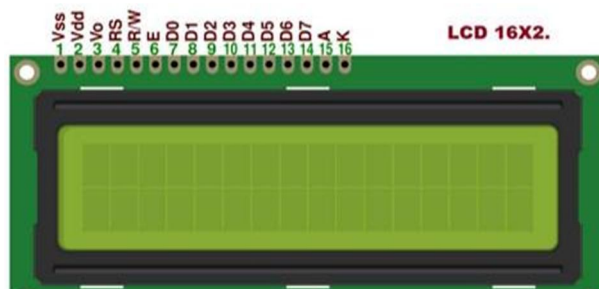


Figure 7.0 16x2 LCD

8) I2C Module

I2C Module is a parallel to serial converter compatible. By using this module, LCD can be interfaced with using only 2 wires. Two-wire serial communication (SCL for clock, SDA for data). Operating voltage: 3.3v-5v

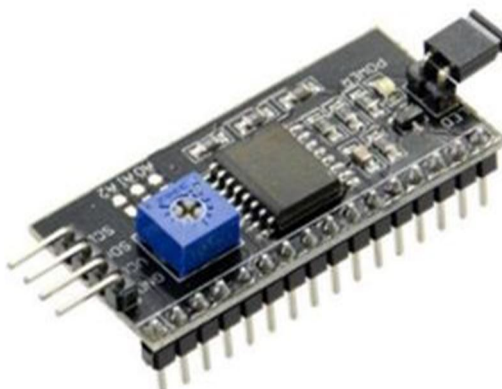
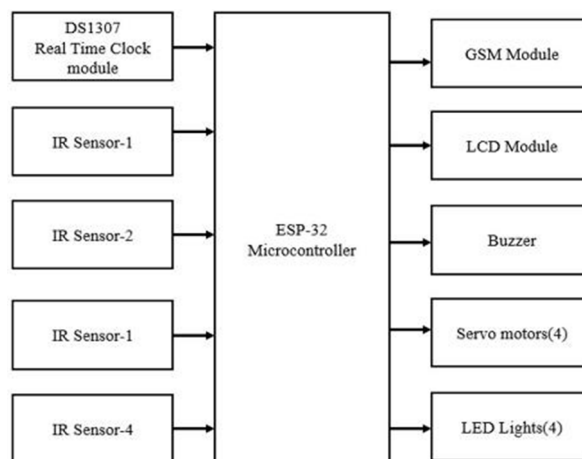


