Medvend: Automated Medicine Vending Machine

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Abstract—**Enhancing efficiency in today's healthcare environment has been essential. The procedure for medication dispensing, as an area of focus, could improve the outcomes for patients and decrease delays in treatment. Our project will introduce an innovative solution- an automatic medicine vending machine, designed to change the face of patients accessing prescribed medicines. The system uses modern technology to ensure that drugs are dispensed accurately, conveniently, and securely. The machine reads a patient's details using his/her login credentials connected to the doctor's prescription and automatically dispenses the correct medicine. The patients can also choose the exact number of medicines they require, giving them more flexibility and control over their treatment. The user interface is easily accessed through a webpage and allows patients to use the machine with ease Such an easy-to-use design, simple yet effective, allows patients to understand the whole process intuitively.**

Index Terms—**Vending Machine, Medicine dispenser, Healthcare, Internet of Things(IoT)**

I. INTRODUCTION

In today's fast-paced and often unhealthy lifestyle, it is challenging for patients, especially when going to hospitals and pharmacies where, normally, there is a long queue and one waits for a long time before receiving medication. This will make them frustrated and even lead to medication errors, which is risky for the health of patients. In order to address this issue, we propose a medicine dispensing system similar to an ATM machine in banks. Installing such machines in hospitals allows patients to rapidly retrieve their medications and pay for them at the same time, thus reducing manual errors and wait times and improving the overall efficiency of the healthcare system.

In addition, the project aims to focus on the issue of medication adherence, which is one of the critical aspects of patient care. It has been revealed that non-adherence to prescribed medications results in a host of severe health complications and increased healthcare costs. To combat this problem, the MedVend machine will have reminder features to remind patients of their medication schedules. These reminders are displayed on the machine interface or even sent to a patient's mobile device, depending on the availability of a dedicated application. They reinforce the importance of taking their medications as prescribed, an aspect that can lead to better health outcomes and mitigate the risk of complications attributed to missed doses.

II. RELATED WORK

In the current era of digitalization, most sectors including health care, manufacturing, finance, and customer service weigh their decision on whether they have to continue with old systems or adopt automatic ones. In addition, as the rate of cognitive diseases of all degrees increases with age, some kind of support to the elders in daily activities such as home maintenance and respecting medication adherence is needed [1].smart medication dispenser (SMD) will help to cope with this issue by giving periodical alerts and notifications at the needed time for the patient and caregiver as it will tell the caregiver instantly if the patient misses a medication. In addition,the system provides a touch interface that can be accessed via a Smartphone application and allows users to take care of and provide pill schedules even remotely [2]. The Internet of Things(IoT) had a significant impact on the healthcare industry. IoT-based automated solid medicine dispenser, the purpose of this device is to prevent neglect, remind patients of their prescription schedule, automatically dispense medicines, retain information about missing med-

ication, and record medication data in a cloud-based storage system [3]. These types of systems have features such as automatic dispensing, user notification, and checking the availability of medicine. the researchers of this study aimed to develop a Smart Medicine Container with Medicine Sorting using the algorithms YOLOv4 and OCR. After testing, it was found that using the YOLOv4 algorithm only is the most accurate in classifying medications for sorting (95.238 percent accuracy) followed by YOLOv4 with Tesseract OCR (19.0476 percentage accuracy) and Tesseract OCR only (14.2857percent accuracy). On the other hand, the sorting capabilities of the system together with its medication provision features were 100 percent accurate with proper calibration of the system's steppermotors [4].

After the COVID-19 pandemic, risks faced by health workers increased. We can reduce the risk by developing a smart system that will carry out the task.PILLBOT is a prototype that moves using voice control mechanisms. It has two main contents: Pill dispenser and Syrup dispenser [5]. With the combined use of Adafruit, the cloud service, a remote-control app, and Google Assistant, health workers can operate the prototype. Once the device is with the patient, the patient can easily put the medicine container on top of a sensor-embedded platform which engages the dispenser circuit to dispense the medicine. Access to primary health care will be the base foundation for developing a healthy future. Considering the physical and infrastructural issues of medical stores in such remote locations, a machine that could deliver essential healthcare services becomes a practical approach.It allows the user to select a medicine, pay the required amount after which it verifies the amount received and dispenses the medicine. The amount is authenticated and identified using an image processing unit controlled by a Raspberry Pi, a credit card sized controller capable of processing still images. The payment module and medicine dispensing module are controlled by the Arduino, a microcontroller based development board [6].

