

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



An-Najah National University
Faculty of Engineering and Information Technology
Computer Engineering Department

Graduation Project 2

Medical Assistant

Done by:
Amr Foqha
Abdelrahman Abboushi

Supervisor: Dr. Muhannad Al-Jabi

Submitted in partial fulfillment of the requirements for the
Bachelor degree in Computer Engineering

Jan-2025

Acknowledgment

“Last but not least, we would like to thank Dr. Muhannad Al-Jabi for his guidance and support throughout this project. His expertise, and constant encouragement were key factors in the success of this project. We are also grateful to our professors for their valuable advice and feedback, as well as our families and friends for their constant support and motivation.

Finally, we appreciate everyone who contributed to this project in any way, helping us complete it successfully.”

Disclaimer

This report was prepared by students Amr Foqha and Abdelrahman Abboushi from the Computer Engineering Department at An-Najah National University. It hasn't been officially reviewed or assessed, so it might contain some mistakes or inaccuracies. The ideas and recommendations in this report reflect only the authors' views. An-Najah National University assumes no responsibility or liability for any use of this report beyond its intended purpose

Table of Contents

Acknowledgment	2
Disclaimer	Error! Bookmark not defined.
Abstract	Error! Bookmark not defined.
1. Introduction	Error! Bookmark not defined.
1.1 Problem Statement.....	Error! Bookmark not defined.
1.2 Problem Objective	Error! Bookmark not defined.
1.3 Scope of work.....	8
2. Constraints, Standards and Codes and Earlier Work	Error! Bookmark not defined.
2.1 Constraints	Error! Bookmark not defined.
2.2 Standards / Codes.....	Error! Bookmark not defined.
2.3 Earlier work	9
3. Literature Review	11
4. Methodology	12
4.1. Technologies – Components.....	12
4.1.1 Esp32.....	12
4.1.2 Arduino Mega 2560	Error! Bookmark not defined.
4.1.3 Stepper motor.....	Error! Bookmark not defined.
4.1.4 LCD.....	Error! Bookmark not defined.
4.1.5 Temperature Sensor	14
4.1.6 Buzzer	Error! Bookmark not defined.
4.1.7 IR Obstacle Sensor.....	Error! Bookmark not defined.
4.1.8 Ultrasonic Sensor	Error! Bookmark not defined.
4.1.9 Keypad	16
4.1.10 ECG Sensor.....	16
4.1.11 Wires	17
4.1.12 RTC.....	18
4.1.13 Max 30100 sensor.....	18

4.1.14	H-bridge L298n.....	19
4.1.15	DHT Sensor	19
4.1.16	Stepper motor Driver A4988	20
4.1.17	DC-DC buck converter	20
4.1.18	RFID and Lock	21
4.1.19	FAN.....	21
4.1.20	Pumb and push button.....	22
4.2.	Design Part.....	23
4.2.1	Design on 3D printer.....	23
4.2.2	Design our project and some photo during we do our project.....	26
4.2.3	Mobile app.....	34
5.	Conclusion and Future Works.....	38
6.	References	38

Table of Figures:

Figure 1: Esp32	12
Figure 2: Arduino Mega 2560.....	12
Figure 3: Stepper Motor	13
Figure 4: 20x4 LCD	13
Figure 5: Temperature Sensor	14
Figure 6: Buzzer	14
Figure 7: IR Sensor	15
Figure 8: Ultrasonic Sensor.....	15
Figure 9: Keypad 4X4.....	16
Figure 10: ECG Sensors.....	16
Figure 11: male to male wires.....	17
Figure 12: male to female wires.....	17
Figure 13: female to female wires.....	17
Figure 14: RTC	18
Figure 15: Max 30100.....	18
Figure 16: H-bridge.....	19
Figure 17: DHT Sensor	19
Figure 18: Stepper motor driver.....	20
Figure 19: DC-DC buck converter.....	20
Figure 20: RFID and Lock	21
Figure 21: FAN	21
Figure 22: Water pump	22
Figure 23: Push button	22
Figure 24: Designed for 3D printer	25
Figure 25: Final project photo.....	33
Figure 26: Mobile app screens	37

Abstract

This project aims to assist elderly or chronically ill individuals, such as those with heart disease, diabetes, or Alzheimer's, by ensuring proper medication management. Its significance lies in providing comprehensive care by organizing and automating the process of taking medication at the correct time, reducing the common issue of forgetting doses. The system schedules medication times based on the patient's input, dispensing water for the patient to take their medicine. Additionally, it measures vital signs and sends the readings to a smartphone app, allowing full control over the medication schedule through the project's interface. When it's time for the patient to take their medicine, notifications and alerts are sent to remind them.

Patients can input their required medication times, Sensors capture patient vitals, displaying the readings in a smartphone app, control panel allows adjustments to medication times, and the system sends alerts to remind patients of their medication schedules.

1. Introduction

1.1. Problem Statement:

The efficacy of medications relies heavily on taking them at the correct time and in the proper dosage. Many elderly individuals and those with chronic illnesses, such as heart disease, diabetes, or Alzheimer's, face challenges in managing their medication schedules effectively. Forgetting doses, taking incorrect amounts, can lead to severe health complications. Despite the availability of medications and treatments, the lack of an organized and automated system for medication management often results in poor adherence to prescribed routines. This issue highlights the need for a solution that simplifies medication scheduling, reminds patients to take their medication on time, and monitors vital health metrics to ensure comprehensive and accessible care.

1.2. Problem Objective:

Creating a system that can store up to four different medications, each with up to nine pills, and set up the specific times for taking these medications is essential for effective medication management. This system would need to be programmed with the prescribed times for each medication using a mobile application. When it's time to take the medications, the system should automatically alert the person with an alarm and dispense the correct medications in the right timing. a system would help ensure proper medication adherence, significantly reducing the risk of. Additionally, this system would be particularly beneficial for older adults or individuals with cognitive impairments who may struggle with managing multiple medications. The patient can also perform a vital examination using sensors such as measuring blood oxygen levels, heart rate, body temperature, ECG, and displaying the readings on the smartphone application screen.

1.3. Scope of work:

Our project focuses on addressing the challenges individuals face in managing their medications, with particular emphasis on older adults and those with cognitive impairments, including Alzheimer's patients. Older adults often have complex medication regimens, increasing the likelihood of errors, such as missed doses.

