

Heal n Care – A Medicinal Vending Machine

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Abstract— Particularly in automated dispensing systems, the growing need for safe and quick access to prescription drugs highlights a clear gap in present market offers. Designed for over-the-counter products, traditional vending machines are insufficient for controlling prescription drugs because of difficulties with regulatory compliance and authentication. This work presents a medicinal vending machine including a sophisticated image processing system for precise prescription verification. The system guarantees exact prescription verification through text extraction, signature recognition, and watermark detection by means of advanced Optical Character Recognition (OCR) and machine learning algorithms. The machine is made to safely dispense drugs following strict healthcare rules, so preserving patient privacy. This study tackles important problems in automated drug dispensing and provides a compliant and dependable means of improving patient access to prescriptions.

Keywords— Automated Dispensing, Prescription Verification, Optical Character Recognition (OCR), Machine Learning, Healthcare Compliance.

I. Introduction

The arrival of technology developments has had a major influence on many fields, including healthcare. Notwithstanding these advances, a significant gap still exists in the automated dispensing of prescription drugs, especially in areas with inadequate medical facilities. Traditional vending machines struggle with handling prescription drugs because of complicated authentication and regulatory issues, but they shine in dispensing over-the-counter items. We have created a new medicinal vending machine with a futuristic image processing-based prescription authentication system to close this difference. Following strict healthcare rules to safeguard patient privacy, this invention meets the crucial demand for safe and quick medication dispensing. Our system seeks to improve patient access to prescription drugs across several environments, from metropolitan centers to remote areas, by offering a scalable solution. The design and implementation of this advanced vending machine will be discussed in this paper together with the difficulties of prescription variability, regulatory compliance, and data security. Emphasizing its part in enhancing patient care and changing drug dispensing procedures, we will also evaluate the possible influence of this technology on the healthcare sector. The paper will provide an in-depth analysis of the technical challenges associated with prescription variability and the measures taken to ensure regulatory compliance and data security. It will also evaluate how this advanced vending

machine could enhance patient care and revolutionize medication dispensing practices in the healthcare industry.

II. Literature Review

The goal of the Automatic Medicinal Vending Machine [1] was to tackle the challenge of ensuring access to medication in countryside regions where accessing medical supplies can be difficult during emergencies or after hours when pharmacies are shut down for the day. The lack of diagnosis and the absence of crucial drugs, in these regions motivated them to create a system that offers round the clock availability of medications. Their solution involved creating a self-service medication dispenser that operates like a store and supports touchless payment methods to order medications conveniently via a web platform. This machine can stock all kinds of medicines and provide them according to individual needs. The setup is designed to be user friendly by displaying medication availability and enabling interaction between users and the machine operator, for problem resolution. In summary, installing these vending machines in settings such as workplaces and educational institutions can greatly enhance the availability of medications in areas lacking resources. This initiative aims to not streamline the delivery of medications but also prioritize patient wellbeing through prompt access to vital treatments.

Medicine vending machine [2] goal was to solve the dearth of medical facilities in rural Indian villages where access to hospitals and medications is sometimes restricted. Their aim was to design a solution that would let people control minor medical problems without the immediate presence of a doctor, particularly in far-off areas or on long train or highway trips. This project includes a keypad in which the sickness and age of the individual will be entered to the microcontroller. Based on the inputs the individual provides, this microcontroller (Arduino Mega) determines their prescription. A motor driver (L293D) forms the tablet delivering system and runs motors. If the same person is regularly taking pills, fingerprint of the person will be taken using biometric which provides data to doctors or pharmacist using GSM SIM900 and also tells them by SMS if drugs are about to run out. By using this medicine vending machine, they hope to increase access to necessary drugs in places lacking medical facilities. The system especially helps developing nations like India, where many people fight to get medications. This initiative not only meets the immediate need for easily available healthcare solutions but also offers

a means of tracking regular medication consumption and guarantees timely supply replenishment.

Medicine Vending Machine [3] aim was to design a medicine vending machine with basic access to common over-the-counter medications in absence of a pharmacist. Especially off-peak or when pharmacies closed, the goal was to give people a handy and readily accessible way to purchase medications. The project sought to create a vending machine capable of delivering painkillers as well as cough and cold remedies. The machine is supposed to let users choose their required medication depending on symptoms, pay with coins, and get their prescription automatically. It provides specifics on the several drugs as well as a LCD display displaying the cost of each. The system controls dispensing using an Arduino controller; motors and a slider mechanism ensure exact delivery of the selected medication. In the end, especially in case of an emergency or when pharmacies are closed, they wish to raise access to required medications by means of this medicine vending machine. Simple design stresses quick access, low maintenance, and ease of use of the machine, which makes it a great addition to hospitals, rural areas, and nearby businesses or colleges. This automated system solves the issue of obtaining timely medication and helps reduce delays and possible health hazards related to unavailability of medications.

III. Block Diagram

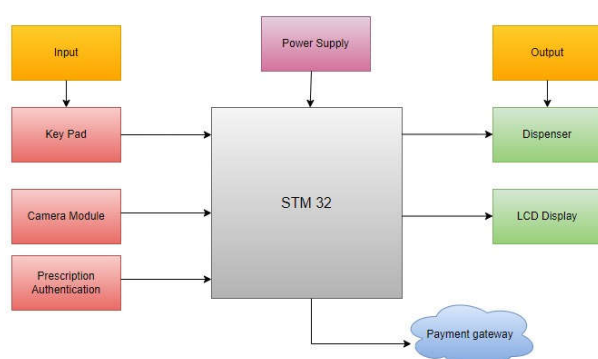


Figure 1-Block diagram

How vending machine will work: -

Case1: -If a user uses the vending machine first, he must choose the product with the help of the keypad if he chooses the product which is non prescribed, he can dispense the product after payment.

