An-Najah National University

Faculty of Engineering and Information Technology

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Purrfect House

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Presented in partial fulfillment of the requirements for Bachelor degree in Computer Engineering.

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Acknowledgment

In light of weeks of working on our project, we would like to express our gratitude to Dr.Manar Qamhieh for her constant guidance and notes, also, we would like to thank each other for always being a reliable partner and finally, we are grateful for the endless support we have received from our families and friends.

Disclaimer

The views and opinions expressed in this report are written by Ileen Shaar and Manar Mayyaleh at the Computer Engineering Department, Faculty of Engineering, An-Najah National University. It has not been altered or corrected, other than editorial corrections, because of the assessment and it may contain language as well as content errors. All opinions expressed in it, as well as any recommendations, are the students' own. The analysis makes assumptions that do not reflect the position of anyone other than the author(s), and changes, revisions, and rethinking are always possible.

Abstract

Cats require regular care and attention, including food and water, which may be exhausting for the owner to be always on time, especially when the owner is out for a long amount of time so there will be no peace of mind while thinking of the cat. as well as the more difficult task of cleaning the litter box. Which is the most undesired task of taking care of cats.

In this project, meals are scheduled according to the data that the owner entered in the web page, automatically throughout DS3231 RTC (Real Time Clock) Module, the device will drop or fill the food bowl based on your cat's eating schedule set in the form. So, it will be easier and less bothersome for the owner to automatically serve food to the cat timely. Additionally, the litter box can be automatically cleaned, making the process much simpler.

The cat feeder already exists, but we plan to develop it to build a complete system that brings comfort to both the cat and the owner.

Chapter 1: Introduction

1.1 Statement of the problem:

It's a big responsibility to own a cat because in order to take care of it effectively, owners must constantly feed, drink, and litter their cat, and due to daily concerns, busy schedules, early morning rushes, traveling, etc. Having a food, drink organizer seems like a great way to make sure your pet's needs are met while you are busy or not around.

By using an automatic pet feeder, the cat's meals will be scheduled during the day, which is something cats love (the same schedule every day), and it also allows monitoring the cat's eating behavior, so that if its appetite drops, it will be caught sooner than if it is free-fed. As well as it is the perfect way to let your cat stick to a diet.

Similarly For the cat, water is essential, so a system that delivers water continuously is a great help for both the cat and the owner.

Let's move on to the part that a cat owner dislikes and is generally an unpleasant task, cleaning the litter box, if their litter box smells bad or there is too much waste

build-up, cats may choose to use the bathroom elsewhere. This makes self-cleaning litter boxes an excellent solution. (reasons to buy a smart automatic pet feeder, n.d.)

(litter box, n.d.)

1.2 Objectives

In Cat Feeder, the cat is able to eat according to its needs and habits at specific times and in specific quantities. The device includes an Internet-connected system that allows users to input information like food amounts, time frames, and the number of times to feed the pet over a specified period using a web page.

This will ensure that the cat receives a constant amount of food based on what the owner inputs in the form.

In addition, the feed button on the web page allows the user to deliver food at any time.

As the food comes down, the remaining food in the plate is weighed first, making a certain amount of food come down until it reaches the amount entered by the owner.

Whenever the food container is almost empty, a notification will be sent to the owner via Whatsapp.

The water supply is completely automatic, Water is constantly supplied to the cat by the water supply, which uses a sensor that checks whether water level has decreased below a certain limit, and fills the bowl until this level is reached.

Whenever the water container is almost empty, a notification will be sent to the owner via Whatsapp.

Additionally, all the water will be drained from the bowl at the end of the day, ensuring that it is always clean and safe to drink.

Litter is automatically collected by the self-cleaning litter box at the end of the day and placed in another container, so all the owner has to do is to dispose the litter from it every couple of days. Also, a button on the web page allows the user to clean the box anytime.

1.3 Significance of the work:

These devices are made for cats, to make the lives of their owners easier, encouraging people to adopt more cats and saving them from life on the street. For the owner, a magnificent part of responsibility vanished. cat is taken care of in terms of food, drink, and litter.

1.4 Organization of the report:

In this report, we present the idea in all its details. By reading the report, you will first see the constraints we faced during our work, such as the equipment, tools, and previous course work we used. Then Afterward, you can read about similar systems to get a sense of the topic and what features we've added to them. After that, the methodology of our work is extensively explained. A discussion of our results is presented in the next chapter, along with a discussion of how they are interpreted and compared. In conclusion, we will discuss our vision for the future of our work and what we expect to improve.

Chapter 2: Constraints, Standards/ Codes and Earlier course work

2.1 Constraints:

The first problem that we faced was the high prices of the components specially for the water supply, also the design for each the feeder and self-cleaning litter box.

Another main problem that we faced was the inaccurate time that the DS1307 RTC (Real Time Clock) reads, which made working take much time longer because of these false readings, to solve this problem we brought a DS3231 RTC that reads time much more correctly.

At first, we thought that we could estimate the amount of food, but then we discovered that it depends on the cat's age, weight, diet, habits and sometimes its vet. So, the amount of food for each cat varied greatly as a result. We gave the owner the task of choosing how much food and when to feed the cat, so our system became more flexible later.

Another problem we had is the food getting stuck as it drops from the container, to solve that we used a vibration motor. Still, the problem is not completely solved as the food gets stuck.

Furthermore, when the closing under the container opens, the food gets thrown in different places out of the plate, so we made the closing move in a very small angle, so the food only falls on the plate.

The equipment of the Load Cell sensor was hard because it was made at home.

After we set the Ultrasonic sensor on our device, we had to take it off and replace it with another one because it wasn't reading properly.

The servo motor needed an external power supply not the ESP32 alone so at first, we didn't know that and connected it directly to the ESP32 on the laptop, which caused damaging it.

Our limited budget and carrying capacity did not allow us to test the self-cleaning litter box in real life, so we were unable to design it in a suitable size for cats.

Different voltages were needed in our project for the various parts so we used Buck converter to get each part its needed voltage.

2.2 Hardware and Standards Codes:

The following list contains the hardware components that have been used in our project:

ESP32-Development-Board-ESP-WROOM-32 30pin:

ESP32 is a highly-integrated solution for Wi-Fi-and-Bluetooth IoT applications, with around 20 external components. ESP32 integrates an antenna switch, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. As such, the entire solution occupies minimal Printed Circuit Board (PCB) area. ESP32 uses CMOS for single-chip fully-integrated radio and baseband, while also integrating advanced calibration circuitries that allow the solution to remove external circuit imperfections or adjust to changes in external conditions. As such, the mass production of ESP32 solutions does not require expensive and specialized Wi-Fi testing equipment.

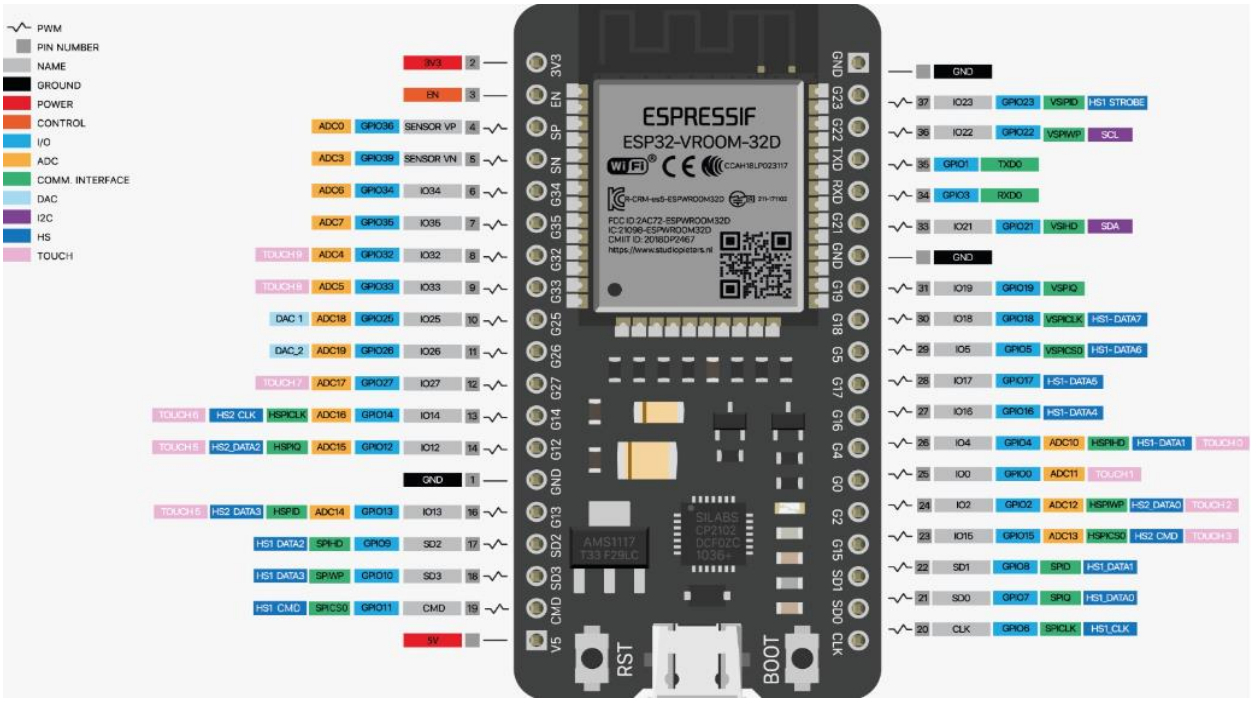

Figure 1_ESP32

DS3231 RTC Module Real Time Clock:

