



An-Najah National University  
Faculty of Engineering & Information Technology

Presented in partial fulfilment of the requirements for Bachelor  
degree in Computer Engineering

## Graduation Project 2

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# Pet Sitter

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## **Disclaimer statement**

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## **Abstract**

Our machine is the best solution for you if you have pets at home and you are a person who spends a lot of time outside the home, or you travel frequently. Pets require special care and there are essential needs that should be considered, which are their food, water and litterbox.

To control all these essentials while you are abroad, we provide a complete implementation that ensures multiple things: serve pets with their daily food meals, keep the water available all the time and filtered also change it if it is impure. The main challenge for pet owners is the litterbox which needs to be cleaned frequently, but in our machine, we provide a smart cleaning method without any effort from you by a strainer which will clean the sand by extracting the dirt from it and get rid of it, also, filling the litter box with sand when the sand amount goes under a specified level.

We will let you control everything with a mobile application that allows you to choose the service you want and monitor the food, sand quantities and water level. For food, you can choose between two categories dry or wet, the number of food plates and the time you want to serve the meal. Regarding the water part, you can control the purity of water and change it when needed by refilling the water bowl after draining all water inside it. As we mentioned, the litterbox has a special cleaning method, in addition, you can choose to refill the sand after cleaning it and keep it at a specific height level.

After doing our research, we found a similar idea done before but it was a robot that follows the pet and serves it with only food and water. Also, in the market, you may find some solutions that still require physical effort from the owner and do not contain all the services. However, our idea is an enhancement to provide an automated full care system for pets that covers all their needs.

# **Chapter 1: Introduction**

## **1.1 Statement of the problem**

The goal of the Pet Sitter is to offer completely autonomous features that other projects were unable to deliver. particularly the inability to manage the entire system with a single, straightforward mobile application. The owner must have a comfortable setup that meets all the demands of the pet.

## **1.2 Objectives of the work**

Our project's goal is to create an effective system that can clean and filter water, deliver cat food and maintain a clean litter box, all while providing a comfortable living space for the cat and its owner. Our device is simple to operate and provides immediate data regarding the amounts of food, water, and sand based on readings from the sensors. Our goal is to provide the owner with the best machine possible, so they won't have to worry about their cat's needs when they're busy.

## **1.3 Scope of the work**

In order to choose the fundamental parts of our project, we first gathered all the necessary components, starting with the main controller, motors, drivers, water pumps, sensors, and convey belt. In order to begin using these parts appropriately, the following step was to begin with their manuals. Our primary problem was creating our machine with distinct parts for each of our three main functions because we needed to keep the cat secure. Subsequently, we began inserting the algorithm flow lines into our code, making sure that the procedure followed the right, seamless sequence. To ensure that the performance is ideal we tested every feature independently. At last, we began compiling all the features needed to give the primary, flawless functionalities.

## **1.4 Significance of our work**

Because our lives are busier these days, a cat owner might not be able to meet all his pet's needs promptly. The ideal option for them is a smart machine that they can operate via a touch screen when they're feeling fatigued or a mobile app when they're away. Without requiring a single human hand, it will bring food, water, and automatically clean the litter box. All that is required of you is a single button click to complete the task. The food will not go bad even if the cat doesn't finish it since it will fall back into a backup container. The cat will be encouraged to drink water by a tiny, adorable fountain, and after cleaning the litter box, a drawer will store the litter. To determine when to replace the food and sand containers, you can keep an eye on their remaining amounts. We offer a distinct, comprehensive solution that is efficient and easy to use.

## **1.5 Organization of the report**

There are five chapters in this report. The introduction provides an overview and an overall background to the topic. It highlights the importance of our work. The prior efforts and projects are covered in the second chapter. The project's methodology, including a brief description of the hardware and software implementation and the components that were employed, is presented in the third chapter. The fourth chapter, which summarizes the findings, talks about a few issues and how we resolved them. The final chapter summarizes our real learnings, future research directions, and recommendations.

# Chapter 2: Theoretical Background and Previous Work

## 2.1 Literature review

### "Household smart cat litter box"

The design and construction of a completely automated litter box that can replace cat litter and handle the tasks of separating, sealing, and disposing of cat waste without the need for human involvement is presented in this work. The purpose of the paper is to address the issues that cat owners encounter with cat feces related to smell, hygiene, and convenience.

The research background and significance, overall design, module design, innovation and benefits, application potential, and conclusion are the five sections that make up this article. The following subjects are covered in the paper's review of essential literature:

- The issues associated with disposing of cat feces and the expansion and demand of the pet cat market in China.
- The circular shell, the litter separation mechanism, the sealing mechanism, the sand feeding mechanism, and the lower box movement mechanism are some of the mechanical concepts and design techniques of the litter box.
- The litter box's control system and human-computer interface, which includes the ESP-32, Arduino MEGA 2560, pressure, ultrasonic, and infrared sensors.