Similarly, Alzheimer's patients and individuals with cognitive impairments may struggle to remember when to take their medications and adhere to the correct dosages. To address these challenges, our project introduces a reliable system designed to ensure proper medication adherence. This system aims to improve health outcomes, enhance the quality of life for patients, and reduce the burden on caregivers

2. Constraints, Standards and Codes and Earlier Work

2.1. Constraints:

1. Simple and Functional Design:

The application must meet all requirements while being easy to use, especially for older adults and people with cognitive difficulties. The design should be user-friendly and accessible.

2. Prototyping and Testing:

Time is needed to create prototypes, including 3D printing, and to test the product thoroughly. Delays in manufacturing, assembly, or feedback could affect the timeline.

3. Limited Budget:

The project must stay within the set budget, covering development, prototyping, testing, and any changes.

4. Regulatory Standards:

The product must follow safety, medical, and usability rules, especially if it's related to healthcare.

5. Storage and Environment:

The product must work well in different conditions and ensure proper storage of medications, like controlling temperature and moisture.

2.2. Standards / Codes:

We used Arduino IDE to write the code and test it into the Arduino mega 2560 and ESP32 for WIFI connection.

2.3. Earlier work:

• Microcontrollers:

This course covered microcontroller architecture, peripherals, timers, system interrupts, device interfacing, and serial communication. It provided the foundation for implementing hardware features in the project.

• Microcontrollers Lab:

Focused on practical applications using Arduino. The lab involved programming the pen controller logic with the Arduino IDE, utilizing external libraries and an Arduino UNO. Serial communication techniques learned here were crucial for ensuring the pen's portability and low latency.

- **Electrical Circuits:**

This course taught circuit analysis and helped in selecting appropriate resistors and sensors for the hardware project, ensuring effective microcontroller connectivity.

- **Digital Circuit Design:**

Topics like push-button debouncing techniques were applied to create a reliable hardware system with state-like architecture and minimal unintended effects.

- **Computer Networks:**

Focused on networking principles, especially wifi network in esp32.

- **Critical Thinking and Scientific Research:**

This course honed research skills, including studying resources online and learning LaTeX for producing scientific papers, which aided in project documentation.

3. Literature Review

Not taking medications as prescribed is a big problem that affects patients' health and increases healthcare costs. A study of 239 patients starting new medications for chronic conditions found that 55% of the 67 patients who didn't follow their medication schedule did so unintentionally (1). Using Reason's (1990) human error theory, the study explained that not taking medications properly can happen due to mistakes like taking the wrong tablet by accident (slips) or forgetting a dose (lapses), as well as intentional errors like making a wrong choice or ignoring the instructions.

Not taking medications as prescribed can lead to more visits to emergency rooms, longer hospital stays, and higher medical costs due to extra tests and treatments (Brickman & Yount, 1996; Rap off, 1999) (2).

Even though following prescriptions has clear benefits, many patients still struggle with taking their medications properly, which is hard to measure and fix. Research also shows that not taking medications as prescribed is linked to higher rates of hospitalization and death in older people (3). Managing and monitoring medication adherence is important to improve health outcomes, reduce hospital visits, and save on healthcare expenses.

4. Methodology

4.1. Technologies – Components:

4.1.1. Esp32:

We used Esp-32 to make a communication between user and our project by mobile application and we used the flash memory in it to make a text file (as database for our project) to help user know how many medicine keep in the box for example and we use it to show the Vital readings ECG, temperature , Oxygen percentage and heart rate that contact of the directly and finally the humidity and the temperature inside the project .

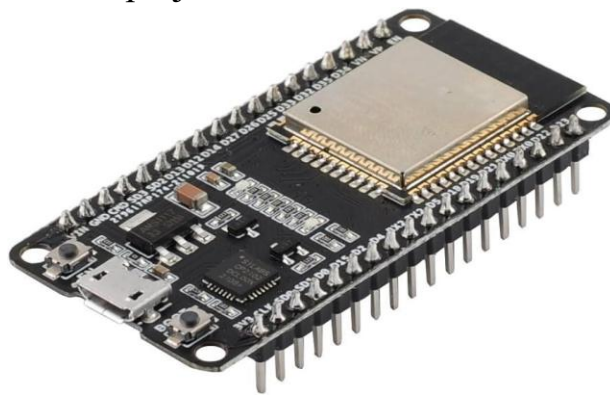


Figure (1): Esp32.

4.1.2. Arduino Mega 2560:

We used Arduino as a main controller for the machine in which it receives information from the esp32 using serial communication (RX, TX) and act accordingly and it control the sensors and the motors and lcd in the system.



Figure (2): Arduino Mega 2560.

4.1.3. Stepper motor:

We used the Stepper Motor to act as the main mechanical part to dispense a pill from each container when it gets a command from the Arduino when it's the time for the patient to take the medicine it will move, in which moves one sector of the container that stores the medicine.

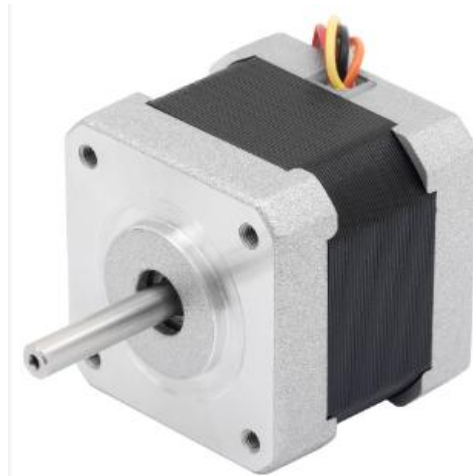


Figure (3): Stepper Motor.

4.1.4. LCD:

We used a 20x4 (20 characters, 4 lines) connected with Arduino by using I2C, to give the patient information about the system. For example, the name of medicine and the quantity and show the date and time.



Figure (4): 20x4 LCD.

4.1.5. Temperature Sensor:

We used temperature sensor to measure the patient's temperature by placing his finger on it and displaying it in the application.



Figure (5): Temperature Sensor.

4.1.6. Buzzer:

This buzzer used in our project to alert the patient of the medication appointment.

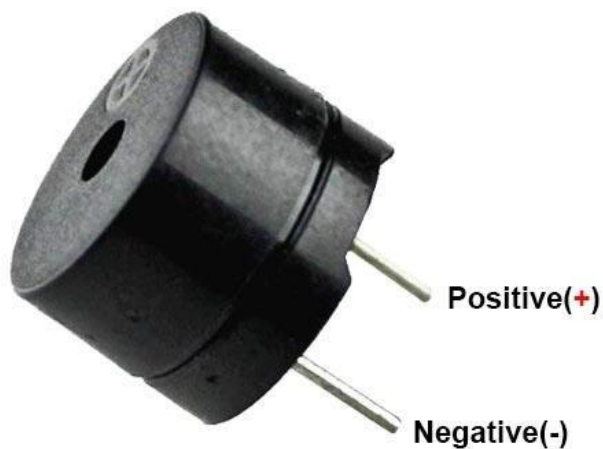


Figure (6): Buzzer.

