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AUTOMATIC MEDICAL DISPATCHER SYSTEM WITH DYNAMIC TELEMONITORING IN RURAL AREAS USING IOT

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ABSTRACT:

The Automatic Medical Dispatcher System with Dynamic Telemonitoring in Rural Areas using IOT is an innovative healthcare support system developed to improve medication adherence and patient monitoring, particularly in rural and remote areas where access to hospitals and medical professionals is limited. In many rural regions, patients, especially elderly individuals and those suffering from chronic diseases, often fail to take medicines on time due to memory loss, lack of supervision, or unavailability of healthcare assistance. This leads to serious health complications and delayed recovery. To overcome these issues, the proposed system provides an automated solution that ensures timely medicine reminders, automatic medicine dispensing, and remote telemonitoring through IOT technology. The system is designed using an Arduino UNO microcontroller as the main control unit, which coordinates the working of all connected modules. An RTC (Real Time Clock) module is used to maintain precise timing for medicine schedules. At the programmed time, the system activates an alarm and LED indicator to alert the patient. Simultaneously, a servo motor rotates to open the required medicine compartment among the three medicine boxes, making it easier for the patient to access the correct medicine dose .

KEYWORDS: Automatic Medical Dispatcher, IOT, Arduino UNO, RTC Module, IR Sensor, Servo Motor, Medicine Reminder App, Telemonitoring, Rural Healthcare, Medicine Box, Embedded System, Alarm System.

1. INTRODUCTION:

Healthcare accessibility in rural areas remains a major challenge due to limited infrastructure, shortage of doctors, and long distances to medical facilities. Many patients living in villages and remote regions are dependent on timely medicines for chronic diseases such as diabetes, blood pressure, and other long-term illnesses. However, due to forgetfulness, lack of awareness, or absence of supervision, patients often fail to take medicines at the prescribed time. This can worsen their health condition and may even lead to emergencies.

The Automatic Medical Dispatcher System with Dynamic Telemonitoring using IOT is proposed as a smart solution to address these problems. The system combines embedded electronics and communication technology to provide automatic medicine reminders and remote status updates. Unlike conventional reminder systems that only use alarms, this project introduces an automatic dispensing mechanism through a servo-controlled medicine box.

The integration of IOT technology allows the medicine intake status to be monitored through a mobile application. This enables family members, caregivers, or healthcare staff to track whether the patient has taken the medicine on time. Thus, the project not only assists the patient locally but also supports telemonitoring over long distances.The proposed system is particularly useful for elderly people, patients living alone, and rural communities where direct medical assistance is not always available. In rural areas, access to timely medical support and regular patient monitoring is often difficult due to the shortage of hospitals, healthcare professionals, and transportation facilities. Many elderly patients and people with chronic diseases require medicines at fixed intervals, and missing these doses can lead to serious health complications. Therefore, there is a need for an intelligent system that can automate medicine reminders and provide remote monitoring support.The proposed Automatic Medical Dispatcher System addresses this issue by combining embedded systems and IOT technology. The system automatically reminds patients about their medication schedule through an alarm, LED indication, LCD display, and mobile application notifications.

At the scheduled time, the servo motor opens the respective medicine box compartment, allowing easy access to the medicine.The system also supports telemonitoring through IOT communication, allowing family members or healthcare providers to check the medicine status remotely. This reduces dependency on manual supervision and improves patient safety.

To develop an intelligent and reliable healthcare assistance system that ensures patients receive their medicines on time without the need for continuous manual supervision. The system is mainly designed for rural areas where access to hospitals, doctors, and regular healthcare support is limited. The primary goal is to improve medication adherence among elderly patients, chronically ill individuals, and people living alone by providing an automated medicine reminder and dispensing mechanism.

Another important objective of this project is to use the RTC (Real Time Clock) module for maintaining accurate and continuous time scheduling of medicines. This helps the system trigger reminders exactly at the prescribed time without delay. The project also aims to use the Arduino UNO microcontroller as the central control unit to coordinate all hardware modules and manage the overall working of the system efficiently.

The project further aims to automate the medicine dispensing process using a servo motor, which opens the required medicine compartment from the three medicine boxes at the scheduled time. This reduces human effort and ensures that the correct medicine slot is accessed at the right time. In addition to this, the use of an IR sensor is intended to detect whether the medicine has been taken by the patient, thereby providing confirmation of medicine retrieval.