According to the report, the litter box offers the following benefits and innovations:

- Completely automated system that minimizes the time and effort required to process cat excrement.
- Using hot melt rods to seal the garbage bags effectively blocks smells.
- Real-time information and reminder delivery to the owner through wireless communication and sensors.

The study concludes that litter boxes are a competitive and promising product that can enhance cat owners' lives and experiences. The study also makes some recommendations for future research, including ways to make litter boxes safer, more aesthetically pleasing, and more reasonably priced. [1]

### "Pet Feeding System"

This research is about a pet feeding system based on Internet of Things (IoT). It describes the design and development of a prototype that can feed and monitor pets remotely using a web application, a raspberry pi, a servo motor, and a webcam. It also reports the results of a survey that shows the potential demand and usefulness of the system. The article suggests some possible applications of the system in the future, such as in zoos, pet shops, and wildlife departments. [2]

### **"Automatic or semiautomatic cat litter box"**

The research paper presents a compact, simple cat litter box and cleaning mechanism. It features a pivotable door, a rotating sifting screen, and a waste collection container. The device overcomes issues like manual handling, unpleasant odor, and space requirements, offering a convenient and hygienic cleaning method. [3]

## **2.2 Related articles**

### **"Buying a Cat Water Fountain? Here's What to Know"**

The primary advantages of providing your cat with a water fountain are outlined in this article. There are several advantages when using a cat water fountain for your beloved cat. By offering fresh, clean, flowing water -which is more enticing than stale water in a bowl- it can aid in your cat's hydration. Encourage your cat to drink more water to avoid health issues like kidney stones, urinary tract infections, and dehydration. Additionally, it can help you save time and money by lowering the frequency with which you need to buy your cat bottled water, refill the bowl, or replace the water. Giving your cat a water fountain is a wonderful way to express your love and concern for them. [4]

### **"Smart Litter Boxes: What You Need to Know"**

The article discusses smart litter boxes, which are devices that remove and clean cat waste on their own. They function by separating the waste from the litter and storing it in a compartment using sensors and a cleaning mechanism. Time savings, odor reduction, and freshness are just a few advantages of using an intelligent litter box. They do have several disadvantages, though, such the fact that they are pricey and need specialized litter and accessories. Additionally, the article offers some advice on how to gradually introduce a cat to a smart litter box, considering the cat's age and attitude. [5]

### **"What Are the Benefits of An Automatic/Smart Pet Feeder?"**

The advantages of providing your pet with an automatic pet feeder are discussed in the article. It describes how you may maintain your pet's health and happiness while simplifying your life using an automatic pet feeder. Additionally, it introduces several kinds of automatic pet feeders, such as smart feeders and basic feeders. [6]

# Chapter 3: Methodology

## 3.1 Standards and specifications

In our project, we have written 3 main pieces of code which are for the Arduino Mega, ESP32 and Arduino Uno (for the touch screen) which were implemented using the Arduino IDE in C++ language that includes several libraries such as Servo.h, Stepper.h, NewPing.h, WiFi.h, Firebase\_ESP\_Client.h and others that helped to done the needed functionalities. The mobile application developed using App Inventor and for data storage, the Firebase database was used. The software and hardware implementation follows the predefined industry standards.

## 3.2 Hardware components

In this section we are going to talk about all the hardware components we used and why we used each one of them:

### 3.2.1 Microcontrollers

#### Arduino Mega 2560

The Arduino Mega 2560 is a versatile microcontroller board that serves as an extended version of the Arduino Uno. It boasts an ATmega2560 microcontroller at its core, providing a generous array of digital and analog pins, memory, and computational power with 54 digital I/O pins, 16 analog inputs, and a larger flash memory capacity. We initially used the Arduino Uno, but as the number of components increased at each step, we switched to the Arduino Mega 2560. The Arduino Uno's limited number of pins was insufficient for all the components, making the Arduino Mega 2560 the main controller in our system. [7]



Figure 3.1: Arduino Mega 2560

#### ESP-WROOM-32

The ESP32-WROOM-32 is a feature-rich microcontroller module that stands out for its advanced capabilities. It offers a blend of Wi-Fi and Bluetooth connectivity with 520KB of RAM and 4MB of flash memory, the module provides ample storage and computational resources. It has an extensive set of peripherals includes GPIO pins, SPI, I2C, UART interfaces, and analog-to-digital converters. The ESP32-WROOM-

32 supports low-power modes and secure boot and flash encryption to enhance the security of embedded systems.

Our project includes a mobile application to remotely control the whole system so we used the wireless feature of ESP-WROOM-32 to take the commands from the mobile application and send them to the Arduino Mega through serial communication to handle them, also, it is used to receive the sensors values come from the Arduino Mega and store them in Firebase in order to display these values in the mobile application.



