

Smart Medicine Reminder Kit with GSM Alerts and Health Monitoring for Senior Citizens

Prof. S. M. Borate¹, G.S. Salunkhe², J.S. Shinde³, T.R. Shinde⁴, P.P. Bidgar⁵

¹Assistant Professor, E & TC Engineering Department, S. B. Patil College of Engineering, Indapur (MH), India,

borate.shraddha@gmail.com

²UG Student, E & TC Engineering Department, S. B. Patil College of Engineering, Indapur (MH), India,

gururajsalunke45@gmail.com

³UG Student, E & TC Engineering Department, S. B. Patil College of Engineering, Indapur (MH), India,

vyotishinde6179@gmail.com

⁴UG Student, E & TC Engineering Department, S. B. Patil College of Engineering, Indapur (MH), India,

Stuka8387@gmail.com

⁵UG Student, E & TC Engineering Department, S. B. Patil College of Engineering, Indapur (MH), India,

pari.waghmode04@gmail.com

Abstract :-

The increasing number of elderly patients suffering from chronic diseases has created a need for reliable systems that ensure timely medication intake. Due to memory loss and lack of supervision, senior citizens often miss their prescribed doses, which may lead to serious health complications.

To address this issue, this paper presents a Smart Medicine Reminder Kit with GSM alerts and health monitoring features. The system is developed using STM32F411 and ESP32 WROOM microcontrollers. At scheduled medicine times, the system activates voice reminders, LED indications, and buzzer alerts. Digital Hall sensors are used to detect whether the medicine compartment is opened. If the dose is not taken within a predefined time, the SIM800L GSM module sends an SMS alert to the caregiver.

Additionally, the MAX30100 sensor continuously monitors vital parameters such as heart rate and oxygen saturation (SpO₂). In case of abnormal readings, emergency notifications are generated. The proposed system is low-cost, portable, and easy to operate, making it suitable for elderly individuals living independently and requiring continuous medication support.

Keywords:-

Smart medicine reminder box Medication safety

Health monitoring Microcontroller

Real-time scheduling GSM module

I. INTRODUCTION

The increasing prevalence of chronic diseases such as hypertension, diabetes, and cardiovascular disorders has made regular medication essential for many elderly individuals. Timely intake of prescribed medicines is critical to prevent complications; however, age-related memory decline and lack of supervision often lead to missed doses, incorrect intake, or overdosing. Such medication non-adherence reduces treatment effectiveness and poses serious health risks.

Existing medicine reminder systems mainly rely on alarm buzzers or mobile notifications. While these methods provide basic alerts, they do not confirm whether the medicine has actually been taken. Moreover, many systems are complex, costly, or dependent on smartphones and internet connectivity, making them less suitable for senior citizens.

To address these limitations, this paper proposes a Smart Medicine Reminder Kit integrated with GSM alerts and health monitoring features using STM32F411 and ESP32 WROOM microcontrollers. At scheduled times, the system activates voice reminders through the SID1820 module along with LED and buzzer alerts. Digital Hall sensors detect whether the medicine compartment is opened, confirming dose intake. If the dose is missed, the SIM800L GSM module sends an SMS alert to the caregiver. Additionally, the MAX30100 sensor continuously monitors heart rate and oxygen saturation (SpO₂), generating emergency notifications if abnormal values are detected.

The proposed system is low-cost, portable, reliable, and user-friendly, making it suitable for elderly individuals requiring independent medication management and continuous health monitoring.

The rising incidence of chronic diseases such as hypertension, diabetes, and cardiac disorders has increased the need for strict medication adherence among elderly individuals. However, memory decline and lack of supervision often

result in missed doses, incorrect intake, or overdosing, leading to serious health complications and reduced treatment effectiveness.

Most existing reminder systems rely on simple alarms or mobile notifications, which do not verify whether the medicine has been taken. Additionally, many solutions are complex,

expensive, or dependent on smartphones, limiting their usability for senior citizens.

