



SMART MEDICAL ASSISTANCE

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Abstract:

A Smart Medical Assistance vending machine using ESP32, which can detect body temperature, heart rate, and oxygen level and automatically dispense tablets, is designed in this hardware mini project. The MLX90614 infrared sensor is used for measuring body temperature without contact, and the MAX30102 sensor is used for measuring heart rate and SpO₂. A 4×4 matrix keypad is used for OTP verification, and servo motors are used to control the tablet dispensing mechanism. The health data and system status will be shown on a display screen. The system is useful in applications like hospitals, rural health centers, pharmacies, and emergency medical support. It is low-cost and easy to implement.

The project demonstrates how sensors and microcontrollers will be combined to create a working model of an automatic medical vending system. Health monitoring systems are used to measure important human body parameters like temperature, pulse rate, and oxygen level to detect abnormal conditions. The ESP32 board is programmed using the Python language. The code will be written and executed in the ESP32 environment and connected to the sensors through GPIO pins. The system reads the health parameters and compares them with normal values. If abnormal conditions are detected and OTP verification is successful, the servo motor rotates and dispenses the required tablet automatically.

Keywords: ESP32, MLX90614 IR Temperature Sensor, MAX30102, Heart Rate Monitoring, SpO₂ Measurement, Servo Motor, 4×4 Matrix Keypad, Automatic Tablet Vending Machine,



Embedded Systems, IoT, Smart Medical Assistance.

1. INTRODUCTION

Healthcare is one of the most essential sectors for human survival and well-being. Early detection of health abnormalities such as fever, irregular heart rate, and low oxygen level is very important for preventing serious medical conditions. Rapid population growth, increasing patient load in hospitals, and the need for contactless health monitoring systems have created demand for automated and smart medical solutions. Traditional medicine distribution and health checking methods are mostly manual, time-consuming, and require human supervision.

With the advancement of embedded systems and Internet of Things (IoT) technologies, automated health monitoring systems have gained significant attention. Microcontroller and single-board computer platforms such as ESP32 provide a flexible, low-cost, and reliable solution for real-time medical monitoring. Integration of biomedical sensors enables accurate measurement of body temperature, heart rate, and SpO₂ levels. Automated control mechanisms like servo motors improve efficiency by enabling controlled tablet dispensing without human intervention.

This project focuses on the development of a Smart Medical Assistance Vending Machine using ESP32, MLX90614 infrared temperature sensor, and MAX30102 heart rate and SpO₂ sensor. Unlike conventional manual medicine distribution systems, the proposed system provides real-time health monitoring, OTP-based user verification, and automatic tablet dispensing. The system aims to offer a practical, contactless, and scalable solution for hospitals, pharmacies, rural health centres, and emergency medical applications.

The Smart Medical Assistance and Automated Medicine Vending System is an innovative healthcare solution designed to improve accessibility, efficiency, and safety in medicine distribution and patient monitoring. Traditional medicine dispensing systems often require manual supervision, which can lead to delays, human errors, and limited availability, especially in rural or emergency situations. This project aims to overcome these challenges by integrating automation, embedded systems, and digital authentication mechanisms.

The system combines hardware components such as an ESP32 microcontroller, stepper motor, motor driver, IR sensor, keypad, and display unit with software technologies including backend server processing, OTP authentication, and database connectivity. Patients can register through a mobile application, request appointments, and receive a One-Time Password (OTP) after doctor approval. The OTP is used at the kiosk machine to securely dispense prescribed medicines.

2. LITERATURE SURVEY

Patil et al. (2024) [1] :Developed an IoT-based patient health monitoring system using temperature and pulse sensors. The system provides real-time monitoring and cloud-based data storage, improving remote healthcare supervision. However, the proposed model lacks an automatic



medicine dispensing mechanism and secure authentication features.

Sharma and Kulkarni (2023) [2]: Designed a Raspberry Pi-based health monitoring device capable of accurately measuring heart rate and SpO₂ levels. The system offers a simple graphical interface and reliable data acquisition. However, it does not include OTP-based security and has limited automation features for medicine management.

Ahmed et al. (2022) [3]: Implemented a contactless temperature monitoring system using infrared sensors. The system ensures safe and hygienic measurement, especially useful during pandemic situations. However, it does not support multi-parameter health analysis or integrated healthcare management.

Verma et al. (2025) [4]: Proposed a smart medicine vending machine with automated tablet dispensing and digital payment support. The system improves accessibility to medicines but does not include real-time health parameter monitoring before dispensing.

Deshmukh et al. (2023) [5]: Developed an automatic pill dispenser for elderly patients with scheduled dispensing and alarm notifications. While it improves medication adherence, it lacks biometric authentication and real-time health condition verification.

Khan and Sheikh (2021) [6]: Evaluated wearable health monitoring systems that enable continuous monitoring and wireless communication. Although effective for mobility, the system involves complex multi-sensor integration and higher implementation costs.

Roy et al. (2022) [7]: Reviewed IoT-based healthcare systems focusing on cloud connectivity, data analytics, and remote monitoring. The study provides strong theoretical insights but includes limited practical hardware implementation.