Figure 3.2: ESP-WROOM-32

### **Arduino Uno**

We have a touch screen and it needs a lot of pins to be connected to the microcontroller, so we used the Arduino Uno as a shield for the touch screen to handle the commands come from the touch screen and send them serially to the Arduino Mega and also send the sensors values from the Arduino Mega to display the project status on the touch screen.



Figure 3.3: Arduino Uno

### 3.2.2 Motors and drivers

#### Servo motor

A servo motor is designed for controlling the position of an object with remarkable accuracy. Unlike typical motors, servos are equipped with a built-in feedback mechanism, usually in the form of a potentiometer, allowing them to continuously adjust their rotational position based on external commands. They come in various sizes and torque ratings.

In our project, Servo motor MG995 was used because of its high torque (maximum torque of around 10 kg/cm). We used four Servos: three of them were employed to regulate the dispensing quantity of dry food, wet food and sand and the last one controlled the opening and closing of the litter box door.



Figure 3.4: Servo Motor MG995

#### Stepper motor

A stepper motor is a specialized type of electric motor designed for precise control of angular movements. A stepper motor divides a full rotation into a series of steps, allowing for accurate positioning without the need for feedback mechanisms. It operates by receiving electrical pulses from a controller, causing it to move in discrete steps. They come in different configurations, including bipolar and unipolar, offering flexibility in terms of torque and speed. The distinct feature of stepper motors is their ability to maintain position even when power is off, making them well-suited for applications requiring stability and reliability in positioning.

In our project, we used 2 types of stepper motors: the first one was Stepper motor NEMA23 that offer a higher torque-to-size ratio which used to rotate the food plates belt that made from iron and we connected it to YS-DIV268N driver, the second one is Stepper motor NEMA17 which used to control opening and closing the dirt drawer by moving the timing belt to drop the dirt after cleaning the litter box and we used the H-bridge L298N to drive the motor. [8]

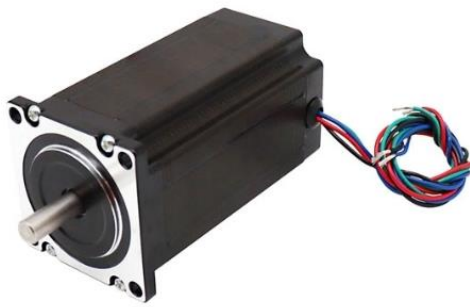


Figure 3.5: Stepper motor NEMA23



Figure 3.6: YS-DIV268N driver

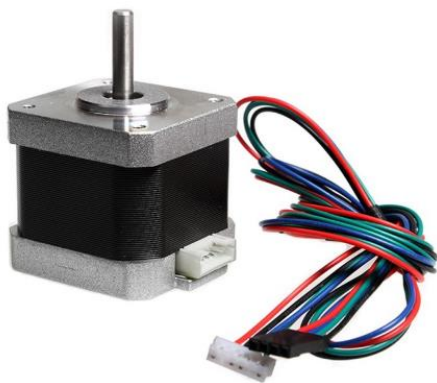


Figure 3.7: Stepper motor NEMA17

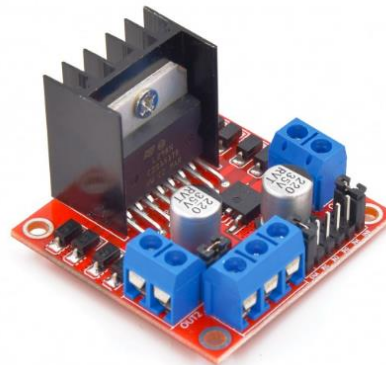


Figure 3.8: H-bridge L298N

## DC motor

A DC (direct current) motor is an electric motor that converts electrical energy into mechanical motion through the interaction of magnetic fields. It operates on the principle of Faraday's law of electromagnetic induction, where a current-carrying conductor placed in a magnetic field experiences a force. In a DC motor, this force leads to the rotation of a shaft.

We used the DC motor in order to move the timing belt that holds the sand strainer forward and backward inside the litter box to remove the dirt and we connected it with H-bridge L298N to drive the motor. [9]



Figure 3.9: DC motor

### 3.2.3 Sensors

#### IR sensor

An Infrared (IR) sensor is a type of electronic device designed to detect and respond to infrared radiation. An IR sensor can detect the presence or absence of an object by emitting infrared light and measuring the reflection or absorption of this light by the object.

There are five IR sensors were used in our project: three of them to detect the amount of the dry food, wet food and the sand (if the containers full or need to refill them), while the fourth used to detect the level of sand inside the litter box and the last one used to detect presence of the pet in front of the water bowl and turn on the fountain if a pet detected.