Since these systems have been designed for individual users or patients, they might not be suitable for handling complex busy social life situations. Also, the delivery of medicines takes time, so there is a greater deal of stress and more possibility of errors in such circumstances. Moreover, the role of vending machines in healthcare has expanded, providing 24/7 access to essential medications and supplies. These machines not only improve accessibility but also assist healthcare facilities in managing costs and resources efficiently. The integration of such automated systems is anticipated to bridge gaps in healthcare access and enhance overall health outcomes. Thus, there's a need for a system that can automate such actions to reduce stress and minimize errors. The authors [7]G Adithya Varaprasad Reddy and A Suman Kumar Reddy emphasize the need for easy access to medicines, especially in rural areas that lack proper health care because, in case of limited health facilities, the failure to reach a pharmacy during the 24-hour medical facility may result in health-related complications.

This is an Arduino ATMega 2560 microcontroller-based over-the-counter (OTC) drug and other vital medication that operates 24/7 with a user-friendly interface for selecting and purchasing medicines. The process includes user authentication, choice of medicine, payment, and picking the medicine, requiring registration and receiving an RFID tag for the transaction. Abhijeet Bhande proposes a new approach [8] aimed at providing 24/7 access to essential medicines and overcoming the problems of availability of medicines in remote areas and emergencies. The system is a controller based on Atmega16, and other integrated components include the ESP8266 Wi-Fi module that provides internet connectivity, the DC motors for dispensing, and the IR sensors that allow monitoring of the medicine in stock. The machine will therefore be able to hold more than one type of drug, There is also LCD that displays the IP of the associated webpage, giving opportunity for the user.

III. PROPOSED METHOD

This medicine vending machine is one of the most advanced solutions designed to revolutionize the way medicines are dispensed. This system is efficient, secure, and user-friendly for both patients and healthcare providers. It has used state-of-the-art technologies, such as IoT integration, and a microcontroller-based framework, to ensure accurate and timely delivery of medications. When a patient enters their ID and passkey the machine retrieves prescription information about that patient from the secured database. ESP32 DevKit powers this system and the computation it undertakes by extracting relevant prescription data for comparison against prescribed drugs; thereby dispensing the correct drug, correct quantity, and proper dosages.
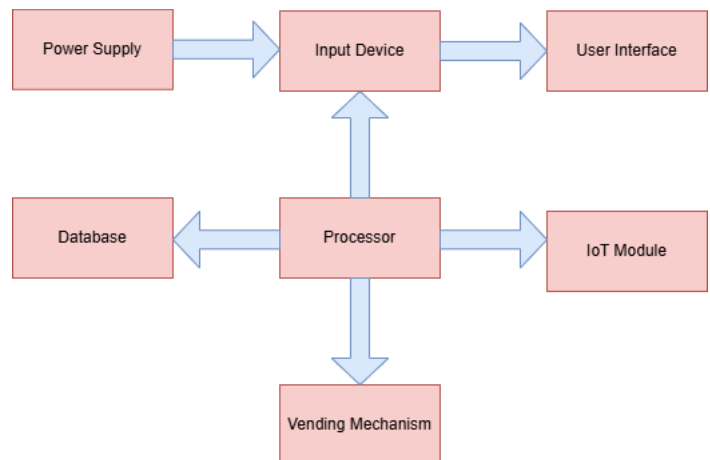

