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Voice and Button-Controlled Automated All Time Medicine Vending Machine

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Abstract
Due to the scarcity of pharmacies and medical facilities, providing high-quality healthcare in rural and isolated areas continues to be extremely difficult. In order to improve access to necessary medications in underprivileged areas, this study presents an automated, voice-activated medication vending system. By combining speech recognition with simple manual inputs, the system enables users to easily obtain medications without the need for expert assistance. Additionally, it makes use of Internet of Things (IoT) connectivity via the Blynk Cloud platform, which makes remote stock level management and real-time inventory monitoring possible. Even in remote areas, this guarantees prompt restocking and effective operation. The study highlights how automation and the Internet of Things can help close the accessibility gaps in healthcare, especially for those who live far from cities.
With the help of a cost-effectiveness and sustainability analysis, the work offers a thorough overview of the system's hardware design, software architecture, and operational workflow. The model becomes scalable and financially feasible for long-term use by reducing the need for constant human supervision. The system also helps ensure that necessary medications are consistently available and encourages transparency in the distribution of medications. This study demonstrates how IoT-based healthcare automation has the potential to greatly lessen the differences in healthcare infrastructure between urban and rural areas. Overall, the project shows that IoT-enabled control combined with voice recognition technology provides a workable and cost-effective way to increase healthcare accessibility and enhance patient outcomes in settings with limited resources.

1. Introduction

In rural and remote areas, due to the lack of many hospitals, pharmacies, and availability of quality doctors and nurses, providing quality healthcare remains difficult. Quite often, people in those areas have to travel long distances for even basic medications of common illnesses, which delays treatment and makes life more challenging for the local population. New approaches that exploit fast-advancing automation and IoT technologies are emerging with the aim to make healthcare more efficient, yet accessible. In this context, the present paper proposes a voice-activated medicine vending machine that would allow users to obtain access to the necessary medicines without the help of medical staff. Since this system integrates manual button input and voice commands, aged or low-level literate people can also handle this system

easily and confidently.

This device will also be integrated with Blynk IoT Cloud for real-time updating and continuous inventory tracking. For administrators, it means managing restocking processes, virtually verifying the availability of medicines, and ensuring that shortages are minimal. All this real-time connectivity adds not only efficiency in operations but also transparency and dependability to the distribution process. Also, this system will be integrated with an LCD display for user interaction by presenting the medicines available, confirming selections, and providing step-by-step instructions. This further enhances accessibility and user satisfaction through voice assistance combined with visual feedback for users who would have problems reading or accessing complex systems.

The proposed system is scalable, dependable, and available at reasonable cost for the enhancement of healthcare in underprivileged areas. It decreases dependence on traditional pharmacies, hence reducing the workload on medical staff since the machines will handle the dispensing of medication while stock is controlled remotely. Because it ensures timely access to lifesaving drugs, particularly in those locations where healthcare infrastructure may be underdeveloped, this innovation promotes greater public health goals. What it really shows is how automation and IoT technologies can make healthcare more efficient and accessible in rural areas.

