ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

Enhancing Medication Adherence in Remote Areas Using a GSM-Based Reminder System

Vishakha Salve[1]; Dr. Shirish V. Pattalwar[2]

[1]M.E Digital Electronics 3rd Year
Prof Ram Meghe Institute of Technology, Badnera-Amravati

[2]Professor, Deptt. of Elect. &Telecomm. Engg.,
Prof. Ram Meghe Institute of Technology & Research, & Research, Badnera-Amravati

Publication Date: 2025/07/09

Abstract: Ensuring timely medication intake and regular health check-ups is crucial for effective treatment, especially among elderly patients and those in rural areas. However, limited access to internet services and complex technologies often hinders adherence to medical schedules. This paper presents an enhanced Patient Reminder System that utilizes GSM technology to deliver scheduled SMS alerts for medications, doctor visits, and other health-related tasks. The system is built using a microcontroller, a GSM module, a keypad for user input, and a real-time clock to ensure timely notifications. Designed to operate independently of internet connectivity, the solution is affordable, user-friendly, and highly suitable for remote or resource-constrained environments. The modular design also allows for future integration with IoT sensors and cloud platforms for real-time monitoring and data analysis. Overall, this system aims to improve patient compliance, reduce missed treatments, and support caregivers in delivering timely healthcare reminders.

Keywords: *GSM Technology, Patient Reminder System, SMS Alerts, Healthcare Compliance, Rural Healthcare, Arduino-Based System, Real-Time Clock, Low-Cost Medical Device, IoT Integration, Medication Adherence.*

How to Cite: Vishakha Salve; Dr. Shirish V. Pattalwar (2025) Enhancing Medication Adherence in Remote Areas Using a GSM-Based Reminder System. *International Journal of Innovative Science and Research Technology*, 10(6), 2820-2825. https://doi.org/10.38124/ijisrt/25jun1847

I. INTRODUCTION

In today's healthcare environment, patient adherence to prescribed treatment schedules plays a vital role in achieving positive health outcomes. This is especially critical for individuals managing chronic illnesses, the elderly, and patients living in rural or underserved regions. Despite the availability of advanced medical technologies, one of the most persistent challenges remains ensuring that patients take their medications on time and attend scheduled medical appointments.

Missed doses or delayed check-ups can lead to serious health complications, increased hospitalization rates, and a rise in overall healthcare costs. While smartphone applications and internet-based platforms have been developed to address these issues, their effectiveness is limited in regions where access to smartphones and stable internet connectivity is lacking.

To overcome these limitations, this paper proposes a cost-effective and reliable Patient Reminder System based on GSM technology. By leveraging basic mobile networks, the system is capable of sending timely SMS alerts to remind patients about their medication schedules and important medical tasks. It is designed with simplicity and accessibility in mind, utilizing a microcontroller, a GSM module, a keypad for input, and a real-time clock for accurate timing. The solution does not rely on internet connectivity and is compatible with basic mobile phones, making it highly practical for rural and low-income communities.

This paper explores the design, implementation, and functionality of the system, highlighting its real-world applicability and potential for further enhancement through integration with modern healthcare technologies.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

➢ *Related Work*

Several technological solutions have been developed over the years to support medication adherence and patient health monitoring. Mobile applications like Medisafe and CareZone provide reminders for medications and health-related tasks. These platforms are effective in urban areas but generally require smartphones and reliable internet connections, limiting their usability in rural and economically challenged regions.

Advanced systems utilizing Internet of Things (IoT) devices, such as smart pill dispensers and wearable health trackers, offer automated reminders and data collection features. However, these solutions tend to be expensive and complex, making them inaccessible for large segments of the population, especially the elderly or those unfamiliar with modern technologies.

Research has also shown that basic SMS-based reminder systems are a practical alternative for healthcare support in low-resource settings. Unlike internet-dependent systems, GSM-based SMS solutions can function on basic mobile phones and in areas with limited digital infrastructure. For example, previous studies have demonstrated the successful use of GSM modules in patient alert systems, where microcontrollers send pre-programmed messages to remind users of important health tasks.

Despite their simplicity, many existing SMS reminder systems are not user-configurable and lack flexibility for multiple users or custom scheduling. Some systems also fail to provide feedback or notifications for failed message delivery, reducing their reliability.