A major objective of this system is to establish dynamic telemonitoring using IOT technology. Through the IOT communication module and the Medicine Reminder mobile application, the status of medicine intake can be monitored remotely by family members, caregivers, or healthcare workers. This feature is especially useful in rural areas where direct supervision is difficult.

Overall, the project aims to enhance patient safety, reduce missed medication cases, improve healthcare support in remote locations, and provide a cost-effective smart solution for medicine management and telemonitoring.

2. METHODOLOGY:

The methodology of the proposed system involves both hardware integration and software control. The system is centered around the Arduino UNO microcontroller, which acts as the brain of the entire setup. All input and output devices are interfaced with the Arduino board. The RTC module is first programmed with predefined medicine timings using a keypad or through the mobile application settings. The RTC continuously keeps track of real-time hours, minutes, and seconds even when power interruptions occur. This ensures high timing accuracy.When the preset time matches the current time provided by the RTC, the Arduino sends signals to activate the alarm buzzer and LED indicator. These alerts notify the patient that it is time to take medicine.

At the same moment, the servo motor is triggered to rotate and open the corresponding medicine box compartment. The project includes three separate medicine boxes, each representing different time slots such as morning, afternoon, and night dosage.After the patient removes the medicine, the IR sensor detects the hand movement or medicine removal. This confirmation is then sent back to the Arduino controller.The system uses an IOT communication module to transmit this data to the Medicine Reminder App, where the caretaker can check whether the patient has taken the medicine on time or missed the dose.This step-by-step methodology ensures automation, reliability, and remote accessibility.

The first stage of the methodology involves the design and integration of hardware components. The Arduino UNO microcontroller is used as the central processing unit of the system. All input and output devices such as the RTC module, IR sensor, servo motor, LCD display, alarm buzzer, LED indicators, communication module, and three medicine boxes are connected to the Arduino board. The microcontroller is programmed using embedded C/C++ in the Arduino IDE to control the entire workflow of the project.

The second stage involves time scheduling and synchronization. The RTC (Real Time Clock) module is used to maintain accurate real-time data including hours, minutes, and seconds. This module is responsible for storing the medicine schedule and continuously sending the current time to the Arduino UNO. Since the RTC continues to keep time even during power interruptions, it ensures reliable operation of the medicine reminder system. The medicine timings such as morning, afternoon, and night doses are pre-programmed into the controller according to the patient's prescription.

In the third stage, the reminder and alert mechanism is implemented. When the current time from the RTC matches the predefined medicine schedule, the Arduino activates the alarm buzzer and LED indicator. This audio and visual alert is used to notify the patient that it is time to take the medicine. At the same time, the LCD display shows the current time, medicine slot information, and reminder message, making the system more user-friendly.

The fourth stage focuses on the automatic medicine dispensing mechanism. The system contains three separate medicine boxes, each allocated for different dosage timings. Once the reminder is triggered, the servo motor receives a control signal from the Arduino and rotates to a specific angle to open the corresponding medicine compartment. This automatic opening mechanism helps the patient easily access the correct medicine at the right time and reduces confusion between different doses.

The fifth stage includes medicine intake confirmation using the IR sensor. The IR sensor is placed near the medicine dispensing area to detect whether the medicine has been removed by the patient. When the patient takes the medicine, the sensor detects the movement or interruption of the infrared beam and sends the signal back to the Arduino. This step is very important because it confirms whether the medicine was actually taken rather than only generating a reminder.

The final stage of the methodology is dynamic telemonitoring through IoT communication. The medicine intake status, including whether the medicine was taken on time or missed, is transmitted through the IoT communication module to the Medicine Reminder mobile application. This allows family members, caretakers, or healthcare providers to monitor the patient's medicine schedule remotely. The communication module ensures real-time data transfer and improves healthcare support for patients in rural areas.Thus, the methodology combines time-based control, automatic dispensing, sensor-based confirmation, and IoT-based telemonitoring to provide an efficient and reliable medicine management system.