The DS3231 is a low-cost, extremely accurate I2C real time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main

power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device as well as reduces the piece-part count in a manufacturing line. The DS3231 is available in commercial and industrial temperature ranges, and is offered in a 16-pin, 300-mil SO package. The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of-day alarms and a programmable square-wave output are provided. Address and data are transferred serially through an I2C bidirectional bus. (DS3231-DS3231S)

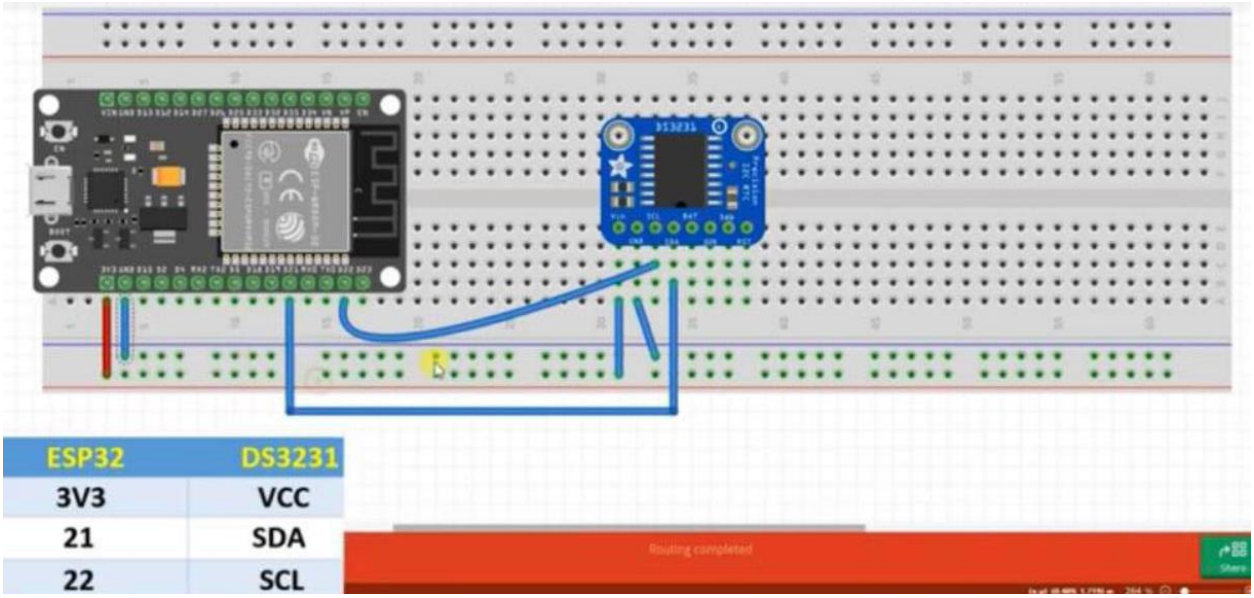

Figure 2_RTC

Ultrasonic sensor:

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor

determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse. (Ultrasonic Sensor, n.d.)

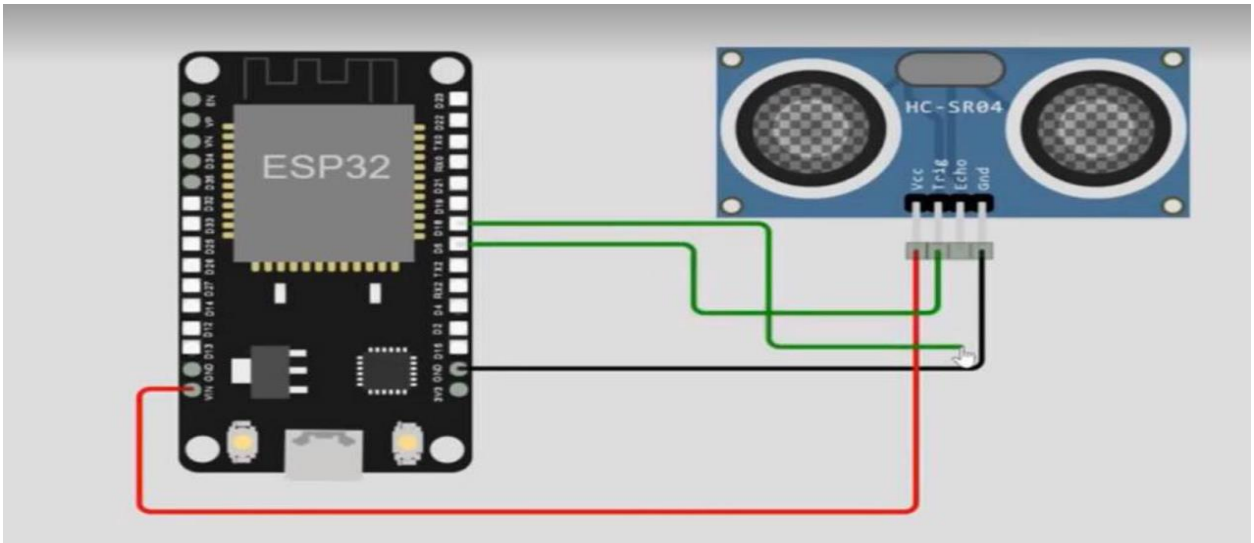

Figure 3_ULTRASONIC

Servo Motor:

The Tower pro MG90S Mini Digital Servo is 180° rotation servo. It is a Digital Servo Motor which receives and processes PWM signal faster and better. It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external forces. (Servo motor, n.d.)

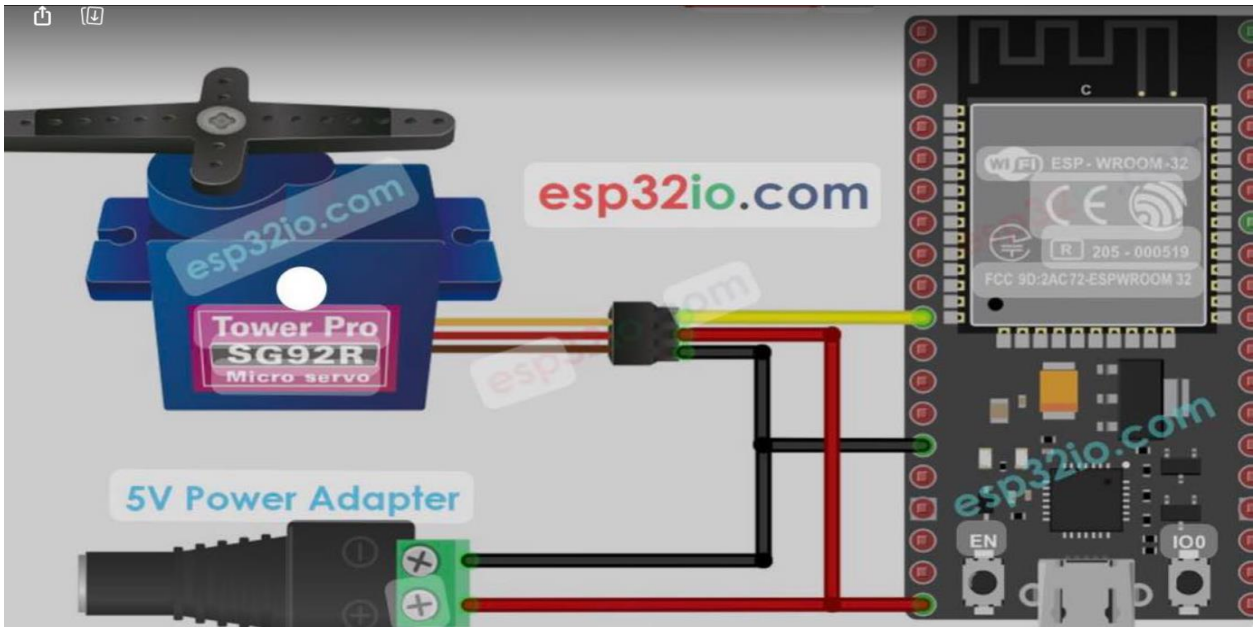

Figure 4_SERVO MOTOR

Vibration Motor:

Vibration motor is a compact size coreless DC motor used to informs the users of receiving the signal by vibrating, no sound. Vibration motors are widely used in a variety of applications including cell phones, handsets, pagers, and so on. (Application Note-yangyi)

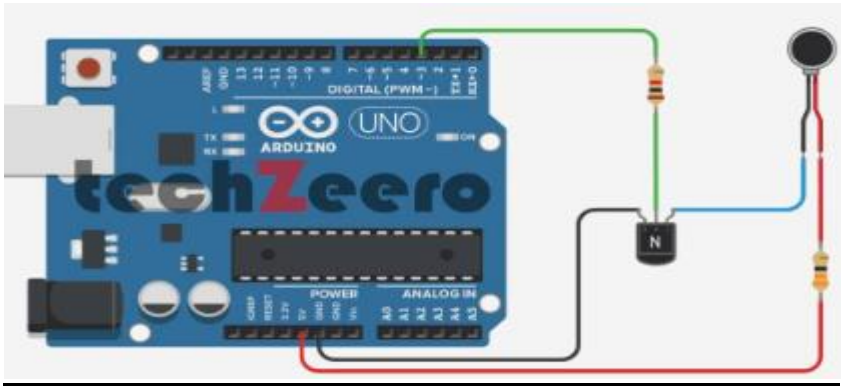

Figure 5_VIBRATION MOTOR

Load Cell Sensor 1KG:

A load cell is a transducer that converts force into a measurable electrical output.