To address these gaps, this paper builds upon existing GSM-based technologies and proposes a flexible, low-cost reminder system that allows user input, supports real-time scheduling, and delivers alerts reliably without relying on internet connectivity.

➢ *Problem Statement:*

A major obstacle in delivering effective healthcare is ensuring that patients adhere to their prescribed treatment routines, including medication intake and scheduled medical visits. This challenge is especially severe in rural and underserved areas, where access to healthcare infrastructure, smartphones, and internet connectivity is limited. Current solutions like mobile applications or IoT-based devices are often unaffordable, require technical knowledge, or depend on internet access, making them inaccessible to a significant portion of the population.

The problem is further complicated for elderly individuals, who may struggle with operating smartphones or remembering critical health-related tasks. Without proper reminders, patients risk missing doses, delaying treatments, or skipping doctor appointments, leading to deteriorating health conditions and increased medical costs.

There is a clear need for a low-cost, user-friendly system that functions reliably without the internet and is compatible with basic mobile phones. Such a system should also allow caregivers or health workers to configure and manage reminders easily. The proposed solution addresses this gap by offering a GSM-based reminder system that operates independently of the internet, providing scheduled SMS alerts to patients and supporting better healthcare compliance in resource-limited settings.

II. LITERATURE SURVEY

Over the past decade, numerous studies and innovations have focused on improving healthcare delivery through automated reminder systems. These efforts aim to enhance medication adherence, improve patient engagement, and reduce preventable health complications.

One major area of research involves mobile health applications that provide reminder notifications for medications and doctor appointments. Although effective in controlled environments, these solutions typically require smartphones and internet connectivity. This limits their accessibility, particularly for older adults or patients in rural communities where advanced digital infrastructure is unavailable.

In contrast, SMS-based systems using GSM modules offer a more accessible alternative. Several projects have explored the use of microcontrollers like Arduino or Raspberry Pi paired with GSM modules (e.g., SIM800L) to deliver health alerts through text messages. These systems have demonstrated success in ensuring timely communication, even in areas lacking internet access. Research has also shown that SMS reminders significantly improve medication compliance, especially for patients with chronic conditions.

Other studies have focused on integrating wearable devices and IoT sensors for real-time health tracking and alert generation. While these systems provide rich functionality, their high cost and technical complexity often make them impractical for large-scale deployment in low-income regions.

Some notable works have combined GSM and real-time clock (RTC) modules to send time-sensitive alerts, enhancing the reliability of standalone systems. Despite these advancements, many existing models are not scalable, lack multi-user support, or do not allow users to customize reminders easily.

The proposed system in this paper draws from these research findings and seeks to bridge the gap by delivering a simple, low-cost, and customizable reminder system using GSM technology. It addresses key limitations in accessibility, affordability, and ease of use, making it well-suited for rural

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

healthcare applications.

III. PROPOSED SYSTEM AND ARCHITECTURE

The proposed system is a **GSM-based Patient Reminder System** designed to send automated SMS alerts to patients for medication intake, medical appointments, or other important health-related activities. The system is specifically built for use in rural and underserved areas where access to smartphones, the internet, or advanced digital health infrastructure is limited.

➢ *System Objectives*

- Send timely SMS reminders to patients using GSM communication.
- Allow user-configurable scheduling of reminders through a keypad interface.
- Provide local feedback via an LCD and an audible buzzer alert.
- Operate independently of internet connectivity.
- Ensure low cost, simplicity, and portability.

➢ *System Components*

The system is built around the following key hardware components:

- Microcontroller (Arduino Nano): Acts as the central processing unit, managing inputs, time monitoring, and communication with the GSM module.
- GSM Module (SIM800L): Sends SMS reminders through mobile networks using AT commands.
- 4x4 Keypad: Enables users or caregivers to input reminder time, message content, and recipient phone numbers.
- 16x2 LCD Display: Displays user input, system status, and confirmation messages.
- Real-Time Clock (RTC) Module (optional): Provides accurate timekeeping for scheduling reminders.
- Buzzer: Emits a sound alert when a reminder is triggered.
- Power Supply: A regulated 5V DC supply powers all components safely and consistently.

