AN-Najah National University

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Medicine Reminder Machine 

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Acknowledgment:

This project has required a lot of effort from us, after months of working on Our Project (Medicine Reminder Machine), we'd like to thank our God, also thank our supervisor, Dr. Sofian Samara, for his direction and assistance, as well as for providing us with important project information. We'd like to thank our family for their unwavering support during our university years. For being there for us through all our difficulties.

Disclaimer:

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Abstract :

Most elderly people need to take their medicines at specific times throughout the day, so if sons are absent throughout the day, it may be difficult for them to keep track of their parents' medicine , also some elderly people may suffer from Alzheimer's disease. Additionally, in the case of epidemics, it may be difficult for the patient to communicate directly with people for fear of spreading infection, and he may forget his medication appointments due to fatigue. Due to these reasons, we designed our project to be a medication reminder machine.

Project working principle : A machine which sets specific dates for giving the medicines at specific times according to the type of medicine needed throughout the day. Medicines are categorized by the admin based on the patient's medicines types and he also determines the doses of medicines. Each type of medicine has a specific disposal location, so that when the time for the medicine comes, the dose is dropped in its specified place, and this place is equipped with a sensor to make sure that the medicine has been taken from its place. Whenever the medicine was not taken, the alert is repeated to the patient after a short period, and at the end a message is sent to the admin to tell him the patient hasn't taken the medicine. This machine is also equipped with a place to get the water needed to take the medicine dose. It also contains a sensor for the presence of the cup so that if there is no cup, the water will not be filled, and there is also a sensor to alert the administrator When the amount of medicine or water in the tank is approaching.

1. Introduction

1.1. Problem Statement

The “Medicine Reminder Machine” project aims to solve many problems for certain groups of society, the most prominent of which are:

1. elderly people whose sons are absent throughout the day so they unable to give them their medicines on time

2. People who suffer from Alzheimer's disease need something to remind them of their medicines.

3.People who suffer from infectious diseases may find it difficult to find people to give them medicine .

1.2. Objectives

The project aims to take care of the health of a specific group of patients by reminding them to take their medications on time. This will increase the recovery rate of these patients, as well as make it easier for their families to organize their daily lives and take care of their patients.

Our project is a model of a medicine reminder machine, consisting of two main interconnected parts, the first part is a smart touch screen that is used by a member of the patient’s family or the nurses responsible for him, through which alarms are set at the times of taking the doses of medical medicines, each type of medicine At a specific time throughout the day, and the other part is the part responsible for dropping the medicine at a specific time when the alarm rings, and then a glass of water is filled in succession to accompany taking the medicine dose.

The project initially accommodates four types of medicines, and more can be added by the same mechanism, and it accommodates a sufficient number of doses for each medicine, which may be sufficient for about a week, and this ensures that the patient takes his medicine for a good period without the need to monitor

his relatives throughout the day.

1.3. Significance of the work:

Our project is mainly for patients who are unable to remember the dates of their medications and take them on time, and there is no one to follow them during the day. It can also be used in hospitals to relieve nurses during their working hours, or in cases of contagious epidemics due to the inability to communicate directly between people.

1.4. Organization of the report:

In this report, we illustrate the idea in its full details. Going through the report you can first see the constraints we faced during our work including equipment, tools we used and time. Then, you can read about similar systems to get a background about the topic being discussed and what special features we have done upon other systems. After that, the methodology of our work is extensively explained. Next chapter states our results and a discussion to interpret and compare the results. Ending it up with the conclusion of the whole work and what is our vision for the future to improve our work.

2. Constraints and Earlier Coursework:

2.1. Constrains :

1-In the beginning, most of the equipment and parts are not very efficient, for example, the servo motor.. We used many servos, but we faced difficulty in operating them collectively because of the energy needed to operate them. Then we solved the matter by using a specific piece(I2C) that helped us solve the problem, in addition to the smart touch screen. It was difficult to deal with it for the first time, as we faced many difficulties in her instructions to operate the alarm , in addition to the inaccuracy in the performance and reading of the sensors…
2- Lack of funds :Some solutions needed more money to make, which would make the project too expensive and unaffordable, especially at a small scale.
3-Lack Of Time : Time is the most important factor in any project. Researching, communicating, testing, developing, understanding the requirements, planning, and the wasted time due to inexperience, all of these things require time which, no matter how tiny, quickly adds up.
4-Lack Of Tooling: Some special tools were needed to cut, prepare and assemble all the parts which are not available or too expensive for home use, so a specialist was required to help with it.

2.2. Earlier Coursework :

Working on our project requires knowledge from some of the courses we took in the computer engineering program, including:

Microcontroller:

The microcontroller provides basic information about understanding the PIC Microcontroller and how to program hardware components, also the lab of this course provides how-to download code on the PIC Microcontroller equipment and how to understand every pin and feature there. so, it is one of the most important materials that helped us understand how to deal with the ESP32 controller in the project, through our knowledge of how to deal with the microcontroller, as the laboratory of this material contributed mainly to help us start working on the project.

Networks and Communication:

This course taught us how to use Wi-Fi to communicate between two devices, as we used Wi-Fi to connect both microcontrollers (Nextion touch screen & ESP32), and we also used it to communicate with the "Signal" application to send notifications to the admin.

Electronic circuits:

This course has mainly contributed to helping us deal with electrical circuits and related connections. as a result of this course that provides basic information about how to deal with many different circuits and how to wire their circuits.

Critical Thinking and Research Skills

The research and the writing of this report were all taught in this course, and it's one of the few non-technical courses which also is life long.

3.Literature Review :

When creating this project, our focus was to build a machine that can be used without the need for people to give medicines to the person in need. We found, according to the latest statistics, that the percentage of the elderly in the world is 16% and Of the approximately 50 million people with dementia worldwide, it is estimated that 60% to 70% of them have Alzheimer's disease, and therefore we need this machine for these people.

The first American alarm clock was made by Levi Hutchins of New Hampshire in the United States. In 1787, Hutchins made it only for himself. The first time, the clock only rang at 4 am to wake him up for work. He patented an automatic adjustable alarm clock in 1817.