The straight bar load cell (sometimes called a strain gauge) can convert pressure (force) into an electrical signal. Each load cell is able to measure the electrical resistance that changes in response to and proportional to the strain (e.g., pressure or force) applied to the bar.

Load cells generally consist of a spring element on which strain gauges have been placed. The spring element is usually made of steel or aluminum. That means it is very sturdy but also minimally elastic. As the name "spring element" suggests, the steel is slightly deformed under load, but then returns to its starting position, responding elastically to every load.

These extremely small changes can be acquired with strain gauges. Then finally, the deformation of the strain gauge is interpreted by analysis electronics to determine the weight. (Load Cell, n.d.)

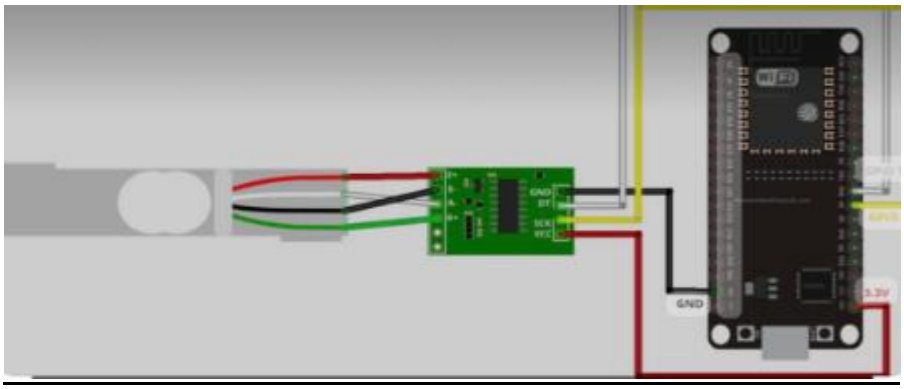

Figure 6_LOAD CELL

Solenoid Valve For Water Air:

A solenoid valve is a control unit that uses electricity to automate the opening and closing of an orifice in the valve body, allowing, preventing, or redirecting the flow of water, gas, or other medium. It is made up of three main parts: the solenoid body, the electromagnetically inductive coil, and internal components (stem, plunger, and spring).

It’s works by controlling the flow of liquids in a positive, fully-closed or fully-open mode. They are often used to replace manual valves or for remote control. Solenoid

valve function involves either opening or closing an orifice in a valve body, which either allows or prevents flow through the valve. A plunger opens or closes the orifice by raising or lowering within a sleeve tube by energizing the coil. (Solenoid Valve, n.d.)

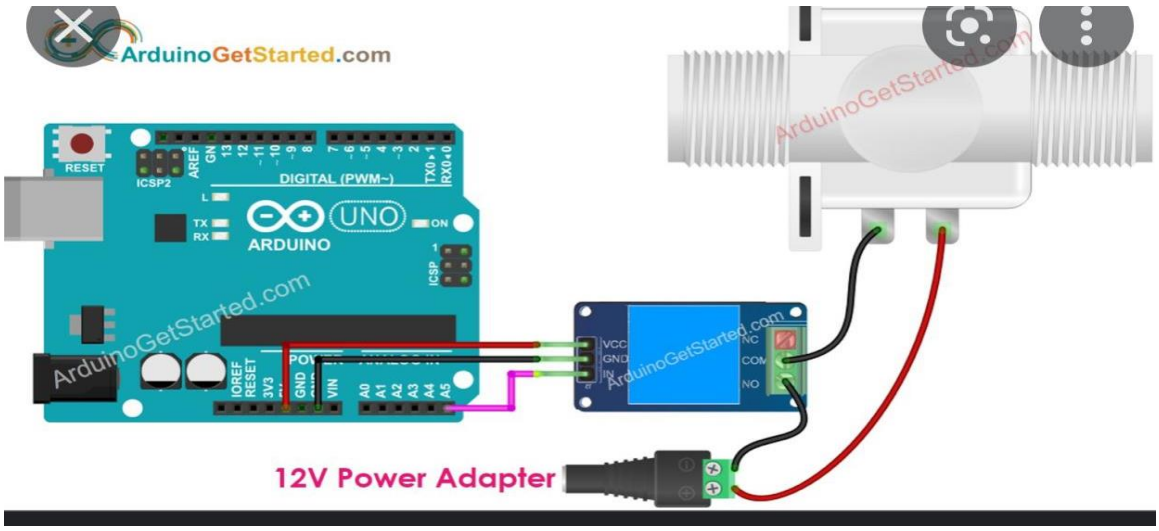

Figure 7_VALVE

Non Contact Liquid Level Capacitive Sensor Switch Xkc-Y25-V:

The intelligent non-contact liquid level sensor uses advanced signal processing technology and a high-speed signal processing chip to break through the influence of the wall thickness of the container and realize the true non-contact detection of the liquid level in the closed container.

The liquid to be tested is required to be electrically conductive, the contact surface is non-metal, and the pipe is easy to install and can be widely used.

Liquid Level Sensors work inductively if there is induction, the output is high level, no induction, the output is low level. Specially designed for non-metallic pipe liquid level detection and it can adjust sensitivity for it by Removing the plastic cover of the sensors and turning the very small screw, clockwise to decrease sensitivity, counterclockwise to increase the sensitivity. (Liquid Level Sensor, n.d.) (Liquid level senser(1), n.d.)

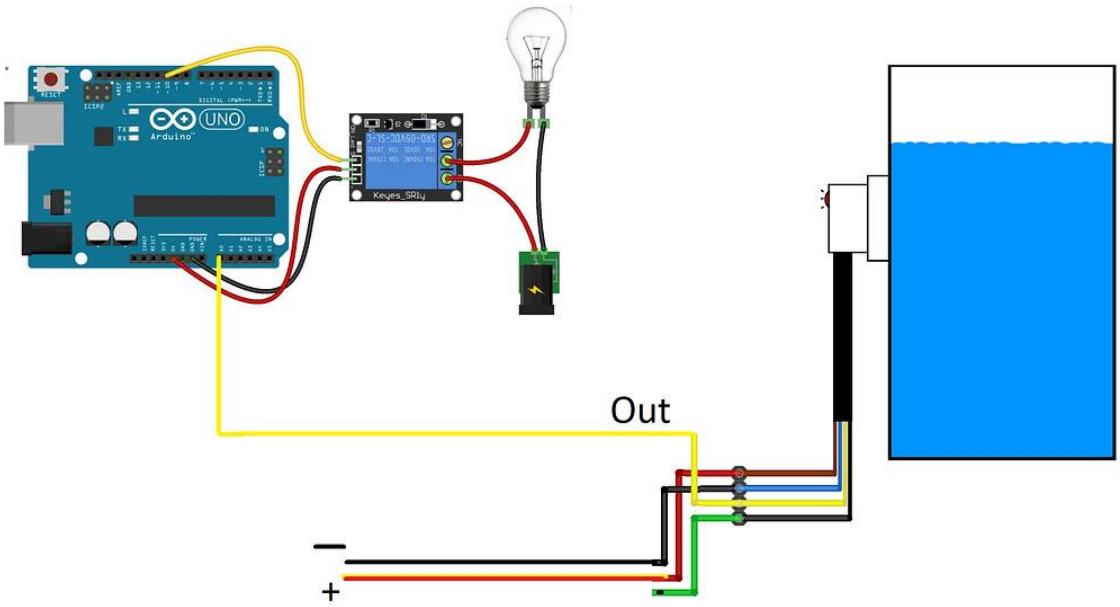

Figure 8_LIQUID LEVEL SENSOR

Rain Drops Sensor:

The Raindrops Detection sensor module is used for rain detection. It is also for measuring rainfall intensity. Rain sensor can be used for all kinds of weather monitoring and translated into output signals and AO.

It includes a printed circuit board (control board) that “collects” the raindrops. As raindrops are collected on the circuit board, they create paths of parallel resistance that are measured via the op-amp. The lower the resistance (or the more water), the lower the voltage output. Conversely, the less water, the greater the output voltage on the analog pin. A completely dry board, for example, will cause the module to output 5V.

So for that when water exists the output is 0 and if not the output is 1. (Rain Sensor, n.d.) (rain sensor, n.d.)

