



An-Najah National University

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Pharma Store 24/7

Student Names : Kenana Turabi & Dina Mashayekh

Supervisor : Dr. Manar Qamhieh

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Disclaimer

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Abstract

This graduation project report presents the design and implementation of a pharmacy vending machine aimed at providing accessible and round-the-clock access to urgent pharmaceutical items. The machine incorporates two distinct modes, storage and retrieval, and features a user-friendly touch-screen interface for convenient item selection and retrieval. The stocked items include essential medications such as painkillers, antipyretics, first aid supplies, medications for high blood pressure, insulin needles, and baby milk. Furthermore, the machine employs advanced sensors to monitor inventory levels and system status, ensuring efficient restocking and maintenance. This project aims to enhance public convenience and accessibility to essential pharmaceutical supplies, particularly during non-business hours when traditional pharmacies may be closed. The pharmacy vending machine offers a self-service solution for individuals to quickly and easily obtain urgent medications, improving overall healthcare accessibility and contributing to community well-being.

1 Introduction

1.1 Problem

Access to urgent items from pharmacies can be a significant challenge for many people, particularly at night or when pharmacies are far away. This can result in individuals being unable to obtain essential items such as painkillers, antipyretics, first aid supplies, medications for high blood pressure, insulin needles, or baby milk. The consequences of not having access to these items can be severe, leading to increased pain or discomfort, worsened health conditions, or even life-threatening situations.

1.2 Objectives

to design and develop a pharmacy vending machine that is available 24/7 and can be easily used by ordinary people. This solution could help address the issue of individuals not being able to access urgent items from pharmacies due to closed stores or distance. By placing these vending machines in convenient locations, such as public areas or transportation hubs, individuals would have access to essential medications and supplies at any time of day. Additionally, by making the machines easy to use and understand, individuals with limited knowledge of medication or language barriers would be able to access the items they need without assistance. Developing a pharmacy vending machine could be a promising solution to help address the challenges of accessing urgent items from pharmacies, and could have a positive impact on the health and well-being of individuals in need.

1.3 Scope of the work

The scope of this project includes the design, development, and implementation of a pharmacy vending machine that can store and dispense urgent medical items such as painkillers, antipyretics, first aid supplies, medications for high blood pressure, insulin needles, and baby milk. The machine will have two modes - Storage and Retrieval - and will include a touchscreen interface for selecting and dispensing items. The machine will also include sensors to monitor inventory levels and ensure that items are replenished as needed. The system will be secured with a password-protected keypad to ensure that only authorized users have access to the machine. Finally, an administrator application will be developed to allow

the administrator to monitor the machine and receive notifications if any errors occur. The project will be completed within a specified timeline and budget, and will include testing and maintenance to ensure that the machine functions reliably and efficiently.

1.4 Significance

The development of a pharmacy vending machine is an important initiative that can provide several benefits to the community. First and foremost, it will enhance accessibility to medical items, allowing people to access urgent medical supplies outside of regular pharmacy hours. This is particularly important for individuals who may not have easy access to a pharmacy, such as those living in rural or remote areas. Additionally, the machine will provide a convenient and time-saving option for obtaining medical supplies, while also promoting safety and security by providing a controlled environment for dispensing medical items. Finally, the development of a pharmacy vending machine can also be a cost-effective solution, reducing the costs associated with running a physical pharmacy location. Overall, the machine will help to address the needs of people who require urgent medical items, while also providing a convenient and cost-effective option for obtaining medical supplies.

1.5 Organization of the report

This report is organized into several sections to provide a comprehensive overview of the pharmacy vending machine project. The report begins with an introduction chapter that contains subsections such as Problem, Objective, Scope of Work, Significance, and Report Organization. The second chapter is the Constraints section, followed by a Literature Review chapter.

The third chapter is the Methodology section, which describes the specific methods and approaches used in the project, including the design, development, and testing of the machine. The fourth chapter is the Results and Discussion section, which presents the findings from the testing and evaluation of the machine, and discusses the implications of the results.

Finally, the report concludes with a Conclusion and Future Work section, which summarizes the key findings and recommendations from the project and discusses potential future improvements or extensions to the machine.

