

IoT- based Vending Machine for Dispensing Medicines

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Abstract—In today's rapidly transforming world, The Vending Machine for Medicine provides a unique way to meet the growing demand for easily accessible healthcare. Time is of the essence in the modern world, and people frequently find themselves limited by long lines and difficult trips to traditional pharmacies. This invention aims to improve convenience and shorten wait times at typical pharmacies by reducing the process of obtaining necessary medicines. The system placement in remote or underserved areas will be a greater help in healthcare accessibility, enabling individuals in rural or isolated regions to access medications promptly. Through the utilization of technology and automation, healthcare providers can maximize the impact of healthcare interventions by optimizing operational efficiency and minimizing human resource allocation. Because of its scalability, this model can be widely implemented in a variety of situations, ensuring that everyone has access to medicines. With the development of this technology, one has the potential to significantly change healthcare delivery systems across the world. This vending machine aims to reduce the inconvenience of purchasing medications by providing a more efficient and automated option, enabling people to obtain essential medications with never-before-seen ease. The customer need not compulsorily know the name of the medicine but the symptom alone is enough for accessing the medicine. The Vending Machine for Medicine initiative provides both customers and healthcare providers with affordable solutions.

Index Terms— Vending machine, Healthcare, Internet of Things (IoT), Medicines, UPI payment, and Customer.

I. INTRODUCTION

The usage of IoT (Internet of Things) techniques in healthcare automation has provided opportunities for creative solutions targeted at improving the efficiency and accessibility of medical services. The proposed model presents an innovative idea that makes use of IoT capabilities to dispense medication through a vending machine. By enabling patients to make intelligent choices regarding their care, the vending machine promotes individual responsibility and self-care. in the medical field. To make our system effortless and simple to use, we've integrated several different components, such as an Arduino Mega, servo motor, LCD, keyboard, and GSM module. The idea of medical vending machines is not completely new; numerous famous authors have researched related projects. While Sabitha et.al [2] developed an Automatic Medicine Vending Machine, Karthik et.al [1] offered a 24/7 General Medicine Vending Machine. Other studies, like the one conducted by Ravi et.al [4], highlighted the value of accessibility in remote places by focusing on the installation of self-service medication vending machines in rural areas.

The LCD lets users choose the condition they have by displaying a menu of symptom options when it is turned on. Subsequently, the system prompts the user to specify whether the medication is intended for an adult or child, ensuring appropriate dosage administration. Upon confirmation, the GSM module initiates an SMS notification to the user's mobile device, containing a secure payment link. The prior research in this field, including that of Adithya Varaprasad Reddy et.al [6] and Sravan Kumar et.al [5] has established the groundwork for automated systems for delivering medicines. The medicine vending machine's operational workflow begins with a simple-to-use interface on the LCD screen. The pharmaceutical buying process is simplified by this first step, which guarantees that consumers may quickly find the necessary medication that is customized to meet their specific healthcare demands and conditions. The proposed model includes the UPI payment-based system as nowadays almost everyone is using this platform. The people are carrying cash in smaller amounts with no change and the utility of coins is also reduced. This method is more comfortable than carrying cash around in hand. The creativity, which uses IoT technology to provide a reliable and focused user's medicine dispensing solution, represents an important turning point in healthcare automation. The vending machine can completely transform the delivery of healthcare by addressing the crucial problems of dependability, accuracy, and accessibility.

II. LITERATURE SURVEY

Karthik et.al [1] have proposed the model '24/7 General Medicine Vending Machine' which dispenses medications by using the microcontroller board, RFID module, Keypad, LCD module, and GSM module. So, in this model, there is a camera that scans the medicine name and the medicines will be dispensed once the payment is done using the card which should be recharged on a timely basis. The proposed model has a disadvantage in that if the prescription was in the doctor's handwriting it would be difficult to fetch the medicine as there is a chance that the spelling may vary and a wrong medicine can be dispensed. One more disadvantage was that if the patient didn't have a particular card for the payment, then it would be difficult. Sabitha et.al [2] proposed the model 'Automatic Medicine Vending Machine' which presented the design and implementation of an automated medicine vending machine that can securely dispense medications without the need for a pharmacist to utilize fingerprint authentication for controlled substances, credit/debit card payments, inventory tracking using weight sensors, and a dispensing mechanism to provide medications to patients. While some limitations are that if the patient or the user doesn't have access to the machine then it will be difficult for him to get the medicine.