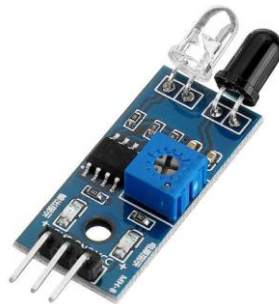


Figure 3. 10: IR sensor

#### Ultrasonic sensor

An ultrasonic sensor emits high-frequency sound pulses and measures the time it takes for these pulses to bounce back after hitting an object, using the echo to calculate the distance between the sensor and the object.

Because of its circular wave, we used it in our project to detect if there is a pet within a specified distance in food and litter box sections: the first one is above the food plates belt so if a body detected above the belt and there is a command from the user to put food, then don't put food and don't rotate the belt (safety reason) and the second one is inside the litter box to detect if there is a pet inside it or not before cleaning the box (safety reason).



Figure 3.11: Ultrasonic sensor

#### Water level sensor

A water level sensor is a specialized device engineered to precisely measure the presence and depth of liquid. Utilizing various detection methods, such as

conductivity or capacitive sensing, the sensor can detect and measure the depth of individual water droplets. This level of precision is particularly valuable in situations where minute changes in liquid levels are critical for maintaining optimal conditions.[10]

We used it to measure the level of water in the water bowl and when it goes under a specified threshold, fill the water bowl until it becomes full.

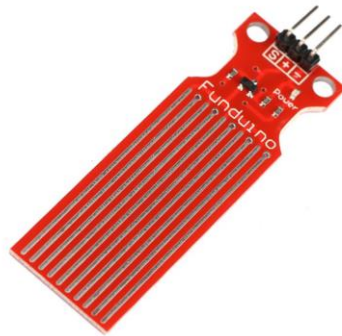


Figure 3.12: Water level sensor

### 3.2.4 Other components

#### Water pump

In our project, we employed five water pumps for various purposes. Two of them were dedicated to cleaning the food plates – the first one for washing the plates and the second for draining the used water. The remaining three water pumps were assigned to the pet water section: one for filling the bowl, another for draining water from the bowl, and the last one for creating a fountain effect inside the bowl.

Since the water pumps operate when connected to 12 volts, they remain continuously powered. To regulate when the water pumps are active, we used relay modules – one for each pump – allowing convenient control to turn them on or off as needed.



Figure 3. 13: Water pump



Figure 3. 14: Relay module

## Fan

We used it in the food section especially in cleaning food plates. After cleaning food plates with water, the plate will go above the fan and then the fan will be turned on in order to dry the plate. To control turning the fan on and off, a relay module was used to connect between the Arduino Mega and the fan.



Figure 3.15: Fan

## Power supply

We used it because it gives different voltages that we need such as 5 volt and 12 volts also it gives a sufficient and suitable output current for our components.



Figure 3.16: Power supply

## Tubes

We connected them to the water pumps.



Figure 3.17: Tubes

### Timing belt and Gears

We used them in the litter box section to control opening and closing the dirt drawer (with Stepper motor NEMA17) and to move the sand strainer to remove the dirt (with the DC motor).



Figure 3.18: Timing belt



Figure 3.19: Gear

### Wires

We used different types of wires: male-to-female, male-to-male and female-to-female.



Figure 3.20: Wires

### Intercom wires

We used them to make the final connections for all components.



Figure 3.21: Intercom wire

### **Belt**

This belt is made from iron, we used it to serve the food (like plates).



Figure 3.22: Belt

### **Touch screen**

We used it to perform basic functionalities such as: empty water bowl, fill water bowl and fill litter box with sand and also used to show the sensors values.

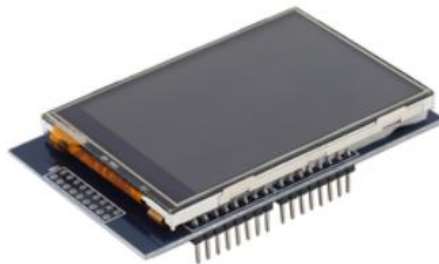


Figure 3.23: Touch screen

### **3.3 Hardware implementation**

We have three main sections in our project, which are: food section, water section and litter box section. In this part, we are going to talk about the detailed implementation for each section.

#### **3.3.1 Food section**

The main component is the belt which used as movable food plates and connected to a NEMA23 Stepper motor to rotate it. This section comprises two parts: the first part serves food for the pet, it has an ultrasonic to detect if there is body on top of the belt before moving it, it includes two containers for dry and wet food, each equipped with an IR sensor to monitor the food levels and each container has a servo motor to regulate the amount of food dispensed. The second part is dedicated to cleaning used plates. As the belt rotates from top to bottom, it releases excess food into a backup container before entering the cleaning section. The cleaning section contains two water pumps, one for plate washing and another for draining the used cleaning water and both placed in a container to hold the water. Following the wash, a fan facilitates plate drying.