Figure 8.0 I2C Module

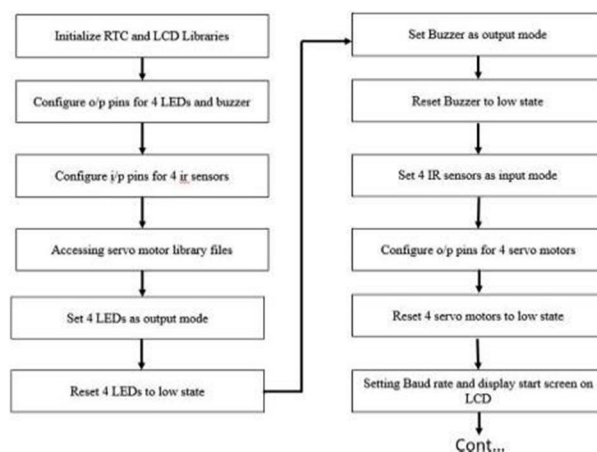
IV. IMPLEMENTATION OF THE PROJECT

A. Algorithm/Flow Chart

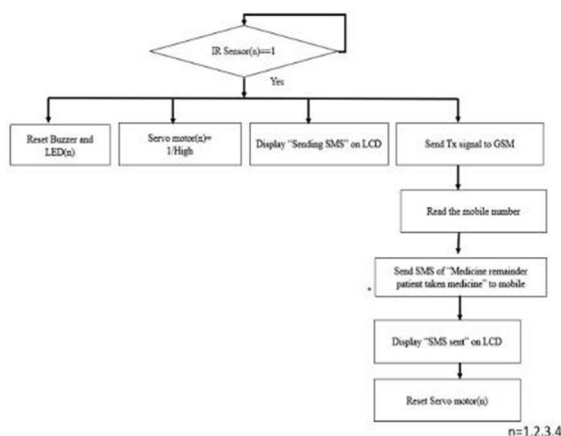


Project Block Diagram

The system represents a comprehensive solution for medication management, integrating various components to ensure timely dosage adherence and patient safety. Central to its functionality is the microcontroller, which coordinates the real-time clock, IR sensors, GSM module, LCD display, LED lights, and buzzer. By leveraging these components, the system organizes medication schedules, displaying upcoming dosages on the LCD for easy reference. When it's time for a dose, LEDs illuminate the corresponding compartment, guiding the patient to the correct medication. The system's sophistication extends to its response mechanisms. Upon accessing the medication, IR sensors reset alarms and silence the buzzer, affirming successful retrieval and administration. However, should a dose be missed, the GSM module steps in, promptly notifying designated caregivers or healthcare professionals. This feature ensures rapid intervention and continuity of care, minimizing the risk of medication errors or omissions. Overall, the system serves as a reliable ally in promoting medication adherence and patient well-being. By delivering timely reminders and notifications while also offering reassurance to both patients and caregivers, it fosters a sense of security and confidence in the medication management process. Through its seamless coordination of components, the system not only optimizes patient care and safety but also contributes to better health outcomes and enhanced quality of life.

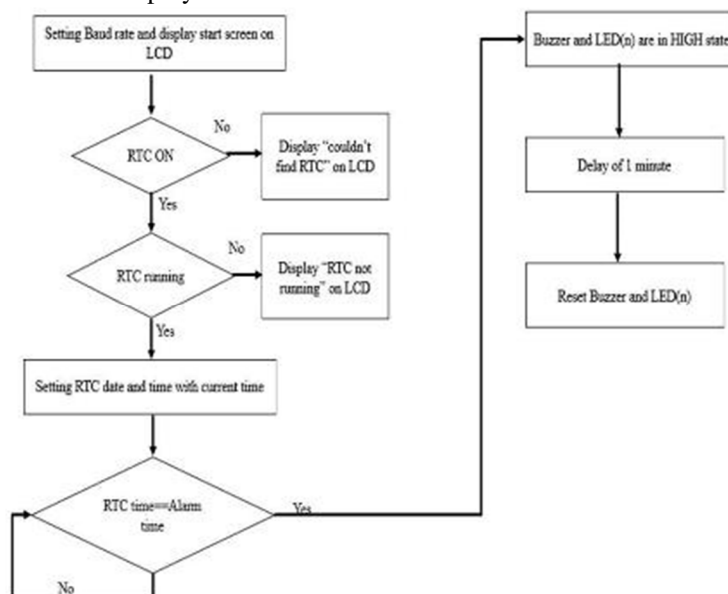


The above flow chart represents the working of software inside the microcontroller to perform the desired output. Initially it will access the RTC and LCD library header files for accessing those modules. Then we will configure four LEDs and buzzer to respected input pins of microcontroller. Now we need to configure four IR sensors as input pins and we need to access the servo motor library files for controlling those motors through commands.



Now we need to set four LEDs as output mode and in initial condition reset them into low state. Now keep the buzzer as output mode and reset it into low state similarly set four IR sensors as input mode as they are used to detect the moment and configure output pins for four servo motors and reset them to low state at initial condition, Now preset the Baud rate for sequential working and displaying the information in LCD module.

In this flow chart it represents the continuance working where the microcontroller will check the status of RTC module and represent the date and time in LCD display.



If RTC current time matches with preset alarm time in microcontroller then it will activate the buzzer and respected LED to HIGH state. After one minute delay it will automatically reset the buzzer and LED. In case the person fails to take the medicine or refuses to, the lid will not open and the buzzer will automatically stop after a preset time and will be put on snooze. Then after taking the medicine the message will be sent to the care taker and servo motors will control the operation this detection of moment in the pill box.