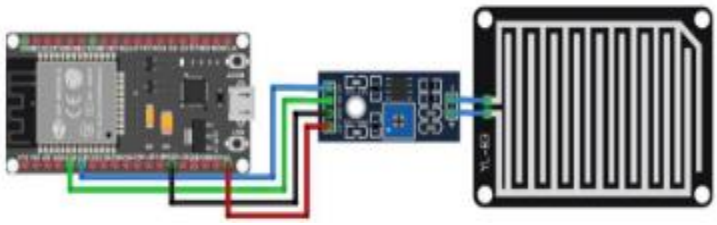

Figure 9_RAIN SENSOR

6-12V Diaphragm Pump For Water:

The water pump can be defined as a pump which uses the principles like mechanical as well as hydraulic throughout a piping system and to make sufficient force for its future use. At present these pumps are utilized within a wide range of housing, farming, municipal, and manufacturing applications.

The working principle of a water pump mainly depends upon the positive displacement principle as well as kinetic energy to push the water. These pumps use AC power otherwise DC power for energizing the motor of the water pump. Pumps like these are used to transport huge amounts of water. (Pump, n.d.)

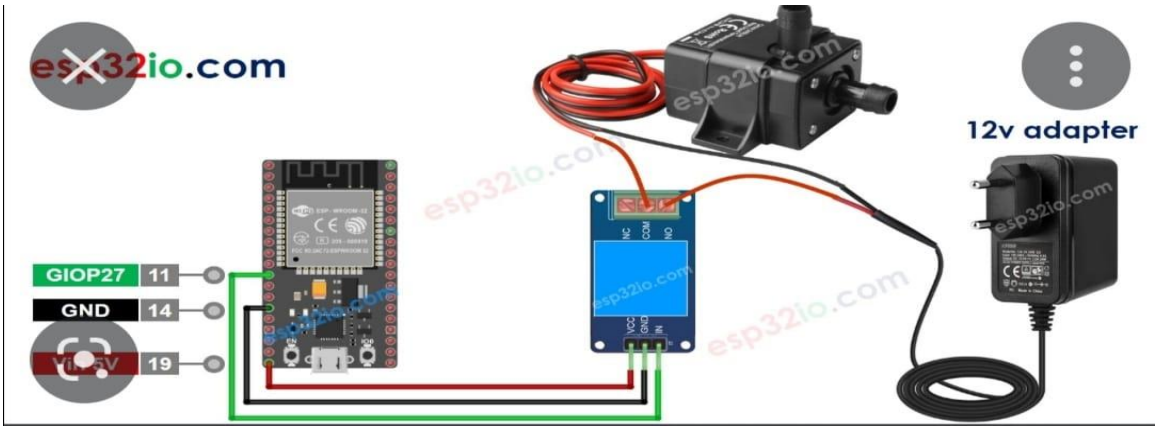

Figure 10_PUMP

LM2596 Adjustable Step Down Buck Converter:

LM2596 is an IC, and the module is a circuit built around the IC to make it work as an adjustable converter. This is a buck converter meaning that it will take higher voltage and convert it into a lower voltage. When the equipment needs a 3-35V

power supply and the corresponding voltage power supply in hand, this module can be used to conveniently adjust the voltage to the required voltage to solve the problem. This module can be used to debug the working voltage range of various voltage test systems when doing projects, which is very easy and convenient. (Buck Converter, n.d.) (Buck-Converter, n.d.)

5V 1-Channel Relay:

The 1 Channel 5V Relay Module provides a single relay that can be controlled by any 5V digital output from the microcontroller. The relay is accessible using screw terminals and can handle up to 2A of current. A handy LED indicates the status of the relay. This module provides a standard 3-pin Signal/Voltage/Ground male header and a 4-pin "Grove" connector.

we use it by connecting the Signal (S) pin to a digital output line on the microcontroller, the Voltage (V) pin to a 5V operating voltage, and the Ground (G) pin to a common ground. Then wire onto the relay by using the screw terminals. The relay works like a common SPDT Single Pole Double Throw switch and has Normally Open (NO), Normally Closed (NC), and Common (COM) screw terminals. When the digital Signal (S) pin is HIGH, the relay will be switched on (closed), otherwise, it will be switched off (opened). (relay, n.d.)

DC Motor:

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation.

DC motors work by generating magnetic fields in the air gap when the field coils of the DC motor are activated. The created magnetic field is in the direction of the radii of the armature. The magnetic field enters the armature from the North pole side of the field coil and “exits” the armature from the field coil’s South pole side. (DC motor, n.d.)

DC Motor Driver Circuits:

Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive. Motor drivers are made from discrete components which are integrated inside an IC. The input to the motor driver IC or motor driver circuit is a low current signal. The function of the circuit is to convert the low current signal to a high current signal. This high current signal is then given

to the motor. The motor can be a brushless DC motor, brushed DC motor, stepper motor, other DC motors etc.

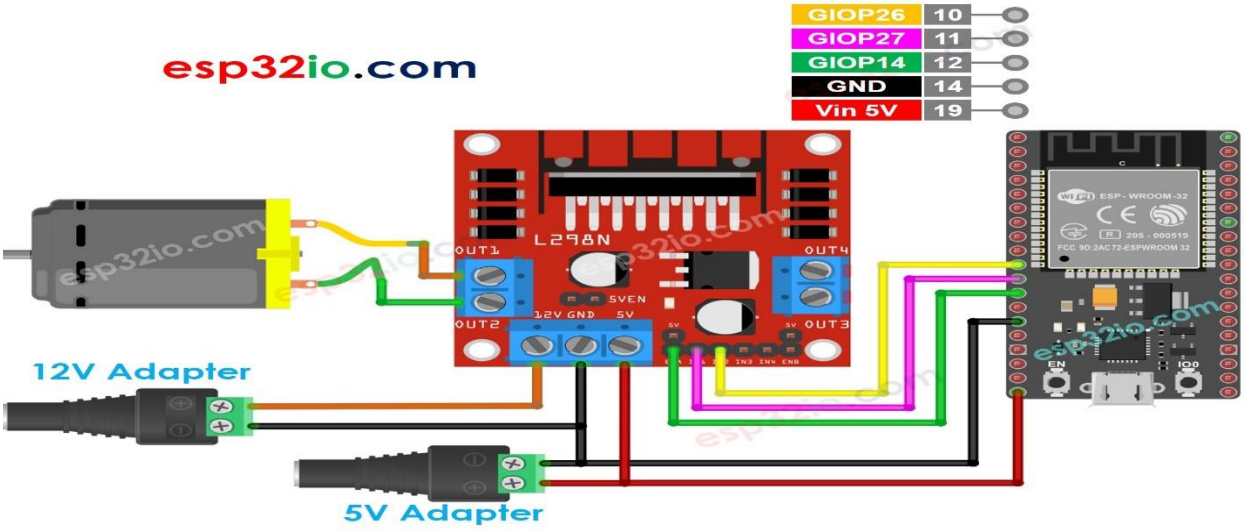

Figure 11)DC MOTOR AND DRIVER

OV-156-1C25 Limit Switch Roller:

Limit switches are electromechanical devices consisting of an actuator mechanically linked to an electrical switch. When an object contacts the actuator, the switch will operate causing an electrical connection to make or break.

Limit switches are available in several switch configurations: Normally Open, Normally Closed, or one of each. (Limit switch, n.d.)

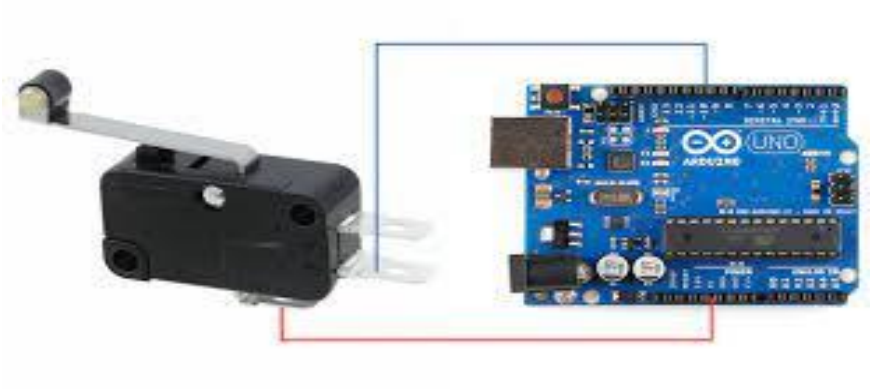

Figure 12_LIMIT SWITCH

Programs:

- We used Arduino IDEs for programming the microcontrollers and all used hardware.
- Flowchart Maker & Online Diagram Software.
- Circuito.io to design the circuits.

2.3 Earlier course work:

Working on our project depends on some courses we learned within the Computer Engineering program such as:

- Microcontroller Lab:

The microcontroller lab taught us how to work with Arduino IDEs, how to upload code, how to deal with LEDs, push buttons, Serial Monitor, interrupts, and servo motors, which were crucial to our project.

- CPU Lab:

During the CPU lab, we developed technical skills such as soldering iron skills to prevent wires from disconnecting and causing problems, as well as general knowledge of ICs.

