
“BIOMETRIC-BASED SMART IOT MEDICINE DISPENSER USING ESP32”

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ABSTRACT

*This paper presents the design and implementation of a **biometric and IoT-enabled smart medicine dispenser** using the **ESP32 microcontroller**. The proposed system is aimed at ensuring **accurate, secure, and timely medication dispensing** for patients, particularly elderly and chronically ill individuals. The system utilizes a **fingerprint authentication module (R307)** to verify patient identity, a **Real-Time Clock (RTC)** for time-based scheduling, and **Blynk IoT integration** for cloud-based monitoring and remote configuration. The dispenser stores multiple patient profiles in **EEPROM**, allowing personalized medication schedules with multiple doses per day. A **servo-controlled compartment system** dispenses medication at the scheduled time only after successful biometric verification. The system sends real-time notifications via Blynk if a dose is missed or dispensed. By combining biometric security, real-time automation, and IoT connectivity, this project enhances patient compliance, reduces medication errors, and offers caregivers a reliable, low-cost healthcare automation solution.*

KEYWORDS: *IoT, Biometric authentication, ESP32, Blynk, Medicine dispenser, Patient monitoring, Smart healthcare.*

1. INTRODUCTION

Medication non-adherence remains a big concern within the health sector, especially among those elderly or chronically sick patients who take multiple doses each day. And due to this fact, many lapses in doses may cause serious complications. This system shall propose a biometric and IoT-based smart medicine dispenser that shall ensure that medication is taken on time and securely.

The proposed system uses an ESP32 microcontroller with built-in Wi-Fi connectivity along with efficient power management. The device incorporates a fingerprint sensor, R307, to ensure that the medicine is released only to the registered patient. A real-time clock, DS3231, maintains accurate time for the scheduled doses without interrupting the power supply. The Blynk IoT platform allows the caregiver or doctor to set the dosing timing, monitor the missed doses, and the patient's adherence remotely through a smartphone. Once the scheduled time is reached, the dispenser asks for fingerprint authentication from the user. If the authentication is successful, the servo motor rotates to open the corresponding compartment for medicine. If the dose is missed, a Blynk alert is sent to the caregiver. With this integration of biometrics, automation, and cloud connectivity, the present system provides a highly reliable and secure operation compared to the conventional medicine boxes.

1.1. MOTIVATION:

A biometric-based smart IoT medicine dispenser is essential to mitigate the increasing problem of mismanagement of medication by elderly patients and patients suffering from chronic disease. The conventional methods for reminding often fail, resulting in missed doses, overdosing, or even unauthorized access to medicines. This system makes sure that the right patient gets the right medication on time by integrating biometric authentication with automated dispensing and real-time monitoring. IoT connectivity further allows caregivers and healthcare providers to remotely track adherence, thereby enhancing security, accuracy, and overall effectiveness of the treatment. Such a novel solution will make the management of medication more secure, reliable, and user-friendly.

1.2 CONTRIBUTIONS:

The system uses IoT-based monitoring and biometric authentication to guarantee safe, accurate, and timely medication dispensing. It facilitates easy communication with caregivers and medical professionals while assisting in the prevention of missed doses, overdose incidents, and unauthorized access.

- In order to prevent abuse and improve safety, biometric user authentication uses fingerprint to guarantee that only the authorized patient can access and receive the prescribed medication.
- Automated medication dispensing reduces human error and increases treatment plan adherence by precisely dispensing the right dosage at predetermined times via an ESP32-controlled mechanism.

- Real-Time Monitoring and Alerts this feature uses IoT connectivity to instantly notify doctors or caregivers about missed doses, successful dispensing, or irregular medication patterns so that prompt action can be taken.
- To prevent running out of necessary medications, medicine stock tracking continuously keeps an eye on the amount of medications in each compartment and sends out refill alerts.
- By facilitating easy communication between patients, caregivers, and medical professionals, remote health support integration supports remote supervision, increases medication compliance, and improves patient safety in general.

2. LITERATURE REVIEW:

1. Sharma et al. (2025): IoT-Based ESP32 Medication Dispenser

For remote scheduling and real-time monitoring, Sharma and associates created an ESP32-based medication dispenser that is connected to the Blynk app. Their system is a good starting point for IoT-driven dispensing solutions because it increases medication adherence but lacks biometric security.

2. Patel & Reddy (2024): Cloud-Based Medication Reminder System

Patel and Reddy suggested a cloud-based reminder system that uses IoT connectivity to track adherence and send alerts. Although it works well for reminders, it doesn't automate dispensing, which exposes a weakness in the actual administration of medications.