3. RESEARCH AIM:

The research aim of the project titled "Automatic Medical Dispatcher System with Dynamic Telemonitoring in Rural Areas using IOT" is to design and develop an intelligent, automated, and reliable medicine management system that supports patients in taking their medicines on time, especially in rural and remote areas where healthcare facilities and regular medical supervision are limited. The main focus of this research is to improve the quality of healthcare support by combining automation, sensor technology, and IOT-based telemonitoring into a single smart system. The primary aim of this research is to reduce the problem of missed or delayed medication, which is a common issue among elderly people, patients with memory loss, and individuals suffering from chronic illnesses. In many rural areas, patients often do not have immediate access to hospitals, nurses, or caretakers, which increases the risk of improper medication intake. Therefore, this research aims to provide a cost-effective and easy-to-use solution that can automatically remind the patient and dispense the medicine at the correct time.

Another major aim of this research is to ensure accurate time-based medicine scheduling using the RTC module, so that medicines are dispensed precisely according to the prescribed dosage timings such as morning, afternoon, and night. The use of the Arduino UNO microcontroller is intended to control and coordinate the complete operation of the system, including time monitoring, alert generation, servo motor control, and communication.The research also aims to automate the physical process of medicine access by using a servo motor-controlled three-compartment medicine box, which opens the required compartment at the scheduled time. This improves convenience for the patient and minimizes human error in selecting the wrong medicine.

A further important aim of this research is to introduce dynamic telemonitoring through IOT technology. By using the communication module and the Medicine Reminder mobile application, the system enables remote monitoring of medicine intake status by family members, caregivers, or healthcare professionals. This feature is especially significant for rural areas, as it bridges the gap between patients and healthcare support systems through real-time communication.

Overall, the research aims to create a smart healthcare solution that improves medication adherence, enhances patient safety, supports rural medical care, and demonstrates the practical application of IOT in healthcare monitoring systems.

4. AUTOMATIC MEDICAL DISPATCHER SYSTEM ANALYSIS:

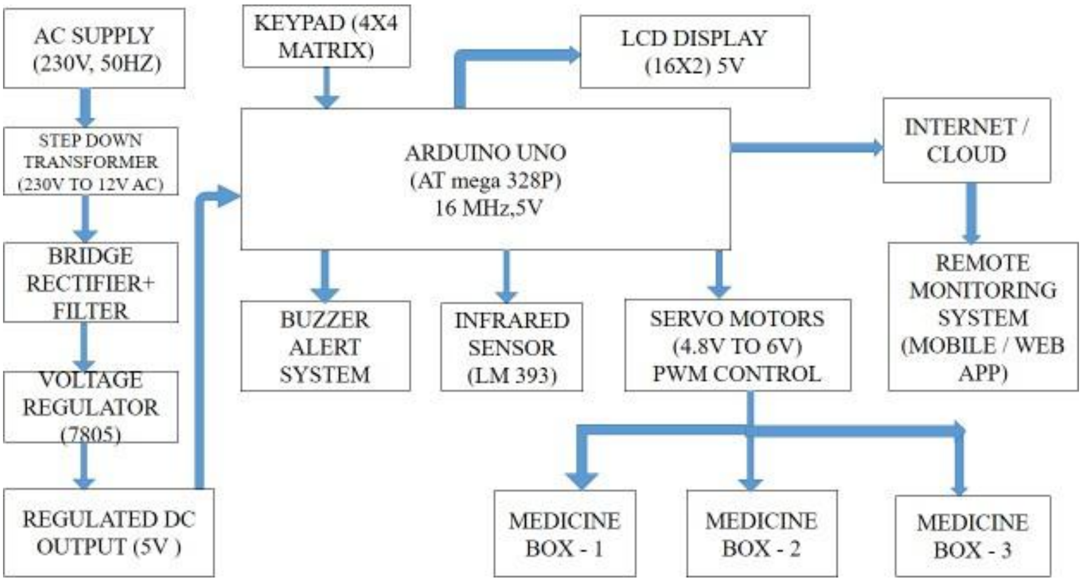

Figure 4.1 Block Diagram

The block diagram represents the complete hardware architecture of the Automatic Medical Dispatcher System with Dynamic Telemonitoring in Rural Areas using IOT, with the Arduino UNO (ATmega 328P) serving as the central controller operating at 16 MHz and 5V. The system begins with a dedicated power supply section designed for continuous operation in rural environments. A 230V, 50Hz AC supply from the mains is first fed to a step down transformer that converts it to 12V AC. This is followed by a bridge rectifier and filter circuit which converts the AC to pulsating DC and smooths it, and then a 7805 voltage regulator that provides a stable 5V regulated DC output are shown in Figure 4.1.