4.1.7. IR Obstacle Sensor:

We used this sensor to decide if the medicine is arrived for user or not.

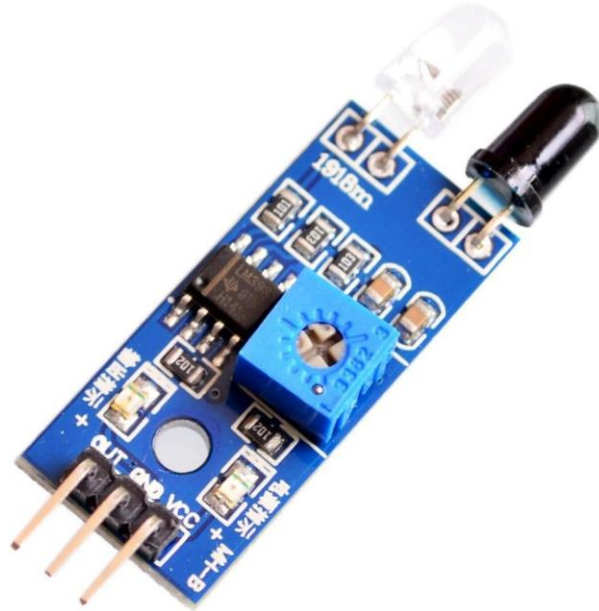


Figure (7): IR Sensor.

4.1.8. Ultrasonic Sensor:

We used this sensor to detect if there's water in tank or not and also display the percentage of water in tank and also to protect the pump from damage.

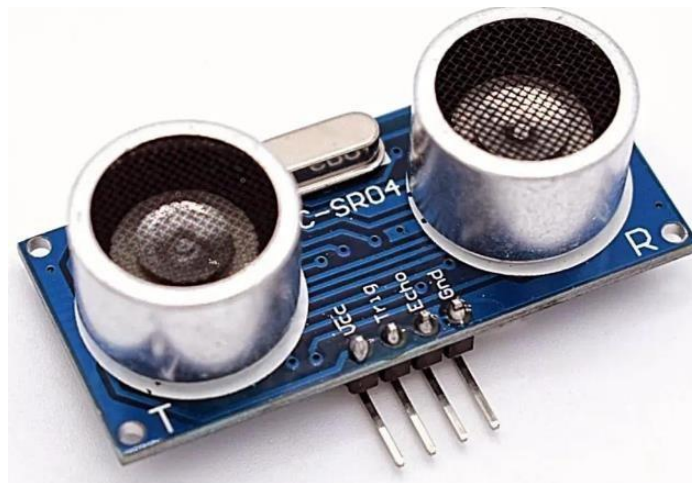


Figure (8): Ultrasonic Sensor.

4.1.9. Keypad:

We used keypad to be a second way for user to request the medicine manually or for emergency situations.



Figure (9): Keypad 4x4.

4.1.10. ECG Sensor:

We used the ECG sensor to Displays the patient's ECG on the app.

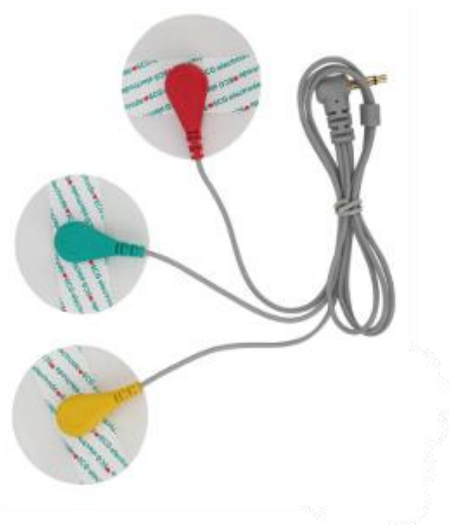


Figure (10): ECG Sensor.

4.1.11. Wires:

We used different type of wires to adapt to the type of connectivity for each component.



Figure (11): male to male wires.



Figure (12): male to female wires.



Figure (13): female to female wires.

4.1.12. RTC:

We used RTC to decode the real time and we display it on the lcd and decode the time for medicine that input by the patient by mobile app.



Figure (14): RTC.

4.1.13. Max 30100 sensor:

We used this sensor to display the Heart rate in addition to blood oxygen level on the mobile app.



Figure (15): MAX 30100.

4.1.14. H-bridge L298n:

We used it to drive water pump, dc fan and solenoid lock.



Figure (16): H-bridge L298n.

4.1.15. DHT Sensor:

We used this sensor to measure the humidity and the temperature inside the project.

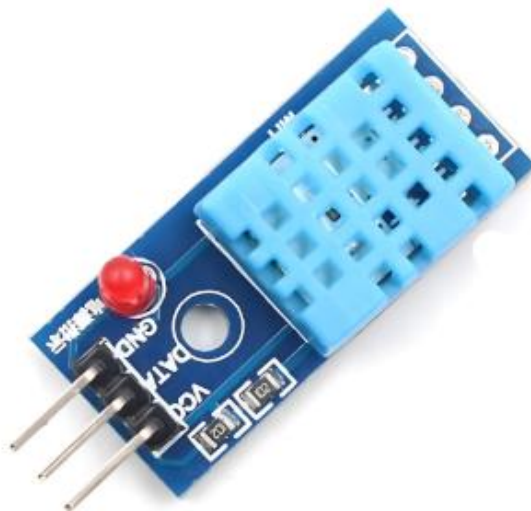


Figure (17): DHT Sensor.

4.1.16. Stepper motor Driver A4988:

We used this driver to drive stepper motors based on signals from Arduino.



Figure (18): Stepper motor driver.

4.1.17. DC-DC buck converter:

We used this component to step down the voltage to 5V used in Arduino, lcd, ESP-32, etc.



Figure (19): DC-DC buck converter.

4.1.18. RFID and Lock:

We used RFID (Card reader) and the lock on our project to protect the medicine from children and to provide a healthy environment for the medicine.



Figure (20): RFID & solenoid Lock.

4.1.19. FAN:

We used the fan to control the inner temperature and protect the medicine and provide the suitable environment for it.



Figure (21): FAN.

4.1.20. Pump and push button:

We used this for bottling water to drink the medicine.



Figure (22): Water pump.