2 Constraints and Earlier coursework

2.1 Constraints and limitation

Here are some examples of the constraints we faced while working on our project:

- **Time limitation:** We found it very challenging to build this project during a normal semester, because it was our first time that we had to build such a machine that contains many electronic parts, needed a lot of power and different levels of voltage (3.3v, 5v, 9v), consisting of hardware components that we do not have sufficient knowledge about, we had to identify the components and know how to use them, and identify the connections, as well as get to know the Arduino and write codes for the hardware, and then build a complete system works properly. It was a little difficult because we did this under the pressure of a normal semester, where we had other commitments like subjects projects and assignments.
- **Precision and accuracy:** Our project included some mechanisms to make sure the medicines is sorted and retrieved correctly. Many mechanisms require high levels of precision and accuracy to function properly. This means that the parts must be manufactured to tight tolerances.
- **Size and weight:** We struggled a bit with the design of our project because of the size and weight. Mechanisms must often fit within specific size and weight constraints. This may be due to space limitations in the device or machine, or because the mechanism needs to be lightweight to reduce energy consumption or increase portability.
- **Safety and security:** Medicine vending machines must be designed to dispense medication safely and securely. This includes measures such as secure storage of medication, and reliable dispensing mechanisms to prevent double doses or dispensing the wrong medication, so We had to make the retrieval of medicines safe and secure and to prevent retrieving the wrong medicine, also in storing medicines so we used a limit switching sensor for that reason.
- **Power distribution:** As mentioned before it was our first time we built such a machine that contained many components and every component needed a different amount of voltage level and power. For example we used touchscreen that needed 3.3v while the motors

in the CD ROMs needed 5v. Another problem was the power, we needed 14A for our system to work properly because we used 13 CD ROMs and every CD ROM needed 0.5-1A to work. So to solve the problem we used a switching control power supply.

2.2 Earlier coursework

We took some beneficial courses under our education phase in computer engineering, we took several courses such as digital design, microprocessors, electrical circuits, electronic circuits, and microcontrollers, which helped us build this system. Moreover, we have taken some online courses for our needs to get the work done and we learned several basics about Arduino and writing codes.

3 Literature Review

We reviewed several previous automated medicine vending machines to take advantage of them in building our graduation project. There are many automated vending machines nowadays that provides medicine at all circumstances. Customers can easily access the medicines in cases of emergency or whenever required.

- **MedBox:** This is a secure vending machine that is used in certain pharmacies and clinics in the United States. The machine is designed to prevent medication theft and to ensure that patients get the correct medication. Patients must first provide their identification and prescription information before using the machine. The machine then dispenses the medication in a secure container that can only be opened by the patient[4].
- **InstyMeds:** This is a prescription drug vending machine that is typically found in hospitals and clinics in the United States. Patients can get their prescriptions filled quickly and conveniently by using the machine. The machine is stocked with a variety of medications that are commonly prescribed in hospitals, such as pain relievers, antibiotics, and asthma inhalers. Patients can use the machine by entering their prescription information, paying for their medication, and then receiving their medication directly from the machine[6].
- **PharmaTrust MedCentre:** This is an over-the-counter medication vending machine that is available in certain locations in the United Kingdom. The machine is designed to make it easy for people to get common medications quickly and conveniently. The machine is stocked with a variety of medications, including pain relievers, cold and flu remedies, and allergy medications. Patients can use the machine by selecting the medication they need, paying for it, and then receiving it directly from the machine.
- **MyDawa:** This is a prescription and over-the-counter medication vending machine that is available in certain locations in Kenya. The machine is designed to make it easier for people to get medications in areas where pharmacies may not be readily available. Patients can use the machine by entering their prescription information, paying for their medication, and then receiving it directly from the machine.