The medication reminder machine is a machine that can be used by the elderly, people who suffer from Alzheimer's, or those who are sick with infectious diseases so that they cannot communicate with nurses and so on. The machine helps remind the person when medication is needed, and thus give the dose of medicine and the glass of water to his/her side without the need for any effort.
The reminder machine, when you turn it on and give it the alarm commands for each medication, and according to the times that were given to it, it activates an alarm sound that alerts the patient through the MP3 feature located inside the smart screen, and then it activates the servos to drop the medication in the specified place and then operates A water pump to bring water into the cup, and the patient can view the details of each medicine and know the number of doses remaining for each medicine via the smart screen, and in the event that the medicine was not taken from its place, the responsible person is contacted immediately, and therefore we need an application to send and display Communication notices on it.

4. Methodology

This section provides detailed information about the methods and techniques we used to develop Machine, from designing and assembling the exoskeleton to the end
Through the smart touch screen and other tools in the reminder machine and how they are linked together to reach the final product.

4.1. Data collection:

We aim in our project to help the elderly and those suffering from Alzheimer's to remind their medicines through the alarm clock without the need for effort, and to achieve this goal we came up with the idea of a medicine reminder machine, so after we decided on the idea we started collecting data about similar projects in this field and what are the components used in this type of project. Then we studied each component individually to understand how it works and what values it offers. A standard circuit is built for each component and its results and output data are collected and saved in order to analyze and compare them with a fixed component so that we can choose the best one that matches our needs.

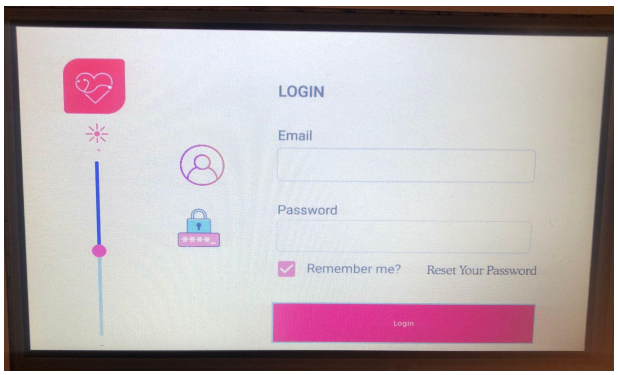
4.2. Data analysis :

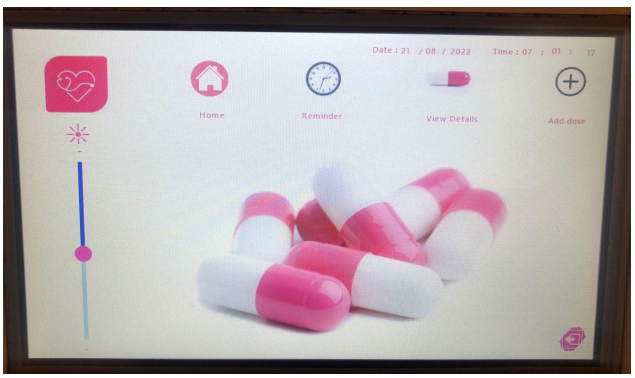
After collecting all the required data, we started analyzing it in order to determine what we really needed to build the Medicine Reminder Machine. We noticed that this machine needs to set the times of medicine dosing and download the dosage of the medicine simultaneously with filling the glass of water.
Alarm: The alarm is determined by the smart touch screen (Nextion), where the required time (hour, minute, second) is entered, as well as the required day is determined, then the specified time is compared to the current time, and when they match, a specific command is sent to the serial, to be read by the microcontroller used (ESP32).
The medicine and water event: When the commands arrive at the serial, they are compared with the required ones, as we assigned each medicine stream two servo motors, both of which work sequentially when the required command matches the command that is read from the serial. We set a specific angle for each servo motor. At first, the first servo is opened, so the dose of the medicine slips and is confined between both servos after closing the first servo, then the second

servo is opened and with the effect of gravity, the medicine package slides into its designated place for the patient to take, and immediately after that, a glass of water is filled By the water pump for a specified period of time to ensure that the cup is filled without increasing or decreasing. This process is controlled by many sensors, including a sensor that senses the presence of the water cup and we used in our case ultrasonic, where we set a specific distance to be read by the ultrasonic in case the distance is less than 10 cm (the expected location of the cup) The water pump is turned on and the cup is filled If the ultrasonic does not sense anything at a distance of 10 cm, the water pump does not turn on. We also used a special sensor to sense the patient's hand to make sure that he took the dose of the medicine, when the alarm rings and the dose of the medicine are downloaded, if the IR does not sense the patient's hand, a notification is sent to the patient in charge. Finally, we used sensors to sense the medicine packages (IR) to ensure that they do not expire, as the patient responsible alerts when they are finished with a notification, and the matter is similar to the water tank.

4.3. Alarm Part (Nexion touch screen) :

The main part in this section is the presence of the smart touch screen, which added a distinctive character to the project. We have added several features and characteristics to it, including the presence of an email and a special pass to operate it, in order to increase safety, in addition to the possibility of displaying all the details of the medicines inside the machine, and the user can also through it Knowing the number of doses of medicines inside the machine, and when the doses decrease, they decrease automatically within the space designated for them, and finally the area for setting the alarm, through which you can set a special alarm for each type of medicine and at the specified time for each medicine. The alarm rings through a special alarm sound