II. LITERATURE REVIEW

Smart healthcare systems have gained considerable attention in the fields of medication adherence and patient monitoring. Studies indicate that a significant percentage of patients fail to take prescribed medicines on time, leading to reduced treatment effectiveness and serious health complications [1]. Traditional reminder methods such as alarm buzzers, mobile notifications, and pill organizers provide basic support but are often inadequate for elderly users who struggle with complex schedules [2]. Earlier systems used microcontroller-based reminder units with audio-visual alerts to notify patients at scheduled times [3]. However, these solutions lacked reliable confirmation mechanisms to verify whether the medicine was actually taken. Some systems incorporated GSM modules for notifications, yet many focused only on reminders without integrating health monitoring features. Additionally, mobile application-based solutions were highly dependent on user interaction and smartphone accessibility, limiting their practicality for senior citizens. Therefore, there is a need for a simple, reliable, and integrated system that combines dose confirmation, GSM alerts, and real-time health monitoring in a single platform. Internet access, limiting their usability among senior citizens

[4]. To overcome these challenges, researchers introduced IoT-based and AI-assisted medication systems, integrating wireless modules, sensors, and intelligent decision-making algorithms. For example, reinforcement learning-based systems provided personalized reminders and warnings to prevent incorrect drug intake [5]. Ambient intelligence and smart home sensors have also been proposed to enhance patient safety

In addition to medication reminders, the system incorporates a health monitoring subsystem using the MAX30100 sensor. This sensor measures heart rate and oxygen saturation (SpO_2) in real time. The controller continuously evaluates these parameters against predefined threshold values. If abnormal readings are detected, the system generates emergency alerts via GSM communication to enhance patient safety.

[6] Despite their advancements, these systems often suffer from high cost, limited portability, or lack of integrated health monitoring features. Recent developments emphasize the importance of multi-functional systems that go beyond simple reminders. Some prototypes incorporated basic health monitoring, such as heart rate or temperature tracking, but most lacked complete integration with environmental monitoring or escalation mechanisms like GSM-based phone msg alerts [7]. The proposed Smart Medicine Reminder Kit addresses limitations of existing systems by integrating GSM phone msg alerts for missed doses and using ESP32 microcontrollers for automated scheduling and LED-guided medicine box unlocking. It provides real-time health monitoring (heart rate, SpO_2 , body temperature) and environmental monitoring (temperature, gas, humidity) [15]. Unlike prior solutions, it is low-cost, portable, and senior-friendly, making it suitable for both home and hospital use. In conclusion, while previous systems improved medication adherence, they often lacked usability, scalability, and integrated monitoring. The proposed system combines

medication management, patient safety, and environmental monitoring into a single, reliable, healthcare management system.

III. SYSTEM ARCHITECTURE

The overall architecture of the proposed Smart Medicine Reminder Kit is designed as an embedded healthcare monitoring system integrating medication management and vital parameter monitoring. The system is built around two microcontrollers: the STM32F411 and the ESP32 WROOM module. The STM32F411 functions as the main processing unit responsible for sensor interfacing, time scheduling, and control logic execution, while the ESP32 WROOM assists in communication handling and efficient task coordination. The medicine reminder subsystem operates based on predefined scheduling logic programmed into the controller. At the scheduled time, the system activates a voice alert through the SID1820 voice playback module, along with LED indicators and a buzzer to capture the patient's attention. Each medicine compartment is equipped with a digital Hall sensor that detects the opening of the box, thereby confirming whether the dose has been taken.

If the medicine compartment remains unopened beyond the predefined delay period, the escalation mechanism is triggered. The SIM800L GSM module sends an SMS notification to the registered caregiver, ensuring remote monitoring and timely intervention in case of non-adherence.

The integration of reminder alerts, dose confirmation, GSM-based escalation, and real-time health monitoring creates a compact, low-cost, and reliable architecture suitable for elderly individuals requiring independent medication management and continuous health supervision.