- Pharma24: This is an over-the-counter medication vending machine that is available in certain locations in Germany. The machine is designed to make it easy for people to get common medications quickly and conveniently. The machine is stocked with a variety of medications, including pain relievers, cold and flu remedies, and allergy medications. Patients can use the machine by selecting the medication they need, paying for it, and then receiving it directly from the machine.
- APT: This is an emergency contraceptive vending machine that is available in certain locations in the United States. The machine is designed to make it easier for people to access emergency contraception quickly and discreetly. Patients can use the machine by selecting the type of emergency contraception they need, paying for it, and then receiving it directly from the machine. The machine is usually located in private locations such as restrooms, to provide privacy to the patients[3].
- ATM (All Time Medicine) counter for medicine Malashree.G1et al. proposed the system, in that users may able to get basic Over-The-Counter (OTC) medicine at any time (24x7). Minor illnesses have a strange way of inviting people in the middle of the night when pharmacies are already closed. Over-the-counter (OTC) drugs are a class of medicines sold directly to a consumer without a prescription from a health care professional, as compared to prescription drugs, which may be sold only to consumers possessing a valid prescription. People will able to access the medicine with the help of this machine even at the night time. With this, first aid can be provided in time to the user. Medicines sold or supplied from a vending machine should satisfy the condition laid down by the Medical Council of India. Medicines which these restrictions apply are mainly aspirin and paracetamol. Products containing these substances should not exceed 16 tablets in a package for sale[5].
- Automatic Vending Machine For Medicines :- Accessibility to basic healthcare is an important part of development towards building a healthy future. Medicines play important role in human's life. Therefore Medicine ATM will be very useful[2].
- Automatic Medicine Vending System Medical ATM :- This Medicine

ATM is the one stop integrated electronic machine which provide medicine anytime and anywhere. It is a convenient, faster and safest with medicine at anytime and anyplace[1].

- Any Time Medicine Vending Machine :- The aim of this project is that people would be able to access the

Although looking towards the requirement, need of medicine .This vending machine provides medicine 24*7 and have a storage system that will compensate any deficiency in any of the medicine boxes, so the owner won't have to fill the storage frequently.

4 Methodology

4.1 Technical Choices

4.1.1 Arduino

The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 256k Flash Memory, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

The Mega 2560 R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Mega 2560 R3 works with all existing shields but can adapt to new shields which use these additional pins.



4.1.2 libraries

- Nextion: We had included this library to be able to use touch screen.
- esp32: We had used this library to make Admin mobile application which can send commands to the machine and recieve data from it.
- SoftwareSerial: This library had been used to work with QR sensor.
- Servo: We had included it to be able to use servo motor.

4.2 Methods and techniques

4.2.1 Electronic Components

- CD ROM: We used 13 CD-ROM drives into our machine, utilizing their mechanism to retrieve items and open the doors of the medicine containers, facilitating the entry of the medicine box into its designated container.



- IR Sensor: We employed eight IR sensors to check the status of the containers, determining whether they were full or empty. Additionally, their values are immediately reflected in the admin application

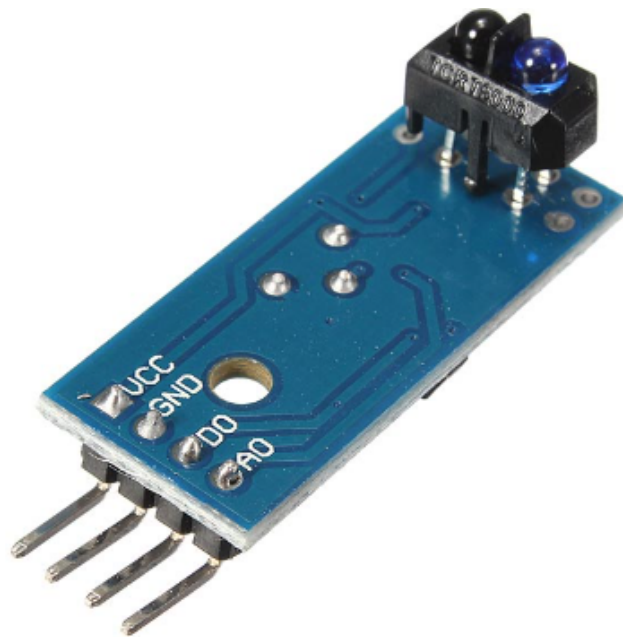


Figure 1: Infrared Reflectance Sensor IR Module Line Follower TCRT5000

- Touch screen: We utilized a touch screen interface to enable users to select medicines from the vending machine and view their corresponding descriptions.