- Web Developments:

The design of the web page was all depending on our knowledge from Web Developments course.

Chapter 3: Literature review

With an automatic pet feeder, food is automatically dropped at certain times and in specific quantities to ensure that the cat is fed enough food daily to remain healthy without worrying about getting food.

By using a mechanical mechanism, the Automatic Pet Feeder opens a piece in the front of the container to allow food to flow down and closes it to prevent food from falling out.

This device and other similar projects deliver food depending on certain times entered through the keypad. Since the time is calculated using the Real Time Clock, the owner must input it manually using the fixed keypad, which is simple, inaccurate, and inflexible.

A Purrfect House drops food according to the weight of remaining food on the cat's plate when needed, and the owner can enter the data anywhere, anytime via a web page. So, the owner only needs to fill out the information once, and then the device will automatically feed at the specified times every day based on the inputs (the first hour, the last hour, the number of feedings in between, and the amount of food in grams.

Purrfect House not only provides food, it also provides water making it always available for the cat. Additionally, there is a self-cleaning litter box.

Both feeder and the litter box can also work by the control of the user, using the web page whenever wanted. (regular pet feeders, n.d.)

Chapter 4: Methodology

4.1 Data Collection:

A Purrfect House is designed to make the cat's parent's life easier and to ensure their peace of mind. We started collecting data about cats' eating, drinking and littering habits, which led us to the conclusion that cats love having the same schedule every day regarding food, as for drinking, water must always be available for survival and to maintain their health, and to finish up with the litter box, cats prefer clean litter boxes otherwise they will search for another location for littering.

As we started looking for devices that shared the same purpose, we began thinking about more ideas and improvements for making the process easier and easier for the owner.

The drinking and litter box devices were original since we could not find them working with Arduino anywhere else.

4.2 Data Analysis:

After collecting all data needed, we started analyzing it in order to decide what we actually need to build the Purrfect House. Also, noticed that we need to detect many details:

- ***Food Container's Fulness:***

Several details in our project have been carefully studied, such as alerting the owner when the cat's food container is almost empty by sending a message on WhatsApp so it can be replenished.

To determine the extent of the stock shortage, we needed a sensor. Therefore, we used an Ultrasonic sensor, which uses the time between transmission and reception to measure the distance to the target. However, this sensor is more accurate at calculating distant distances, so we increased the sensor's height from the food container to get a better reading.

We used the Median Value to avoid errors and make the calculation more accurate by canceling very small values such as zero and very large that could be read incorrectly by the Ultrasonic sensor.

- ***Right Amount of Food to Drop:***

Regardless of the cat's diet, type of food, health status and age, it's hard to create a fixed schedule for all cats, because the amount of food in each meal varies greatly. Moreover, it is difficult to decide by ourselves using a form that collects data about the cat, because there are so many variables, and there is no clear equation to calculate it, so the owner or their vet should make that decision.

In our web page, we decided to make a form that allows the owner to choose what amount they think is best for their cat, by using a load cell. Using this load cell, it weighs how much food is left in the plate before each drop, ensuring that the food drops only until the specified amount is reached, and the number of drops is also specified.

- ***Food dropping hole details:***

What we had to take into account during the food dropping process was that the food must drop into the plate only and in the right amount.

The details of making that happen were that the piece attached to the servo motor, which is connected to the container of food, has a hole that matches the hole of the container (they both have the same dimensions). When the container stands on a part of this piece that isn't the hole, it doesn't drop food; it only drops when it stands on the hole.

To ensure that the food only drops on the plate we made the servo motor only moves in a very small angle (less than 20) so it does not scatter.

Finally, to adjust the amount of food, we made the delay very small (200 MS), making the food drops few grams each time until it reaches the right amount.

- ***Litter Box Brushing Process:***

In order to guarantee that the brush is strong enough to brush the litter box sand, it got made out of wood and tall, thin nails.

This brushing process involves moving the brush circularly by a DC motor from a starting point to a certain point where a piece beneath opens by the servo motor attached to it, allowing the litter to fall into another container.

To accomplish this, two bump sensors (limit switches) were used. The first is near the starting point, so the brush starts there. The second is near the litter drop area, so when the brush reaches it, the piece opens, and then it returns to the starting point (first limit switch). In addition, a barrier was built at the end of the hole so that the sand could not fall into the hole.

- ***Water Limit:***

For the water supply, we used a Solenoid Valve to bring the water into the bowl. There are two ports in the valve, an inlet, and an outlet. In order to ensure that the water descends easily through water pipes, the tank must be installed at the top of the column. Also, to ensure the water descends down the pipe uninterrupted, we punctured the cover of the tank so the air could enter and allow the water to descend freely.

Opening and closing the valve is governed by a Rain Sensor reading, which changes as water is immersed, so the Solenoid Valve is opened to refill the bowl again until the water reaches the sensor, at which point the water stops filling, so no water flows out.

- ***Water Container's Fulness:***

In the same way that we used a sensor for the food container, we used one for the water container to see if it had emptied.

The sensor (Liquid Level Capacitive Sensor) checks if water is present or not. We fixed it at the base of the container, so if the reading changes after the water is gone, it sends a WhatsApp message telling the owner to refill it.

4.3 Connecting components:

Purrfect House contains 3 devices, automatic feeder, automatic water supply and self-cleaning litter box, all connected via ESP32.

Each device works individually, making a complete system for the cat, that is safe, satisfies most of its needs which makes the owner's responsibilities much less.

- ***Feeder:***

the cat needs food for the entire day, so we designed this device to meet its needs. We used DS3231 RTC, Ultrasonic Sensor, Load Cell Sensor, Servo motor, Vibration motor. All of these components used supply voltage comes from a 5-volt power supply. Except for the vibration motor that used TIP41C Transistor to lower the voltage from 5-v to 3-v. the output is a device drops certain amount of food at certain times.

- ***Water System:***

The purpose of this device is to keep water available at all times for the cat's survival and health. We used Rain Sensor, Liquid Level Capacitive Sensor, Solenoid Valve and pump. Both Rain Sensor and Liquid Level Capacitive Sensor need 5-v so we used a Buck Converter in order to decrease the voltage from the12-v power supply to 5-v, but the valve and pump uses 12-v. The cat now has a complete automatic water system.

- ***Litter Box:***

In order to ease the hassle of cleaning the litter box, we built this device. We used 2 bump sensor (limit switches), DC motor and Servo motor that all consumed 5-v except for the DC motor that consumes 12-v.

4.4 Code Flows:

- ***Feeder Flow Chart:***

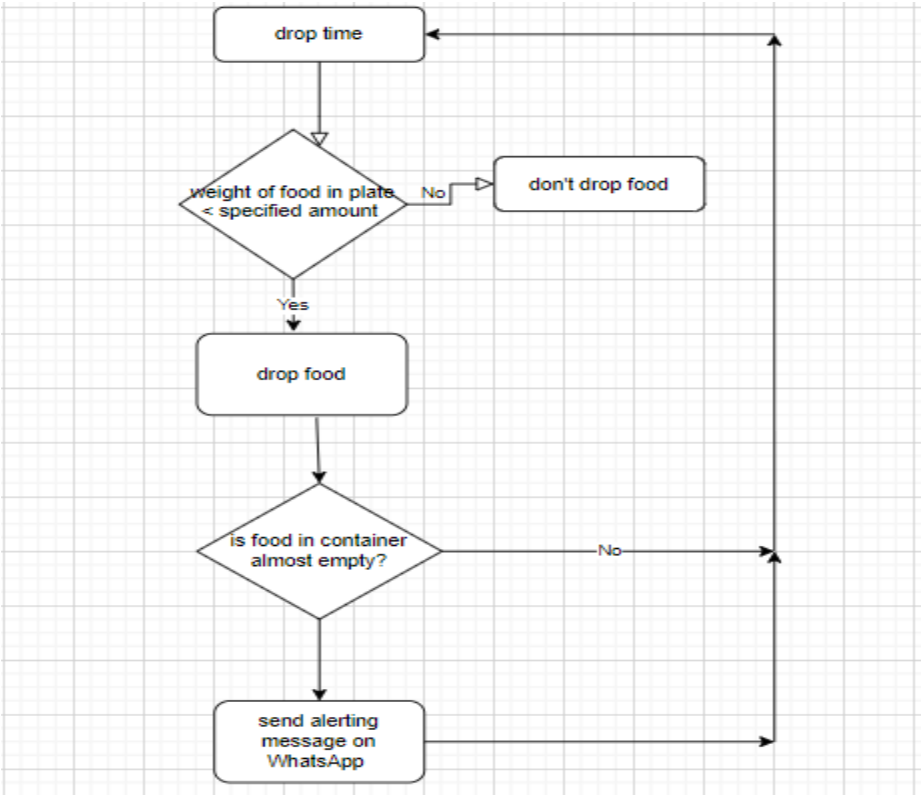

Figure 13_FEEDER FLOW CHART

The first step in code is to initialize all the module's components by specifying the pins numbers and all necessary constants and variables, then define the necessary libraries for RTC, Load Cell, Ultrasonic, Servo motor, EEPROM, Web server, also included the html design and many functions to write and read to EEPROM, to handle when a button is clicked, send a message to WhatsApp and store inputs values from the form in web page to the EEPROM.