Jadhav et al. (2024) [8] :Designed a low-cost embedded health monitoring prototype suitable for educational and small-scale healthcare setups. The system is affordable and easy to implement, but has limited scalability and does not include a secure authentication mechanism.

Table 1 Gap Analysis

Ref. No.	Title	Technology Used	Limitations	Gap Analysis
1	IoT-Based Patient Health Monitoring System (2024)	Temperature Sensor, Pulse Sensor, Cloud	Limited to health monitoring only.	Integrates ESP32, AI analysis, OTP authentication, and automatic medicine dispensing.
2	Raspberry Pi-Based Health Monitoring Device (2023)	Raspberry Pi, Heart Rate Sensor, SpO ₂ Sensor	High cost and no medicine dispensing.	Uses low-cost ESP32 with IoT connectivity and automatic tablet dispensing.
3	Contactless Temperature	Infrared Temperature Sensor	Monitors only body temperature.	Supports multi-parameter monitoring



Ref. No.	Title	Technology Used	Limitations	Gap Analysis
	Monitoring System (2022)			with AI-based diagnosis and medicine dispensing.
4	Smart Medicine Vending Machine (2025)	Embedded System, Payment Module	No patient health monitoring or authentication.	Adds health monitoring, OTP verification, and AI-assisted medicine dispensing.
5	Automatic Pill Dispenser for Elderly (2023)	Microcontroller, Alarm System	Schedule-based dispensing only.	Dispenses medicine based on real-time health parameters.
6	Wearable Health Monitoring System (2021)	Wearable Sensors, Wireless Communication	No medicine dispensing functionality.	Provides a portable healthcare kiosk with automated medicine dispensing.
7	IoT-Based Healthcare Systems Review (2022)	IoT, Cloud, Data Analytics	Review paper without implementation.	Develops a complete ESP32-based healthcare prototype.
8	Low-Cost Embedded Health Monitoring Prototype (2024)	Embedded System, Basic Sensors	Supports only basic monitoring.	Includes AI analysis, cloud connectivity, OTP authentication, and medicine dispensing.
9	Multi-Parameter Health Monitoring	Arduino, Multiple Sensors, IoT	Monitoring only; no automated response.	Integrates health monitoring with automatic medicine
10	Wireless Health Monitoring System (2022)	Bluetooth, Sensors	Limited communication range and no automation.	Uses cloud-based IoT with AI-driven healthcare assistance.
11	Smart Healthcare System with IoT (2024)	IoT, Mobile Application	No medicine dispensing feature.	Combines IoT, OTP authentication, AI analysis, and medicine vending.
12	Digital Health Kiosk for Rural Areas (2023)	Embedded System, Sensors	Lacks automated healthcare support.	Provides a low-cost ESP32-based smart medical kiosk with medicine dispensing.
13	IoT-Enabled Smart Healthcare System (2021)	IoT, Cloud Storage	Stores health data only.	Adds automatic medicine dispensing and secure OTP authentication.
14	Biometric-Based Healthcare Authentication System (2024)	Biometric Sensor, Security System	Focuses only on authentication.	Integrates authentication with health monitoring and medicine dispensing.
15	Automated Healthcare Assistance System (2025)	Sensors, Cloud, Automation	No AI prediction or vending mechanism.	Combines AI, IoT, ESP32, cloud storage, and automated medicine dispensing.



3. THE GAP SUMMARIZED AS FOLLOWS:

The objective of this project is to design and develop a Smart Medical Assistance Vending Machine using ESP32, as such automated medical vending machines are not widely available. The system will check the user's health condition by measuring important parameters such as body temperature, heart rate, and SpO₂. The collected health information will be provided to the doctor for evaluation and verification. An OTP will be sent to the authorized doctor, who will assign the appropriate medicine based on the patient's health condition. After successful OTP authentication, the machine will automatically dispense the prescribed tablets through a motor-controlled mechanism. Overall, the project will provide a low-cost, contactless, portable, and efficient healthcare support system while reducing human intervention.

Conclusion:

This review concludes that the Smart Medical Assistance Vending Machine provides an effective and practical approach to automated healthcare assistance by integrating sensors for monitoring body temperature, heart rate, and SpO₂ levels. The incorporation of OTP-based authentication improves security, while the motor-controlled dispensing mechanism enables controlled and automated medicine delivery.

The reviewed studies indicate that existing healthcare monitoring systems mainly focus on health parameter measurement and often lack secure medicine dispensing and integrated automation. The proposed system addresses these limitations by combining health monitoring, authentication, and medicine dispensing within a single low-cost and compact unit. This reduces human intervention and provides quick access to basic healthcare services.

The review also highlights the potential of IoT and embedded technologies in improving healthcare accessibility, particularly in rural areas, hospitals, pharmacies, and emergency situations. The proposed design makes the system economical, easy to implement, and suitable for real-time monitoring and control.

Overall, the review confirms that integrating health monitoring sensors, secure authentication, and automated medicine dispensing can provide a more efficient and accessible healthcare solution. The proposed system demonstrates the feasibility of developing low-cost smart medical assistance systems and provides a strong foundation for future improvements such as cloud-based monitoring, AI-based health analysis, remote doctor consultation, and automated prescription verification.

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