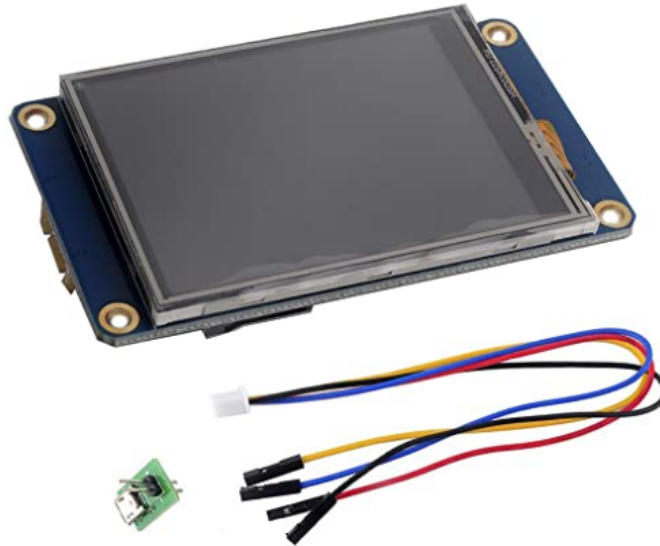


Figure 2: 2.8" TFT Touch LCD Screen For Arduino Mega

- H-bridge: To control the vending machine, we employ a total of seven H-bridges, with each H-bridge responsible for managing the operation of two CD-ROM drives.
- Switch sensor: We employed the switch sensor as a crucial component, which effectively prevents any medicine box from being placed in an incorrect container by halting its movement from the storage container into the vending machine containers whenever any of the limit switches is open.

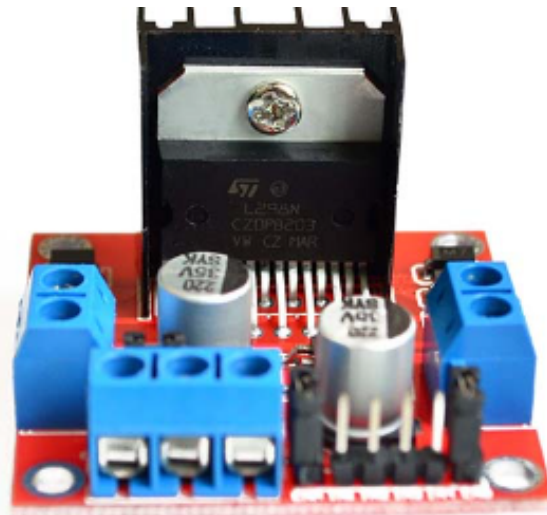


Figure 3: L298N Dual H-Bridge Motor Drive Module Board

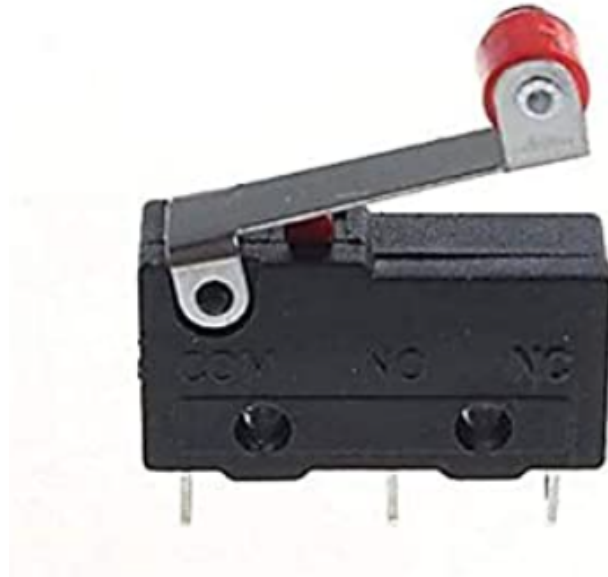


Figure 4: Bump Sensor – Limit Switch with Roller Lever

- Qr sensor: We utilized a QR sensor to scan barcodes and retrieve corresponding medicines, enabling users to receive the medicine corresponding to the scanned barcode.



Figure 5: SH-400 TTL 2D Barcode And QR Scanner

- We used LM2596 DC-DC Buck Converter Step-Down Power Module to convert the 12 volt we took from the switching power supply to 9 volt so that we can connect it with the arduino, because LM2596 DC-DC Buck Converter Step-Down Power Module is an electronic component that is used to step down a higher voltage to a lower voltage. The module is based on the LM2596 voltage regulator IC, which is manufactured by Texas Instruments.

The module is designed to take an input voltage that is higher than the desired output voltage, and convert it to a stable output voltage that is lower than the input voltage. It is commonly used in electronic circuits to power devices that require a lower voltage than the power source.).

- For the mobile application that is going to be used by the admin, we used the ESP Wi-Fi module because it uses a microcontroller unit (MCU) that is capable of running custom firmware. This firmware allows the module to connect to Wi-Fi networks, send and receive data over the internet, and interact with other devices in the IoT ecosystem. The module supports a variety of communication protocols such as HTTP, MQTT, and CoAP, which allows it to be integrated with a wide range of IoT platforms.