Fig. 1: Block Diagram

The block diagram of the automated medicine vending machine architecture Fig.1 is designed to efficiently dispense medicines accurately. The entire system provided the power supply using a 12V battery, ensuring that the equipment
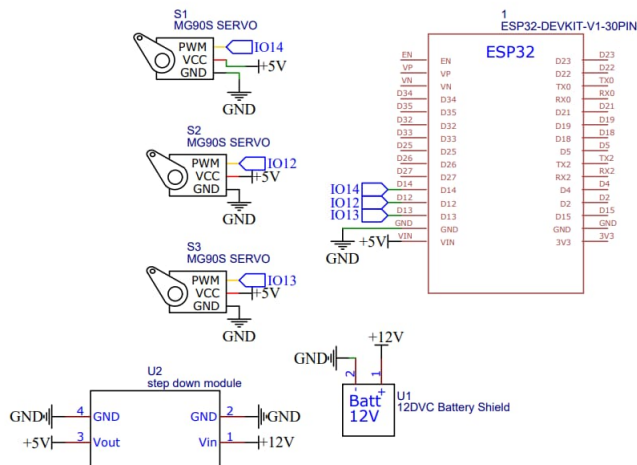
Fig. 2: Circuit Diagram

remains uninterrupted. Input devices such as the barcode scanner and ID scanner are used for capturing patient identification and prescription details. The user interface that features a display enables the patients to communicate with the system, view their prescriptions, pick medicine, and pay for it. The system is powered by the ESP32 DevKit. This processor manages inputs, controls data flow, and organizes machine operations. There is a centralized database, which keeps the patient prescription information, and creates an easy mechanism to access prescription details without hassle. The IoT module ensures real-time communication with the pharmacy's inventory stem, updating stock availability. The vending mechanism, one that is driven by three servo motors, dispenses the selected medicines efficiently, providing a reliable and user-friendly experience.

The circuit diagram Fig.2 represents the hardware architecture of the automated medicine vending machine, showing the integration of key components.ESP32 DevKit (V1) acts as the core IoT module, which will manage data flow and be in charge of controlling all the peripherals connected, enabling wireless connectivity for real-time data exchange and remote monitoring. MG90S servo motors, which enable precise and reliable mechanical control for dispensing medicines. S1, S2, and S3 are those that drive the vending mechanism; their PWM signals are connected to GPIO pins IO14, IO12, and IO13 of the ESP32. These servo motors will be powered by a regulated 5V supply to ensure consistency and reliability. The power system is designed to be efficient and stable. A 12V battery shield, U1, is the main source for supplying power to this system. From this, a step-down voltage regulator module, U2 converts 12V into a stably needed output at 5V to support both ESP32 as well as the servo motors.

The ground connections are carefully wired to maintain a uniform reference, so signal integrity and smooth operation are ensured. This integrated design helps achieve precise control of the vending mechanism while being power efficient, thus establishing a reliable foundation and scalable automation for dispensing medicine.

IV. RESULTS AND DISCUSSIONS

This section introduces the web application and presents the product form of our idea. Fig.4 (a) shows the MedVend homepage is professionally designed with easy access through streamlined login and register buttons. Its user-friendly interface prioritizes functionality, making navigation effortless for patients and healthcare providers. The login page ensures secure access with a clean layout for entering email and password, offering prompts for first-time users and password recovery, balancing security and usability for a smooth experience.

The MedVend registration page, Fig.4 (b), is both safe and attractive to newly signed-up users. A basic layout has been designed for user inputs for simple details such as names, emails, and passwords. Instructions are precise so that the whole process runs efficiently, with all privacy and data security statements reminding that MedVend safeguards their users' data. Registration is followed by an immediate login prompt to transition into the newly created account smoothly. the register page, page is designed with an aesthetic appeal and ease of navigation, enabling users to confidently enter their accounts for healthcare management within the MedVend platform.

The MedVend doctor's dashboard, Fig.4 (c), is a secure environment with an organized design for healthcare providers. Doctors log on by using their unique email address and password to control data privacy. After logging, they select their department as well, which customizes their dashboard to show only useful tools and information. Doctors are easily able to add new patients, create unique profiles, and prescribe precise amounts of medication. Its user-friendly design facilitates shorter administrative time, leaving the doctors more time for patient care. This safe, efficient space empowers healthcare providers to give high-quality, personalized treatment.