#### **3.3.2 Water section**

This section is for offering drinkable water for the pet, it consists of an IR sensor and three water pumps: the first one used for filling the water bowl, the second one used to drain the water from the water bowl and the last one is used to offer a fountain effect inside the bowl when the IR sensor detects a close body in front of the water bowl. The last component is a water level sensor to monitor the level of water inside the bowl.

#### **3.3.3 Litter box section**

In this section we have three components, the first one is the litter box which contains an IR sensor to monitor the sand level inside the box, an ultrasonic sensor to detect if there is a pet inside the box before cleaning it, DC motor with timing belt and a gear to move the sand strainer from the back of the box to the front to clean the sand by removing the dirt and the last element in the box is a servo motor connected to the box door in order to open it to facilitate disposal of the dirt. The second component is the dirt drawer, designated for holding the dirt after cleaning the litter box, we used a stepper motor NEMA17 with timing belt and gear to open and close the drawer.

The third component is the sand container which contains an IR sensor to monitor the level of sand inside it and a servo motor to regulate the amount of sand dispensed into the litter box.

We used a touch screen to perform some basic commands which are divided between the three predefined sections: for food section, show the status of the food containers (dry and wet food) if they are full or should refill them. For water section, show the level of water inside the bowl, drain the water from the water bowl and refill the water bowl. For the litter box section, show the status of the sand container it is full or should refill it, refill the litter box with sand, open dirt drawer (if the user wants to remove the dirt bag) and close dirt drawer.

### 3.4 Software implementation

The user that owns our project has three sections to manage, which are: food, water and litter box.

First, in the food section, the user is asked to choose the food type, either dry food or wet food and then specify the number of food plates to be served. These values will be stored in the database. If there is no body detected on the belt the amount of the chosen food will be checked, if the container has sufficient amount of food, then the process of serving food will start, but if no food exists in the container or a body detected it will not serve food and will let the user know. Another thing can be managed in this section is cleaning food plates, when the user chooses clean food plates, the firebase will be checked if there is used plates or not, if yes then the cleaning process will start to clean all the used plates but if there are no used plates then a notification will appear to the user saying that no plates to clean. The last functionality is monitoring level of food, the amount of food in each container is stored in the database after any change happened and the user can see them at any time.

Second, the water section, it always checks if there is a pet close to the water bowl, if yes then the water fountain will be turned on automatically to encourage the pet to drink water and after this the level of water in the bowl will be checked, if it goes under the specified threshold then the water bowl will be filled until the water level sensor reads full, which will ensure that the water bowl is full all the time without the need for human checks. Another three things are draining all water from the water bowl, filling water bowl with water until it is full and monitoring the level of water in the bowl, which is stored in the database after any change happens (to let the user ensure that the bowl is always full).

Third, litter box section, the user can choose cleaning litter box then the following will be done: first, the system will check if there is a pet inside the box, if a pet detected then the cleaning process is denied and the user will be notified, if nothing detected, then the box cleaning process will start to remove the dirt from the box and throw it into the dirt drawer. After this, the system will check the level of sand inside the box and if it goes under the needed level, it will automatically fill the box with sand until it reaches the needed level. Another functionality is open and close dirt drawer when the user needs to clean the drawer and throw the dirt. The last two things are the ability to refill the litter box and monitor the level of sand in the sand container which is stored in the database after any change happens.

The whole communication happened through the ESP32-WROOM-32 which is connected wirelessly with the mobile application and serially with the main controller Arduino Mega and it used to send commands from the mobile application to the system, send information from the system to the mobile application and store data in the database. [11]

### 3.5 Touch screen & Mobile application

#### 3.5.1 Touch screen

For the touch screen, MCFRIEND\_kbv and Adafruit\_GFX\_library were the two main libraries used in the implementation of it. We utilized them to create the various interfaces that make use of the sensor readings to track the amounts of food, sand, and water in the containers. Additionally, we employed two interfaces. The first was utilized to manage the litter box area, including emptying, refilling, and opening and closing the drawer. The second one is for refilling and emptying the water bowl in the water section.

