Automated Pill Dispenser Using Raspberry Pi and Servo Motors

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***Abstract*—This paper presents the development of automatic pill dispenser with simple components and low cost materials. The dispenser is constructed using card boards and acrylic sheets and connected along with servo motors which helps in pushing mechanism. Dual website have been created for doctor to prescribe medicines and for patients to view the prescription and to make payments. Communication between doctor and patient website has been done with the help of Firebase Server. The system verifies the payment and then activates the respective servo and the respective pill will be dispensed. After it gets dispensed it will be collected in the conveyor belt which gets rotated with the help of BO motors with the wheel attached to it and power connections is give by DC power supply. Servo motors control and connection are managed by Raspberry Pi. The ideology of the project is to give best automatic pill dispensing mechanism at a cheaper cost and also in a user friendly manner.**

***Keywords*—Automated pill dispenser, Raspberry Pi, servo motor, BO motor, Firebase, pill, healthcare automation.**

I. Introduction

A. Need for Pill Dispensers

In the quickly changing world of healthcare technology, making new solutions to make patient care and medication management better is very important. Among these improvements, the automatic pill dispenser stands out as a key invention designed to increase the precision, accuracy, safety, and efficiency of giving out medication.

B. What is a Pill Dispenser?

An automatic pill dispenser is a smart machine made to automate the process of giving out medicines to patients. These machines are programmed to release specific amount of medicines at set times, thereby making sure patients take their prescribed treatments correctly. This technology not only reduces the workload on healthcare workers but also significantly decreases the risk of human mistakes, which can lead to harmful drug incidents.

The importance of automatic drug dispensers goes beyond just being convenient. They are especially helpful in managing long-term health issues, where taking the right medicines consistently is very important. They reduce the workload of pharmacists who give out over-the-counter medicines. For elderly patients and people with thinking difficulties, these devices offer a reliable way to stay independent while making sure their health needs are met.

In simple terms, automatic drug dispensers combine healthcare and technology aimed at helping people have better health results. By using IoT and automation, these devices promise to change the way medicines are given out, making healthcare more available, dependable, and safe for patients all over the world.

II. Literature Survey

This paper [1] presents the design and development of a cost-effective, scalable protoype of a robotic medication dispenser intended for use by pharmacists. The prototype has an automated capability to count the medicines and dispense into vials. The novelty of this machine lies in its scalability because of the usage of low-cost materials. Scalability was one of the main factor to achieve while building our model. We have also used recyclable materials without compromising on the efficiency of the model. A graphical user interface(GUI) application was developed using the ”Processing” software to enable user-machine interaction.

IoT is frequently integrated with other data-intensive technologies such as Machine learning and Cloud computing. This integration makes the overall system too complex and sophisticated. Numerous proposed solutions address various issues like security, scalability, and reliability. But to work upon these solutions, unique knowledge base is required, which makes it tough to implement. The research [2] outlines aims to develop a highly scalable Internet of Things (IoT) system that simplifies complex server tasks. It describes the utilization of ready-to-use platforms to ease the tasks. One such platform is Firebase, offered by Google. In this paper, an IoT system using various services provided by Firebase is implemented. We have adopted the methodology of integrating 'Firebase with Raspberry Pi' from this paper [2] and implemented in our project. Firebase provides hosting, database services, cloud functions, cloud messaging, and much more, which helped us in our software part.

The elderly with multiple chronic conditions face difficulties in managing their daily medication intake. To overcome these problems, in this paper [3], they have designed a low cost smart IoT mobile medication dispenser (SMMD). The dispenser consists of hardware (a medication dispenser) and software (a website for the user to control the device and program the time to dispense the medication). Here, they have used NodeMCU to control the stepper motor, OLED display and motor driver. The OLED displays the current time and the time set by the caregiver or elderly to take the medicine. The NodeMCU connects to Firebase database to access the time required for dispensing the medicine. We have gained insights on establishing connection between any microcontroller and Firebase through a website from this paper [3]. They have provided a detailed explanation on the usage of firebase and its integration with hosting a website.

We used insights from this paper [4] to develop the overall process or workflow of the model. They have also developed a dispenser for the purpose of replacing the pharmacists and providing over-the-counter medicines through this dispenser. The prototype hardware is made up of low cost materials, with a focus on the dispensing system. They have used Arduino Mega microcontroller and coin acceptor for payment, making it simple for pharmacists and customers to buy things. A good thing about the system is that, custom-made disks are used that holds different kinds of pills. For dispensing, servo motors are used. We have also used servo motors in our model because of its precised rotation angle and also this paper proved that the results are accurate while using servo motors for dispensing compared to other models. They have used separate dispensers for different pills from which we got inspired and implemented the same in our prototype.