The MedVend patient dashboard Fig.4 (d) provides a clear, well-organized, and easy-to-use interface that assures the easy availability of crucial information. It shows all prescribed drugs along with the respective dosages recommended, so the patients can view their treatment summary at a glance. It also includes the prescribing doctor's name, thus making it easy to get in touch with them, if required. The unique feature of the dashboard is that it allows patients to choose the amount they prefer to retrieve, giving patients much flexibility in taking care of their medication stocks. The design is intuitive; it gives confidence to the patients in managing their health, making medication easy, clear, and convenient. The MedVend system separates and dispenses individual tablets rather than full blister packs. It ensures that the patient receives the exact number of tablets prescribed by the doctor, preventing
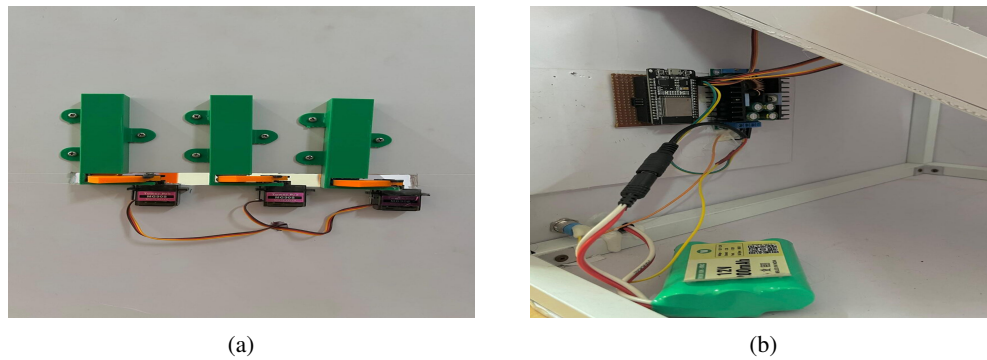
(a)

(b)

Fig. 3: Medicine storing and dispensing mechanism and hardware setup
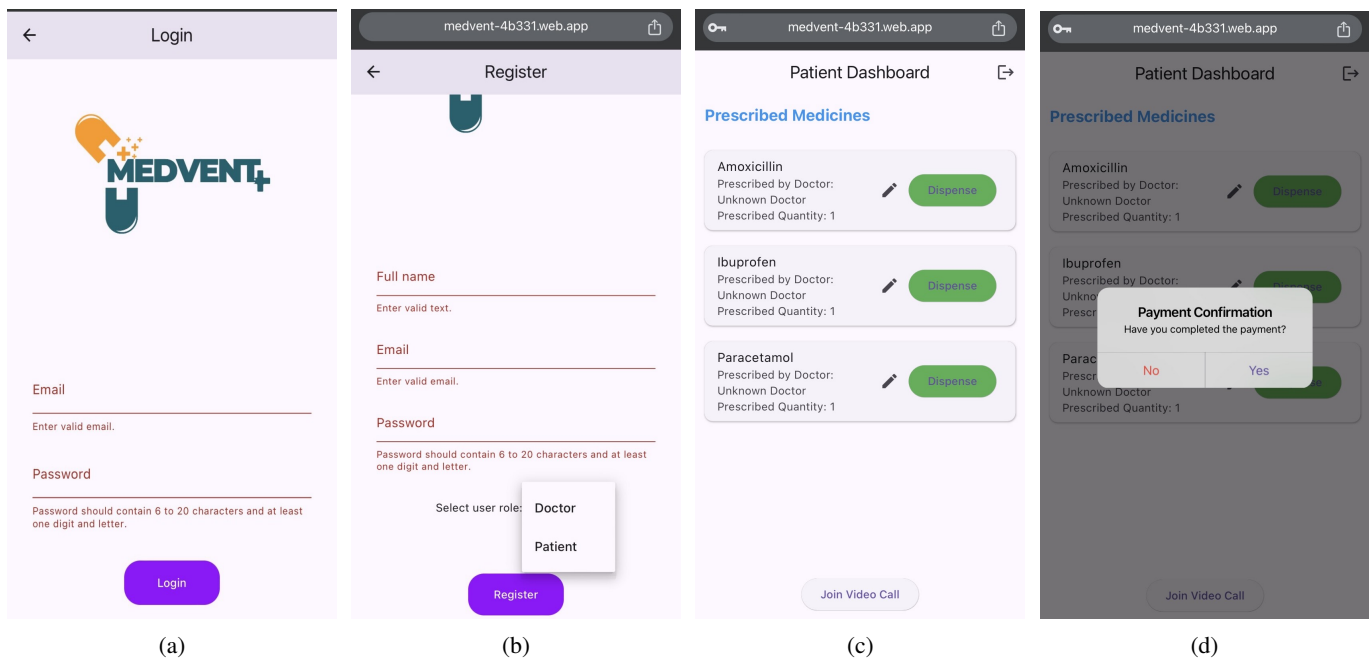