Start page:

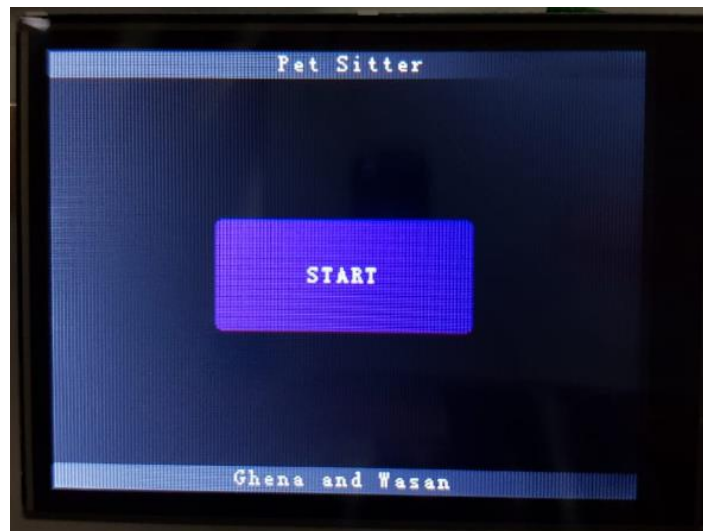


Figure 3.24: Touch screen – start page

When press start this page will appear:



Figure 3. 25: Touch screen – page 1

Status button is to show the containers amounts if full or need to refill them;

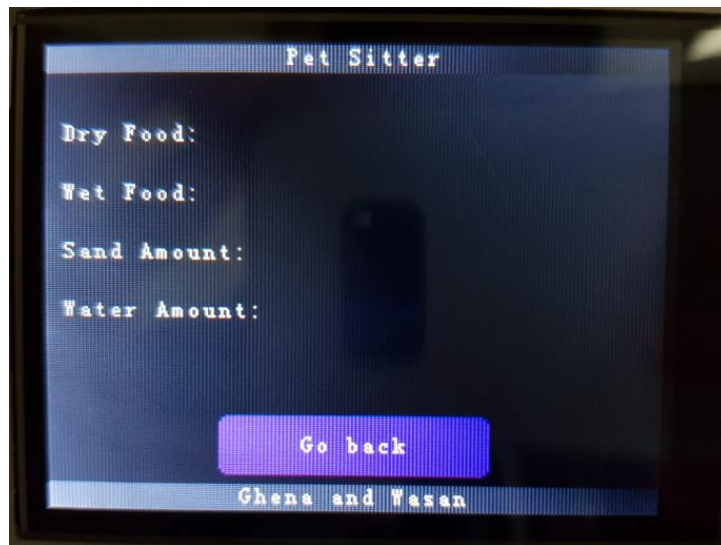


Figure 3. 26: Touch screen – status

Services button is to perform some management functionalities in water and litter box sections:



Figure 3. 27: Touch screen – services

Water section services:

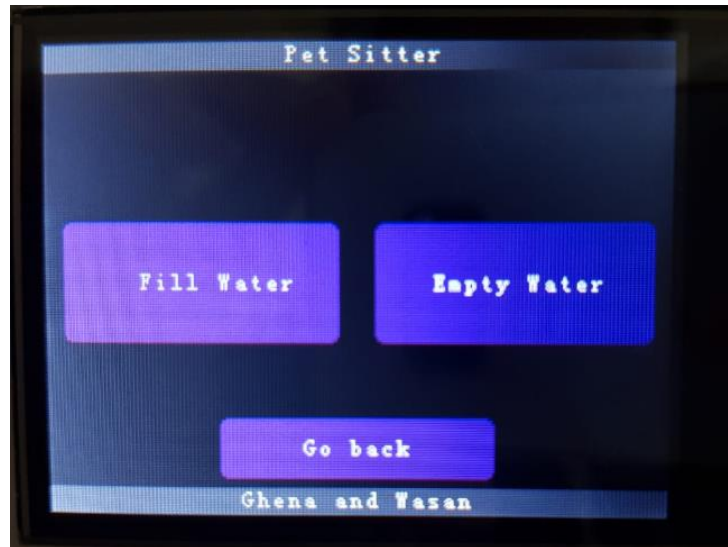


Figure 3. 28: Touch screen – water

Litter box section services:

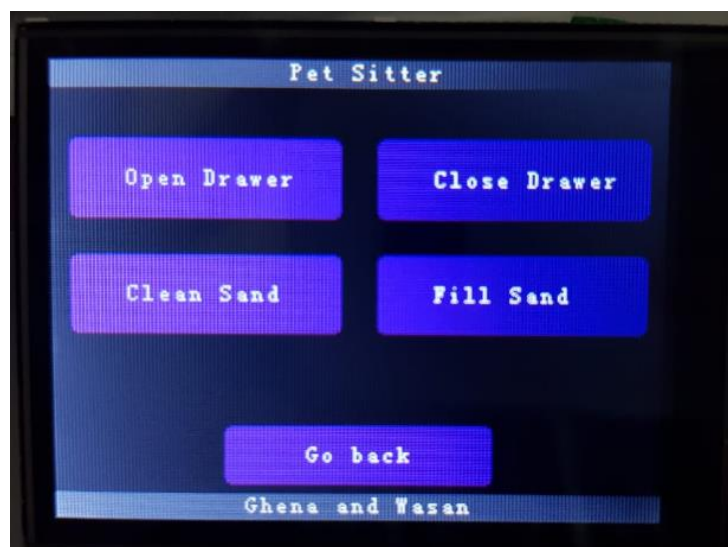


Figure 3. 29: Touch screen – litter box

### 3.5.2 Mobile application

Our mobile application provides a full control of the system for the user, it is implemented using App Inventor and connected with Firebase database. [11]