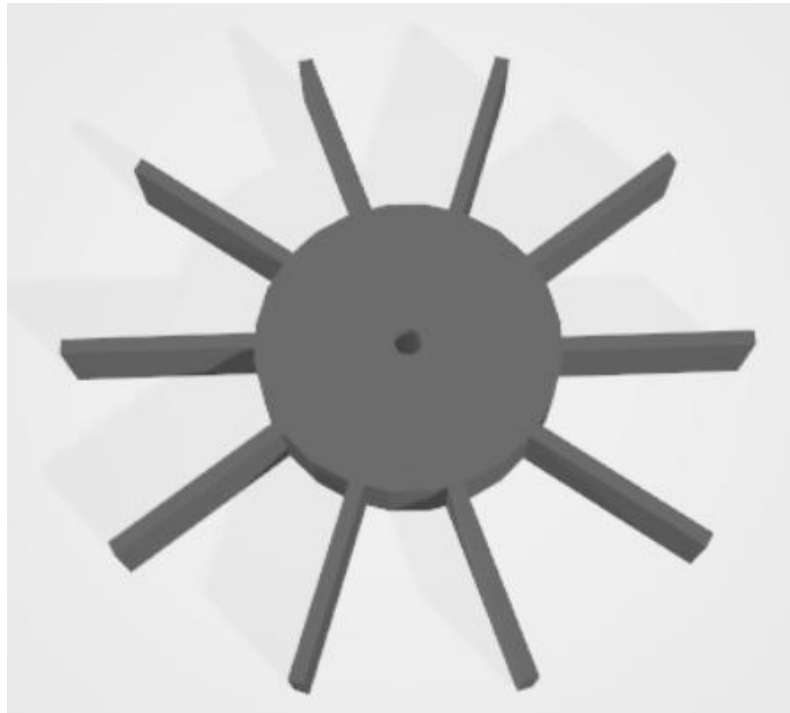


Figure (23): Push button.

4.2. Design Part:

4.2.1. Design on 3D printer:

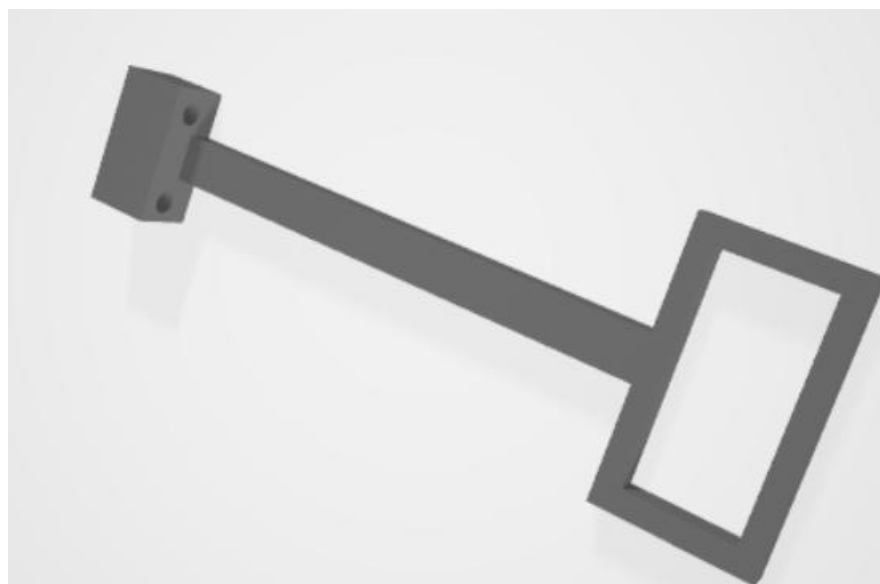
We designed these slot cases on 3D printer we make 4 for different medicine:



We designed this for lock on 3D printer.



We designed this carrier on 3D printer for the Ultrasonic to monitor the amount of water in the tank.



We designed this tank water on 3D printer.

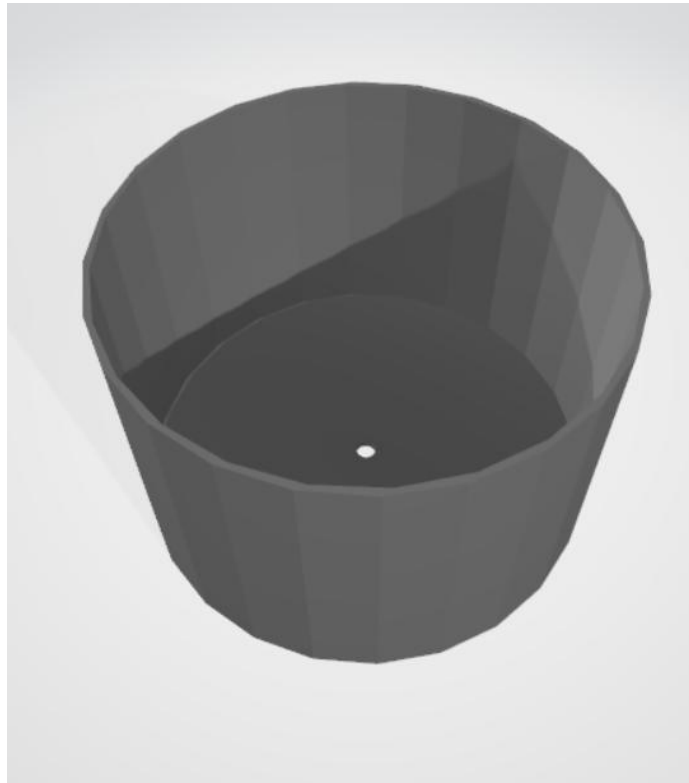


Figure (24): Designed for 3D printer.