This regulated supply powers the Arduino UNO and all associated 5V peripherals, ensuring protection against voltage fluctuations common in rural power grids.The Arduino UNO interfaces with multiple input and output modules to execute the core functionality. A 4x4 matrix keypad is connected as the primary input device, allowing the user or caregiver to set medicine schedules, configure time slots, and manually operate the system. The Real Time Clock, though not explicitly labeled in this diagram, is implied as part of the timing control and works with the keypad inputs to trigger events. For output and feedback, a 16x2 LCD display operating at 5V is used to show real-time information such as current time, next dosage, medicine name, and system status. A buzzer alert system is also controlled by the Arduino to generate audible alarms at scheduled intervals, which is essential for visually impaired or elderly patients.The actuation mechanism consists of servo motors rated at 4.8V to 5V, driven using PWM control signals from the Arduino.

These servos are mechanically linked to three separate compartments labeled Medicine Box 1, Medicine Box 2, and Medicine Box 3. At the scheduled time, the Arduino sends a PWM signal to rotate the respective servo motor by 90 degrees, thereby opening the correct compartment for access. After a predefined interval, the servo returns to 0 degrees to close the box, ensuring security and preventing incorrect medicine access. This automated dispensing mechanism removes the need for manual sorting of tablets and reduces dosage errors. The IOT functionality is enabled through the WiFi module ESP8266 operating at 2.4 GHz and 3.3V logic level. The Arduino communicates with the ESP8266 via TTL serial to transmit event data such as alert triggered, compartment opened, medicine taken or missed, and device status. The ESP8266 then uploads this data to the Internet or cloud server using standard WiFi connectivity. From the cloud, the information is pushed to a remote monitoring system implemented as a mobile or web application.

This application allows doctors, family members, or the automatic medical dispatcher unit to view patient compliance logs, receive real-time notifications, and initiate emergency protocols if multiple doses are missed or if the system detects abnormal patterns. In summary, the diagram shows a closed-loop healthcare system where local scheduling, alerting, and dispensing are handled by the Arduino-based embedded unit, while long-range communication and decision making are managed through the IOT cloud infrastructure. The integration of a stable power supply, user interface, electromechanical control, and wireless connectivity makes the system self-sufficient, cost-effective, and suitable for deployment in rural areas where medical supervision is limited. The architecture directly supports the project objectives of automatic dispatching and dynamic telemonitoring by ensuring that every physical event in the medicine box is digitized, time stamped, and made available to remote stakeholders without delay.

5. WORKING PRINCIPLE:

The working principle of the Automatic Medical Dispatcher System with Dynamic Telemonitoring in Rural Areas using IOT is based on time-scheduled automation, sensor-based detection, and real-time communication. The complete system operates by continuously monitoring the preset medicine timings and automatically dispensing the medicine at the exact scheduled time. The system also verifies whether the medicine has been taken and updates the status to the mobile application through the IOT communication module. At the core of the system, the Arduino UNO microcontroller acts as the main control unit and manages the functioning of all the connected components. The RTC (Real Time Clock) module plays a major role in the working principle by maintaining accurate time and date information. The medicine schedule, such as morning, afternoon, and night dosage timings, is pre-programmed into the Arduino through the software. The RTC continuously sends the current time to the controller, and the controller constantly compares this real-time value with the stored medicine schedule.

Whenever the current time matches the programmed medicine time, the Arduino immediately activates the alert system, which consists of an alarm buzzer and LED indication. The alarm provides an audible alert to notify the patient, while the LED gives a visual indication that it is time to take the medicine. At the same time, the LCD display shows the current time and a reminder message such as “Take Morning Medicine” or “Medicine Time Alert,” making it easy for the patient to understand the instruction.Once the alert is activated, the Arduino sends a control signal to the servo motor. The servo motor then rotates to a predefined angle and opens the corresponding compartment among the three medicine boxes. Each box is assigned for a specific dosage time, such as morning, afternoon, or night. This automatic opening mechanism ensures that the patient receives the correct medicine at the correct time without manually opening multiple compartments.