Sangeetha et.al [3] proposed model 'Automatic medicine vending system medical ATM' presented the design and implementation of an automated medicine vending machine system that operates like an ATM for dispensing medications. The machine uses membership cards, touchscreen input, online payment, and sensor-controlled dispensing to provide controlled access to pharmaceuticals without the need for pharmacist oversight. Limitations exist around refrigeration needs and restocking logistics. One more limitation was that access to medicine was not possible for everybody only the people with a membership card that is an RFID tag could get the medicine. Ravi et.al [4] proposed the model 'Implementation of Self-service medicine vending machines in rural areas' implemented automated self-service medicine vending machines in rural areas to improve access to medications. In this proposed system used are an RFID reader, ATmega 2560, GSM, and Voice module. The machine would incorporate fingerprint identification, online payments, barcode scanning, climate control, and inventory sensors to dispense medications without a pharmacist securely. The drawback is that without an RFID tag, the patient will not be permitted to use the vending machine.

Adithya Varaprasad Reddy et.al [6] proposed the model 'Anytime Medicine Vending Machine' that presents the system which was built by using the components Arduino microcontroller, Keypad, RFID reader, LCD, GSM modem, and stepper motor. When the user touches the RFID card, if the card is valid, the medication is dispensed; if not, a message informing the user that the medication is unavailable is sent using the GSM module. As a result, the mobile number receives the alert message. So, the system works only for the people who have the RFID tag, and the payment system was not mentioned. Abhijeet Bhande et.al[7] proposed model 'Automatic Medicine Vending Machine' presented the system that is built by using the ATmega16 controller, ESP8266 wifi module, IR sensor, LCD, DC motor, and a webpage. The web page consists of the medicine that is present in the vending machine and the cost of the medicines that should be paid. After the payment, the medicine will be dispensed. A limitation of the model is the possibility that an error might occur on the web page.

III. COMPONENTS USED IN DESIGN

The below components are used in designing the vending machine for dispensing medicines.

A. Arduino Mega



Figure 1 Arduino Mega

Figure 1 shows the Arduino Mega diagram. The Arduino Mega microcontroller board, which is built around the ATmega2560 CPU, has more memory, digital I/O pins, and analog inputs. It features 54 digital I/O, 16 analog inputs, and four UART. With 256 KB of flash memory and 8 KB of SRAM, the Arduino Mega supports complex projects requiring extensive code and data storage. Designed for more advanced projects and prototyping, the Arduino Mega is suitable for applications such as robotics, automation, and data logging. Its extensive connectivity options and compatibility with a wide range of sensors, actuators, and shields make it a versatile platform for building diverse electronic projects.

B. LCD I2C(20x4) Display



Figure 2 LCD

Figure 2 shows the LCD I2C display. The LCD is a liquid crystal display module that combines a 20-character by 4-line configuration with an I2C interface, offering simplified connectivity and control. This display module features a backlight for improved visibility in various lighting conditions and provides a clear and easy-to-read interface for displaying text and basic graphics. The LCD requires only two wires for interfacing with microcontrollers, reducing the complexity of wiring and conserving valuable GPIO pins. The I2C interface allows for efficient data transfer and enables the use of multiple devices on the same bus.

C. Stepper motor

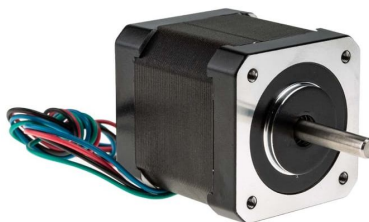


Figure 3 Stepper Motor

Figure 3 shows the stepper motor diagram. An electromechanical device called a stepper motor converts digital pulses into precise mechanical motion. Unlike conventional motors, which rotate continuously when voltage is applied, stepper motors move in discrete steps, making them ideal for applications requiring precise control over movement and position. They consist of multiple coils arranged in phases and a rotor with teeth or a magnet arrangement. By energizing the coils in a specific sequence, the motor rotates incrementally, with each step corresponding to a fixed angular displacement.

D. Key Pad

Figure 4 shows the Keypad used in the design of the machine. A Keypad is a user interface device commonly used to input data or make selections in electronic systems. It consists of a set of buttons arranged in a grid pattern resembling a telephone keypad. Each button represents a unique input, usually a numeric digit, symbol, or function key.



Figure 4 Keypad

They provide a convenient and intuitive way for users to interact with electronic devices, allowing them to enter passwords, PINs, commands, or other types of data quickly and accurately. Keypads can be interfaced with microcontrollers or other processing units to capture user inputs and perform corresponding actions based on the pressed buttons. They are versatile, cost-effective, and easy to integrate.

