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"Medicine Dispenser"

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ABSTRACT:

The Medicine Vending Machine is an automated system designed to simplify medicine dispensing and improve inventory management in healthcare facilities. The proposed system uses an ESP32 microcontroller to control the dispensing process, push buttons for medicine selection, servo motors for dispensing medicines, and an LCD display to show medicine availability and system status. The system integrates Internet of Things (IoT) technology with Wi-Fi connectivity and an IoT cloud platform to enable remote monitoring of medicine stock levels. Inventory information is updated according to the programmed dispensing logic, helping users track available medicines and identify when restocking is required. This approach reduces the need for manual stock checking and provides a more organized method of medicine distribution. The system is intended for use in pharmacies, clinics, and other healthcare facilities to support convenient medicine access and efficient inventory management. The proposed solution combines embedded systems and IoT technology to provide a practical foundation for automated medicine dispensing and real-time inventory monitoring.

KEYWORD: Medicine Vending Machine, ESP32 Microcontroller, Internet of Things (IoT), Automated Medicine Dispensing, Servo Motor.

INTRODUCTION

The availability of medicines is an essential part of effective healthcare services, and proper medicine distribution and inventory management are important for pharmacies, clinics, and hospitals. Traditional medicine dispensing and stock monitoring often involve manual work, which can make inventory tracking time-consuming and increase the possibility of recording errors. With the development of automation and Internet of Things (IoT) technology, smart medicine dispensing systems can provide a more organized approach to medicine distribution and stock monitoring. Previous studies have explored IoT-based medicine dispensers using microcontrollers, motor-based dispensing mechanisms, displays, and cloud platforms to support automated operation and remote monitoring. These developments demonstrate the potential of integrating embedded systems and IoT technology to improve the convenience and efficiency of medicine management.

This research presents a Medicine Vending Machine using an ESP32 microcontroller. The system uses push buttons to select medicines, servo motors to control the dispensing mechanism, and an LCD display to show medicine availability and system status. Wi-Fi connectivity and an IoT cloud platform enable remote monitoring of medicine inventory, helping users identify stock availability and determine when replenishment is required. Similar research has demonstrated the usefulness of ESP32-based dispensing systems and cloud-connected inventory monitoring in healthcare applications. The proposed system aims to reduce manual effort, simplify stock tracking, and provide a convenient method of medicine dispensing. It offers a practical approach to combining automated dispensing and remote inventory monitoring in pharmacies and other healthcare facilities.

LITERATURE SURVEY

Harshini D. A., Amiritavarshini S., V. Sudha, and Raja R. presented an *Internet of Things (IoT) Enabled Intelligent Medication Dispensing Solution* in 2023. Their work focuses on automated medication dispensing using microcontrollers, sensors, and IoT technology to improve medication management and remote monitoring. Gupta et al. discussed smart medicine vending machines using Arduino in 2025, examining existing technologies, their applications, and future improvements in accessibility, automation, and security. Similarly, Y. B. Bachkar, A. D. Tekale, and N. S. Pawar developed an *IoT-Based Automatic Medicine Dispenser Using ESP32 Microcontroller* in 2024. Their approach integrates an ESP32 microcontroller with dispensing components and

IoT connectivity to support automated medicine distribution and monitoring.

The reviewed studies demonstrate the potential of microcontrollers, automated dispensing mechanisms, and IoT platforms in improving medicine distribution and inventory monitoring. However, reliable dispensing, accurate stock updates, network connectivity, and secure access remain important considerations for practical implementation. The proposed Medicine Vending Machine addresses these requirements by integrating an ESP32 microcontroller, push buttons, servo motors, an LCD display, and an IoT cloud platform. This combination supports medicine selection, automated

dispensing, and remote stock monitoring through a simple, connected system. Further practical testing is required to evaluate dispensing accuracy, inventory consistency, and overall system reliability.