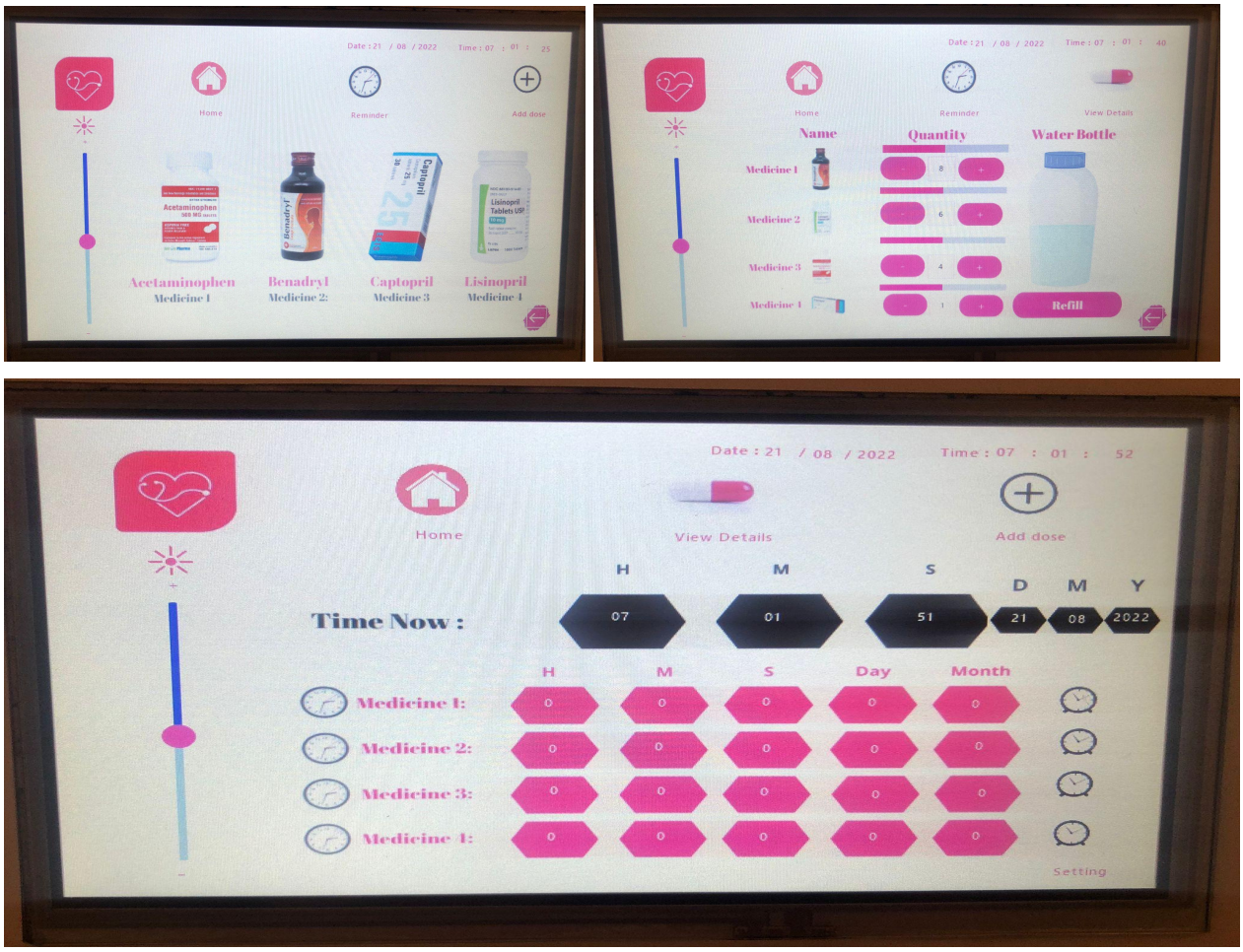


Figure 1: Nexion Touch Screen

4.3.1 Smart Touch Screen Implementation :

```
covx rtc0,va11.txt,0,0 //year
t18.txt=va11.txt
covx rtc2,va9.txt,2,0 //day
t16.txt=va9.txt
covx rtc1,va10.txt,2,0 //mon
t17.txt=va10.txt
covx rtc3,va6.txt,2,0 //hour
t0.txt=va6.txt+" "
covx rtc4,va7.txt,2,0 //min
t6.txt=va7.txt+" "
covx rtc5,va8.txt,2,0 //secr
t15.txt=va8.txt
```

Figure 2: Display current Time & Date

Through the internal rtc on the screen, we were able to display the current time and date on the main screen, which we will use for the alarm.