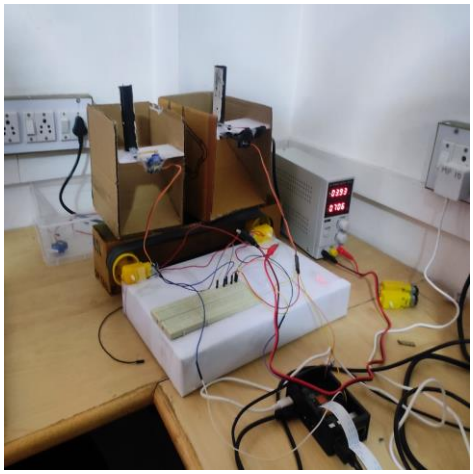

Fig. 1. Dispense

III. METHODOLOGY

A. Hardware

The pill disperser was constructed using carboards and glue and in our project we made two dispensers. In parallel to the dispensers we set up two servo motors , in this case we used SG90 servo motors. These servo's have been pasted along with the acrylic sheets in the dispenser. We used acrylic sheets for the steady purpose which is not mandatory when the dispenser is made using plastics or metal, we used this sheets since we made the dispensers with the help of cardboards. In top of the servo we attached a metal strips which helps to push the pill when servo gets activated. Based on the commands from the software side the particular servo will gets activated and the pill corresponding to that servo will be pushed and fall in to the conveyor belt. Pills have been stacked on the top if one gets pushed automatically the one which is on the top will be occupying the previous pill's place. Servo motors gets the power supply from Raspberry Pi. Since the wire connections are more we took the help of Bread Board which is not mandatory if only one dispenser is required. Conveyor belt have been made with the help of rubber tube, so that after the pill is being dispensed it will fall on to the conveyor belt and it will be collected in the box which has been placed at the end of the conveyor belt. To rotate the belt we used two BO motors of 65 rpm and a pair of wheel which is connected at the ends of belt. With the help of DC power supply the motor along with the wheel gets rotated which results in the rotation of the conveyor belt. To rotate the motor the appropriate voltage is 3.5V-5V.

B. Software

We developed a website Figure 3 for doctor side which will be running on the local host for doctor so that after the patient is being analyzed, the doctor will prescribes the medicine based on the patient condition on the patient's portal. For the existing patients separate portal will be created so that doctor

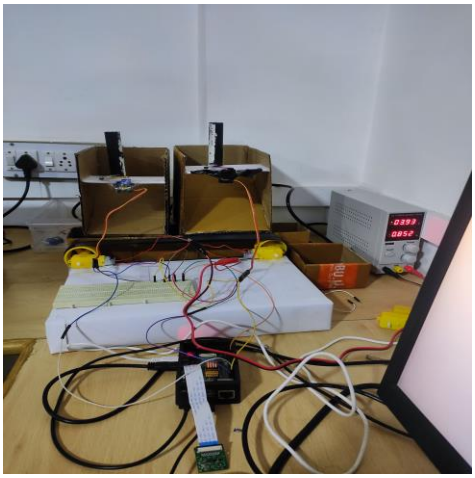

Fig. 2. Dispenser

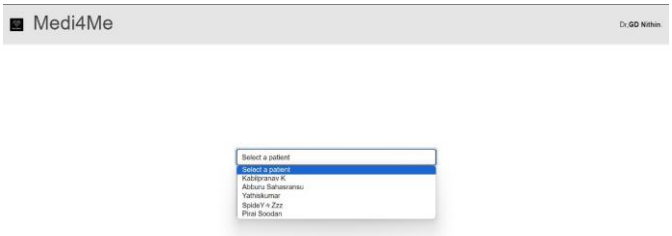

Fig. 3. Doctor's website for searching patient

after knowing the patient's name they can enter into patient's portal and prescribes the medicine.