Table 1: Comparative Analysis of Existing Methods

Authors	Methods	Application Areas
1. Authors not specified in the thesis reference	IoT-enabled intelligent medication dispensing and remote monitoring.	Automated medication dispensing and healthcare management.
2. Authors not specified in the thesis reference	Analysis of Arduino-based smart medicine vending technologies.	Medicine vending, healthcare accessibility, and automation.
3. Y. B. Bachkar, A. D. Tekale, and N. S. Pawar	ESP32-based automatic medicine dispenser using IoT technology.	Medicine dispensing and remote monitoring.
4. Authors not specified in the thesis reference	Systematic review of pill and medication dispensers from a human-centered perspective.	Medication management, usability, and patient support.
5. Espressif Systems	ESP32 hardware specifications and technical documentation.	Embedded systems and mic rocontroller-bas ed automation.
6. Arduino	Integrated development environment documentation for programming microcontrollers.	Embedded programming and hardware control.
7. Espressif Systems	ESP-IDF development framework and programming guidelines.	ESP32 software development and device integration.
8. IEEE	Standardized functions and communication protocols for smart transducers.	Sensor integration and automated monitoring systems.
9. IEEE	IEEE 802.11 wireless local-area networking standards.	Wi-Fi communication and connected healthcare devices.
10. J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami	IoT architecture, enabling technologies, and future directions.	Smart environments, connected devices, and cloud-based systems.
11. L. Atzori, A. Iera, and G. Morabito	Survey of IoT concepts, technologies, and applications.	IoT-based automation and networked systems.
12. D. Evans	Overview of IoT development and its technological impact.	Connected devices, smart services, and digital transformation.
13. M. Weiser	Pervasive computing concept and vision for integrated computing environments.	Smart environments and user-centered computing systems.

PROBLEM DEFINITION

Traditional medicine dispensing and inventory management often rely on manual processes, which can be time-consuming and make it difficult to maintain accurate stock records. Monitoring medicine availability, identifying medicines that require replenishment, and dispensing the correct medicine efficiently are important challenges in healthcare facilities. Manual stock checking may also lead to delays and inconsistencies in inventory records. Therefore, an automated solution is needed to simplify medicine selection and dispensing while improving the visibility of available stock.

The proposed Medicine Vending Machine addresses these challenges using an ESP32 microcontroller, push buttons, servo motors, and an LCD display. The system allows users to select medicines through push buttons, controls the dispensing mechanism using servo motors, and displays medicine availability and system status on the LCD. Furthermore, Wi-Fi connectivity and an IoT cloud platform support remote stock monitoring. The main objective is to reduce manual effort, simplify inventory tracking, and provide an organized approach to medicine dispensing. However, dispensing accuracy and inventory-update reliability must be verified through practical testing before the system can be considered suitable for wider healthcare use.

METHODOLOGY

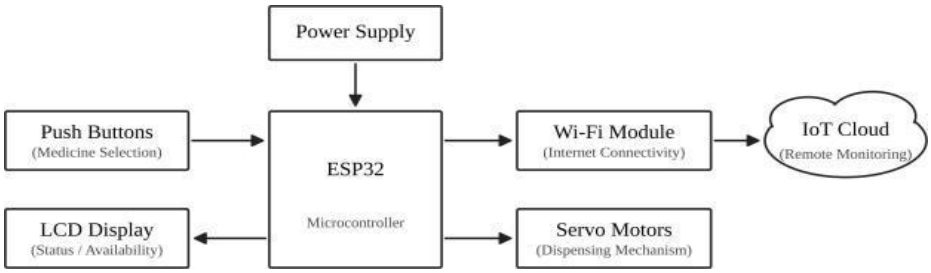


Figure 1: Block Diagram

Figure 1 shows the block diagram of the proposed Medicine Vending Machine. The ESP32 microcontroller is the central control unit to which all other modules are connected. The power supply provides energy to the ESP32, LCD display, servo motors and other components. The push buttons allow the user to select the required medicine, and the ESP32 reads this input and checks the recorded stock. If the medicine is available, the ESP32 sends control signals to the servo motors of the dispensing mechanism to release it. The LCD display shows medicine availability and system status. After dispensing, the stock information is updated and sent through the Wi-Fi module to the IoT cloud for remote monitoring.

1. Medicine Selection

The user selects the required medicine using the push buttons provided on the vending machine. The ESP32 microcontroller receives the selection input and processes it according to the programmed logic to identify the requested medicine and its availability.

2. ESP32-Based Control

The ESP32 microcontroller acts as the main control unit of the system. It processes user inputs, manages the dispensing operation, updates stock information, and coordinates communication between the connected components.

3. Automated Medicine Dispensing

Servo motors are used to operate the medicine dispensing mechanism. When a valid medicine selection is received, the ESP32 controls the corresponding servo motor to dispense the selected medicine, helping simplify the distribution process.

4. Display and Inventory Tracking

The LCD display provides information about medicine availability and the current system status. The inventory is updated according to the programmed dispensing logic, helping maintain organized stock records and identify medicines that may require replenishment.

5. IoT-Based Remote Monitoring

The system uses Wi-Fi connectivity to communicate with an IoT cloud platform. This integration allows users to monitor medicine stock information remotely, reducing the need for frequent manual stock checking and supporting more efficient inventory management.