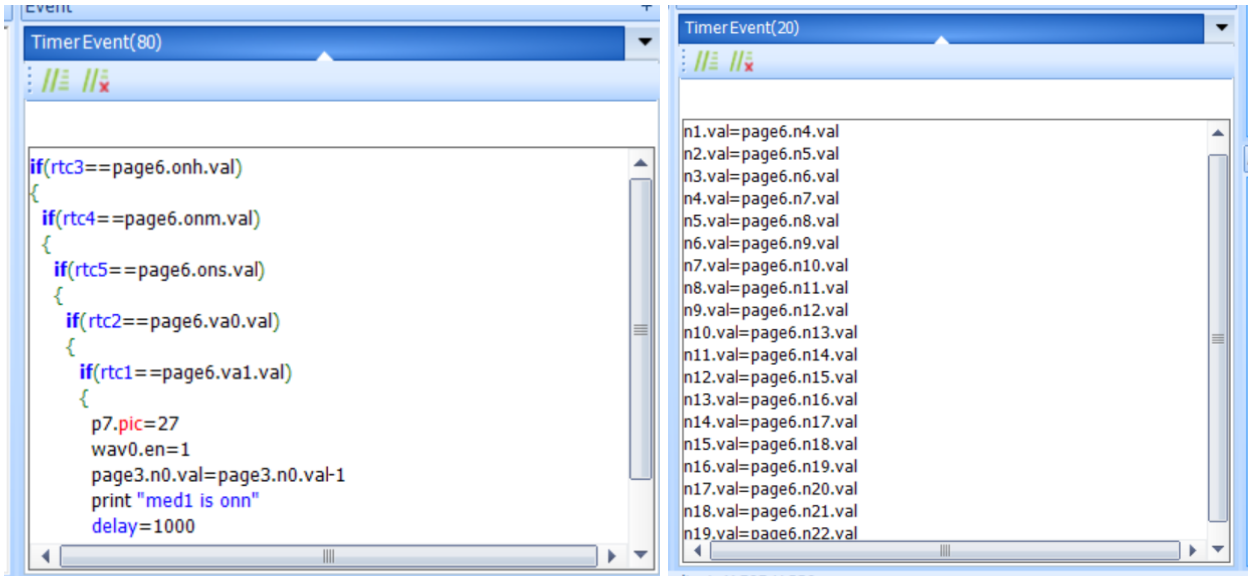


Figure 3: Set Reminder

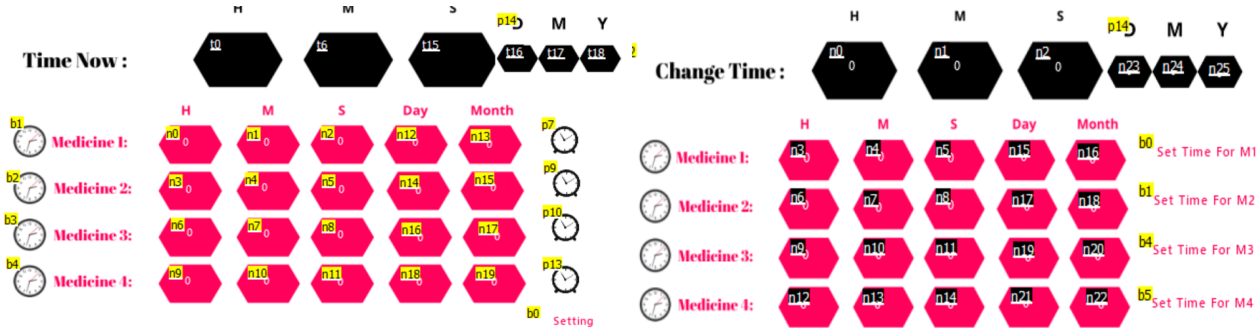


Figure 4: GUI (Nexion)

Through this code, we set specific times for medicines and then we compare the hours, minutes, seconds, day and date

In the event that the current time is equal, the alarm will work and a special command will be sent to the serial in order to implement the event

4.4. Mechanical Part :

The mechanical part of the project is the part responsible for moving the medicine ports
It requires the presence of a number of servoMotors to generate movement in cooperation with the Nexion controller to direct it. To do this, it requires performing the following steps:

4.4.1 Mechanical Design :

The first step is to design the structure that will give graceful movement and provide precision
And fixed information about where the pieces are and how they move.

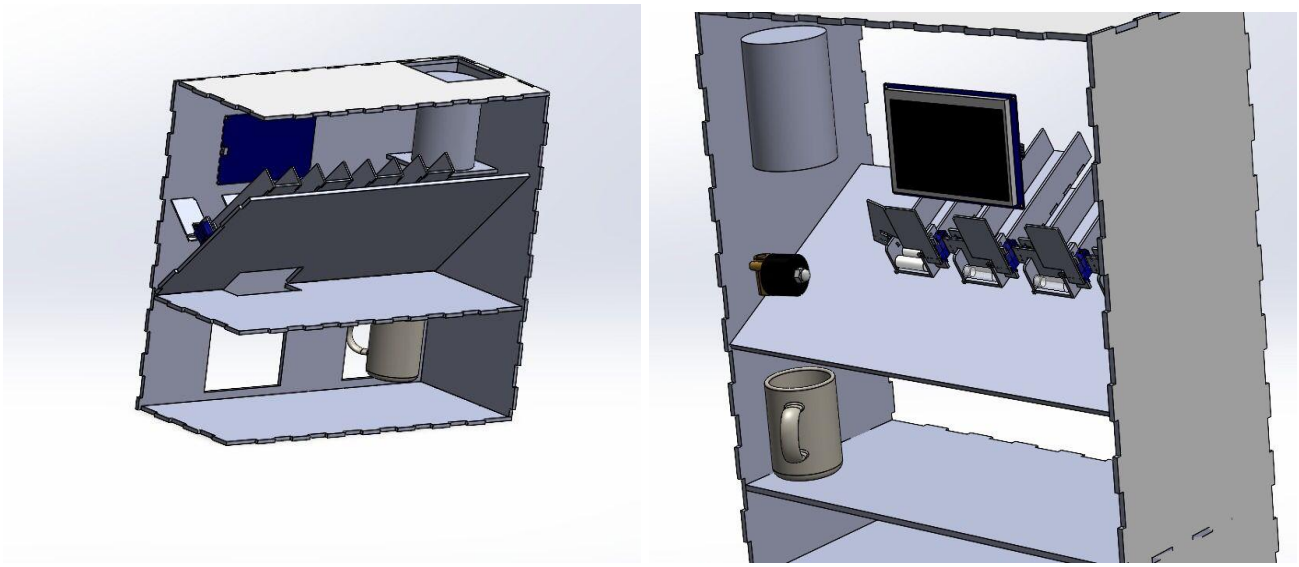


Figure 5: Mechanical Design

4.4.2 Assembling :

It is the part that requires the use of screws and screwdrivers to assemble the pieces together, and this must be done accurately in order for the project to work as required.

