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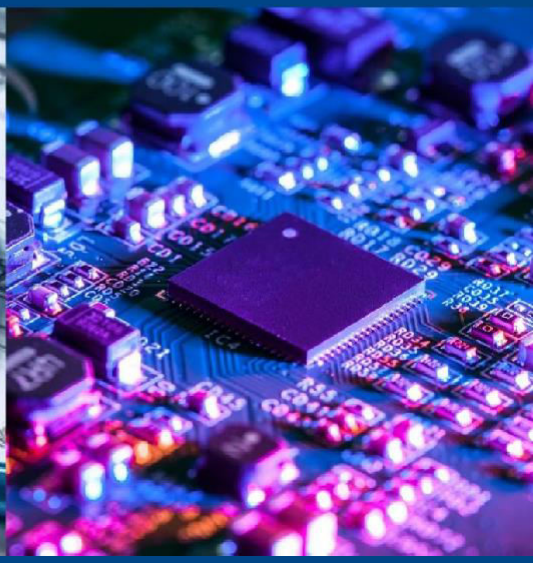

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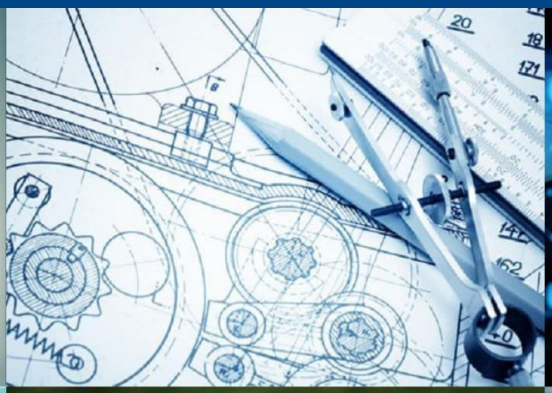

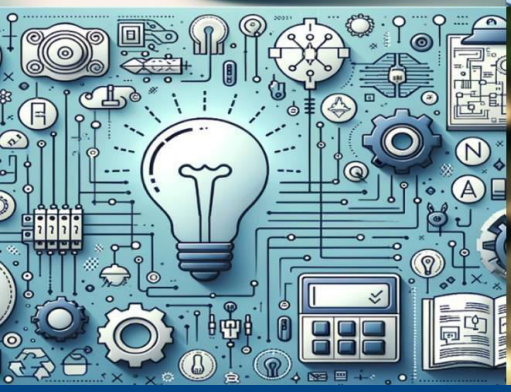

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IoT-Based Speaking Medication Reminder System using Raspberry Pi

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ABSTRACT: Medication non-adherence is a critical challenge in modern healthcare systems, particularly among elderly patients and individuals suffering from chronic diseases. Missed or incor- rect medication intake can lead to severe health complications and increased healthcare costs. This research presents an IoT- based Speaking Medication Reminder System using Raspberry Pi to assist patients in adhering to prescribed medication schedules. The proposed system uses real-time clock synchronization, voice- based alerts, and embedded system technologies to provide timely medication reminders. The system is designed to be user-friendly, cost-effective, and reliable, making it suitable for home healthcare environments. Experimental results demonstrate that the system effectively improves medication adherence and reduces depen- dency on manual supervision. This solution contributes to smart healthcare development by integrating automation, accessibility, and reliability into daily patient care.

KEYWORDS: IoT, Raspberry Pi, Medication Reminder, Smart Healthcare, Speech Synthesis, Embedded Systems.

I. INTRODUCTION

Medication adherence plays a vital role in ensuring the effectiveness of medical treatment. However, a significant percentage of patients fail to follow prescribed medication schedules due to forgetfulness, complex treatment routines, or cognitive limitations. This issue is particularly common among elderly individuals and patients with chronic diseases, resulting in increased hospitalization rates and healthcare expenses.

With the rapid advancement of Internet of Things (IoT) technologies, smart healthcare systems have become increas- ingly accessible. IoT-based solutions enable real-time mon- itoring, automation, and intelligent decision-making. Voice- assisted technologies further enhance accessibility, especially for users who have visual impairments or limited interaction with digital interfaces.

This research proposes an IoT-based Speaking Medication Reminder System using Raspberry Pi. The system provides voice alerts at predefined times, ensuring timely medication intake. The proposed solution is designed to be affordable, scalable, and user-friendly, making it suitable for personal and clinical healthcare environments.