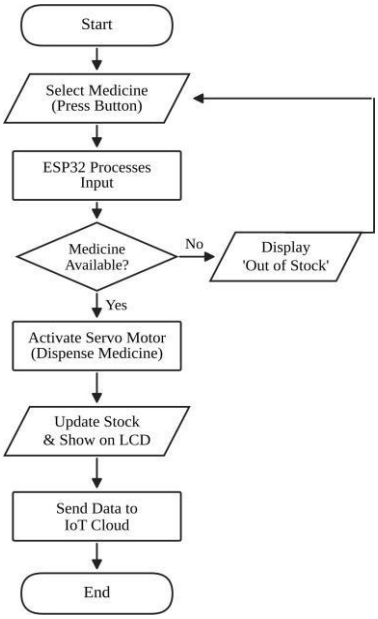


Figure 2 :Flowchart Of Model

The flowchart illustrates the step-by-step operation of the proposed Medicine Vending Machine. The process begins when the user selects a medicine using the push button, and the ESP32 microcontroller processes the input to check its availability. If the medicine is unavailable, the system displays an "Out of Stock" message and allows the user to select another medicine. If the medicine is available, the ESP32 activates the servo motor to dispense it, updates the stock information, and displays the updated status on the LCD. Finally, the updated inventory data is sent to the IoT cloud through Wi-Fi, enabling remote
stock monitoring and improving inventory management.

The proposed methodology combines embedded system control, automated dispensing, and IoT-based inventory monitoring to provide an organized medicine distribution process. The ESP32 microcontroller coordinates the push buttons, servo motors, and LCD display according to the programmed instructions. When a user selects a medicine, the system checks its availability before activating the dispensing mechanism. After dispensing, the stock information is updated and displayed on the LCD. This process helps reduce manual effort and provides users with clear information about medicine availability. The integration of these components creates a simple and practical approach to automated medicine management.

Furthermore, Wi-Fi connectivity and an IoT cloud platform enable remote monitoring of medicine stock levels. This feature helps pharmacy staff and other authorized users observe inventory information and identify medicines that may require replenishment. The overall methodology is designed to improve convenience, support organized inventory management, and reduce dependence on manual inventory checking. However, practical testing is necessary to evaluate the reliability of dispensing, the consistency of stock updates, and the performance of cloud communication. These evaluations can help identify limitations and guide future improvements to the proposed medicine vending machine.

Table 2: Components Used in the System

Sr. No.	Component/ Module	Function
1	ESP32 Microc ontroller	Acts as the central control unit, processes user inputs, controls medicine dispensing, and manages stock information.
2	Push Buttons	Allow users to select the required medicine by providing input to the ESP32 microcontroller.
3	Servo Motors	Control the dispensing mechanism and release the selected medicine according to the programmed instructions.
4	LCD Display	Displays medicine availability, stock status, and relevant messages to help users understand the system's current condition.
5	Wi-Fi Connectivity	Connects the ESP32 to the internet, enabling the transfer of medicine stock information to the cloud platform.
6	IoT Cloud Platform	Provides remote access to inventory information, allowing authorized users to monitor medicine stock levels through the connected platform.
7	Power Supply	Provides the electrical energy required for the microcontroller, display, and other electronic components to operate.
8	Medicine Storage and Dispensing Unit	Holds the medicines in designated storage sections and works with the servo-controlled mechanism to dispense the selected medicine.

The proposed medicine vending machine consists of eight major components and modules that work together to automate medicine dispensing and inventory monitoring. The ESP32 processes selection inputs from the push buttons and controls the servo motors to dispense the requested medicine. The LCD displays medicine availability and system status, while Wi-Fi connectivity enables communication with an IoT cloud platform for remote stock monitoring. The power supply supports the operation of the electronic components, and the medicine storage and dispensing unit organizes the medicines for controlled distribution. Together, these components provide a simple and organized solution for medicine dispensing and inventory management in pharmacies, clinics, and other healthcare facilities.

Algorithms Utilized

- **Medicine Selection Algorithm:** This algorithm accepts the user's medicine selection through push buttons and sends the input to the ESP32 microcontroller for processing.
- **Input Processing Algorithm:** The ESP32 reads the selected input and identifies the corresponding medicine according to the predefined program logic.
- **Medicine Availability Checking Algorithm:** The system checks the recorded availability of the selected medicine before proceeding with the dispensing operation.
- **Servo Motor Control Algorithm:** When the medicine is available, the ESP32 sends control signals to the corresponding servo motor to operate the dispensing mechanism.
- **Medicine Dispensing Algorithm:** This algorithm controls the dispensing process according to the user's selection and the programmed instructions.