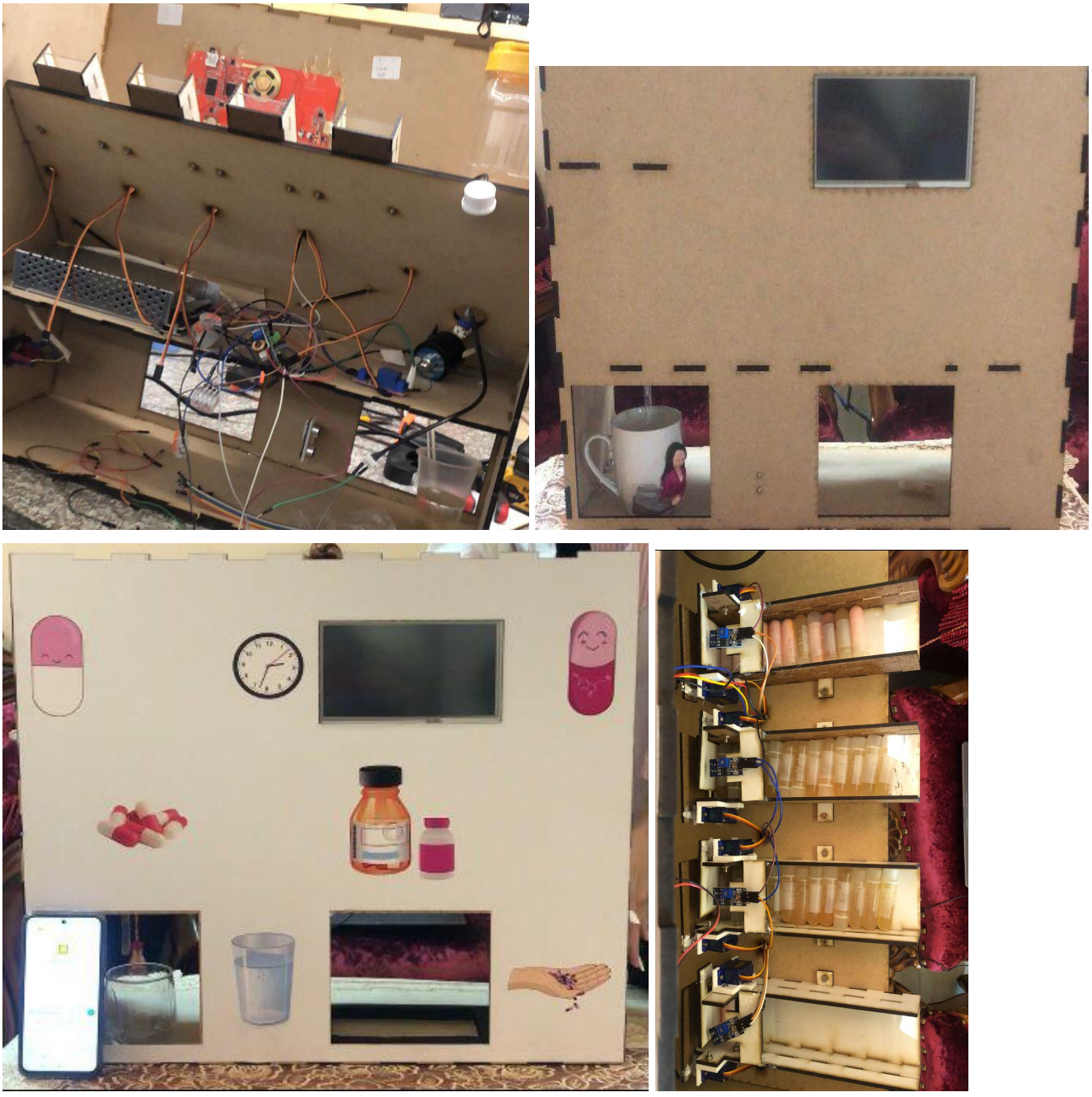


Figure 6: Mechanical Body

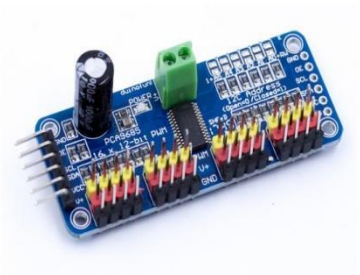
At this point, we also tested agility to make sure everything was moving freely.

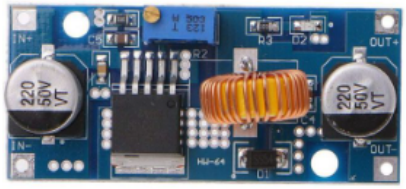
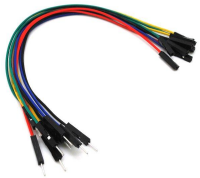
In addition to testing the ability of the motors to move the pieces of each medicine, and testing the water pump to ensure that it pumps water in the correct way. We used several models of wood of different sizes to suit each part.
Some parts require special tools for cutting and handling, so a professional was necessary

4.4.3 Parts :

Item Name	Item Image	Quantity
ESP32		1
Nextion 7 inch display		1
SD card (For Touch Screen)		1

Servo Motor		8
IR		5
Ultrasonic		1
Water Solenoid Valve		1

Water Level Contactless		**1**
Power Supply		**1**
Relay		**1**
PCA9685 I2c Interface		**1**

Buck Converter		**1**
Wires (male -male , male-female , female-female)		**50**

4.5. Controller Part :

The controller part is responsible for directing the mechanical part and providing it with power, and it includes two main parts :

4.5.1 ESP 23 :

We preferred to use it because it contains the internet feature that we need in order to send notifications on a specific application in order to communicate with the responsible person for many needs

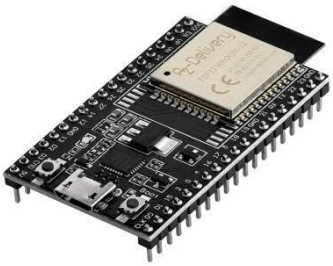


Figure 7 : ESP 32

4.5.2 Nexion Display :

The controller of the smart screen, through which we can control all the instructions of the

screen and all the commands on it, and then it is linked to the other controller (esp32).

Figure 8:Nexion Display with SD-Card

4.5.3 Other Parts :

4.5.3.1 Servo Motors :

For each medicine, we used 2 servo motors, the first to separate the first and second doses, and the other to open the medicine gate in order to drop it in its designated place at the appropriate time .

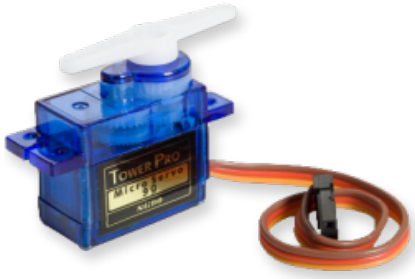


Figure 9: Servo Motor

4.5.3.2 IR-Sensor :

We used this sensor for two main purposes:

1- to check the doses of medicines, when the doses are finished, it is felt that there is no dose, and therefore send a notification to the responsible person.

2- to feel if the patient took the medicine from its designated place or not. If he did not take it, the responsible person will be contacted.

Figure 10 : IR-Sensor

4.5.3.3 Ultrasonic-Sensor :

We used this sensor in order to measure the distance to the cup we want to fill. If the distance between the sensor and the cup is more than 10 cm, and therefore there is a possibility that there is no cup, the pump will not operate. But if the distance is greater than zero and less than 10, the possibility of a cup is very large. so the pump will Turn on and fill the cup of water .