3. Khan et al. (2023): Fingerprint Based Arduino Dispenser

To stop unwanted access, Khan and colleagues developed a safe dispenser with fingerprint authentication. Because of Arduino's limitations, the system guarantees precise dispensing but provides limited IoT capabilities, highlighting the need for more sophisticated microcontrollers like ESP32.

4. Kumar & Sharma (2022): IoT Health Monitoring with Alerts

Kumar and Sharma used Blynk to integrate health monitoring with an IoT-based medication alert feature. While useful for remote notifications, it lacks secure access control and automatic dispensing.

5. Thomas & George (2021): Fingerprint-Based Pill Dispenser and RTC

A standalone RTC-controlled dispenser with biometric verification was created by Thomas and George. Although it guarantees prompt and safe dispensing, its lack of IoT connectivity restricts remote supervision.

3. OBJECTIVES

- To design a smart medicine dispenser that works automatically using IoT.
- To ensure secure access to medicines through fingerprint authentication.
- To help patients and elderly people take medicines on time without missing doses.
- To use the Blynk IOT app for setting and monitoring medicine schedules.
- To alert users using a buzzer and OLED display during medicine time.
- To enable remote monitoring and manual control through the mobile app.
- To reduce human errors in medicine management.

4. METHODOLOGY

Fingerprint enrollment is the first step in the biometric-based smart IoT medication dispenser's process. To guarantee authenticated access, the patient's fingerprint is scanned and safely stored. For precise dose reminders, medication intake times are planned via the Blynk application and stored in the real-time clock (RTC) module. Before dispensing any medication, the system uses the user's fingerprint to confirm identity at each scheduled time. The servo motor rotates to open the proper compartment and release the right dosage after authentication. IoT monitoring through the Blynk app ensures effective and safe medication management by offering real-time status updates, missed dose alerts, and remote control functionality.

4.1. BLOCK DIAGRAM

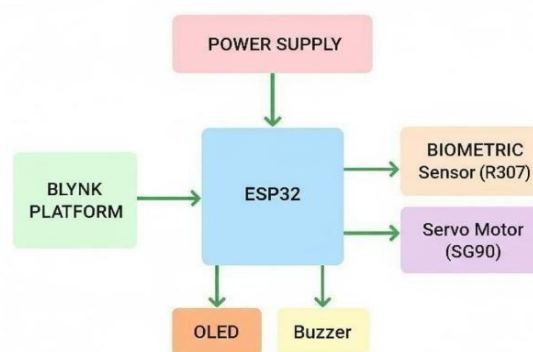


Fig 3.1 block diagram of the proposed system.

5. RESULTS

- **Accurate Biometric Authentication:** To ensure that only the registered patient could access the medication and prevent misuse or unauthorized dispensing, the fingerprint module consistently verified the authorized user with high accuracy.

- **Reliable Time-Based Medicine Delivery:** By executing medication dispensing at precisely scheduled times, the ESP32 control and RTC-based scheduling reduced missed doses and enhanced adherence to recommended medication regimens
- **Smooth and Accurate Dispensing Mechanism:** Throughout numerous tests, the servo-driven compartment system demonstrated dependable mechanical performance by operating smoothly and dispensing the right pills without jamming.
- **Effective IoT Monitoring and Alerts:** The Blynk app effectively offered real-time updates, missed dose notifications, and remote monitoring features, allowing caregivers to effectively monitor patient compliance and take appropriate action when needed.

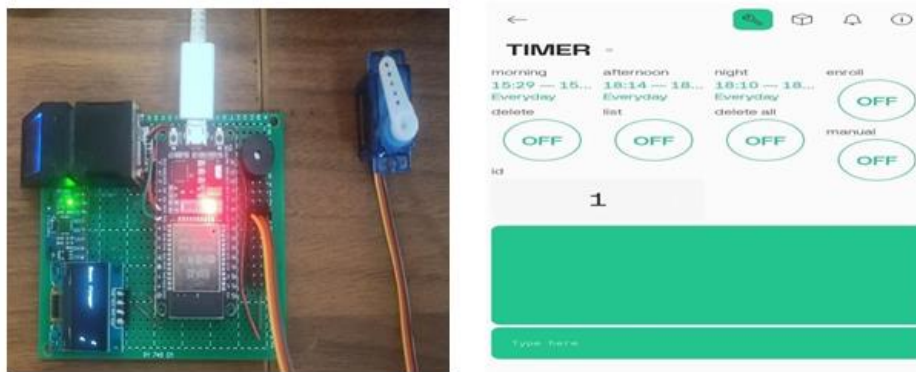


fig 4.1 Biometric based smart IoT medicine dispenser.

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