➢ *System Workflow*

- Initialization: The system initializes all modules, checks connections, and displays a welcome message.
- User Input: The caregiver or user enters the desired time, recipient number, and reminder message via the keypad.
- Display Confirmation: The entered data is displayed on the LCD for confirmation.
- Time Monitoring: The microcontroller continuously compares the current time with the scheduled reminder time.
- Reminder Execution: When the time matches, the GSM module sends the SMS to the specified number. Simultaneously, the buzzer is activated for local alerting.
- Feedback and Error Handling: The LCD confirms successful message delivery or displays an error message if the GSM module fails.

➢ *Block Diagram*

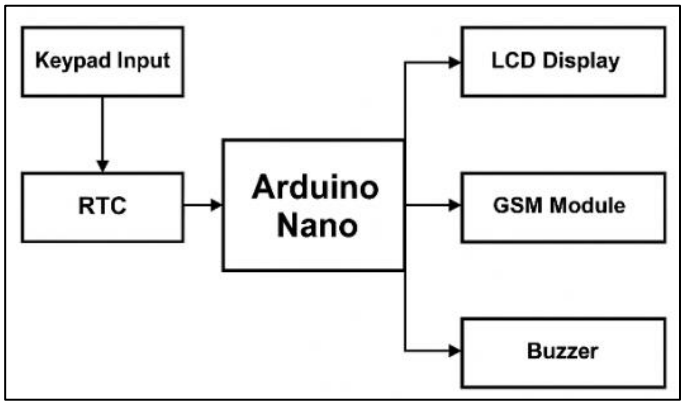

Fig 1 : Block Diagram

➢ *Key Features*

- Supports basic GSM-enabled mobile phones (no smartphone needed).
- No internet dependency.
- Modular design for easy customization and future upgrades.
- Low power consumption and portable design.

This architecture offers a practical and scalable solution for healthcare providers and patients, especially in regions with limited access to modern technologies. Its flexibility allows for future enhancements like sensor integration or cloud-based monitoring.

IV. IMPLEMENTATION DETAILS

The implementation of the Patient Reminder System involves both hardware assembly and software development. The system is designed to be compact, cost-effective, and easy to operate, making it suitable for use in both home and clinical environments, particularly in rural areas.

A. Hardware Implementation

The hardware of the system is built around an **Arduino Nano** microcontroller, chosen for its small size, low power consumption, and sufficient I/O pins. The circuit integrates the following key components:

- Arduino Nano: Acts as the brain of the system, controlling all other components based on user input and real-time monitoring.
- SIM800L GSM Module: Connected to the Arduino via serial communication (TX and RX), this module is responsible for sending SMS reminders.
- 4x4 Matrix Keypad: Used to input the patient's phone number, message, and reminder time. It is connected to the digital pins of the Arduino.
- 16x2 LCD Display (I2C): Displays entered data, system messages, and confirmation alerts. I2C reduces the number of required wires.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

- RTC Module (DS3231 or DS1307): Provides accurate real-time clock data to trigger reminders at the correct time.
- Buzzer: Emits a short beep when the reminder is triggered, providing a local alert alongside the SMS.
- Power Supply: The system runs on a 5V regulated power supply using either a USB adapter or a battery pack with voltage regulation.

All components are mounted on a perfboard or custom PCB to ensure a clean layout. Proper isolation and decoupling capacitors are used to stabilize power to the GSM module, which is sensitive to voltage drops.

B. Software Implementation

The software is written using the **Arduino IDE**, utilizing libraries such as:

- *SoftwareSerial.h* for communication with the GSM module
- *Wire.h* and *RTClib.h* for RTC module operation
- *LiquidCrystal_I2C.h* for interfacing the LCD display
- *Keypad.h* for capturing user inputs

C. Key Functional Steps:

➢ *System Initialization:*

- Initialize serial communication with the GSM module.
- Display a welcome message on the LCD.
- Synchronize current time using the RTC module.

➢ *User Input Handling:*

- The system prompts the user to enter the mobile number, reminder time, and message through the keypad.
- Inputs are confirmed and stored temporarily in the microcontroller's memory.

➢ *Real-Time Monitoring:*

- The Arduino constantly checks the current time from the RTC module.
- When the current time matches the set reminder time, it initiates the reminder process.

➢ *SMS Sending Process:*

- Using AT commands, the Arduino communicates with the GSM module to send the SMS.
- The system checks for successful delivery and displays confirmation or an error on the LCD.