Figure 11 : Ultrasonic-Sensor

4.5.3.4 Water Solenoid Valve :

We used it to pump water from the tank designated for filling water into the cup

Figure 12 :water Solenoid Valve

4.5.3.5 Water Level Contactless :

We used this sensor in order to feel the water inside the tank. When the water in the tank runs out, the responsible person is contacted

Figure 13 :water Level Contactless

4.5.3.6 Power Supply :

Figure 14 : Power Supply

4.5.3.7 Relay :

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the esp32 pins

Figure 15 : Relay

4.5.3.8 I2C :

We used this piece to interlock all servo motors to give them the appropriate power and to run more than one servo at the same time.

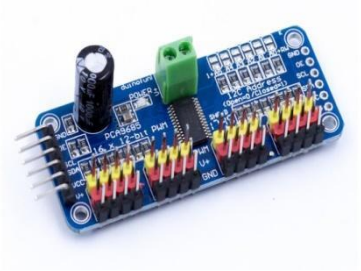


Figure 16 : I2C

4.5.3.9 Buck Converter :

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage - often creating 5V DC from perhaps a 12 or 24V DC source.

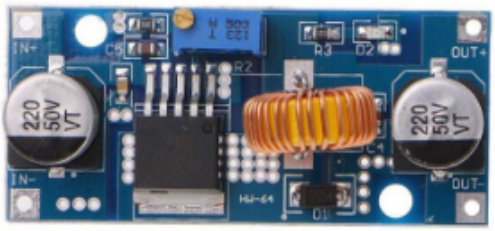


Figure 17 : Buck Converter

4.5.3.10 Different type of wires :

Figure 18 : male-male wires

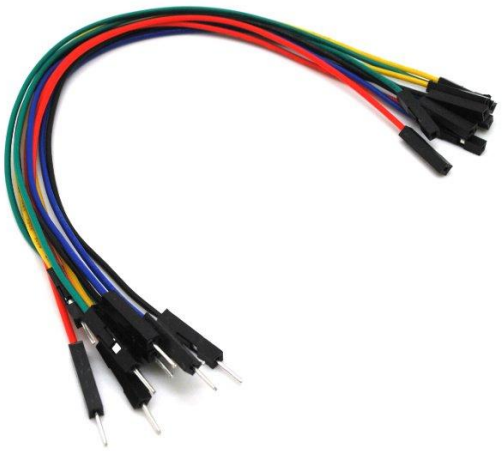


Figure 19 : male-female wires

Figure 20 : female-female wires

4.5.4 Implementation for mechanical Part :

```
  if(Serial.available()>0){
  xl = Serial.readString();
  Serial.print(xl);

    Serial.write(0xff);
  Serial.write(0xff);
  Serial.write(0xff);
  int index=xl.indexOf("med1 is onn");
 if(index>=0){
  Serial.print("done1");
//    send_message = "***done connection1***";
//  message_to_signal(send_message); // Send send_message to Signal app
 if(servonum==0){
    pwm.writeMicroseconds(servonum,USMAX);
    delay(1000);
       pwm.writeMicroseconds(servonum,1500);
    delay(1000);
   servonum=1;
}
 if(servonum==1){
    pwm.writeMicroseconds(servonum,USMIN);
    delay(1000);
```

Figure 21: Implementation (ServoMotors)

In the beginning, we connected the controller of the smart screen to the ESP32. When sending a certain command to the serial from the screen, we read the serial to make sure that the required command was received.. For example, when the first alarm was triggered, we sent a command (med1 is onn) and then we made sure that The command is up to the serial, if it arrives, the servo motors of the first medicine part will be activated, so that the first separates the first dose of medicine from the other, and the second lowers the dose to the place designated for it.

```
 if(servonum==1){
    pwm.writeMicroseconds(servonum,USMIN);
    delay(1000);
       pwm.writeMicroseconds(servonum,1600);
    delay(1000);
        if(distanceCm>10 && distanceCm<50)
  {
  //  Serial.print("error");
      digitalWrite(solenoidPin,LOW);
      Serial.print("put water cup");
//      send_message = "***put water cup***";
//  message_to_signal(send_message); // Send send_message to Signal app

  }else if(distanceCm>1 && distanceCm<10){
      digitalWrite(solenoidPin,HIGH);
        delay(6000);
        digitalWrite(solenoidPin,LOW);
       delay(1000);
       Serial.print("we have water cup*");
//        send_message = "***we have water cup***";
//  message_to_signal(send_message); // Send send_message to Signal app
```

Figure 22: Implementation (Valve+UltraSonic)

After turning on the second servo and dropping the dose of the medicine in its designated place, the presence of a water cup is checked,and that is through the Ultrasonic, where it checks the distance. If the distance is greater than 1 cm and less than 10 cm, the possibility of having a cup of water is high, and therefore the pump is turned on and filled with the cup of water, but if the distance is greater than 10, this means that there is no cup water and therefore will not be filled. And this mechanism is repeated when descent any of the 4 types of medicines .

```
  if(millis()-timer>time1_delay){
  handSensor(irvaluehand);
  timer=millis();
}
 }
 xl="";
 Serial.flush();
 }
 delay(2000);
}
   }


  void  handSensor(int y)       // user define function to send meassage to Signal app
{
  if(y==1)
  {
      send_message = "***The patient didn't take the medicine!***";

  Serial.println("*No hand !");
  Serial.println(send_message);
  message_to_signal(send_message); // Send send_message to Signal app
```

Figure 23: Implementation (IR-Sensor for hand)

When the medication is lowered into its designated place, it is checked if the medication has been taken from its place.