The ESP Wi-Fi module has a range of features, including support



Figure 6: LM2596 DC-DC Buck Converter Step-Down Power Module

for WPA/WPA2 security protocols, an integrated TCP/IP stack, and support for OTA (over-the-air) firmware updates. Additionally, the module can operate in both client and access point modes, which means it can be used to connect devices to the internet as well as create a Wi-Fi network.



Figure 7: Switching control power supply

- It was very helpful to us to use a switching power supply, also known as a switched-mode power supply (SMPS) because we needed different types of voltage levels and also a high amount of power to make all the 13 CD ROMs work and the other components. The switching

power supply is an electronic device that converts electrical power efficiently from one form to another. It typically converts alternating current (AC) voltage from a source, such as a wall outlet, to direct current (DC) voltage suitable for powering electronic devices.

The main advantage of switching power supplies is their high efficiency compared to linear power supplies. They achieve this by rapidly switching the input voltage on and off at a high frequency and then regulating the output voltage through control circuitry. This switching action allows for smaller and lighter power supply designs.



Figure 8: ESP32 wroom module

- The copper core cables(8 Core) we used in our project was very useful to use because we needed longer cables to suit with our machine and also to ensure optimal performance and reliability..

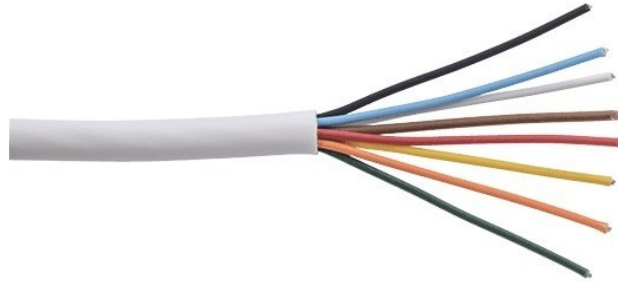


Figure 9: Copper core Cable (8 CORE)

- Arduino wires: We used three types of Arduino wires which are male to male, male to female and female to female.

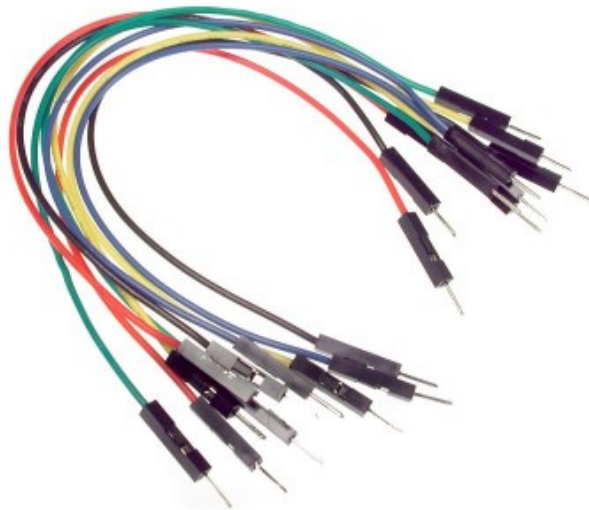


Figure 10: Male to Male



Figure 11: female to female



Figure 12: female to male

- Switch button: We used switch button to turn on and off the power supply.



Figure 13: switch button

- RGB LEDs: We used RGB leds as indecator for the system status such as followes(Green: System is on, R: System is OFF and Blue: error in the system).



Figure 14: RGB LEDs

- USB A to USB B cable for Arduino Mega: This cable connects the Arduino with Laptop.



Figure 15: USB A to USB B cable for Arduino Mega

4.2.2 External design

The whole design (vending and storage) as shown below we have 4 medicines boxes containers (vending) also 4 medicines containers in the storage.

The vending shape is matrix 2*2 we have on the right CDROM when a medicine box come from the storage if it belong to the first 2 containers then the door will be close. But if it belongs to the 2nd row of the matrix container then the door will be open and the medicine box will be stored in the correct place.