For the new user/patient's they need to create an account for that hospital is another website. Once if it's created it will be automatically updated in the doctors website. We again developed a website for this purpose where the new users can create their account and also after the doctor prescribes the medicine their prescription will available in the website Figure 4 under their particular portal and amount will be visible and they can also make their payment. If the patients thought of buying the medicine through the dispenser the first thing they should do is to make their payments. Then they need to go to the place where the dispenser is located. Next to the dispenser a computer will be available which will be asking for the unique code Figure 5 . In the website which we made for patients under their portal the unique code will be available so that after the patient types the unique code it will be checking whether the payment has been done. Once it verifies that payment has been made it start it's work. This computer will be connected with Raspberry Pi so that it will check which medicine needs to be dispensed and then it will be enabling that particular servo in the Raspberry Pi's code. So that after the servo is being activated the medicine will be dispensed properly which can be collected by the users.

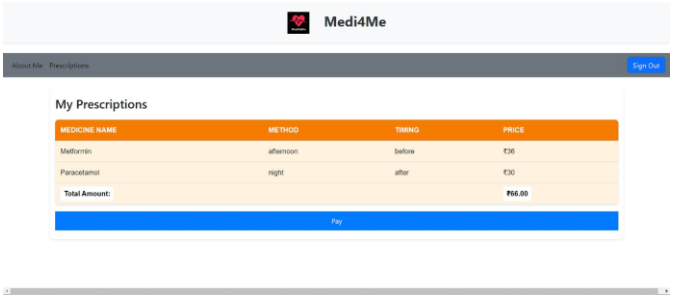

Fig. 4. Prescription in Patient's website

The communication between doctor side website and patients side website has been done with the help of Firebase Database server which is being offered Google. In simple terms we can say it like once the doctor prescribes the medicine the data will be collected and stored in Firebase Database and then from there it will be reaching the patients side website.

Total workflow of our process has been shown in Figure 6.

IV. Results and Analysis

The automated pill dispenser was successfully developed and tested. The following observations were made:

A. Dispensing Accuracy

The dispenser demonstrated high accuracy in dispensing the correct pills. During multiple runs, the servo motors accurately pushed the pills onto the conveyor belt without any jamming. The accuracy of the dispensing mechanism was observed to be around 87%, with occasional misalignment mainly due to manual errors in stacking the pills.

B. System Efficiency

The system's efficiency is measured by the time taken from the initiation of the command to the actual dispensing of the pill. On average, the entire process took approximately 10 seconds, including verifying the payment and activation of the servo motor. This efficiency is enough for real-world applications where the dispenser is used periodically rather than continuously.

C. User Interface and Experience

The user interface for both the doctor Figure 3 and patient interface Figure 4 was evaluated for ease of use and responsiveness. The doctor's portal allowed for quick prescription updates and easy access to patient records. The patient's portal provided clear view of the prescribed medicine along with easy payment option.Users verified the safety, ensuring that only authorized respective individual could view the prescriptions and access the dispenser.

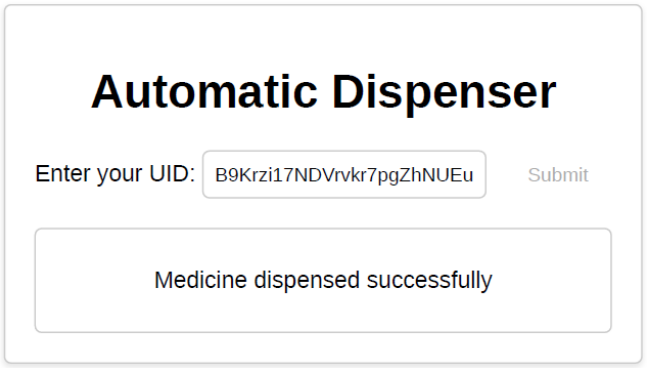

Fig. 5. Unique Code for Dispensing

D. System Scalability and Cost Analysis

The use of low-cost materials such as cardboard and acrylic sheets, along with easily available electronic components like servo motors and Raspberry Pi, made the system highly cost-effective Figure 1. The total cost of constructing the prototype was significantly lower than existing commercial products. This allows our system to be easily scalable and also cost effective. And also supports multiple dispensers to be connected to a single Raspberry Pi for larger deployments.

E. Reliability and Maintenance

The reliability of the system was tested over an extended period with continuous operation. The servo motors, BO motors, dispenser operated smoothly without significant wear and tear, indicating a robust design. Maintenance requirements were minimal, involving occasional checks required to prevent pill blockage at the output of the dispenser.