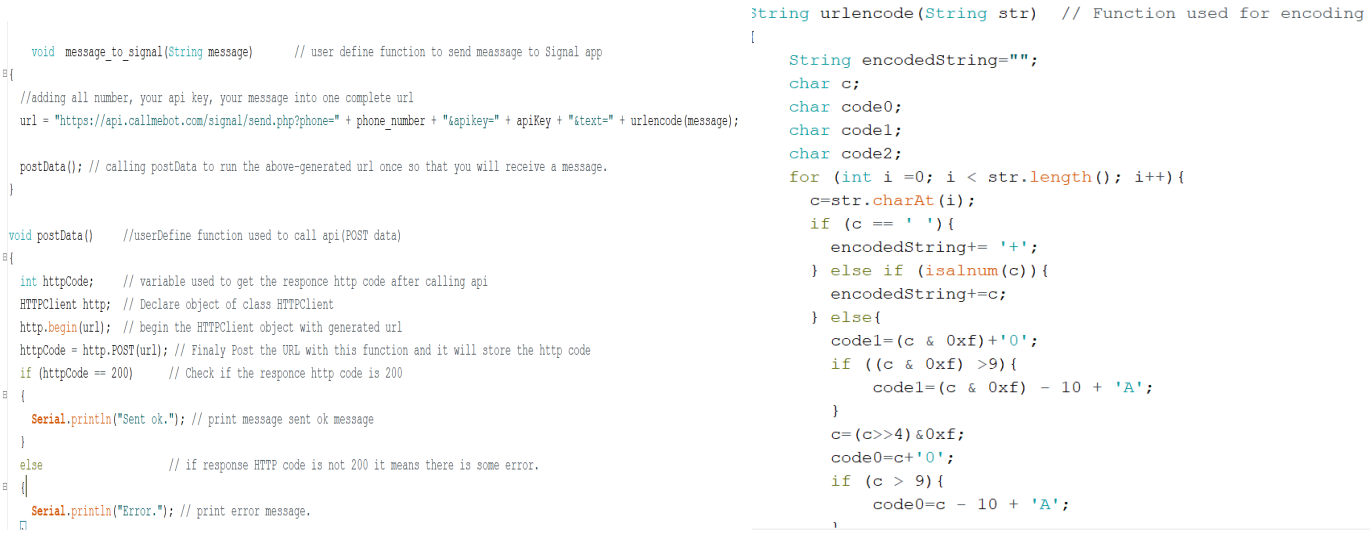
In the event that the medicine is not taken (i.e. the patient's hand is not felt), a notification is sent to a special application of the responsible person informing him that the patient did not take his medicine.

```
   void  WaterSensor(int y)       // user define function to send meassage to Signal app
{
  if(y==0)
  {
      send_message = "***Please Fill The water Tank***";
  Serial.println("waterTank Empty !");
  Serial.println(send_message);
  message_to_signal(send_message); // Send send_message to Signal app
  }

}
   void  medicSensor(int y,int flag)       // user define function to send meassage to Signal app
{
  if(y==1)
  {
    if(flag==1){
      send_message = "***Please Fill Medicine 1***";
    }
  else  if(flag==2){
      send_message = "***Please Fill Medicine 2***";
    }
   else if(flag==3){
```

Figure 24: Implementation (Water Sensor + Medicine Sensor (IR))

In this project, we have a water tank in order to fill the water in the cup, and therefore the possibility of running out of the tank is high. For this reason, we have put a special sensor(Water Level contactless) in order to check the amount of water inside the tank. When the water closes to the end of the tank, a notification is sent to the responsible person (Please Fill The Water Tank).
And also with regard to the amount of doses inside each type of medicine, when it is near to the end, using a special sensor for examination, a notification is sent(Please fill the medicine #) in order to fill the medicines when needed.



```
void message_to_signal(String message)       // user define function to send meassage to Signal app
{
//adding all number, your api key, your message into one complete url
url = "https://api.callmebot.com/signal/send.php?phone=" + phone_number + "&apikey=" + apiKey + "&text=" + urlencode(message);

postData(); // calling postData to run the above-generated url once so that you will receive a message.
}

void postData()     //userDefine function used to call api(POST data)
{
int httpCode;     // variable used to get the responce http code after calling api
HTTPClient http;  // Declare object of class HTTPClient
http.begin(url);  // begin the HTTPClient object with generated url
httpCode = http.POST(url); // Finaly Post the URL with this function and it will store the http code
if (httpCode == 200)      // Check if the responce http code is 200
{
  Serial.println("Sent ok."); // print message sent ok message
}
else                      // if response HTTP code is not 200 it means there is some error.
{
  Serial.println("Error."); // print error message.
```

```
String urlencode(String str)  // Function used for encoding
{
    String encodedString="";
    char c;
    char code0;
    char code1;
    char code2;
    for (int i =0; i < str.length(); i++){
      c=str.charAt(i);
      if (c == ' '){
        encodedString+= '+';
      } else if (isalnum(c)){
        encodedString+=c;
      } else{
        code1=(c & 0xf)+'0';
        if ((c & 0xf) >9){
            code1=(c & 0xf) - 10 + 'A';
        }
        c=(c>>4)&0xf;
        code0=c+'0';
        if (c > 9){
            code0=c - 10 + 'A';
        }
```

Figure 25: Implementation (Connection to WIFI)

5. Result and Discussion :

In the final stage, the project fulfilled the requirements related to it, such as setting the alarms, dropping the medication, and filling the patient's water cup at the required time, by communicating between both microcontrollers through a series of specific commands that are sent to the serial from the smart touch screen and then read to start the implementation of the mechanical part . The alarm sound is heard by an internal mp3 unit in the nextion screen and a loudspeaker.

The following figures shows the last shape for the Medicine Reminder Machine , as shown the machine is clear and comfortable to deal from the admin without any challenges.