4.2.2. Design our project and some photo during we do our project:

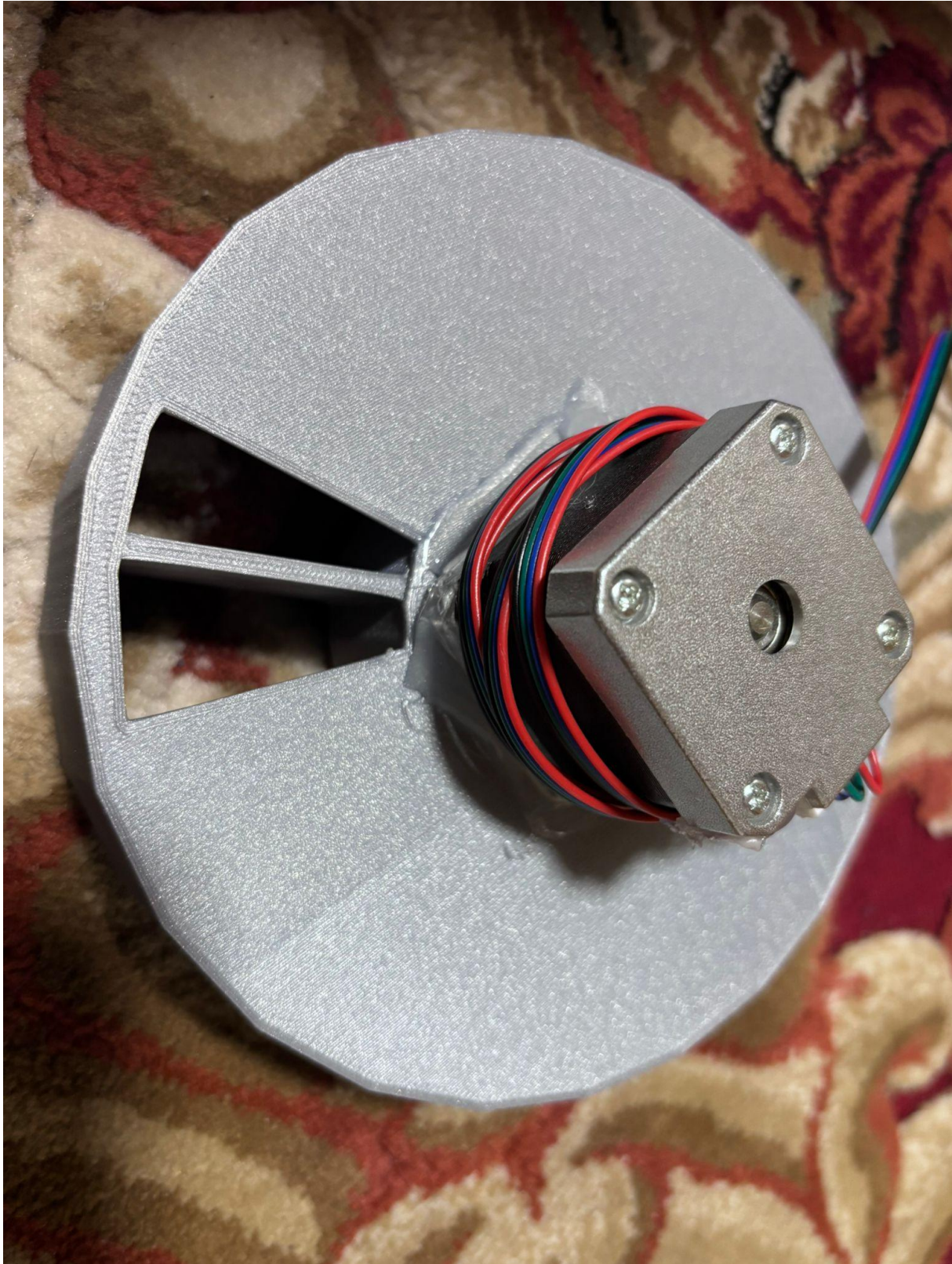
Here after we put the pump for tank.



Here the lock .



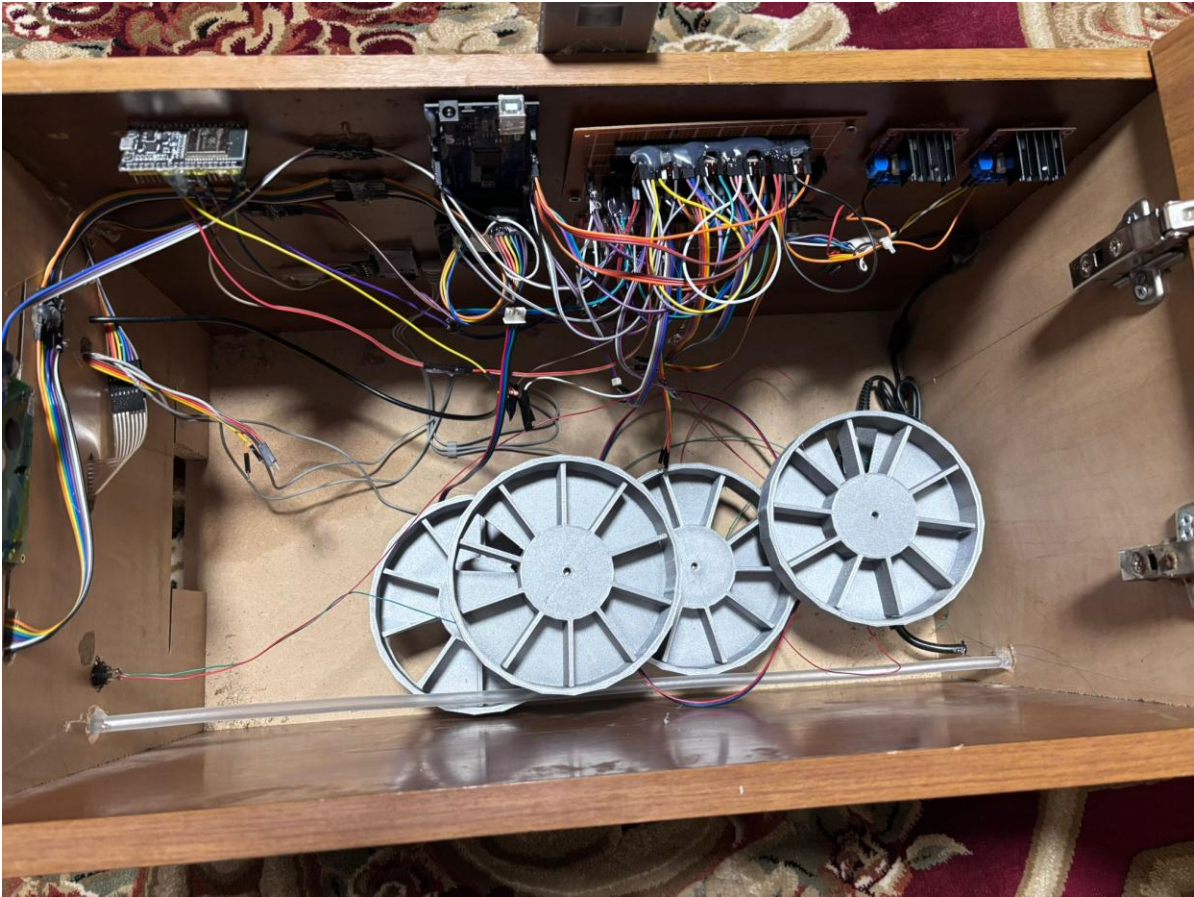
Here after we installing the stepper motor on the slot.