E. GSM Module

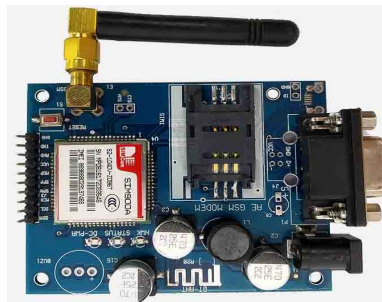


Figure 5 GSM module

Figure 6 shows the diagram of the GSM module. A GSM module is a small electronic device used for cellular network connectivity. It serves as a bridge between electronic devices and the GSM network, allowing them to send and receive data, make voice calls, and exchange SMS messages. They offer an array of functionalities, including making and receiving calls, sending and receiving SMS messages, and data connectivity for applications such as internet browsing and email. The above components are used in designing the vending machine for dispensing medicines. Each of the components has a unique function that performs to make the machine work.

IV. PROPOSED METHODOLOGY

The proposed methodology for the vending machine is that when the user approaches the vending machine the symptoms will be displayed as the user selects the payment message will be sent to the given mobile number. As the payment is done the medicine will be dispensed and the customer can collect the medicine this complete process is given in the below use case diagram Figure 7.

A. User interface design

An LCD with an I2C interface is used to show medicine selection options and user instructions. The keypad is used to allow users to navigate and select medicine based on concerns.

B. Dispensing mechanism

The used stepper motors to rotate the spring which makes the product dispense. The stepper motors to allow the dispensing multiple medicine types from different storage bins.

C. User interface design

An LCD with an I2C interface is used to show medicine selection options and user instructions. The keypad is used to allow users to navigate and select medicine based on concerns.

D. Dispensing mechanism

The used stepper motors to rotate the spring which makes the product dispense. The stepper motors to allow the dispensing multiple medicine types from different storage bins.

E. Microcontroller and control

Using an Arduino Mega microcontroller to control the user interface keyboard, LCD display, servo motors, and dispensing. Programming the Arduino to coordinate user selection, payment processing, and dispense mechanism actuation.

F. Internet connectivity

Connect the system to the internet via a GSM module interfaced to Arduino. This allows connectivity to the UPI payment gateway. This is used for remote monitoring and control.

G. Power supply

Use a suitable power adapter and voltage regulators to power the Arduino, stepper motors, and other components.

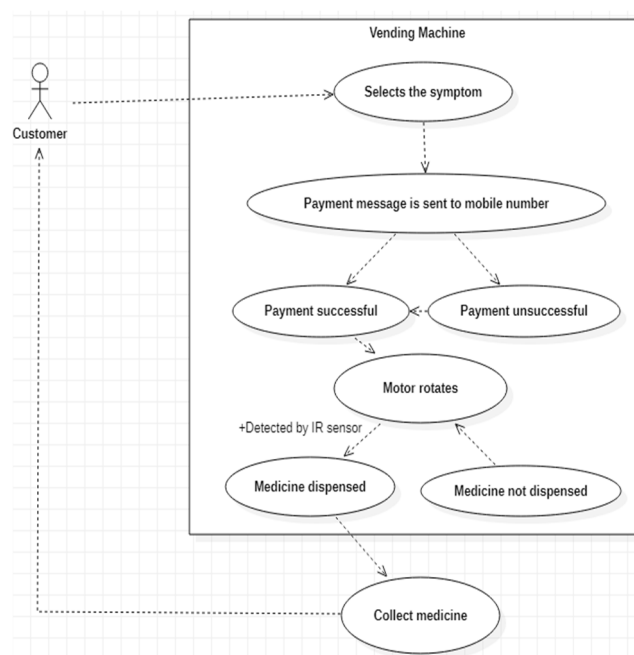


Figure 6 Use case diagram of vending machine for dispensing medicines

Figure 8 shows the block diagram of the proposed model with the components that are used. So, we can see that the LCD and Keypad are connected to Arduino Mega so the LCD will display the information, and through the keypad, we will select the options then the GSM module sends an SMS to the user's entered mobile number. Once the payment is done the signal is sent back. Then the stepper motor rotates. Then the customer can collect the medicine from the vending machine.

The design of the vending machine consists of the above components and they are connected to the function of dispensing medicine. Figure 9 shows the connections between the components to build the system using Arduino Mega, Stepper motor, Keypad, IR proximity sensor, and LCD. The stepper motor has four ports which

are input ports. The LCD has four ports ground, VCC, SCL, and SDA as it is an I2C. Each stepper motor will be connected to one medicine column. As the user selects an option that particular stepper motor will rotate and dispense the medicine.