The above flowchart represents the implementing process of Automatic Medicine Remainder for Elder People Using RTC module. The setup consists of a small box divided into multiple compartments, each having a lid to open and an IR sensor attached to it.

The box is connected to a real time clock, a microcontroller device ESP 32 which processes the activities and accordingly displays the pill details and time of intake on the LCD attached to the box and a GSM module which sends message to the family physician or members in case the pill is not taken. The box consists of several compartments each having a pill for a definite time of the day.

An electronic real time clock, with factory predetermined time interval, is automatically activated in sync with the pill intake timings. The real time clock will start beating and as it reaches the stipulated time of pill-intake, the buzzer will go on and message will be displayed regarding which pill to take and time to take each pill. The pill dispenser may be preloaded by the patient himself or may be preloaded by someone assisting the patient once a day, thereby minimizing or totally eliminating the possible confusion as to when to take the prescribed medicine and what dosages to take.

- 1) Now if the person/user takes the pills, i.e. opens the lid, the IR Sensor attached to the lid will detect that the lid is opened and hence will send the output to Arduino which will stop the buzzer. This will be taken into the log registering the person has taken his medicine successfully.
- 2) In case the person fails to take the medicine or refuses to, the lid will not open and the buzzer will automatically stop after a preset time and will be put on snooze. Then after taking the medicine the message will be sent to the care taker and servo motors will control the operation this detection of moment in the pill box.

V. RESULTS AND DISCUSSIONS

Advancement in medication management solutions, particularly tailored to address the needs of elderly individuals and their caregivers. Through meticulous design and integration of various components, the automatic medicine reminder system offers a comprehensive approach to ensuring timely medication intake and enhancing caregiver oversight.

At its core, the system relies on the precise coordination between the RTC module, ESP32 microcontroller, IR sensors, servo motors, GSM module, and alert mechanisms to facilitate seamless medication reminders and communication channels. When the RTC matches the preset alarm time, the system triggers visual and auditory cues, manifesting as a blinking LED light and an activated buzzer. This serves as an effective prompt for the patient to take their medication, mitigating the risks associated with forgetfulness or incorrect dosage intake. The integration of IR sensors adds an additional layer of functionality by enabling the automatic opening of the compartment lid as the patient approaches the medicine box. This feature not only enhances user experience by simplifying access to medication but also ensures that the medication intake process is seamless and effortless for elderly individuals, who may experience mobility challenges or dexterity issues.

One of the most innovative aspects of the system is its ability to facilitate real-time communication between the patient and their caregiver through the GSM module. Upon the patient accessing the medication, a transmission signal is sent to the GSM module, which then promptly notifies the designated caretaker. This proactive communication mechanism allows caregivers to stay informed about the patient's medication adherence status, even when they are not physically present, thereby fostering peace of mind and enabling timely intervention if necessary. Furthermore, the system's ability to reset automatically after sending the notification ensures optimal efficiency and minimizes unnecessary alerts, preserving the user experience and avoiding potential disruptions.