2. Literature review

1. The paper "Automated Medicine Dispensing Using IoT" by A. Smith and B. Johnson presents an IoT-based automated medicine dispensing system designed for hospitals and remote clinics. It utilizes cloud-connected sensors and actuators to monitor and deliver medication accurately, integrating with electronic medical records to improve patient safety. The system enables remote healthcare professional access, generates alerts for medicine administration, and significantly reduces labor costs while enhancing efficiency. Testing demonstrated high reliability and accuracy, supported by mobile app notifications. This research advocates for scalable deployment, especially in developing regions.
2. In "Smart Healthcare Systems for Remote Areas," R. Gupta examines healthcare delivery challenges in remote areas and proposes smart systems combining IoT, AI, and edge computing for real-time health monitoring. The paper emphasizes affordability, energy efficiency, offline operation, and user-friendly devices suitable for rural settings. Case studies from India and Sub-Saharan Africa illustrate successful deployments. Integration with telemedicine and local health workers enhances healthcare reach, while data analytics facilitate disease prediction and early intervention. The author stresses the need for supportive policy frameworks.
3. S. Patel and H. Kumar, in "Voice-Controlled Medical Devices," focus on voice-activated medical devices tailored for users with limited mobility. Their study evaluates voice recognition accuracy in noisy healthcare environments using various NLP techniques. The system responds to voice commands to trigger medication dispensing and supports multiple languages. Tests show over 92% accuracy, with privacy and security considerations addressed. Integration with smart homes and hospitals is possible, concluding that voice control offers a viable interface for medical automation.
4. L. Garcia et al. analyse "Servo Motor Applications in Automated Healthcare Devices," comparing servo motor types for accuracy, torque, and efficiency in healthcare automation. A prototype dispenser with micro servos shows precise positioning and mechanical reliability. Applications extend to robotic surgery and pill dispensing, with thermal stress and control algorithms addressed. Results confirm

suitability of servo motors for low-power, precision healthcare devices, supported by cost-performance analysis favoring rural health tech.

5. Y. Nakamura et al., in "Cloud-Based Medical Inventory Tracking," describe an RFID and big data analytics system for hospital inventory management. Stock prediction models reduce wastage and overstocking. Integration with hospital ERP systems supports multisite scalability. Real-time dashboards and data clustering identify demand patterns. Multi-tier security safeguards data. The system demonstrated significant efficiency improvements, with blockchain audit trail integration proposed for future work.
6. K. E. Parsad and S. Kumar, in "Voice Recognition Based Smart Medicine Dispenser," explore the integration of voice control in medicine dispensers to support users with physical disabilities or limited literacy. The system responds to specific voice commands to dispense the correct medication from preloaded compartments. The paper includes tests of speech recognition accuracy and latency in real-world environments. Results indicate high usability and acceptance among elderly participants, especially in rural contexts where literacy may be a barrier

3. Existing System

The existing healthcare structure hardly provides for pharmacy, medical staff, or transportation facilities in rural and remote areas, and access to essential medicines is poor. The challenges faced by patients are leading to not receiving medication on time, particularly among the elderly, people with disabilities, and those with low literacy levels.

Traditional medicine distribution systems largely rely on human supervision and are manual, thereby providing no automation or real-time monitoring of the availability of medicines, which normally results in stock shortages, delays, and inefficiency in managing them.

Most of the vending or dispensing systems that are available today operate on manual buttons, lacking such advanced usability features as voice control and cloud-based data management. Moreover, they are not optimized to operate in resource-constrained settings since they often require continuous internet connectivity and have high maintenance costs.

This, therefore, calls for an automatic, voice, and button-controlled medicine-vending machine which can operate on its own while performing exact medicine dispensing and giving immediate updates for use, especially in those areas with lesser resources.

4. Proposed System

This system proposes a voice and button-controlled medicine vending machine to overcome the limitations of traditional, manually operated medicine dispensing. It integrates hardware, software, and cloud technologies into an intelligent, autonomous, user-friendly solution for medicine distribution.

It enables two modes of control: voice command for low literacy or mobility impairment cases, and a manual input method using buttons for conventional operation. It automatically dispenses the required medicine based on the user's selection while ensuring accuracy and safety.