In "setup", we connected the ESP32 to WIFI, then we sat the scale to -1965.232, then using server.on to switch to another link.

In "loop", first, we take the values saved in the EEPROM and take real time readings by the RTC using DateTime now = rtc.now(); to check if it is the time to drop based on the values saved in the EEPROM, if it is the time to drop, we check the Load Cell reading by scale.get_units(10); if it is less than the amount desired based on the values saved in the EEPROM , the servo motor will move by servo.write(); to let the food drop. Then we check the ultrasonic sensor's reading by sonar.ping_cm();

to check if the container is almost empty, if it is we send an alerting message to the user's WhatsApp. (EEPROM, n.d.)

- ***Water Flow Chart:***

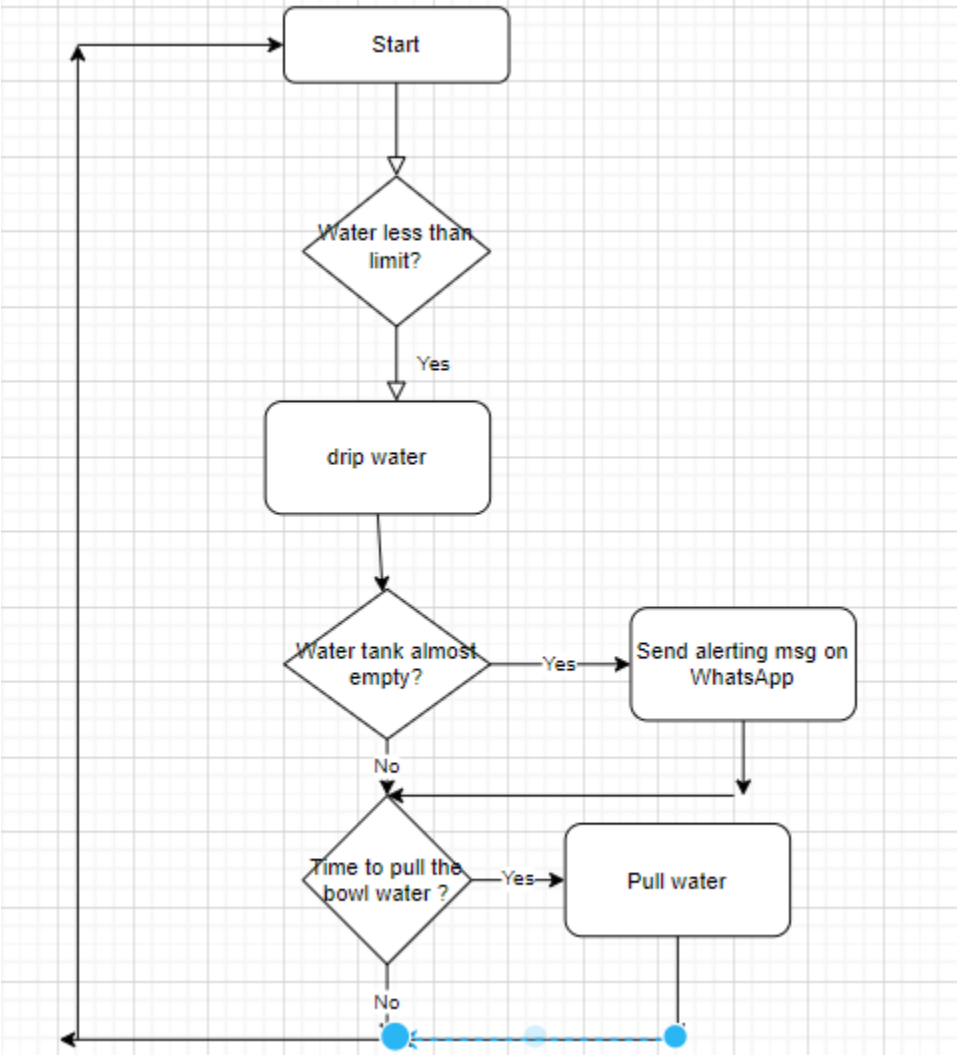

Figure 14_WATER FLOW CHART

In "setup", we initialized pin modes for all components needed in water device.

In "loop", first, we read the Rain Sensor(digitalRead(rain);) to check if the water in the bowl is at a certain limit, if it is not, the valve will open digitalWrite(valve, HIGH); to descend water into the bowl, until it reaches that limit again, then we stop the valve by digitalWrite(valve, LOW); Then at a certain time usually at the end of the day, we read the Liquid Level Capacitive Sensor (digitalRead(sensor);) to check if the water in the tank is almost empty, if it is, an alerting message will be sent to

the used, then we pull the water from inside the bowl by using the pump for 5seconds digitalWrite(pump, HIGH); delay(5000); digitalWrite(valve, LOW);.

- ***Litter Box Self-Cleaner Flow Chart:***

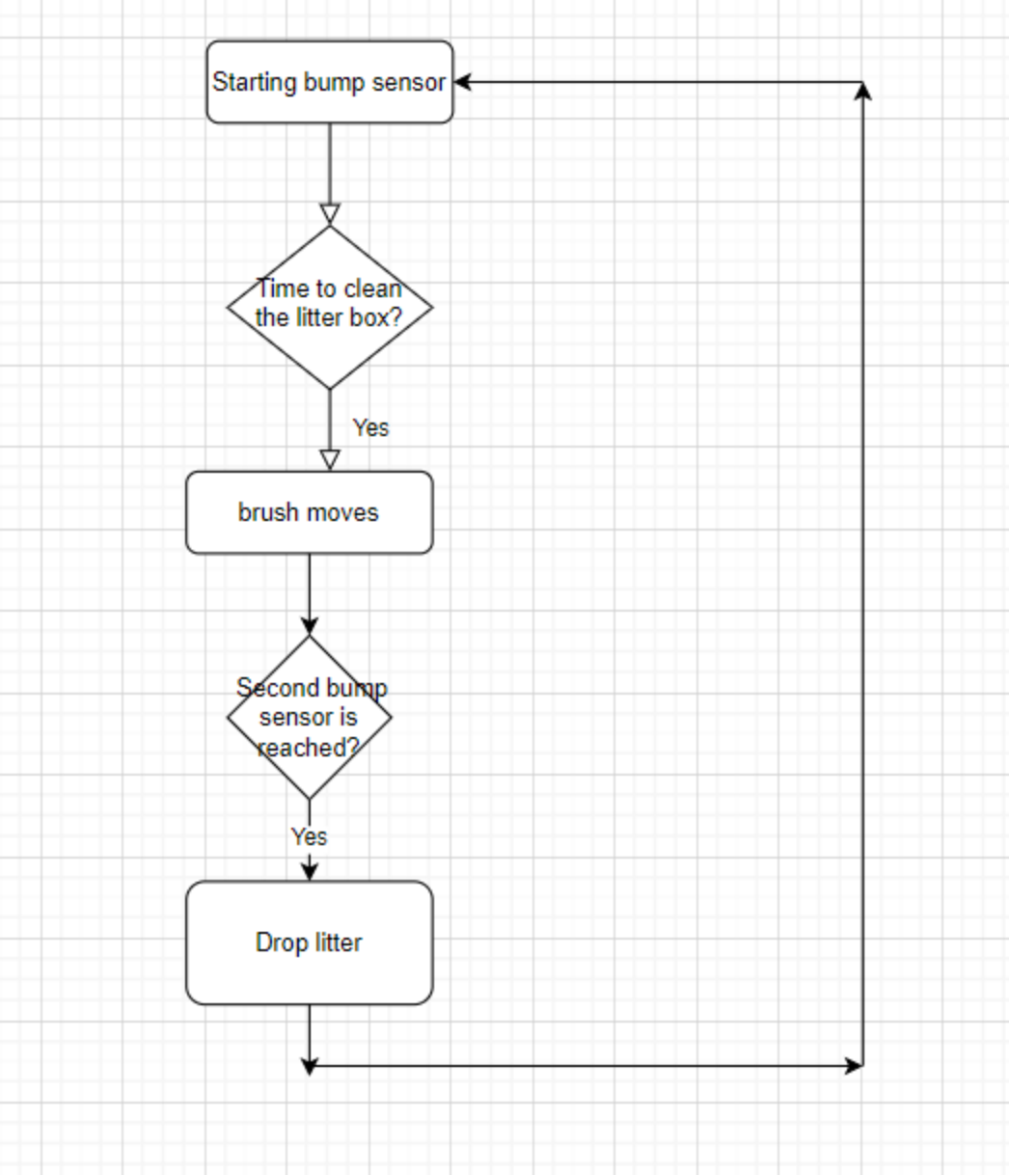

Figure 15_LITTER BOX FLOW CHART

In “setup”, we initialized pin modes for all components needed in litter box.

In “loop”, The brush moves counterclockwise if it is time to clean the litter box, and inverts its direction if the pump reaches the start switch, at which point it stops moving.