Case 2: -If the user chooses the product which needs a prescription the vending machine will display will ask the user to show the prescription, then the user must show the prescription to the camera module which will check if the prescription is correct or not if it is correct, it will proceed further to payment and then it will dispense the product. But if the prescription is not correct it will display a message sorry your prescription is not correct, and the vending machine will stop the process there itself

IV. Methodlody

Using an image processing system for prescription authentication, the approach for creating a vending machine

intended to dispense prescription-based drugs consists in several main stages.

The evolution of the vending mechanism takes front stage in the first phase. This covers choosing and ordering hardware items including control systems, storage spaces, and dispensing units. These parts have to be dependable, fit, and able of merging with the prescription authentication system. Apart from hardware choice, software is designed or modified to manage the vending mechanism, so guaranteeing flawless interaction with the authentication system. Hardware and software must be properly integrated to guarantee seamless user interface, authentication system, vending component communication.

The prescription authentication system takes front stage in the next phase. Text from scanned prescriptions is extracted using optical character recognition (OCR) systems. Preprocessing images to improve readability, using OCR models to identify characters, and post-processing to fix any recognition mistakes comprise this process. Designed to find doctor signatures and other distinctive elements on prescriptions, pattern recognition systems Models are taught on several signature patterns and prescription forms using machine learning methods. Furthermore, included are watermark detection methods, which find and authenticate embedded watermarks to confirm prescription document au-

thenticity. The third phase attends to user interface design. To help users across the prescription scanning and authentication process, a simple interface is developed. This calls for creating simple procedures and unambiguous guidelines. Feedback systems are included to let users know whether authentication is successful, failed, or pending, so guiding their prescription status. With iterative improvements based on user comments, usability testing—which involves several user groups—assessed the effectiveness and simplicity of the interface.

This approach guarantees the development of a dependable and user-friendly vending machine for prescription-based drugs by integrating advanced image processing techniques for prescription authentication, so addressing important aspects of hardware and software integration, as well as user interaction.

V. Implementation

A. Hardware Implementation

Sophisticated hardware design in the vending machine system guarantees accurate and consistent dispensing of prescription-based drugs. The STM32F746ZG microcontroller, selected for its great computational power and wide I/O capabilities, is fundamental in this system. Running an ARM Cortex-M7 core at 216 MHz, it effectively manages complicated authentication chores and real-time image processing. While compatibility with Real-Time Operating Systems (RTOS guarantees exact task scheduling and synchronizing, its flexible I/O interfaces—including GPIO, UART, SPI, and I2C—support seamless connectivity with many subsystems. Correct prescription verification

depends on the image processing subsystem. Its high-resolution camera module, the OV5640 or MT9V034, records finely detailed images of prescription paperwork. Noise reduction and binarization methods in first image preprocessing on the STM32F746Z improve image quality. Text extraction uses optical character recognition (OCR) libraries including Tesseract and Easy OCR; advanced signature verification uses SIFT and SURF, and machine learning models including SVM and CNN for comparison. Using SSL or TLS for data transmission and SQL or NoSQL searches for cross-referencing, the system securely links with outside databases to validate prescription details. Using hardware acceleration and advanced memory management approaches to guarantee responsiveness and accuracy, performance optimization consists in effective data throughput management and real-time processing.

B. Software Implementation

Image processing and machine learning are combined in the software implementation of the vending machine system to guarantee accurate prescription authentication and effective operation. Real-time management depends on firmware development; motor and actuator control using Proportional-Integral-Derivative (PID) controllers; sensor fusion methods including Kalman filters help to increase accuracy. Real-Time Operating Systems (RTOS) such as Free RTOS or Zephyr OS handle concurrent tasks; development is done with STM32CubeIDE and Arduino IDE.

The subsystem on image processing concentrates on advanced methods of prescription authentication. Image quality and contrast are improved by preprocessing techniques including adaptive thresholding and Gaussian blur. With post-processing to increase accuracy, Tesseract OCR pulls text from images. Signature verification classifies and verifies signatures using feature extraction techniques including SIFT and SURF together with machine learning models including Support Vector Machines (SVM) and Convolutional Neural Networks (CNN). These models are developed on large-scale data to raise authentication accuracy.

Backend integration guarantees effective hardware and user interface data management and communication. While SQL and NoSQL databases handle prescription data, RESTful and GraphQL APIs help to enable data exchange. Maintaining system efficiency and responsiveness, cloud platforms including AWS, Azure, and Google Cloud offer scalable solutions for hosting services and distributing machine learning models.

VI. Conclusion

Combining cutting-edge hardware and sophisticated software, the study has effectively created a highly advanced vending machine system for dispersion of prescription drugs. The STM32F746ZG microcontroller forms the core of this system since it efficiently controls prescription verification and real-time image processing. High-end camera modules,

sophisticated preprocessing methods, and strong OCR libraries guarantee accurate prescription data extraction and authentication. Combining machine learning models with the signature verification of the system using SIFT and SURF improves its dependability and precision even more.

This success simplifies the verification and dispensing procedures, so indicating major progress in automated medicine distribution. The system offers a dependable and effective way for prescription management by combining advanced software algorithms with high-performance hardware. The effective application of these technologies emphasizes the possibility of the system on automated healthcare solutions, so providing a strong basis for next advancements in the field.

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VIII. References

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