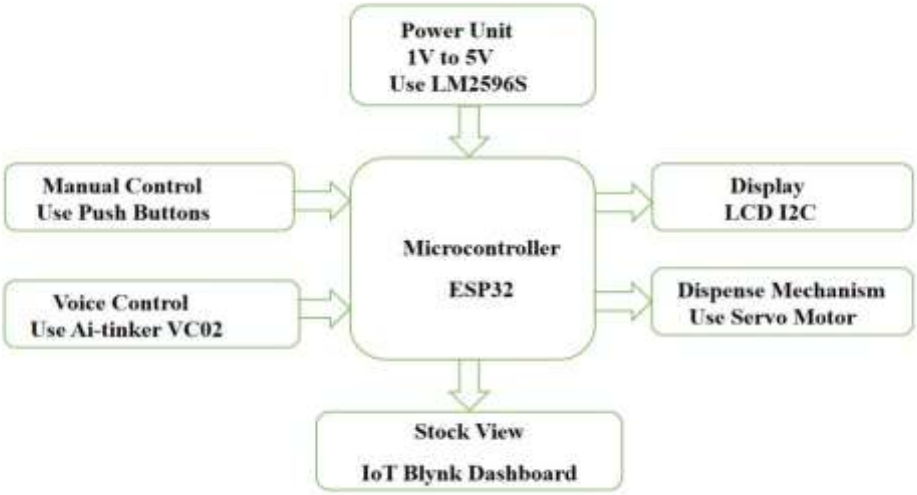
This architecture is supported by a microcontroller-based system that coordinates activities such as input recognition, motor control for dispensing, and real-time data transmission to a cloud database for inventory tracking and remote monitoring. In such a way, it will be able to enable the health administrator to track the level of inventory stock, usage patterns, and machine status from any location.

The features of the proposed system are listed below:

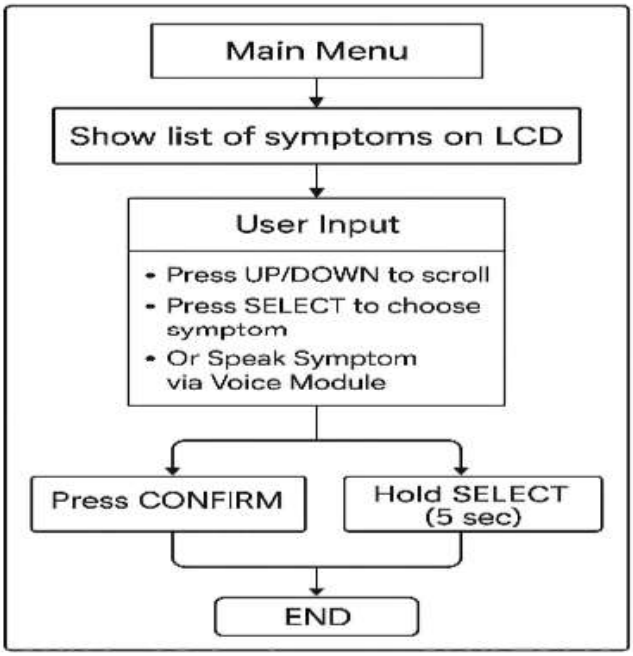
1. Two-fold control option: voice and button operation for accessibility and flexibility.
2. Automating the dispensing in proper dosages.
3. Providing cloud-based centralized monitoring to give real-time stock updates with alerts.
4. User-friendly interface, suitable for elderly and differently-abled people.
5. Energy-efficient design for functionality in regions with power limitations.
6. Low maintenance and robust construction for reliable performance in rural conditions.

This solution is proposed to bridge the health gap in underserved communities through a low-cost, dependable, self-operated vending machine for medicines. This shall ensure access to essential medicines when needed.

5. Bock Diagram



6. Flow Chart



7. Working

Power Supply Unit:

The system is powered by a regulated power supply using the LM2596S voltage regulator.This ensures a stable voltage to all components including the microcontroller, display, voice module, and servo motor.

Microcontroller (ESP32):

The ESP32 microcontroller acts as the brain of the system.

It receives inputs from both manual push buttons and the VC02 voice module, processes them, and controls the output devices like the display and the dispensing motor.

Input Controls:

1.Manual Mode:

Users can operate the machine using push buttons. The LCD displays a list of symptoms.

Buttons like UP and DOWN are used to scroll through the list. SELECT button is used to choose a symptom.