Chapter 5: Results and Discussion

To sum up, upon the completion of the project, we obtained satisfactory results with this system. In order to achieve all the desired outcomes, we built a complete and integrated system that contains all the details the project requires. To maintain a healthy environment and a safe life for cats, the cat feeding device provided food, water, and cleaning, as well as a system that ensured the comfort of its owner, the system provided specific times for food to drop, taking into account all the details of the begin and last time for food and the amount of food, by the most available and easy ways (web page) as mentioned earlier in this report.

Three separate devices make up our design, but they all work together with the microcontroller. also shared with the real-time clock to get the time to work automatically.

Each device's distinctive feature can be seen in the final form of the design shown below.

Figure 16_ALL SYSTEM

A feeder device is illustrated in the figure below, which is designed by a specialist using a 3D printer in order to fit all of the details like the servo motor, which opens the piece so the food can go down, as well as its height is proportionate to the home handmade scale under the bowl and the height of the piece that holds the Ultrasonic in order to take the correct readings.

Figure 17_FEEDER

Also, the device is based on an integrated system to take the necessary readings, whether from sensors such as the ultrasonic sensor that checks the tank's fullness or the Load Cell sensor that checks the need to drop food or through the web page that connects the device with the owner to enter the necessary data.

The figure below shows the design of the water system. It was designed by us completely manually in the house from fixing the wood and all components on it.

Figure 18_WATER SUPPLIER

Additionally, to suit the need of providing water continuously it takes the necessary readings such as the rain sensor that checks the limit of water in the bowl and the tank Liquid Level Capacitive Sensor that checks the container's fullness, and also at the end of the day emptying the water to ensure its cleanliness automatically by the pump

According to the figure below, the design of the self-cleaning litter box was made with simple household tools, but the mechanical parts were fixed by a specialist to set it to enable the brush to move correctly with the sand that contains dirt. The design also contains a bump sensor (limit switch) that reverses the movement of the motor and also gives a signal to move the slot installed in the servo motor Bottom of the bowl to get rid of litter through it.

Figure 19_LITTER BOX

1) Feeder Device circuit design:

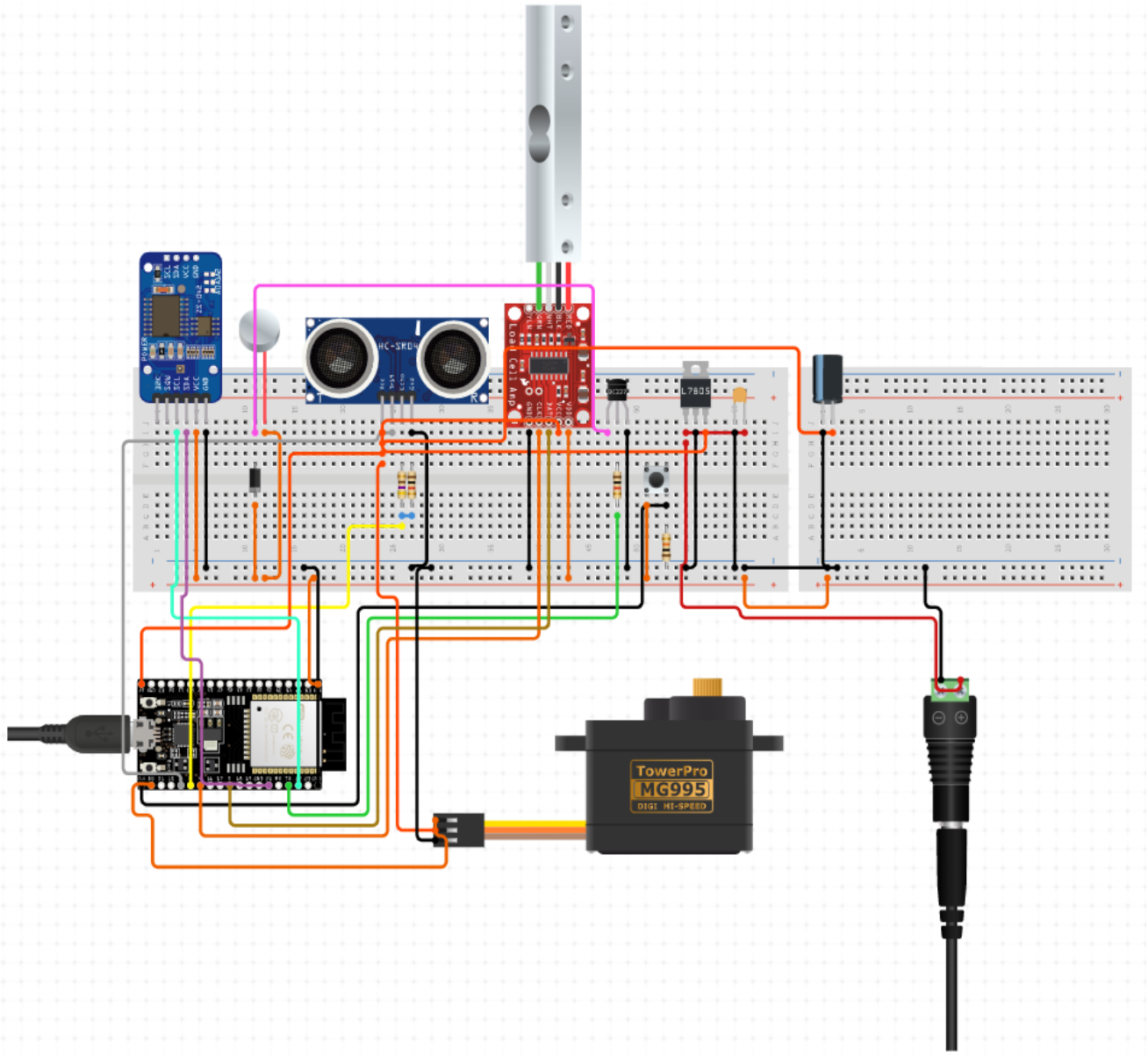

Figure 20_FEEDER CIRCUIT DESIGN

2) Water Device circuit design:

This circuit does not use the exact components we used in our project. This is just an imitation of the real circuit (because we could not find the exact components we used).

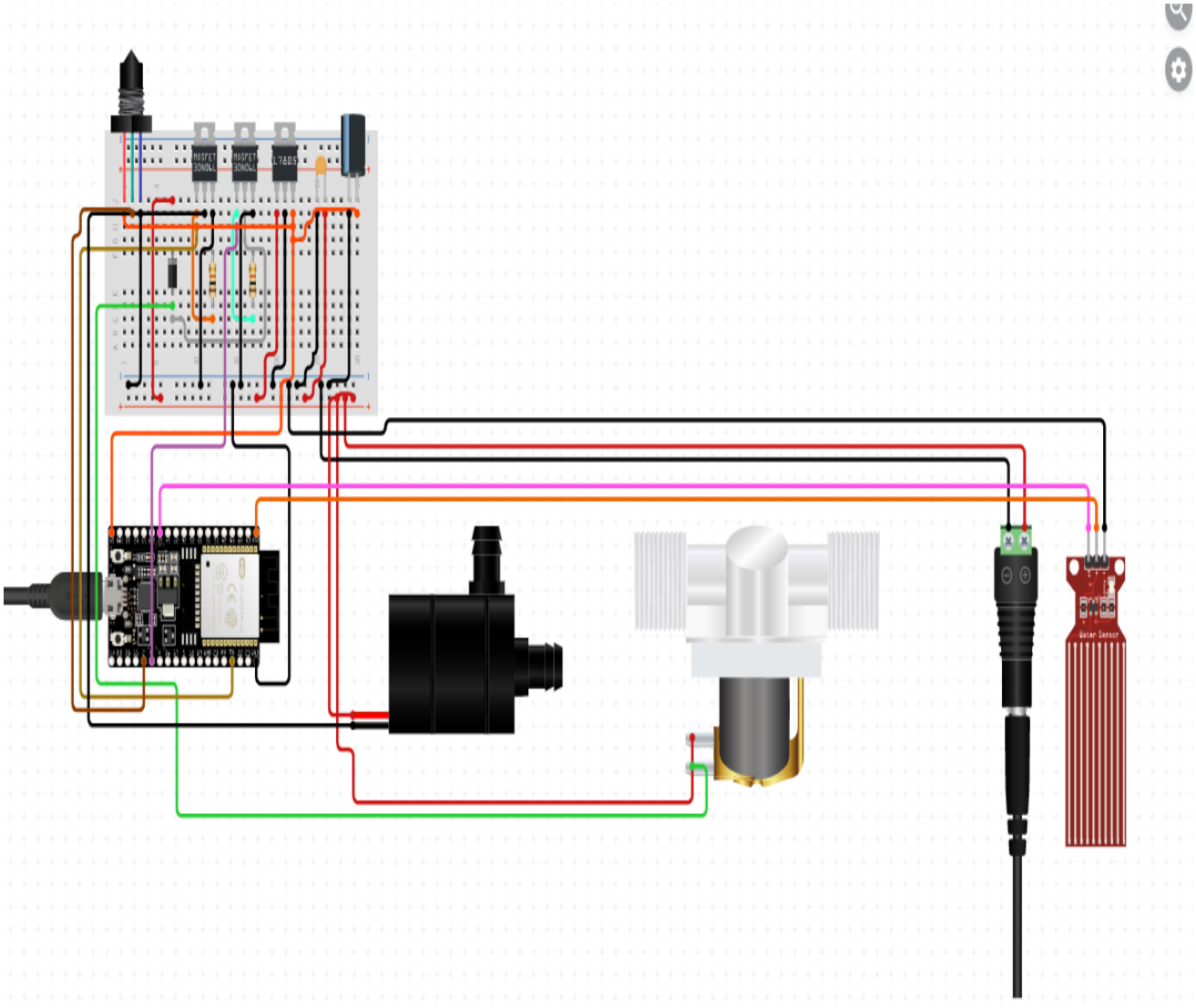

Figure 21_WATER SUPPLIER CIRCUIT DESIGN

3) Self-cleaning litter box Device circuit design:

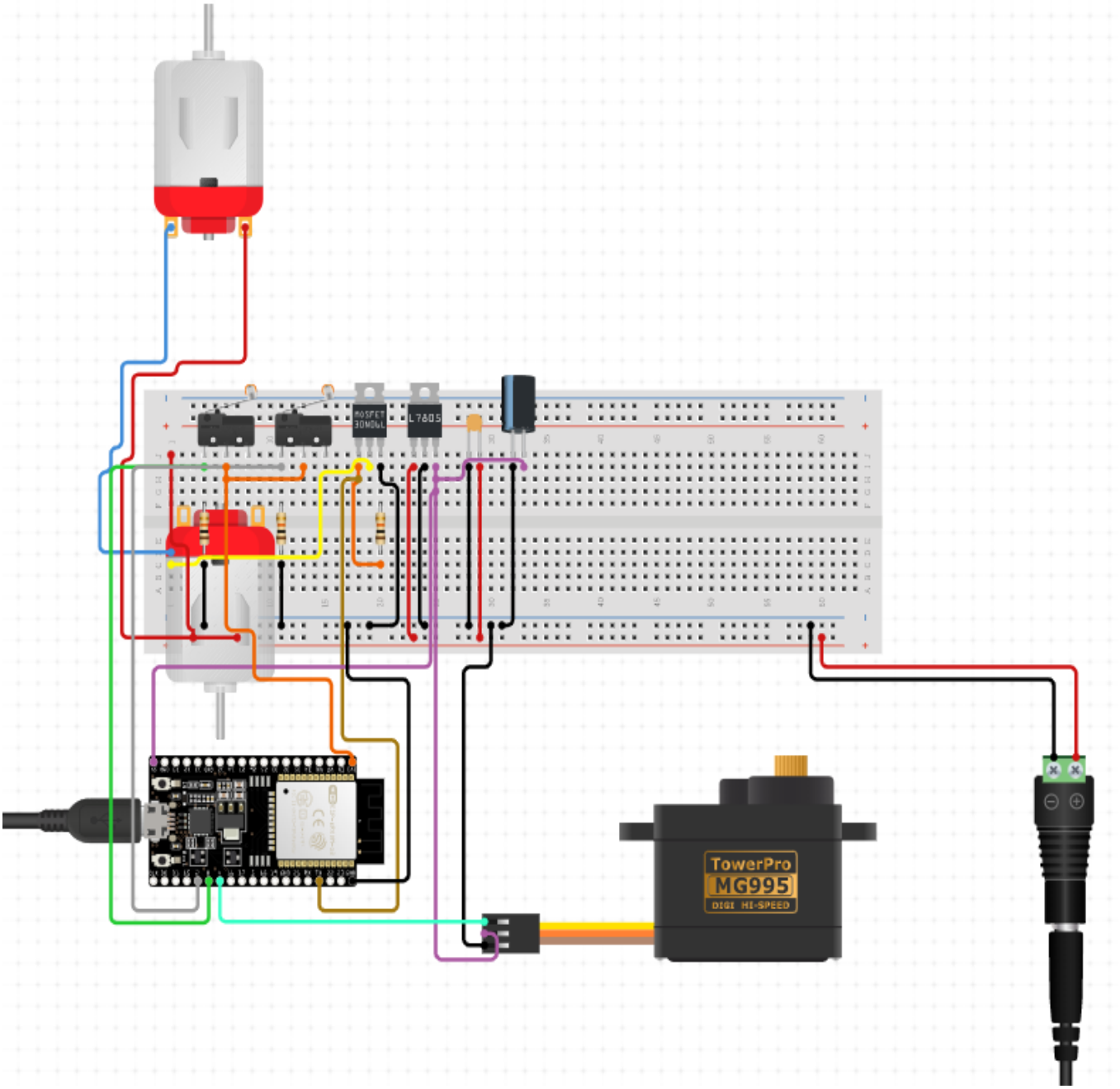

Figure 22_LITTER BOX CIRCUIT DESIGN

Chapter 6: Conclusion

In conclusion, Purrfect House consists of three systems: feeder, water supply, and litter box. The combination of these three systems gives the cat a whole system that fulfills its essential needs, thereby reducing the owner's responsibilities.

This project taught us how to use Arduino and program it. Also, our work taught us a great deal about hardware components, including how to connect them, as well as the calculations required to avoid damaging them.

For future work, we hope to add more features to our project such as tracking system on the cat's collar, also our feeder and water supplier won't be only for one cat, they will be able to have more than one schedule for each cat. Additionally for litter box, when it gets rid of the litter to the other container, we hope to make it dispose the sand from the litter automatically, also make it more practical. Moreover, making a toy that runs automatically.

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Appendices:

We used the following example code to know the calibration factor for the Load Cell:

```
void loop() {

  if (scale.is_ready()) {
    scale.set_scale();
    Serial.println("Tare... remove any weights from the scale.");
    delay(5000);
    scale.tare();
    Serial.println("Tare done...");
    Serial.print("Place a known weight on the scale...");
    delay(5000);
    long reading = scale.get_units(10);
    Serial.print("Result: ");
    Serial.println(reading);
  }
  else {
    Serial.println("HX711 not found.");
  }
  delay(1000);
}
```

Figure 23_APPENDIX1

And used this code to write and read from EEPROM:

```
int writeStringToEEPROM(int addrOffset, const String &strToWrite)
{
  byte len = strToWrite.length();
  EEPROM.write(addrOffset, len);
  for (int i = 0; i < len; i++)
  {
    EEPROM.write(addrOffset + 1 + i, strToWrite[i]);
  }
  return addrOffset + 1 + len;
}
int readStringFromEEPROM(int addrOffset, String *strToRead)
{
  int newStrLen = EEPROM.read(addrOffset);
  char data[newStrLen + 1];
  for (int i = 0; i < newStrLen; i++)
  {
    data[i] = EEPROM.read(addrOffset + 1 + i);
  }
  data[newStrLen] = '\ 0'; // !!! NOTE !!! Remove the space between t
  *strToRead = String(data);
  return addrOffset + 1 + newStrLen;
```

Figure 24_APPENDIX2

And used this code to send alerting messages to WhatsApp: (WhatsApp, n.d.)

```
void  message_to_whatsapp(String message)       // user define function to send meassage to WhatsApp app
{
  //adding all number, your api key, your message into one complete url
  url = "https://api.callmebot.com/whatsapp.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.
  }
  http.end();          // After calling API end the HTTP client object.
}
```

```
String urlencode(String str)  // Function used for
{
    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';
        }
        code2='\0';
        encodedString+='%';
        encodedString+=code0;
        encodedString+=code1;
        //encodedString+=code2;
      }
      yield();
    }
```

Figure 25_APPENDIX3

And started working on our code from this example. (serve motor with web page, n.d.).

This is how the time between two meals is calculated, by subtract the last and beginning hour, then divide it on number of times to drop minus 1.

```
int t=(last2-beg2)/(time1-1);
```

Figure 26_APPENDIX4

This is how the amount of food eaten during the day by the cat is calculated, by adding previous eaten quantity to the subtract of the quantity the user declared for each meal in the form and the Led Cell sensor reading at the moment.

```
int rr=scale.get_units(10);
q= q+(quantity2-(rr-722));
```

Figure 27_APPENDIX5

Here is how the process of dropping food is implemented, by keeping on dropping the food until it reaches the quantity the user declared for each meal in the form.

```
 while((rr-722)<=quantity2-5){//30
countw++;
if (ma==0){
  digitalWrite(valve, LOW);
}
          if(countw>=6){
            message_to_whatsapp("An Error occured");
            break;
          }
    servo1.write(49);
    digitalWrite(27,HIGH);
    delay(200);
        digitalWrite(27,LOW);
                servo1.write(29);
                delay(1500);
                rr=scale.get_units(10);
  }
  countw=0;
```

Figure 28_APPENDIX6

Our method of calculating when to drop the food next is to add the starting hour to the time between two meals and multiply it by the number of the current food drop.

```
  counter++;
  t2=beg2+(counter*t);
}}}else if(counter>=time1){
  counter==0;
  t2=100;
} if(m==last2+2&&s<=2)
{int rr=scale.get_units(10);
  q=q+(quantity2-(rr-722));
  ////////////////////// display
}
```

Figure 29_APPENDIX7