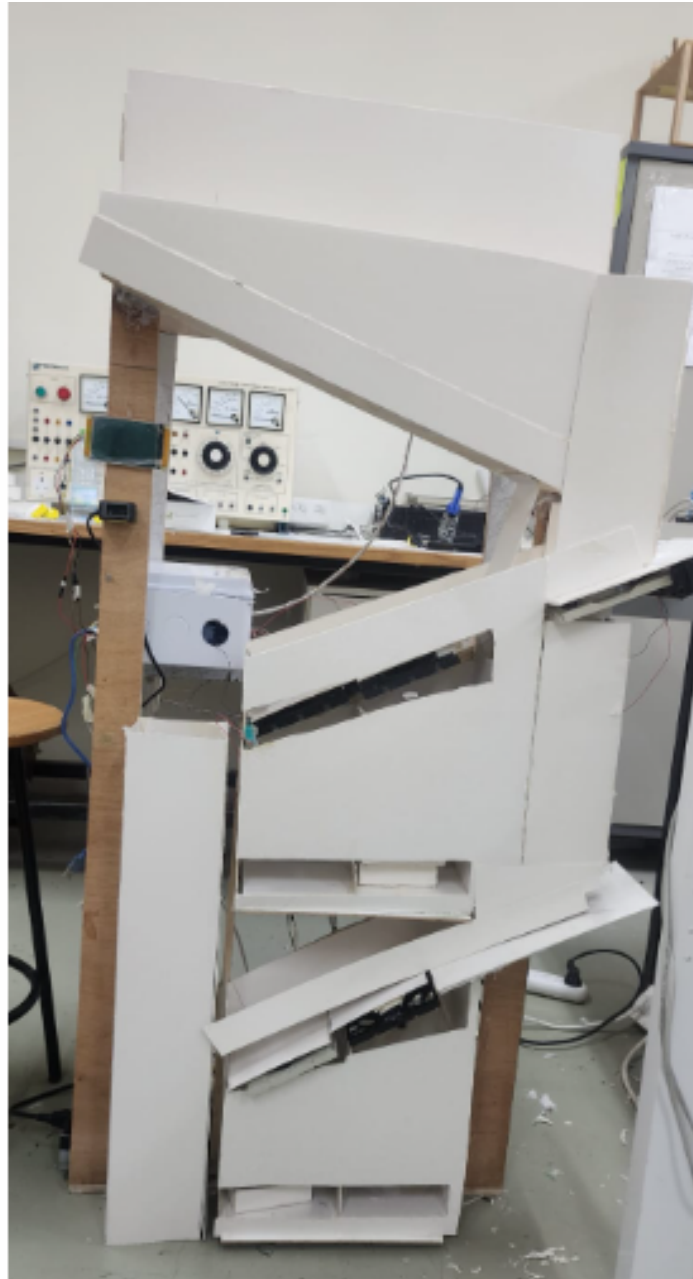


Figure 16: Vending and storage design

In the left side we have QR reader which can read the barcode of a medicine and retrieve it from the vending also we have touch screen which design is friendly to the users and gives them list of medicines, description of the selected medicine and its price

as shown below.