II. LITERATURE SURVEY

Smith et al. [1] introduced a mobile-based medication re- minder system that uses smartphone notifications to alert users. However, such systems depend heavily on smartphone acces- sibility and user interaction. Johnson and Lee [2] proposed an IoT-based smart pill dispenser, which improved accuracy but lacked voice assistance.

Patel et al. [3] developed a healthcare monitoring system using IoT and cloud computing. While effective, the system required continuous internet connectivity, limiting usability in rural areas. Kumar and Singh [4] introduced a voice-enabled healthcare assistant but faced privacy concerns due to third- party service dependency.

Lee et al. [5] implemented a Raspberry Pi-based health monitoring system but focused primarily on vital signs rather than medication management. Zhao et al. [6] demonstrated that speech synthesis significantly improves user compliance in healthcare systems.

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Gupta et al. [7] developed a wearable medication reminder, but the cost and maintenance were high. Chen and Wang [8] proposed a smart pillbox system; however, mechanical failures affected reliability. Ahmed et al. [9] discussed mobile health platforms emphasizing simplicity and usability.

Cloud-based healthcare monitoring systems were studied in [10], but security and data privacy remained major challenges. Edge computing approaches presented in [11] reduced latency and enhanced system reliability. Additional studies [12]–[15] emphasized the importance of embedded systems and IoT in improving healthcare automation.

The literature highlights the need for a low-cost, reliable, and voice-assisted medication reminder system that can operate independently with minimal infrastructure requirements.

III. SCOPE OF THE PROJECT

The scope of the proposed system includes assisting elderly and chronically ill patients in medication adherence, reducing human dependency, and providing an affordable healthcare so- lution. The system supports voice alerts, local data processing, and future expansion through cloud and mobile integration. It can be deployed in homes, hospitals, and assisted living centers.

IV. MOTIVATION

The motivation behind this project stems from the increasing number of medication errors caused by forgetfulness and improper dosage management. Many existing solutions are complex or inaccessible to elderly users. This project aims to provide a simple, reliable, and cost-effective system that enhances patient independence and improves healthcare out- comes.

V. METHODOLOGY

The system uses a Raspberry Pi as the central processing unit. Medication schedules are stored locally using Python-based data structures. A real-time clock module ensures ac- curate time tracking. When the scheduled time is reached, a text-to-speech engine generates a voice alert announcing the medication details. The system continuously monitors time and repeats the process daily. Optional modules such as LCD display and mobile alerts can be integrated for enhanced functionality.

VI. SYSTEM ARCHITECTURE AND WORKING

The system consists of four main components: input in- terface, processing unit, output module, and power supply. The user inputs medication details, which are stored locally. The Raspberry Pi continuously checks the real-time clock. Upon reaching the scheduled time, the system triggers a voice alert through a connected speaker. The process repeats for all scheduled medications.

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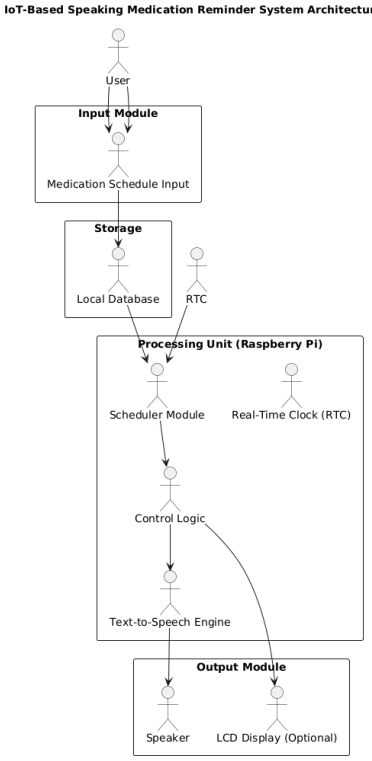

Fig. 1. System Architecture of IoT-Based Speaking Medication Reminder

VII. RESULTS AND APPLICATIONS

The proposed system successfully delivers timely voice reminders with high accuracy. It improves medication adherence, reduces dependency on caregivers, and ensures ease of use. The system is suitable for home healthcare, elderly care centers, hospitals, rehabilitation centers, and assisted living facilities.

VIII. CONCLUSION

The IoT-based Speaking Medication Reminder System pro- vides an effective solution for improving medication adherence through automation and voice assistance. Its low cost, reliabil- ity, and scalability make it suitable for real-world healthcare applications. Future enhancements may include cloud integra- tion, mobile applications, and AI-based health analytics.

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