VII. HARDWARE SUBSYSTEM INTERACTION

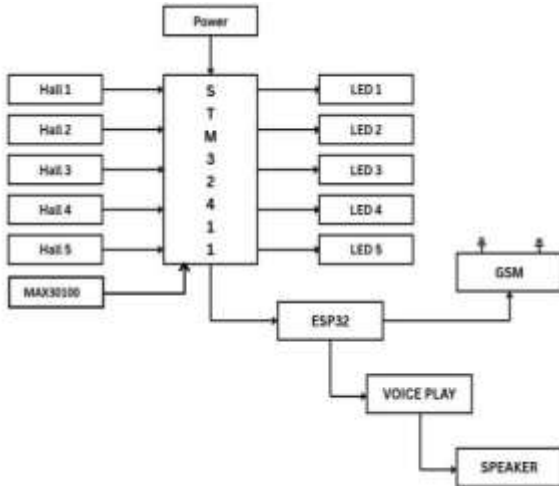


Fig.1. Block Diagram of Smart medicine reminder kit with mobile phone msg and some health monitoring features for senior citizens

The hardware subsystem integration of the proposed Smart Medicine Reminder Kit combines sensing, control, alert, and communication modules into a unified embedded platform. The STM32F411 microcontroller acts as the central processing unit, interfacing with all peripheral components through GPIO, UART, and I2C communication protocols. The ESP32 WROOM module supports communication handling and improves overall processing efficiency.

Digital Hall sensors are connected to the GPIO pins to detect the opening of individual medicine compartments. These sensors provide real-time feedback to confirm dose intake. LED indicators and a buzzer are interfaced through current-limiting resistors to generate visual and audio alerts during scheduled medication times. The SID1820 voice playback module is connected to the controller to provide clear voice reminders.

The SIM800L GSM module communicates with the controller via UART interface using AT commands. Proper voltage regulation and power conditioning circuits are implemented to ensure stable GSM operation, as the module requires a consistent power supply during transmission.

For health monitoring, the MAX30100 sensor is integrated using the I2C protocol. It measures heart rate and oxygen saturation (SpO₂) and transmits the data to the microcontroller for processing. Pull-up resistors are used in the I2C lines to ensure reliable communication.

All components are powered through a regulated power supply circuit to maintain stable voltage levels and prevent system instability. The overall hardware integration ensures synchronized operation of reminder alerts, dose confirmation, GSM communication, and vital parameter monitoring, resulting in a compact, reliable, and efficient healthcare support system.

IV SOFTWARE IMPLEMENTATION

The software implementation of the proposed Smart Medicine Reminder Kit is designed using embedded C language and developed under an ARM-based development environment for the STM32F411 microcontroller. The ESP32 WROOM module operates as a supporting controller for communication handling and task coordination. The software architecture follows a structured and modular programming approach to ensure reliability, scalability, and real-time performance.

A. System Initialization

At power-on, the microcontroller initializes all peripherals including GPIO pins, UART communication (for GSM module), I2C interface (for MAX30100 sensor), timers, and interrupt configurations. The system performs a self-check routine to ensure proper sensor connectivity and module readiness before entering the main execution loop.

B. Scheduling and Reminder Algorithm

The reminder mechanism is implemented using internal timer interrupts. The software continuously compares the preset medicine schedule with the system clock. When the scheduled time is reached, the alert routine is activated.

The alert routine performs the following actions:

- Activates the SID1820 voice playback module
- Turns ON LED indicators assigned to the specific medicine compartment
- Enables buzzer for audio notification

The alert continues until confirmation of dose intake is received or the timeout period expires.

C. Dose Confirmation Logic

Digital Hall sensors are interfaced through GPIO pins to detect the opening of medicine compartments. The software continuously monitors the sensor status. Once the compartment is opened, the system:

- Registers the dose as taken
- Stops the buzzer and LED indication
- Resets the reminder timer

If no confirmation is received within the predefined delay interval, the system activates the escalation mechanism.

D. GSM Communication Module

The SIM800L GSM module communicates with the controller via UART using AT command instructions. When a missed dose or abnormal health parameter is detected, the software sends formatted SMS messages to the registered caregiver number. The communication sequence includes:

1. GSM network check
2. SMS mode configuration
3. Message formatting
4. Transmission and confirmation

This ensures reliable remote notification and enhanced patient supervision.

E. Health Monitoring Algorithm

The MAX30100 sensor is interfaced using the I2C communication protocol. The software periodically reads heart rate and SpO₂ values. Digital filtering and basic threshold

comparison are applied to eliminate noise and detect abnormal readings.

If values exceed predefined safety limits, the emergency alert function is triggered, and an SMS notification is sent through the GSM module.