➢ *Local Alert:*

- The buzzer is activated for a few seconds to notify the user locally in addition to the SMS.
- *Resetting for Next Reminder:*
- After sending the reminder, the system resets the variables and allows the user to set the next reminder.

V. APPLICATIONS

The proposed Patient Reminder System offers several practical benefits, particularly for users in rural or low-resource settings. Its simplicity, affordability, and reliability make it a valuable tool for improving healthcare adherence. The key advantages of the system are as follows:

➢ *No Internet Required*

The system operates entirely through GSM technology, eliminating the need for internet connectivity. This makes it especially suitable for remote areas with limited digital infrastructure.

➢ *Low-Cost and Affordable Components*

The use of inexpensive hardware like the Arduino Nano, SIM800L GSM module, and basic peripherals ensures that the system is cost-effective and accessible to a wider population.

➢ *Simple and User-Friendly Interface*

With a 4x4 keypad for input and an LCD for feedback, the system can be used by individuals with minimal technical knowledge, including elderly patients and caregivers.

➢ *Reliable and Timely Alerts*

Reminders are sent precisely at the scheduled time via SMS, and a buzzer provides a local sound alert. This dual-notification system enhances the chances that reminders are noticed and acted upon.

➢ *Portability and Compact Design*

The system is compact and lightweight, allowing it to be deployed in a variety of settings such as homes, clinics, and mobile health units.

➢ *Scalable and Customizable*

The modular design allows for future enhancements, such as integrating sensors for real-time health monitoring or supporting multiple users with expanded memory and software upgrades.

➢ *Independence from Smartphones*

Since the system works with any GSM-enabled mobile phone, there is no dependency on smartphones or mobile applications, making it highly inclusive.

VI. RESULT AND DISCUSSION

A. Result

The The GSM-based Patient Reminder System was developed and tested successfully under various real-life scenarios to evaluate its functionality, efficiency, and reliability. The results demonstrate that the system effectively sends timely reminders via SMS and provides local alerts, meeting the core objective of supporting patients with medication schedules and health appointments.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

➢ *Functional Testing*

The system was tested with multiple reminder inputs, including different time schedules, message content, and mobile numbers. During testing, the following functions were verified:

- Accurate Time Monitoring: The RTC module maintained precise timing for scheduled reminders, even after power interruptions.
- Successful SMS Delivery: The SIM800L GSM module reliably sent SMS alerts to both local and long-distance mobile numbers.
- User Input Handling: The 4x4 keypad correctly registered time, message, and number entries, which were then confirmed via the LCD screen.
- Alert Notification: The buzzer provided an additional level of notification, alerting nearby individuals about the reminder.

➢ *Performance Evaluation*

Table 1 : Performance Evaluation

Test Parameter	Result
SMS Delivery Accuracy	100% within GSM coverage
Time Accuracy (RTC)	±1 second per 24 hours
Power Consumption	Low (5V supply, GSM peaks at ~2A)
User Input Accuracy	High (no misread or skipped entries)
Local Alert Response	Immediate upon trigger time

➢ *Advantages Observed*

- Offline Capability: The system operates entirely without internet, making it ideal for rural and low-resource settings.
- Ease of Use: The interface is simple enough for elderly users or caregivers to operate with minimal training.
- Customizability: The system allows real-time input of reminders, offering flexibility to users for changing schedules.

➢ *Challenges and Limitations*

- GSM Signal Dependency: In areas with poor mobile network coverage, SMS delivery may be delayed or fail.
- Memory Limitation: The Arduino Nano has limited memory, which may restrict storing multiple reminders at once.
- No Feedback Mechanism: The current model does not confirm whether the SMS was read or the reminder acknowledged.

B. Discussion

The proposed system effectively addresses the common issue of missed medications and appointments, particularly for patients who lack access to smartphones or internet connectivity. The use of basic and affordable components ensures that the system can be deployed widely at minimal cost. With some upgrades, such as adding EEPROM for storing multiple reminders or integrating feedback mechanisms, the system can be scaled for use in clinics or elder care centres.