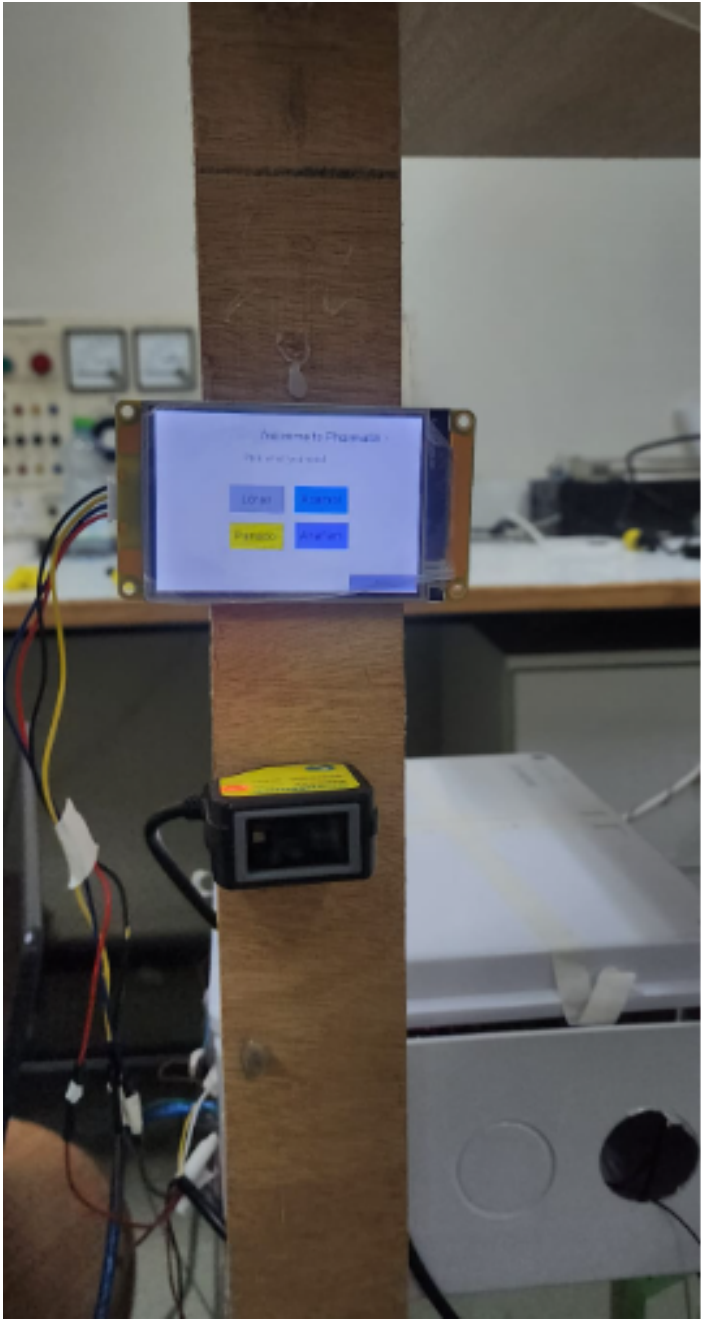


Figure 17: qr and touch screen

when the user select a medicine (from touch screen or by barcode)then the selected medicine will be retrieved from the vending by the CDROM and the ER sensor will detect that so the container door will be open and another box medicine will be come from the storage system above.

We have switch sensor on the vending boxes to avoid the errors from happening (if the corresponding switch to the storage container is not open then the medicine box will not go out of its container also the same if one of the other switches is open)

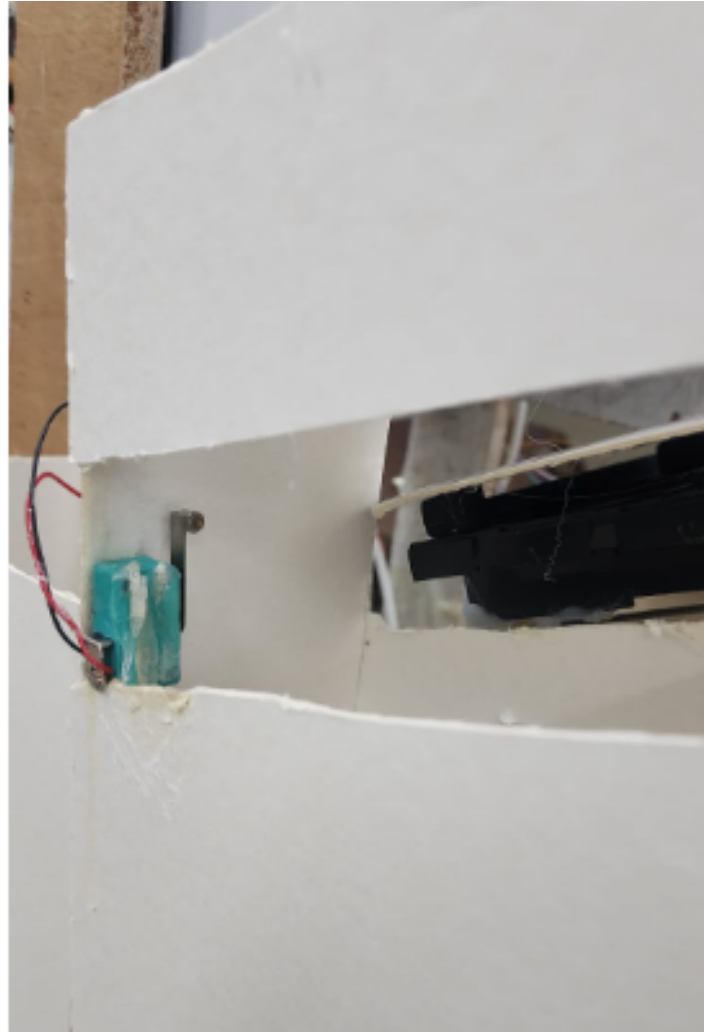


Figure 18: switch sensor

4.2.3 Admin mobile application

This is the mobile application we made for the admin or for the one responsible for the machine. As shown below there are two buttons to control the machine, the first one is to turn on the system and the second one is to turn of the system. We also have indicators for the storage, it will show which box in the storage that is empty and which isn't. This