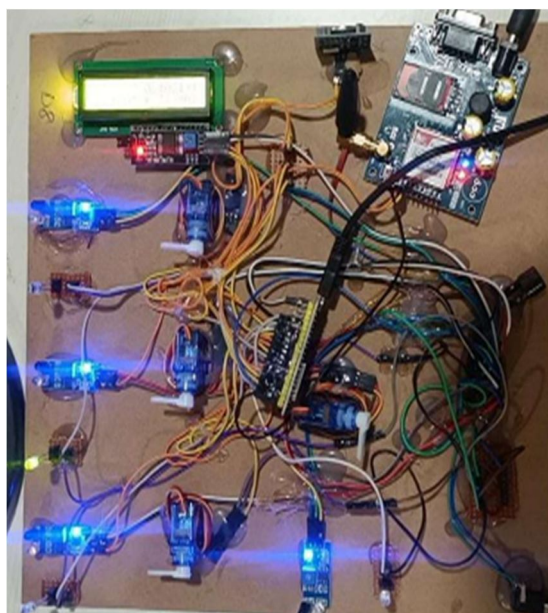


Fig 9.0: Prototype kit

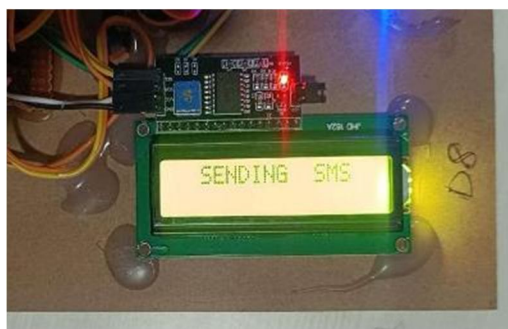


Fig 10.0: GSM module sending message

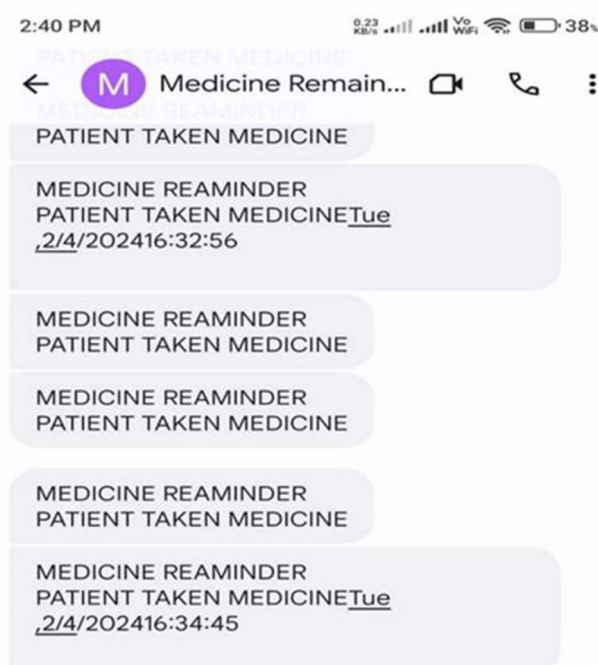


Fig-11.0: SMS to mobile via medicine boc

VI. CONCLUSION

In conclusion, the automatic medicine reminder system developed in this project represents a significant advancement in addressing the critical issue of medication management, particularly for elderly individuals and patients requiring regular medication intake. The primary objective of the device is to ensure that individuals adhere to their medication schedules promptly and accurately, thereby enhancing their overall health outcomes and quality of life.

One of the key strengths of this system lies in its simplicity, affordability, and high accuracy. By integrating essential components such as the RTC module, ESP32 microcontroller, IR sensors, servomotors, GSM module, buzzer, and LEDs, the system offers a user-friendly solution that is accessible to a wide range of users. The inclusion of visual and auditory cues, such as the blinking LEDs and activated buzzer, further enhances the ease of use and ensures that patients are promptly reminded to take their medication at the prescribed times.

Moreover, the system's ability to automatically notify family members or caretakers when the patient takes their medication is a significant benefit. This feature not only provides reassurance to caregivers but also enables them to remotely monitor the patient's medication adherence, thereby facilitating timely intervention if necessary. The real-time communication capability offered by the GSM module strengthens the support network surrounding the patient, fostering a collaborative approach to healthcare management.

Overall, the automatic medicine reminder system holds immense potential in improving medication adherence rates and reducing the risks associated with missed doses or incorrect dosage intake among elderly individuals and patients with chronic conditions. By promoting independence, enhancing caregiver oversight, and streamlining medication management processes, this innovative solution has the power to positively impact the lives of millions of individuals worldwide. As further advancements and refinements are made, it is conceivable that similar technologies will become integral components of modern healthcare systems, contributing to improved patient outcomes and overall well-being.

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