These are the application interfaces:

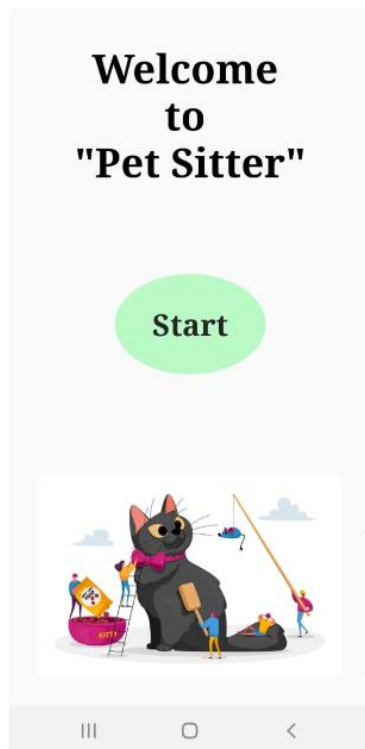


Figure 3. 30: Mobile application – start page

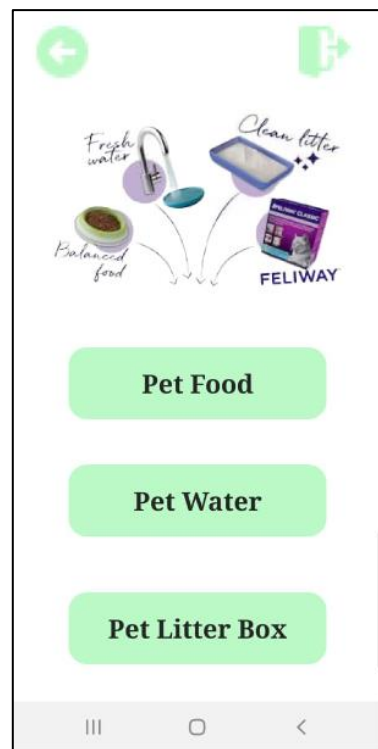


Figure 3. 31: Mobile application – sections page



Figure 3. 32: Mobile application – food section (1)

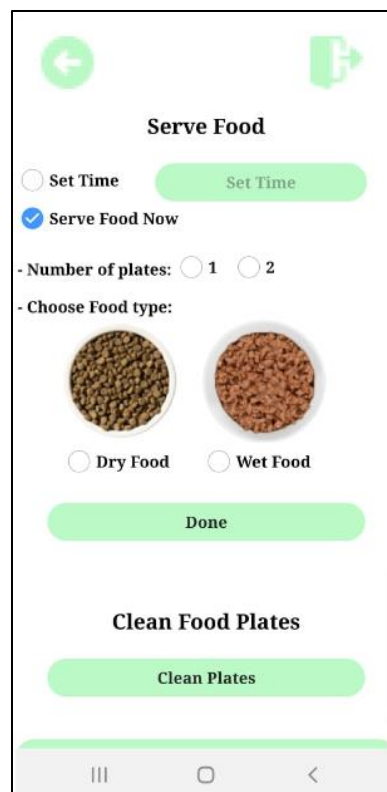


Figure 3. 33: Mobile application – food section (2)

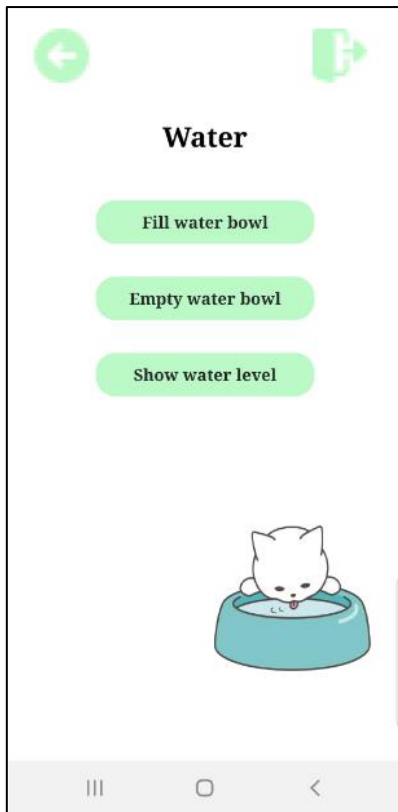


Figure 3. 34: Mobile application – water section



Figure 3. 35 Mobile application – litter box section

### 3.6 Constraints

1. The outside shape: Our machine's body is split into three sections, each of which required several modifications to suit our requirements. We had to create our own modifications because it was difficult to get the carpenters to picture the necessary machine. Additionally, the blacksmith who built the belt for us made a few mistakes that initially made it difficult to move smoothly, forcing us to perform routine maintenance on our own.
  