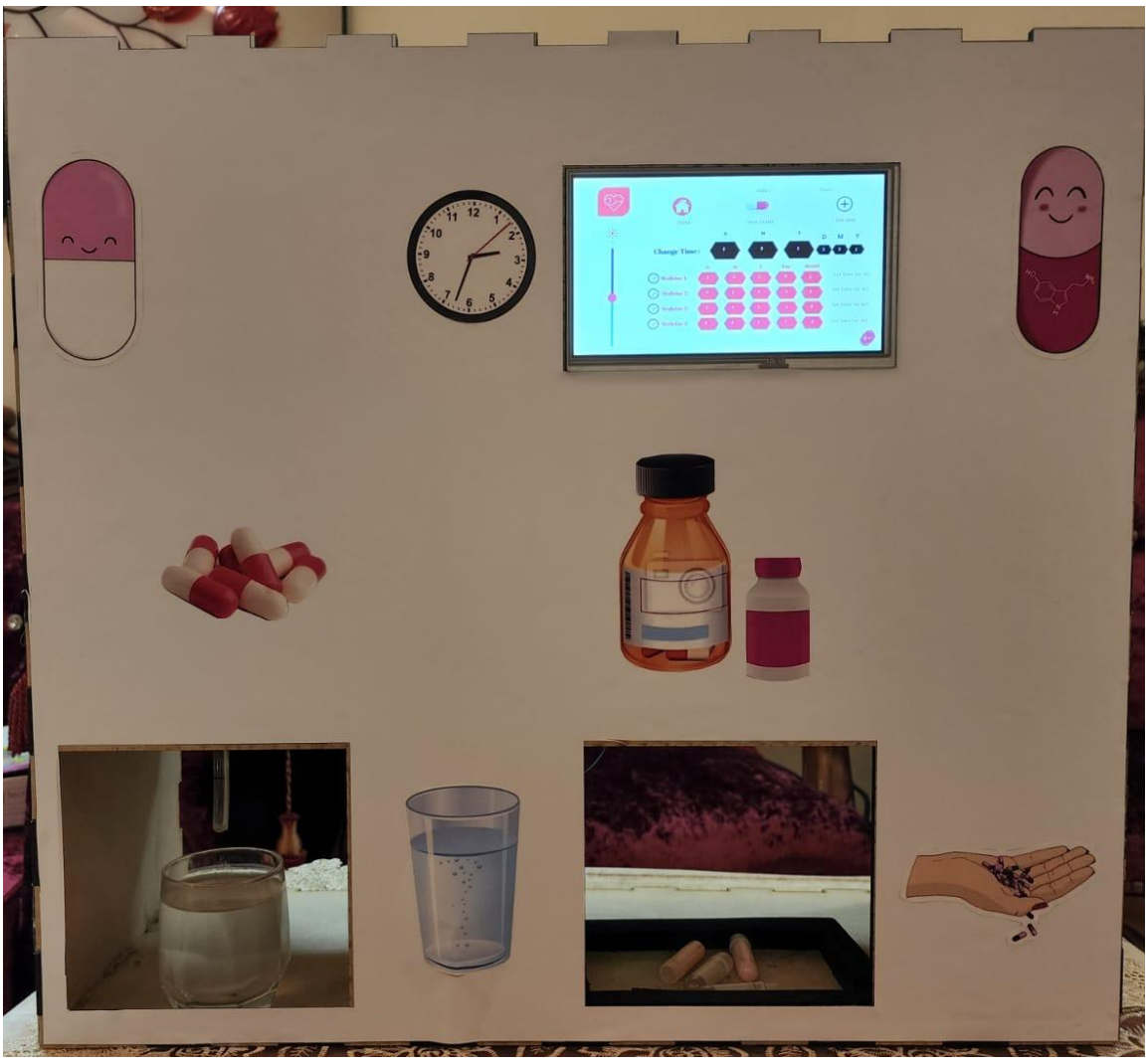


Figure 26: Results

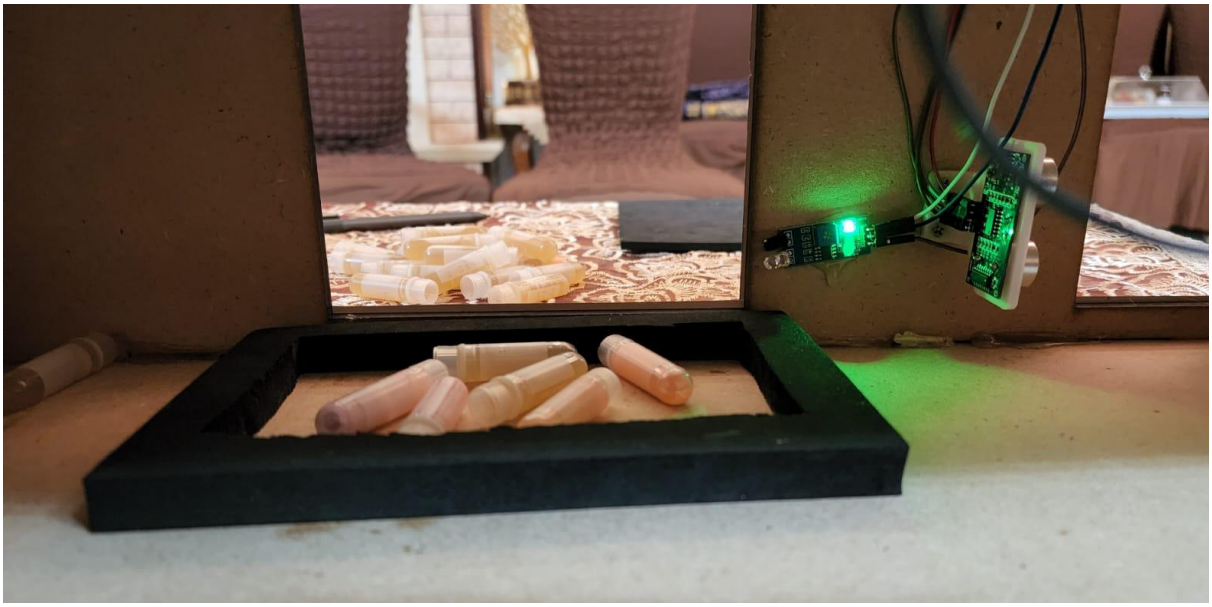


Figure 27: Results

6. Conclusions and Future work

In conclusion, the medicine reminder machine is a prototype that helps everyone who needs to take medicine for a long time without having someone to remind them of medicines and monitor them throughout the day and ensure that they get their medicine regularly and continuously without interruption, thus improving their health quickly. It consists of two main interconnected parts: a smart touch screen for the administrator to set the alarms, and the mechanical part responsible for ensuring that the patient receives the required medicine accompanied by a glass of water on time. Thankfully, we have achieved all the goals that were written in the first proposal.

While we were working we learned many new things about hardware components and how to connect them together while keeping in mind the calculations required to avoid damaging any component. We learned how to use and program ESP32, as well as how to work with the Nextion smart screen and how to program it with its own editor.

However, we had the problem of being restricted to summer term time. But for future work, we aspire to be a medicine reminder mechanism that can be used for more than one patient simultaneously, and it may be developed to accommodate more medicines, we also aspire to design a mobile application for it, and this will not be difficult because we have worked with a basic standard that can be developed easily.

7. References

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