(a)

(b)

(c)

(d)

Fig. 4: Web application interface of Medvent

over-dispensing or misuse. This means the system will have a mechanism to extract single tablets from bulk storage or blister packs, ensuring precise counting and dispensing. Since patients cannot increase the medicine count beyond the prescription, it enhances medication adherence and reduces wastage.

This further helps ensure security and reliability, activating active patients' participation in their healthcare journey with confidence in the transparency and accuracy of their medication management.MedVend is an efficient and streamlined approach to dispensing medicines. The system is coupled with computerized prescriptions and allows patients to access prescribed medications by scanning the patient's ID and confirming payment. Prescription verification is smooth, which ensures the safe selection and purchase of the medicines.

MedVend increases accessibility, reduces waiting time, and

minimizes errors because of manual Dispensing. It's a system that is reliable and user-friendly to manage automated medications in healthcare practice. Fig.3 (a) shows Upgrades on the medicine dispensing mechanism have been implemented by new 4x sheet configurations that enhance reliability and efficiency.The vertical frame is there to support the structure of the pills or capsules arranged in a row, thereby maximizing space efficiency and accessibility. Maintaining the horizontal orientation of the medication also allows users to easily see and select the desired dose. The servo motor is mounted at the bottom right corner of the unit to power the dispensing mechanism. Its ability to rotate 180 degrees is what makes its controlled release of medication key. The hardware team redesigned the system to make it work with increased functionality, providing for the accurate dispensing of drugs while minimizing error rates significantly. Fig.3 (b) is the crucial

component that serves as the brain of the automated medicine vending machine, enabling real-time communication and control of other hardware elements. Right now, MedVend is still in development, so its compliance with pharmaceutical safety standards depends on how it is designed and implemented.

V. CONCLUSION

The MedVend automatic medicine vending machine is a forward-thinking solution that utilizes technology to make medication dispensing more effective, patient-friendly, and safe. In addressing critical challenges in the lives of patients and healthcare providers, this project demonstrates how innovation can bring about better health outcomes. As we see ourselves in a more technologized healthcare environment, innovations like MedVend shall become critical in ensuring timeliness and accuracy in medicaments administered to patients; however, it shall keep empowering patients to take an active role in their well-being. The successful realization of the MedVend system marks a milestone of how automation can be interjected into healthcare and exemplifies the model for developments yet to come. As we explore new opportunities and innovations, lessons learned from the MedVend project will continue to guide development into even more sophisticated solutions better focused on patient care and operational efficiency in an ever-changing healthcare world.The Scope of MedVend is very vast, with many opportunities for enhancing healthcare delivery through technology. With integration into telehealth services, advanced security measures, predictive analytics, and collaboration with healthcare partners, the MedVend system can improve patient experiences and health outcomes significantly. Moreover, the implementation of IoT technology, integration with the mobile application, and globalization strategy establishes the MedVend project as an essential solution for modern healthcare needs.

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