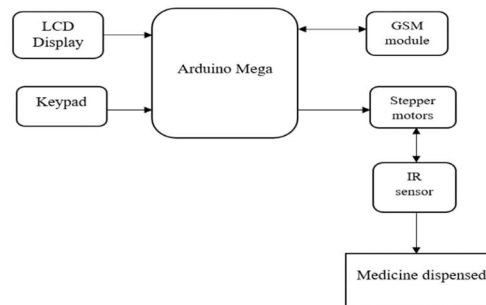


Figure 7 Block diagram of vending machine

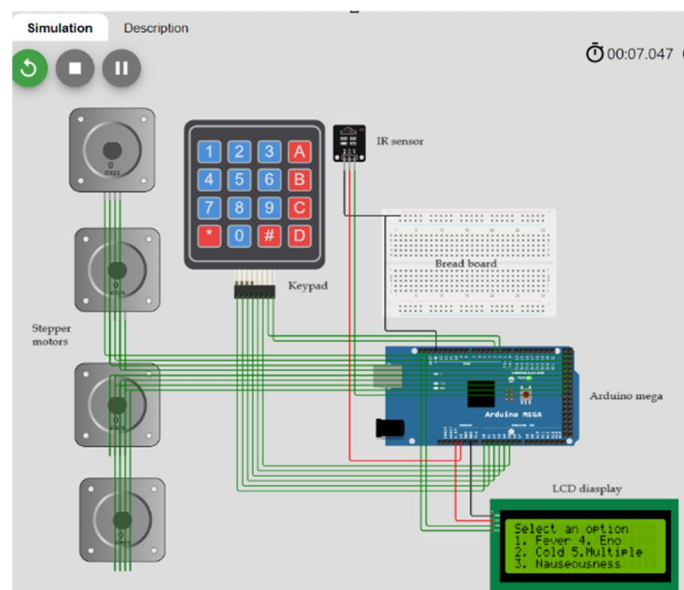


Figure 8 Design of the vending machine

The Arduino Mega is the controller that checks all the operations of all the components that are connected to it. The GSM module will also be connected so that the message is sent from the system to the person for the payment. The LCD will display the payment message and medicine dispensing message.

V. RESULT

The result of the proposed model is that when the customer selects the medicine the medicine is dispensed. If we select any one of the options it displays whether the medicine is for a child or an adult as shown in Figure 10 if the option selected is adult then the medicine is dispensed and displays the message as shown in Figure 11.

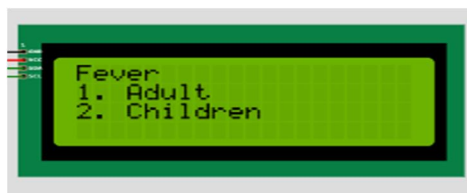


Figure 9 Selected Fever option

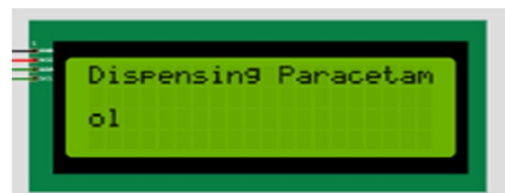


Figure 11 Selected Adult option for fever

Figure 11 shows the dispensing message of medicines. Whatever medicine is dispensed it will display the message. If the option selected is children then the message is displayed as shown in Figure 12 as it is dispensing the medicine that is related to that option.

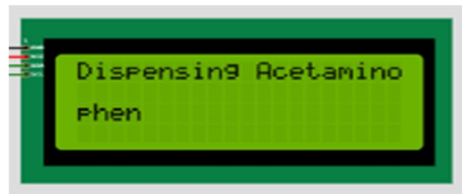


Figure 12 Selected Children option for fever



Figure 13 Selected Multiple option

Each medicine in each column is connected to one motor so that according to the option selected by the user the servo motor rotates the spring so that the medicine will be dispensed. If we have multiple symptoms then we need to select the option multiple then the message is displayed as shown in Figure 13. If we select any option then multiple medicines will be dispensed. The servo motors connected to that particular option will be rotated and the medicine in that column will be dispensed.

VI. ACKNOWLEDGEMENT

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VII. CONCLUSION

The Vending Machine for dispensing Medicines using IoT represents a significant advancement in healthcare accessibility and convenience. Through the use of Internet of Things (IoT) technology and the integration of several components, including servo motor, LCD, keypad, and Arduino Mega controller, this creative solution provides an accessible, flexible, and reasonably priced method of supplying basic medicines. One of its most important advantages is that it eliminates the need for people to drive great distances to pharmacies, particularly in isolated or underdeveloped locations, by offering 24/7 access to necessary medications. Moreover, the user-friendly interface, which only requires users to input their symptoms rather than specific medication names, enhances accessibility for individuals with limited medical knowledge. Overall, the proposed vending machine for medicines holds promise in improving healthcare outcomes and quality of life by ensuring timely and convenient access to essential medications, thereby positively impacting communities and individuals alike.

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