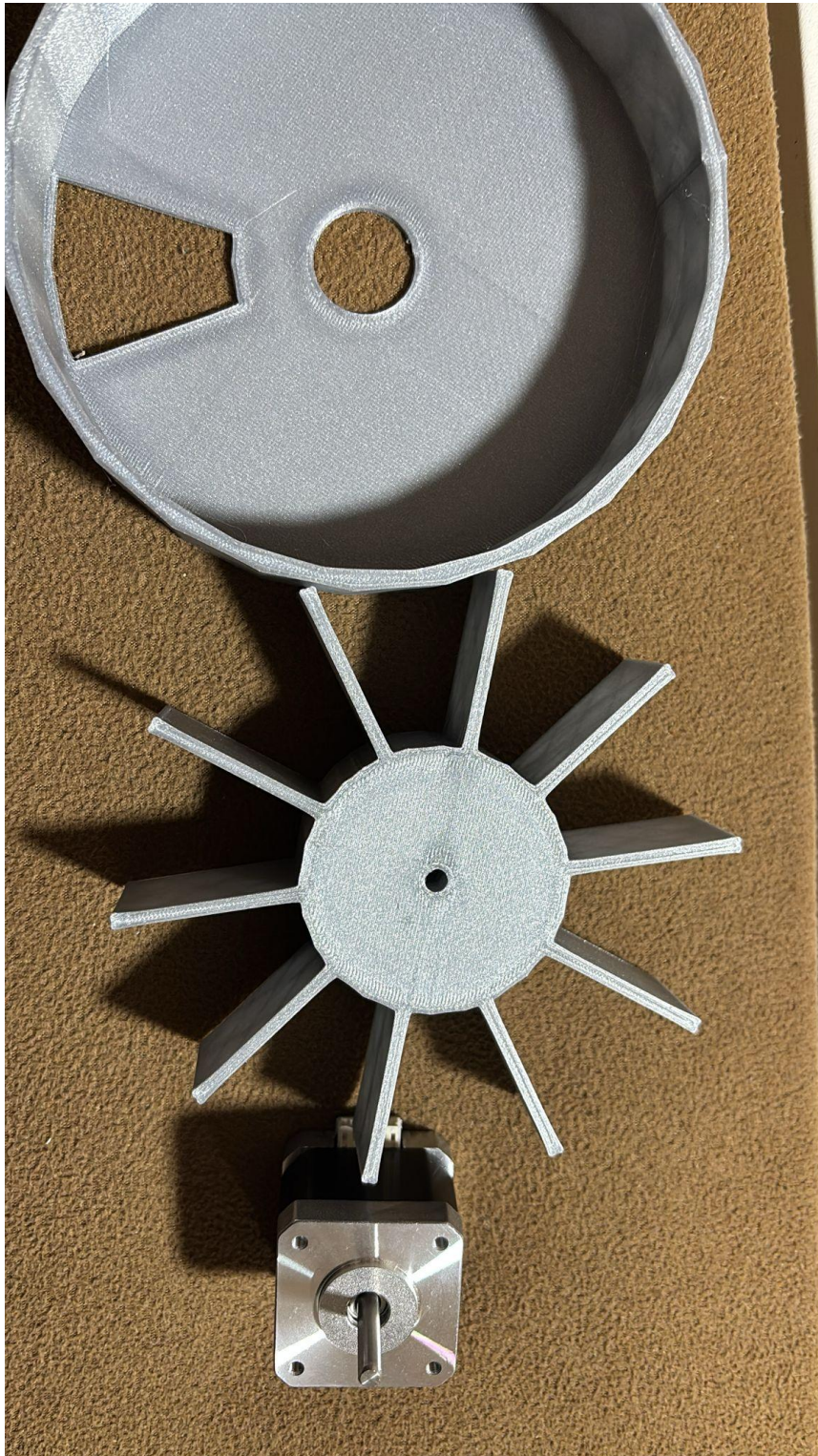
Here the interface of our project after we put every thing.



Here inside our project as shown.



Here after ending print on 3D printer.



Here final submission.