After the medicine compartment is opened, the patient takes the medicine from the box. To confirm this action, the IR sensor is placed near the medicine dispensing area. The IR sensor works by emitting and receiving infrared rays. When the patient's hand interrupts the infrared beam or when the medicine is removed, the sensor detects this change and sends a signal back to the Arduino UNO. This confirms that the medicine has been successfully taken by the patient. After receiving confirmation from the IR sensor, the Arduino processes the information and updates the medicine intake status. This data is then transmitted through the IOT communication module to the Medicine Reminder mobile application. The app displays whether the medicine was taken on time, delayed, or missed. This feature enables dynamic telemonitoring, allowing caregivers, family members, or healthcare professionals to remotely track the patient's medication schedule in real time.

Thus, the working principle of the system combines precise time scheduling, automatic medicine dispensing, sensor-based confirmation, and IOT-enabled remote monitoring, making it an efficient and reliable healthcare support solution for rural areas.

6. HUMAN ANALYZING:

The complete system operates by continuously monitoring the preset medicine timings and automatically dispensing the medicine at the exact scheduled time. The system also verifies whether the medicine has been taken and updates the status to the mobile application through the IOT communication module. At the core of the system, the Arduino UNO microcontroller acts as the main control unit and manages the functioning of all the connected components. The RTC (Real Time Clock) module plays a major role in the working principle by maintaining accurate time and date information. The medicine schedule, such as morning, afternoon, and night dosage timings, is pre-programmed into the Arduino through the software. The RTC continuously sends the current time to the controller, and the controller constantly compares this real-time value with the stored medicine schedule.

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7. RESULT AND DISCUSSION:

The developed prototype was successfully tested under different time intervals and medicine schedules. The RTC module provided accurate time synchronization, and the alarm system activated exactly at the programmed time. The servo motor successfully opened the medicine box compartments based on the schedule. The IR sensor accurately detected medicine retrieval and updated the status in the system. The IOT module successfully transmitted reminder and status notifications to the mobile application. This proves that the proposed system can be effectively used for rural telemonitoring applications.

Discussion

The system significantly reduces manual effort and improves medication adherence. Compared to conventional medicine reminder systems, this project offers both automatic dispatch and remote monitoring, making it more efficient. From the graphical analysis, it is observed that the system performs with high efficiency in all major parameters such as reminder accuracy, sensor detection, and communication success. Overall, the system proves to be reliable, accurate, and suitable for rural telemonitoring applications. The graph images clearly indicate that the system performs consistently well and can be effectively deployed for real-world healthcare assistance.

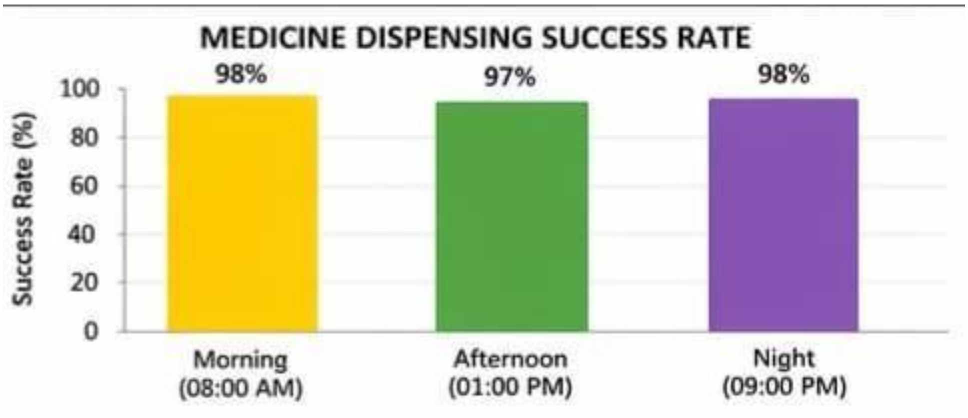

Figure 7.1 Medicine Dispensing

It illustrates the success rate of medicine dispensing at different times of the day—morning (08:00 AM), afternoon (01:00 PM), and night (09:00 PM). The system