2. Selecting motors:
  - Litter box section: Initially, we attempted to move the litter box forward using a colander to remove the litter. However, in order to have the sand return to its proper location, it had to travel backward. To do this, we employed two servo motors. Regretfully, because of the weight of the sand and the box, it was exceedingly challenging to move backward and reach the reference. Consequently, to make the litter box stable, we replaced the previous design with a horizontal sand strainer that is moved by a DC motor, which then pushes the dirt into the drawer.
  - Food: We had to swap out the mini servo motors for high-torque servo motors because the weight of the food in the containers prevented us from using the mini servo motors.

3. Dealing with Water: We utilize two water pumps in the food section to clean the plates. When we tested this feature, water leaked to the wires and Arduino, so we had to cover the belt side with a transparent table cover and make sure the water strainer was high enough to stop any leaks.

## Chapter 4: Results and Discussion

By the time this project comes to a finish, we have already created an integrated system that offers the primary capabilities we were expecting. The machine's owner can use it and be happy with the outcome. The needs for cats are completely planned and carried out as we initially desired.

Here are a few of the issues we encountered and resolved:

- The first plan for the litter box was to move it forward and backward with two servo motors. However, due to the weight of the sand, this design presented many challenges. In order to remove the dirt, we used a DC motor to move the sand strainer and altered the design to be fixed.
- In order to accomplish a smooth transfer and properly transport the food, we moved from the Nema17 motor to the Nema23 motor because the conveyor belt we were using was difficult to move.
- We discovered that, based on our connection, we must connect the water pumps using the normally open relay since the water pumps activate themselves when we switch on the power supply.
- When we tested the small servo motors, we had intended to use for the food containers, they would not move when we added food. Rather, we used high torque servo motors.
- Since there are many kinds of touch screen libraries and their manuals are not always clear and their descriptions are ambiguous, it was difficult to locate the libraries that were needed. As a result, we continued testing the example projects until it functioned properly.

We were able to deliver our system with the three main sections -the litter box section, the water section with fountain and the automatic feeder- after resolving these issues.

## **Chapter 5: Conclusions and Recommendation**

### **5.1 Summary**

The automated device, designed to make the owner's life easier and meet the cat's constant requirements, was successfully built by the Pet Sitter team. The owner may easily and directly interact with the device thanks to its connection to mobile app and a touch screen.

First, let's talk about the food area, where we have included all the necessary details. The primary feature is that you may select how many plates to fill and choose between two types of food: wet and dry. Moreover, you can use the IR sensors to monitor the amounts in the dry and wet food containers. An ultrasonic sensor was used to ensure that there is no cat on the belt before rotating it. The fact that our machine keeps any food that hasn't been eaten in a backup container after the conveyor belt starts cleaning the plates is one of its amazing features. After the plates are unloaded, the procedure is finished by the water pumps and the fan.

By using the automatic litter box cleaning method and clearing the dirt from the garbage drawer, our device maintains the house smelling fresh and stops odors from spreading throughout the house. The device automatically refills the litter box by using an IR sensor to detect the amount of sand within. Before cleaning the box, an ultrasonic sensor is also utilized to make sure the cat is not inside.

By turning on the fountain in the water part when the cat is close by, you can get it to drink. By emptying and refilling the water dish, it maintains the cleanliness of the water. The water level in the bowl is tracked using a water level sensor.

In conclusion, Pet Sitter is an automated, user-friendly, integrated, and time-saving device that provides the optimal experience for both the owner and the cat.

### **5.2 Recommendations**

1. To obtain the necessary voltage and guarantee the proper operation of the components, unify the power supply and the Arduino's ground.
2. Try to utilize jumpers to organize your work and keep your cables organized and insulated.
3. Before integrating any component into the project, test each one separately.
4. To find out the necessary voltage, read the manuals that come with every component.

### **5.3 What we learned**

1. How to use Arduino to interface with sensors, fan and pumps, how to connect with motors, DC, servo and stepper.
2. How to leverage the ESP32's Wi-Fi capabilities by connecting an Arduino to it.
3. How to link an Arduino to a touch screen.
4. How to make a mobile application and connect it to a database and ESP32.

### **5.4 Future work**

1. To autonomously supply food at predetermined times and intervals, use a real-time clock.
2. Use a timer to clean the litter box fifteen minutes after the cat enters.
3. Empty the litter box of all the sand and replace it.
4. Use sensors to detect the cat's activities.

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