VII. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The development of a GSM-based Patient Reminder System offers a practical, affordable, and effective solution to one of healthcare's ongoing challenges—ensuring patient adherence to medication schedules and appointments. By utilizing readily available components like a microcontroller, GSM module, keypad, and LCD display, the system successfully sends timely SMS reminders without relying on internet connectivity. Its design is simple, user-friendly, and especially suitable for use in rural or underserved communities where advanced digital solutions may not be feasible. The system also enhances patient safety by reducing the likelihood of missed treatments, while offering a local alert through a buzzer to further support the user. Overall, this project demonstrates how low-cost embedded systems can be leveraged to improve healthcare access and patient outcomes.

B. Future Scope

There are several opportunities to enhance and expand the system's capabilities:

➢ *Multi-Patient Support*

By incorporating memory storage (e.g., EEPROM or SD card), the system could manage reminders for multiple users simultaneously, making it suitable for clinics or eldercare centres.

➢ *Sensor Integration*

Adding sensors such as heart rate monitors, temperature sensors, or glucose meters could transform the system into a real-time health monitoring platform with automatic alert generation based on patient vitals.

➢ *Cloud Connectivity*

Integration with cloud services would allow remote monitoring, data storage, and management by healthcare providers or family members, creating a more connected care environment.

➢ *Mobile and Web Interface*

Developing a user-friendly application or web dashboard would enable caregivers to configure and monitor reminders from anywhere, enhancing system flexibility.

➢ *Voice Call and Multi-Language Support*

Adding automated voice call reminders and supporting different languages would make the system more inclusive, particularly for visually impaired users or non-native speakers.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1847

- *Battery Backup and Solar Power*

Introducing solar power options or battery backups would improve reliability in areas with unstable electricity.

- *AI-Based Alerts and Analytics*

Machine learning algorithms could be applied to analyze reminder patterns, missed doses, or health data, enabling predictive healthcare and early intervention.

By incorporating these advancements, the system can evolve into a more intelligent, scalable, and impactful healthcare solution that bridges the gap between technology and accessibility.

REFERENCES

[1]. T. Khandpur, *Handbook of Biomedical Instrumentation*, 2nd ed. New Delhi, India: Tata McGraw-Hill, 2003.
[2]. M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, *The 8051 Microcontroller and Embedded Systems*, 2nd ed. Upper Saddle River, NJ, USA: Pearson Education, 2006.
[3]. G. M. Patil, "Embedded Microcontroller-Based Digital Telemonitoring for ECG," *Journal of the Instrumentation Society of India*, vol. 32, no. 2, pp. 114–118, 2002.
[4]. S. Atalla, K. Aziz, S. H. Ismail, and S. Tarapiah, "Smart Real-Time Healthcare Monitoring and Tracking System Using GSM/GPS Technologies," in *Proc. 3rd MEC Int. Conf. Big Data Smart City (ICBDSC)*, Muscat, Oman, 2016, pp. 1–5.
[5]. P. Puneet Singh, N. Rout, R. Tiwary, and R. Bhandari, "Zigbee and GSM-Based Patient Health Monitoring System," in *Proc. Int. Conf. Electronics and Communication Systems (ICECS)*, Coimbatore, India, 2014, pp. 1–5.
[6]. B. Mehta, D. Rengarajan, and A. Prasad, "Real-Time Patient Telemonitoring System Using LabVIEW," *Int. J. Sci. Eng. Res.*, vol. 3, no. 4, pp. 1–4, Apr. 2012.
[7]. M. Priya and M. Kathiresh, "Wireless Patient Health Monitoring System Using LabVIEW," *Int. J. Emerg. Technol. Comput. Sci. Electron.*, vol. 22, no. 2, pp. 46–50, May 2016.
[8]. Y. Zhang and H. Xiao, "Bluetooth-Based Sensor Network for Remotely Monitoring the Physiological Signals of Patients," *IEEE Trans. Inf. Technol. Biomed.*, vol. 13, no. 6, pp. 1040–1048, Nov. 2009.
[9]. H. Sagahyroon, A. Raddy, A. Ghazy, and U. Suleman, "Design and Implementation of a Healthcare Monitoring System," *Int. J. Electron. Healthcare*, vol. 5, no. 1, pp. 68–86, 2009.
[10]. G. Swamy, R. K. Kodali, and B. Lakshmi, "An Implementation of IoT for Healthcare," in *Proc. IEEE Recent Adv. Intell. Comput. Syst. (RAICS)*, Trivandrum, India, 2015, pp. 411–415.