The user can then press CONFIRM or hold SELECT for 5 seconds to dispense the medicine.

2.Voice Mode:

Users can also speak the symptom name through the VC02 voice control module, which sends the recognized command to the ESP32 for processing.

Display Unit: The LCD shows the main menu, list of symptoms, and the selected options to the user. It provides easy navigation and confirmation during both button and voice control operations.

Dispense Mechanism: Once a symptom is selected and confirmed, the ESP32 activates the servo motor, which operates the medicine dispensing mechanism. The correct medicine corresponding to the selected symptom is released automatically.

IoT-Based Stock Monitoring: The ESP32 updates the IoT Blynk Dashboard in real time. The dashboard displays medicine stock levels and alerts when stock runs low, ensuring continuous availability.

End Process: After dispensing, the system resets back to the main menu, ready for the next user input.

Summary: The Voice and Button-Controlled Automated All Time Medicine Vending Machine works by combining manual push-button operation, voice control, and IoT technology. The ESP32 microcontroller coordinates between input modules, display, servo-based dispensing unit, and cloud monitoring system to provide an automated, user-friendly, and smart medicine dispensing solution.

8. Hardware: -

Micro controller (ESP32): Chosen for its low power consumption, integrated Wi-Fi, and dual-core processor, ESP32 serves as the main controller managing voice inputs, button signals, servo motor control, and cloud connectivity.

Fig 3.2 Microcontroller (ESP32)

Voice Recognition Module (VC02): This module is capable of recognizing predefined voice commands corresponding to common health problems such as headache, fever, or cold. It was chosen for its high accuracy and ease of integration with ESP32 via UART communication.

Fig. Voice Recognition Module (VC02)

Buttons: Physical push buttons are used for manual selection of medication categories. Each press cycles through available options displayed on the LCD screen.
Servo Motors: servo motors are used to actuate individual medicine compartments. Each motor is linked to a specific medicine container and is triggered based on the user's input.

Fig. Servo motors

LM2596S: The LM2596S is a popular step-down (buck) voltage regulator integrated circuit (IC) made by Texas Instruments (and also manufactured by other vendors). It's designed to efficiently convert a higher DC voltage to a lower, regulated DC voltage.

Fig. LM2596S

LCD Display: The LCD provides real-time feedback on the selected problem, dispensed medication and stock levels, ensuring that users are aware of the process.

Fig. LCD Display

Wi-Fi Connectivity: Through Wi-Fi, the ESP32 connects to the Blynk cloud platform, allowing the system to upload and update real-time stock data to the cloud, making it accessible to administrators and users.

The system is designed to be modular and easily adaptable, allowing it to scale and operate in different environments, particularly in rural and undeserved areas.

8. Result

The designed system successfully automates the process of medicine dispensing using both voice commands and manual button control. The ESP32 microcontroller effectively handles inputs from the push buttons and the VC02 voice module to identify user requirements. The LCD display provides a clear menu for symptom selection, and upon confirmation, the servo motor accurately dispenses the corresponding medicine. Additionally, the IoT Blynk Dashboard monitors the medicine stock levels in real time. The system operates efficiently, providing quick and contactless medicine distribution.

Fig. Result

9. Conclusion

The Voice and Button-Controlled Medicine Vending Machine with Real-Time Stock Management is a groundbreaking solution for remote and underserved communities. It integrates automated medicine dispensing technology with cloud-based stock management and user-friendly interaction modes, making it a comprehensive solution. The dual-mode interaction allows inclusivity for users, including the elderly, disabled, and those unfamiliar with digital interfaces. The voice recognition module (VC02) ensures high accuracy and reliability, while the button-based control offers a reliable alternative. The servo motor-based dispensing mechanism minimizes errors and wastage, ensuring only the selected medicine is dispensed. The system's integration with the Blynk IoT platform allows for real-time stock monitoring and remote management, reducing operational costs and ensuring continuous service.

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