F. Challenges and Limitations

While the prototype performed well in Closed environment, certain challenges were identified when deploying it in real time. The reliability on internet connection for Firebase communication posed a potential issue in areas with poor connection. And the use of cardboard, while it may seem to be cost effective, may not be suitable for long-term use in environments with high humidity or exposure to liquids. So we have to explore for more durable materials while maintaining cost efficiency.

Overall, the automated pill dispenser project achieved its objectives of providing a low-cost, efficient, and user-friendly solution for medication dispensing.

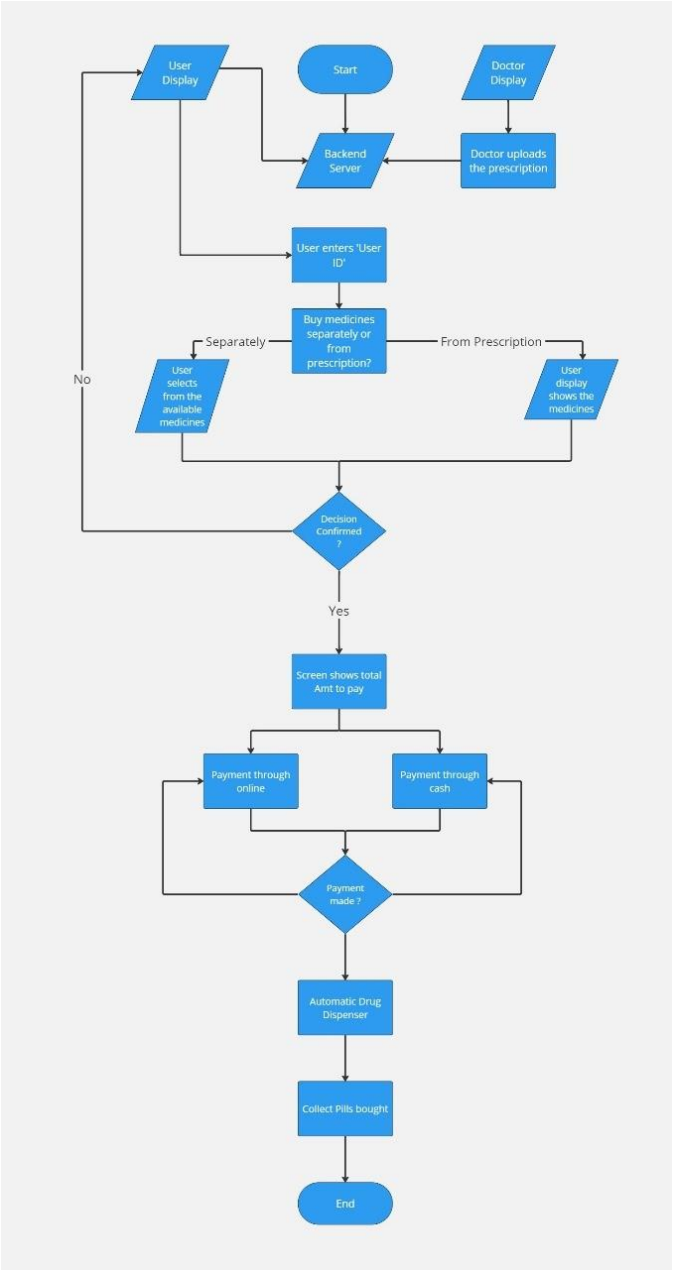

Fig. 6. Workflow

V. Conclusion

In this project, we have successfully developed a low-cost, efficient automated pill dispenser using Raspberry Pi and servo motors. The system effectively addresses the need for a reliable and scalable solution for medication dispensing in healthcare system. Our prototype demonstrated high accuracy in pill dispensing and provided a user-friendly interface for both doctors and patients.

The use of readily available materials such as cardboard and acrylic sheets, along with cost-effective electronic components, ensures that the system can be easily replicated and scaled for larger deployments. The integration with Firebase for real-time data management and communication between doctor and patient portals further improves the system's functionality, reliability as well as ensure safety of the overall process.

While the prototype showed promising results, certain challenges, such as internet dependency and the durability of ma-

terials, were identified. These challenges provide opportunities for future improvements, including the use of more robust materials and exploring offline data management solutions.

Overall, our automated pill dispenser offers a practical and affordable solution for improving medication and management, particularly in resource-constrained environments. The project's aim in contributing to better healthcare delivery and patient outcomes.

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