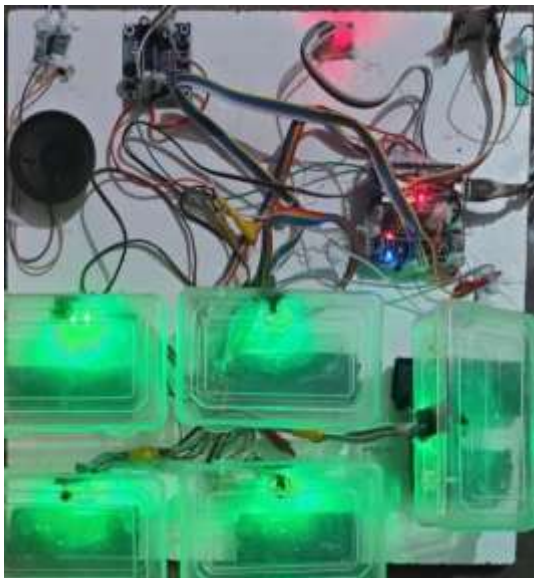
F. Main Execution Flow

The entire system operates in a continuous loop structure supported by interrupt-driven timing control. The software ensures:

- Real-time reminder generation
- Continuous sensor monitoring
- Immediate response to missed doses
- Efficient communication handling

The modular and interrupt-based design improves processing efficiency, reduces latency, and enhances overall system stability, making the software reliable for long-term healthcare application

V. RESULTS AND DISCUSSION



The proposed Smart Medicine Reminder Kit was successfully designed, implemented, and tested to evaluate its performance in real-time medication management and health monitoring. The system demonstrated reliable operation in generating scheduled reminders, confirming dose intake, and sending GSM-based alerts when required.

During testing, the reminder mechanism accurately triggered voice alerts, LED indications, and buzzer notifications at predefined medication times. The digital Hall sensors effectively detected the opening of the medicine compartment, confirming dose intake with minimal delay. When the compartment remained unopened beyond the specified time limit, the SIM800L GSM module successfully transmitted SMS notifications to the registered caregiver, validating the escalation mechanism.

The MAX30100 sensor was tested for heart rate and oxygen saturation (SpO₂) monitoring. The sensor provided stable and consistent readings under normal operating conditions. Threshold-based evaluation enabled the

system to detect abnormal values and generate emergency alerts accordingly. System performance analysis indicated low response time between scheduled alert generation and notification activation. Power consumption remained within acceptable limits for portable operation. The modular software structure ensured stable execution without system crashes during continuous operation tests.

Compared to conventional reminder systems that rely solely on alarms, the proposed design offers improved reliability through dose confirmation and remote notification features. The integration of health monitoring further enhances patient safety by providing real-time vital parameter tracking.

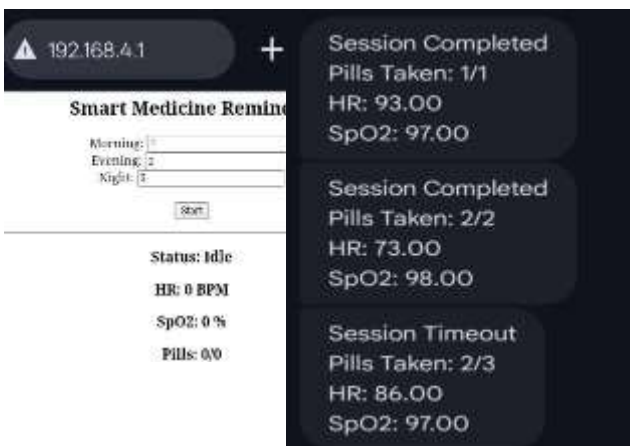
Overall, experimental results confirm that the proposed system is effective, accurate, and suitable for elderly individuals requiring dependable medication management and basic health supervision.

VI. CONCLUSION

This paper presented the design and implementation of a Smart Medicine Reminder Kit integrated with GSM-based alert and health monitoring features for elderly individuals. The system ensures timely medication intake through voice alerts, LED indicators, and buzzer notifications. Digital Hall sensors provide reliable dose confirmation by detecting the opening of medicine compartments, reducing the chances of missed or incorrect medication intake.