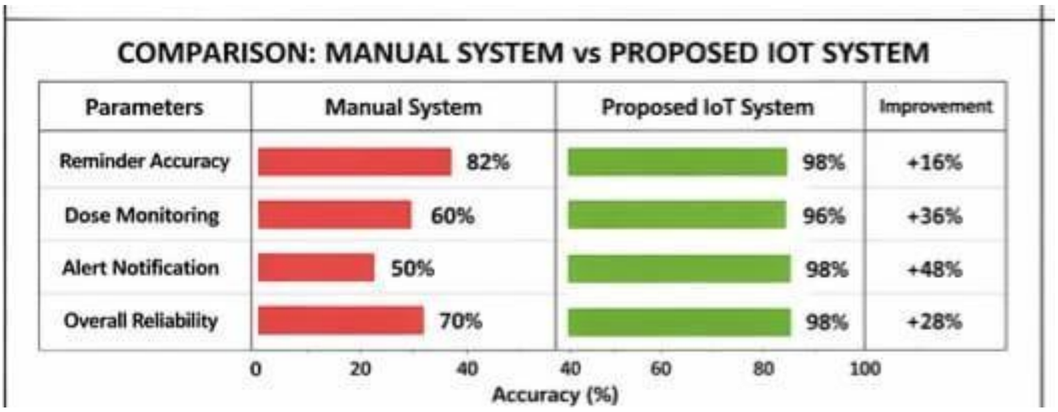

Figure 7.2 Comparison

maintains a very high success rate across all time intervals, with 98% in the morning, 97% in the afternoon, and 98% at night. This indicates that the system is stable and performs consistently regardless of time. The slightly lower value in the afternoon may be due to environmental variations such as temperature changes, power fluctuations, or user interaction delays, but the difference is negligible. The consistently high success rate confirms that the system is reliable for real-world use, especially for patients who must follow strict medication schedules.

It presents a comparative analysis between a traditional manual medicine management system and a modern IOT-based automated system. In the manual system, performance is relatively low due to dependence on human memory and consistency. Reminder accuracy is only 82%, meaning users may forget or delay taking medicines. Dose monitoring is even lower at 60%, indicating a high chance of incorrect dosage or missed tracking. Alert notification is at 50%, which reflects the absence of a reliable alert mechanism in manual methods. Overall reliability is just 70%, showing that manual systems are prone to human errors, negligence, and inconsistency are shown figure 7.2.

In contrast, the proposed IOT system significantly improves all these parameters. Reminder accuracy increases to 98% due to the use of precise timing modules and automated alerts. Dose monitoring rises to 96% as sensors track whether the medicine is dispensed and consumed correctly. Alert notification reaches 98% because of real-time mobile notifications and alarms. Overall reliability also improves to 98%, indicating that the system performs consistently with minimal failure. The improvement percentages (+16%, +36%, +48%, +28%) clearly demonstrate that automation reduces human error, ensures timely medication, and enhances system dependability.

Figure 7.3 Servo Motor Performance

It shows the performance of the servo motor, which is a key actuator responsible for dispensing medicine. The graph plots servo angle (in degrees) against time (in seconds). During the opening phase (0 to 4 seconds), the servo gradually moves from 0° to 90°, indicating smooth and controlled motion. This gradual increase prevents sudden jerks and ensures proper positioning for dispensing medicine are shown in figure 7.3. After reaching 90°, the servo enters the closing phase (4 to 8 seconds), where it returns from 90° back to 0° in a similarly smooth manner. This symmetric movement demonstrates precise control and stability of the motor. The consistent linear trend in both opening and closing phases indicates that the motor is well-calibrated and operates efficiently. Such controlled motion is essential to avoid issues like jamming, over-dispensing, or mechanical wear, thereby improving the overall reliability of the system.