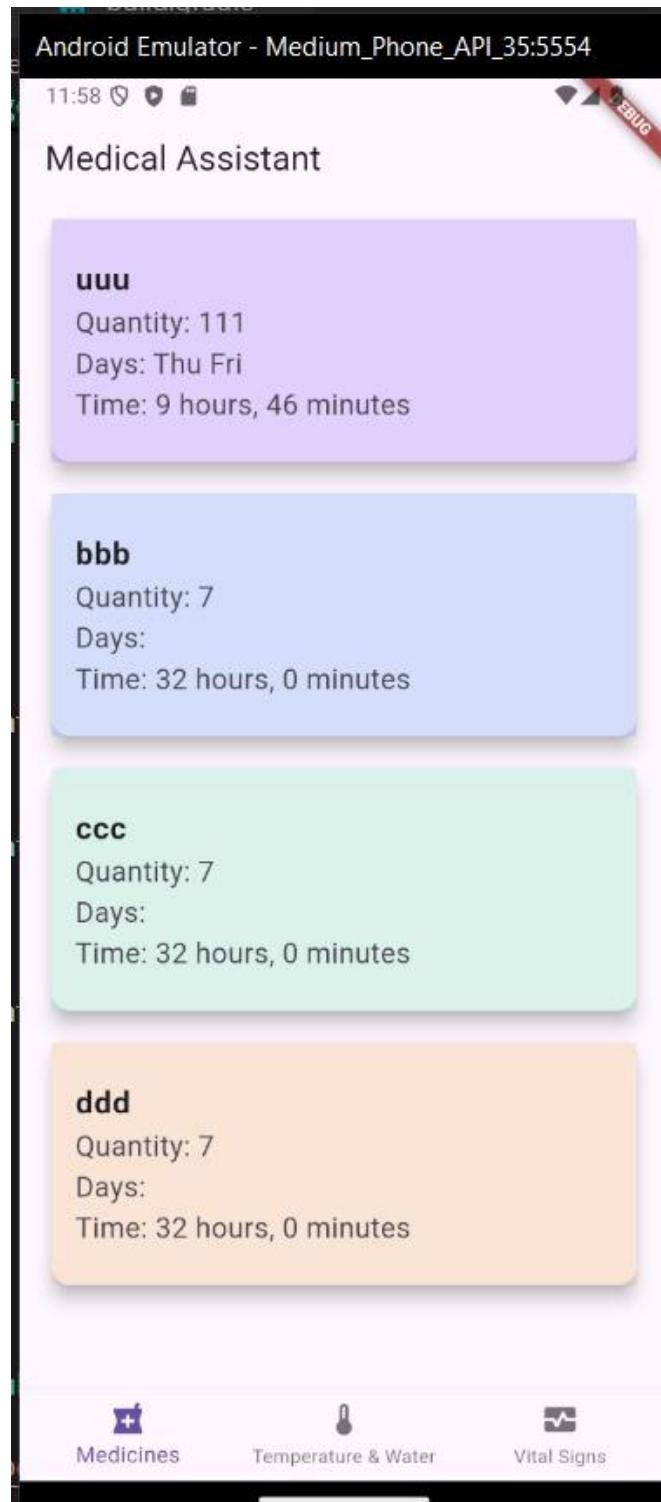


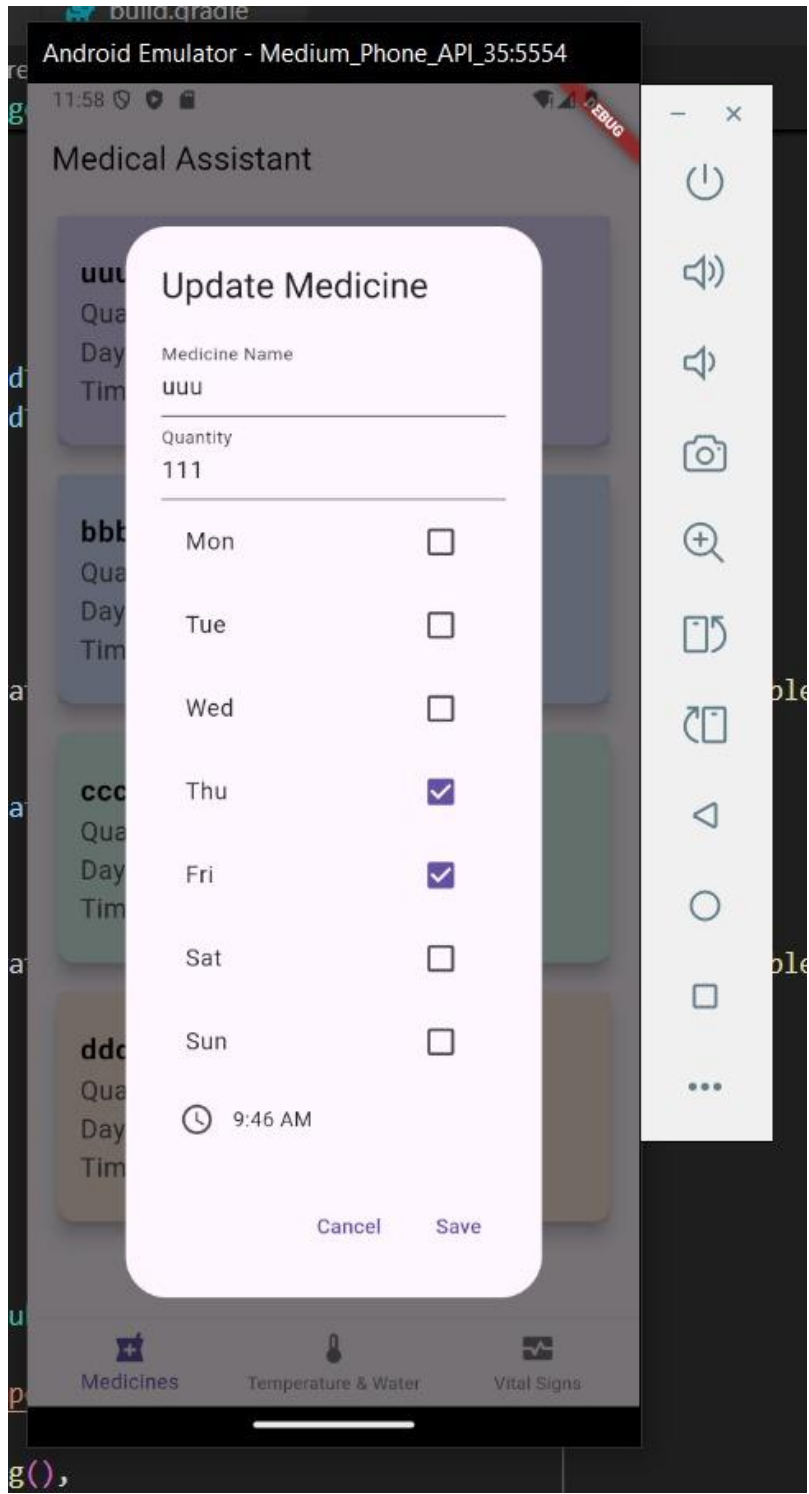


Figure (25): Final project photo.

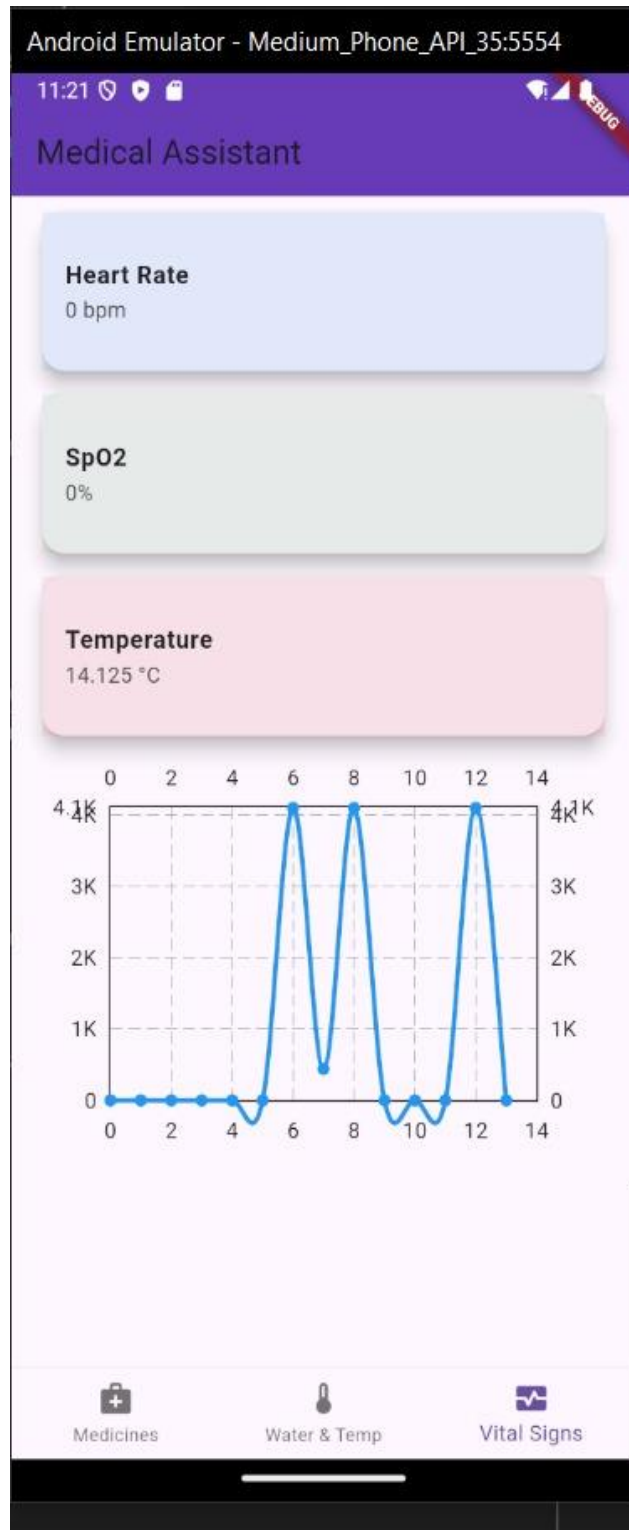
4.2.3. Mobile app:

The patient or caretaker can sync the device's time, set the medicine schedule, and track the remaining pills in each container and enter the medicine name.





Here The patient or caregiver can see the patient's vital readings.



Here the patient or caregiver can see the amount of water in the tank and the temperature and humidity inside the project.

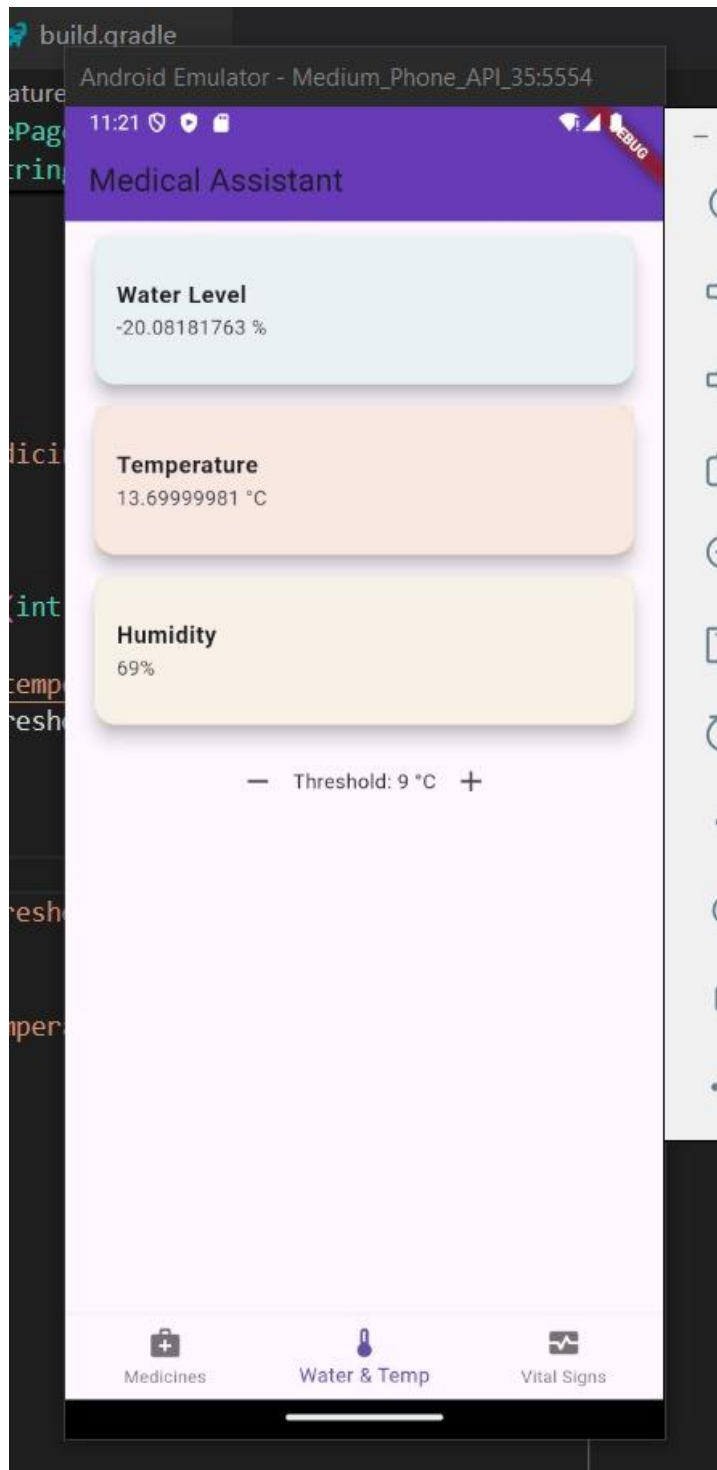


Figure (26): Mobile app Screen.

5. Conclusion and Future Works.

5.1. Future Works:

1. Add more sections for each medicine to store more pills & different types of medicine.
2. When the patient performs his vital tests and these readings are abnormal, project calls the emergency room and gives the patient the appropriate medication pill.
3. Give the patient more than one pill in the day if this requires in his medical prescription.

5.2. Conclusion:

We have made a simple and easy project to deal with, taking into account the elderly, which contains many advantages, most notably scheduling medication appointments for patients to facilitate the process of taking medication and reduce the burden on their caregivers, and measure some vital readings of patients and display them on the mobile application.

6. References:

- [1] R. Horne et al., "Concordance, adherence and compliance in medicine taking," NCCSDO, London, 2005, no. 40, p. 6
- [2] N. Zelikovsky and A. P. Schast, "Eliciting accurate reports of adherence in a clinical interview: development of the Medical Adherence Measure," *Pediatric Nursing*, vol. 34, no. 2, pp. 141-146, 2008.
- [3] C. A. Walsh, C. Cahir, S. Tecklenburg, C. Byrne, M. A. Culbertson, and K. E. Bennett, "The association between medication non-adherence and adverse health outcomes in ageing populations: a systematic review and meta-analysis," *British Journal of Clinical Pharmacology*, vol. 85, no. 11, pp. 2464-2478, 2019.