Pharma Store 7/24

Turn ON

Turn OFF

Lorax storage

NOT EMPTY

Acamol storage

NOT EMPTY

Panadol storage

NOT EMPTY

Anaflam storage

NOT EMPTY

will make it easy for us to control the system further more, for example if one of the boxes in the storage is empty then the system will stop feeding the box that belongs to that box in storage which is empty.

5 Results, Analysis and Discussion

The results of our pharmacy vending machine project demonstrated successful implementation and functionality of the system. We were able to design and develop a machine that provides accessible and round-the-clock access to urgent pharmaceutical items. The machine offers two modes, storage and retrieval, and features a user-friendly touchscreen interface for item selection and retrieval.

During testing, the inventory levels were monitored using advanced sensors integrated into the machine. These sensors effectively detected when items were running low, allowing for timely restocking to ensure the availability of essential medications.

The touchscreen interface proved to be intuitive and easy to use, even for individuals with limited knowledge of medication or language barriers. Users were able to navigate through the menu options, select their desired items, and retrieve them from the machine without any difficulties. The machine's retrieval mechanism functioned reliably, ensuring that the correct items were dispensed to users.

Our project also included the development of an admin application. The admin application provided real-time monitoring of the machine's inventory levels and system status. Whenever items were running low or there was an issue with the machine, the admin was promptly notified, enabling timely action to be taken.

Through the implementation of this pharmacy vending machine, we aimed to enhance public convenience and accessibility to essential pharmaceutical supplies, particularly during non-business hours when traditional pharmacies may be closed. The self-service nature of the machine allows individuals to quickly and easily obtain urgent medications, improving overall healthcare accessibility and contributing to community well-being.

While our project was successful overall, we did encounter some challenges and limitations. One of the constraints we faced was the time limitation. Building such a complex machine with multiple electronic com-

ponents required extensive research, learning, and troubleshooting. Balancing this project alongside other coursework and commitments proved to be demanding.

Precision and accuracy were critical factors in the design and implementation of our pharmacy vending machine. The mechanisms responsible for sorting and dispensing medications required meticulous calibration to ensure proper functionality. Meeting size and weight constraints was another challenge, as the machine had to fit within specific dimensions and be lightweight for ease of installation and transportation.

Safety and security were paramount considerations in the design. We implemented measures to securely store and dispense medications, incorporating limit switching sensors and reliable dispensing mechanisms to prevent errors or unauthorized access.

Power distribution was also a challenge due to the varying voltage requirements of different components. To address this, we utilized a switching control power supply to provide the necessary power and voltage levels for the system to operate effectively.

6 Conclusions, Recommendation and Future Work

In conclusion, the development of a pharmacy vending machine that is accessible to the public and operates 24 hours a day provides a valuable solution to address the need for convenient access to urgent pharmaceutical items. The implementation of two modes, storage and retrieval, along with a user-friendly touchscreen interface, enhances the user experience, allowing individuals to easily select and retrieve the required medications and supplies.

By stocking essential items such as painkillers, antipyretics, first aid supplies, medications for high blood pressure, insulin needles, and baby milk, the vending machine caters to a wide range of immediate health-care needs. This availability of urgent pharmaceutical products in a self-service format can significantly benefit individuals who require immediate access to medications outside regular pharmacy hours or in locations where traditional pharmacies may be limited.

The integration of sensors to monitor inventory levels and system status adds an extra layer of efficiency and convenience. The automated notifications sent to the admin application ensure timely restocking and maintenance, minimizing the risk of stockouts and providing a reliable service to the public.

Overall, this graduation project successfully demonstrates the feasibility and effectiveness of a pharmacy vending machine in meeting the needs of individuals seeking immediate access to essential medications and supplies. With its user-friendly interface, 24/7 availability, and continuous monitoring, this innovative solution has the potential to enhance public healthcare accessibility and contribute to improved community well-being.

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