In case of non-adherence, the SIM800L GSM module sends SMS alerts to the registered caregiver, enabling remote supervision and timely intervention. Additionally, the integration of the MAX30100 sensor allows continuous monitoring of vital parameters such as heart rate and oxygen saturation (SpO₂), enhancing patient safety through emergency notifications when abnormal conditions are detected.

Experimental results demonstrate that the proposed system is accurate, reliable, low-cost, and user-friendly. By combining medication management with real-time health monitoring, the system offers an effective solution for improving adherence and supporting independent healthcare for senior citizens.



VIII REFERENCES

9.

1. S. Mohapatra, P.K. Sahoo, Internet of medical things: applications and research issues in healthcare monitoring, in: IoT Applications for Healthcare Systems. EAI/Springer Innovations in Communication and Computing, Springer, Cham, 2022, https://doi.org/10.1007/978-3-030-91096-9_1 et al. Heliyon 10 (2024) e2631018.
2. A.P. Sankar, D.C. Nevedal, S. Neufeld, M.R. Luborsky, What is a missed dose? Implications for construct validity and patient adherence, AIDS Care 19 (6) (2007) 775–780, <https://doi.org/10.1080/095401206000708501>.
3. A. Jabeena, A.K. Sahu, R. Roy, N.S. Basha, Automatic pill reminder for easy supervision, in: 2017 International Conference on Intelligent Sustainable Systems (ICISS), 2017, pp. 630–637, <https://doi.org/10.1109/ISS1.2017.8389315>.
4. K. Gupta, A. Jain, P.H. Vardhan, S. Singh, A. Amber, A. Sethi, MedAssist: automated medication kit, in: 2014 Texas Instruments India Educators' Conference (TIIEC), 2014, pp. 93–99, <https://doi.org/10.1109/TIIEC.2014.024>.
5. A. Chinnasamy, R. P. J, S.R. Ahmed, A. S, Cloud computing based medical assistance & pill reminder, in: 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2022, pp. 628–633, <https://doi.org/10.1109/ICICCS53718.2022.9788398>.
6. B. Kumar, W.W. Goh, S. Balakrishnan, Smart medicine reminder device for the elderly, in: 2018 Fourth International Conference on Advances in Computing, Communication & Automation (ICACCA), 2018, pp. 1–6, <https://doi.org/10.1109/ICACCAF.2018.8776734>.
7. Y. Bai, T. Kuo, Medication adherence by using a hybrid automatic reminder machine, in: 2016 IEEE International Conference on Consumer Electronics (ICCE), 2016, pp. 573–574, <https://doi.org/10.1109/ICCE.2016.7430735>.
8. A. Mathew, J. Paul, K. Nair S, U.S. Sachin, S. Koncherry, C.V. Raghu, Design and implementation of a smart medicine dispenser, in: TENCON 2019 - 2019 IEEE Region 10 Conference, TENCON), 2019, pp. 1059–1064, <https://doi.org/10.1109/TENCON.2019.8929483>.
10. M.P. Kumar, U. Rani Nelakuditi, IoT and I2C protocol based M-health medication assistive system for elderly people, in: 2019 IEEE 16th India Council International Conference (INDICON), 2019, pp. 1–4, <https://doi.org/10.1109/INDICON47234.2019.9030322>.
18. S. Jayanth, M.B. Poorvi, M.P. Sunil, MED-Alert: an IoT device, in: 2016 International Conference on Inventive Computation Technologies (ICICT), 2016, pp. 1–6, <https://doi.org/10.1109/INVENTIVE.2016.7824900>.
12. D. Salama, A. Minaam, Smart drugs: improving healthcare using smart pill box for medicine reminder and monitoring system, Future Computing and Informatics Journal 3 (2) (2018) 443–456, <https://doi.org/10.1016/j.fcij.2018.11.008>.
13. M. Naeem, G. Paragliola, A. Coronato, A reinforcement learning and deep learning based intelligent system for the support of impaired patients in home treatment, Expert Syst. Appl. 168 (114285) (2021) 1–12, <https://doi.org/10.1016/j.eswa.2020.114285>.
14. M. Ciampi, A. Coronato, M. Naeem, S. Silvestri, An intelligent environment for preventing medication errors in home treatment, Expert Syst. Appl. 193 (116434) (2022) 1–11, <https://doi.org/10.1016/j.eswa.2021.116434>.