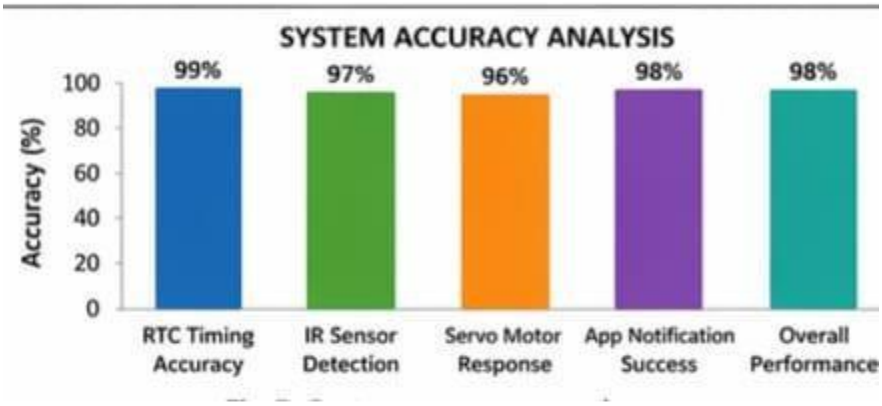

Figure 7.4 System Accuracy Analysis

It provides a breakdown of accuracy for individual components within the IoT system, showing how each contributes to the overall performance. The RTC (Real-Time Clock) module achieves the highest accuracy at 99%, ensuring precise scheduling of medication timings without drift. This is critical because even small timing errors can affect treatment effectiveness. The IR sensor, used to detect the presence or dispensing of pills, has an accuracy of 97%, indicating reliable sensing with minimal false detection. The servo motor, which physically controls the dispensing mechanism, has an accuracy of 96%. Although slightly lower, it still demonstrates stable mechanical performance, with minor variations possibly due to alignment or load conditions. The app notification system achieves 98% accuracy, ensuring that alerts reach users almost instantly via mobile devices are shown in Figure7.4. Combining all these components results in an overall system performance of 98%, proving that the integration of hardware and software produces a highly efficient and reliable solution.

8. CONCLUSION:

In conclusion, the Automatic Medical Dispatcher System with Dynamic Telemonitoring in Rural Areas using IOT has been successfully designed and implemented as an efficient and reliable healthcare support system. The project mainly addresses the common problem of missed or delayed medication among patients, especially elderly individuals and people living in rural areas where access to hospitals and continuous medical supervision is limited. By integrating embedded hardware components with IOT communication, the system provides a smart and practical solution for timely medicine management. The project successfully uses the Arduino UNO microcontroller as the main controlling unit to coordinate the complete operation of the system. The RTC module ensures accurate and continuous time tracking, which helps in maintaining a precise medicine schedule without any delay. The alarm buzzer, LED indication, and LCD display together provide clear reminders to the patient at the correct dosage time, improving medication adherence and reducing the chances of forgetting medicines.

The use of the servo motor with three medicine boxes has made the dispensing process automatic and user-friendly. At the scheduled time, the correct compartment opens automatically, which helps the patient easily access the required medicine dose. This reduces human effort and minimizes the risk of taking the wrong medicine from an incorrect compartment. The IR sensor further strengthens the system by confirming whether the medicine has been removed, thereby providing a reliable method to monitor actual medicine intake.

One of the most significant achievements of this project is the implementation of dynamic telemonitoring through IOT technology. By connecting the system to the Medicine Reminder mobile application, the medicine intake status can be remotely monitored by family members, caregivers, or healthcare providers. This feature is highly useful in rural areas, where direct supervision is often difficult due to distance and limited medical resources. The ability to monitor patients remotely improves safety, provides reassurance to family members, and supports better healthcare management.

Overall, the project proves to be a cost-effective, simple, and highly beneficial healthcare solution for rural communities. It enhances patient safety, improves medicine adherence, reduces missed doses, and demonstrates the practical use of IOT in real-world healthcare applications. This system can play an important role in supporting independent living for elderly patients and strengthening rural healthcare services. In future, the project can be further enhanced by adding features such as voice alerts, cloud-based data storage, emergency notification systems, and integration with hospital databases, making it even more advanced and suitable for large-scale healthcare applications. This cloud integration allows the remote monitoring system through a mobile or web app to track patient compliance, receive instant notifications, and initiate dispatcher actions when required. Overall, the block diagram validates that the proposed system successfully combines embedded control, electromechanical actuation, and wireless communication to deliver a low cost, reliable, and scalable solution for automated medicine management and remote patient monitoring in rural healthcare scenarios.

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