- **Stock Update Algorithm:** After the dispensing operation, the system updates the medicine stock information according to the programmed inventory logic.
- **LCD Display Algorithm:** The system displays medicine availability, dispensing status, and relevant messages on the LCD to provide information to the user.
- **Wi-Fi Communication Algorithm:** This algorithm enables the ESP32 to connect to a Wi-Fi network and communicate with an IoT cloud platform.
- **Cloud Monitoring Algorithm:** The system sends available stock information to the IoT cloud, allowing authorized users to monitor inventory remotely.
- **Out-of-Stock Handling Algorithm:** If the selected medicine is unavailable, the system displays an out-of-stock message and allows the user to make another selection.
- **System Initialization Algorithm:** At startup, the system initializes the ESP32, display, input buttons, servo motors, and required communication settings before normal operation.
- **System Status Monitoring Algorithm:** The system manages the display and inventory information during operation to support organized dispensing and stock monitoring.

OBJECTIVES

1. To develop an automated medicine vending machine using an ESP32 microcontroller to simplify medicine selection and dispensing.
2. To implement a user-friendly medicine selection system using push buttons, allowing users to select the required medicine easily.
3. To automate medicine dispensing using servo motors controlled by the ESP32 according to the programmed instructions.
4. To display medicine availability and system status on an LCD display, helping users identify available medicines and dispensing information.
5. To implement real-time stock monitoring using Wi-Fi connectivity and an IoT cloud platform for remote inventory tracking.
6. To reduce manual effort in inventory management by updating stock information after dispensing and helping identify medicines that require replenishment.

RESULT

The proposed Medicine Vending Machine integrates an ESP32 microcontroller, push buttons, servo motors, and an LCD display to support automated medicine dispensing. The system is designed to receive medicine selections through push buttons, process the input using the ESP32, and operate the servo motor to dispense the selected medicine according to the programmed instructions. The LCD displays medicine availability and system status, helping users understand the dispensing process. This approach provides an organized method of medicine distribution and reduces dependence on manual operations. The system's practical performance depends on the correct coordination of its hardware components and the accuracy of the programmed dispensing logic.

The integration of Wi-Fi connectivity with an IoT cloud platform enables remote monitoring of medicine stock information. Stock details can be updated according to the dispensing logic, allowing users to monitor inventory and identify medicines that may require replenishment. This feature can reduce the effort required for manual stock checking and support more efficient inventory management in pharmacies and healthcare facilities. However, quantitative performance results, such as dispensing accuracy, response time, and stock-update consistency, require experimental measurements and validation. Further testing under different operating conditions would help evaluate the system's reliability and identify improvements for practical deployment.

CONCLUSION

The proposed Medicine Vending Machine provides an automated approach to medicine dispensing and inventory monitoring by integrating an ESP32 microcontroller, push buttons, servo motors, an LCD display, and IoT technology. The system enables users to select medicines, checks their recorded availability, and controls the dispensing mechanism according to the programmed instructions. The LCD displays medicine availability and system status, making the dispensing process easier to understand. By reducing dependence on manual operations, the proposed system offers a practical solution for improving the organization and convenience of medicine distribution in pharmacies, clinics, and other healthcare facilities.

Furthermore, the integration of Wi-Fi connectivity and an IoT cloud platform supports remote monitoring of medicine stock information. Updating inventory records after dispensing can help users identify medicines that require replenishment and improve inventory management. The proposed system demonstrates the potential of combining embedded systems and IoT technology to develop a convenient and connected medicine dispensing solution. However, further practical testing is required to verify dispensing accuracy, stock-update consistency, communication reliability, and overall system performance. Future enhancements, such as low-stock notifications, medicine expiry tracking, improved authentication, and dispensing verification sensors, could further improve the system's reliability and suitability for real-world healthcare applications.

FUTURE SCOPE

The Medicine Vending Machine can be improved in the future by introducing advanced features to enhance its reliability, security, and usability. A low-stock alert system could notify pharmacy staff when medicine quantities fall below a predefined limit, helping ensure timely replenishment. Medicine expiry-date tracking could also be incorporated to identify expired or soon-to-expire medicines and support safer inventory management. Additionally, dispensing verification sensors could be integrated to confirm whether the selected medicine has been dispensed

successfully and whether the stock information has been updated correctly. These improvements would help make the system more reliable and suitable for practical use in pharmacies, clinics, and healthcare facilities.

Further development could include a dedicated mobile application for monitoring inventory, checking medicine availability, and receiving notifications remotely. Improved authentication methods could restrict access to authorized users and protect sensitive system information. The system could also be expanded to accommodate a larger number of medicine types and storage compartments to support different healthcare requirements. In addition, improved connectivity and systematic performance testing could help evaluate the system under different operating conditions. These future enhancements could strengthen the integration of embedded systems and IoT technology, making medicine dispensing more convenient and inventory management more efficient.

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