# SMART DUSTBIN PROJECT - TECHNICAL REPORT - FINAL SUMMATIVE



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**Class Code:** TEJ20R-Computer Technology
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## EXECUTIVE SUMMARY

This report will analyze and describe the functions and building process of a smart dustbin built using Arduino electronics and components to automate the work of a normal dustbin. This report will do its best to focus on the project outline, problems, solutions, code, and detailed descriptions of the schematics and wiring diagrams of the circuit, as well as give a full self evaluation of what went wrong, what were the hardships, and how would this project help others or benefit others.

The first few pages explain the problem description including the purpose, what is being done, how it is being done, talking about safety, precautions, and etc… Here we are using the SPICE model to explain our thoughts, brainstorming, and ideas out on paper to better understand how to go about building the projects and creating a basic project outline. Next, we will focus on solutions, examining the different solutions and how our solution is the most efficient and most effective for dustbins alike. The report will consider the advantages and disadvantages of the specified solutions and identify methods which might include: placing the components in a specific manner, configuring the right way to open the dustbin using the servo, arrangement of wires, etc… All methods tie in to having a good well-rounded solution that meets criteria of efficiency and effectiveness to produce the best output.

Problems faced will be discussed and resolved using small fixes that all contribute to making the solution better. The project plan and task details section will talk about the plan for completing the project, how it went about, and what had happened in each stage of the building process. Schematic diagrams will be labeled alongside a full on wiring diagram which explains the functions of the components used. Program code and edits done to make sure it works perfectly will also be supplemented. In sum, a self-evaluation will also be written to identify strengths and weaknesses of the project, what went wrong, what went well, what could have been improved, and a reflection on the project details, which will be crucial in understanding the project in full.

# 1.0 - PROBLEM DESCRIPTION

## 1.1 - What is the purpose?


The purpose of this project is to simply automate the functionality of an ordinary dustbin. An ordinary dustbin for many people takes time to open and fully put the garbage inside. For some people, they are not able to kneel down and open small/tiny garbage bins. For this reason, an automatic dustbin using a sensor will prove to be useful due to the sensing capabilities that will open the lid automatically and hold it open for as long as the sensor “senses” something. Due to this, the purpose of this project will be to help other people and at the same time use technology’s power to automate our daily tasks which include putting something in the garbage from time to time. Also, the purpose of this project is to explore the world of computer engineering through the eyes of arduino electronics. This project’s purpose will be to teach the builder how to use an arduino controller, different types of electronic components, and how to program them as well. This project aims to create and manifest a nice learning experience for the builder.

## 1.2 - What is being done?

The creation of a smart dustbin is what is being done to accomplish the goal/purpose of this project. We will be using a multitude of tools, components, and skills to make something that will be beneficial to everyone and a great learning experience for the builder.

## 1.3 - What are the issues/challenges?

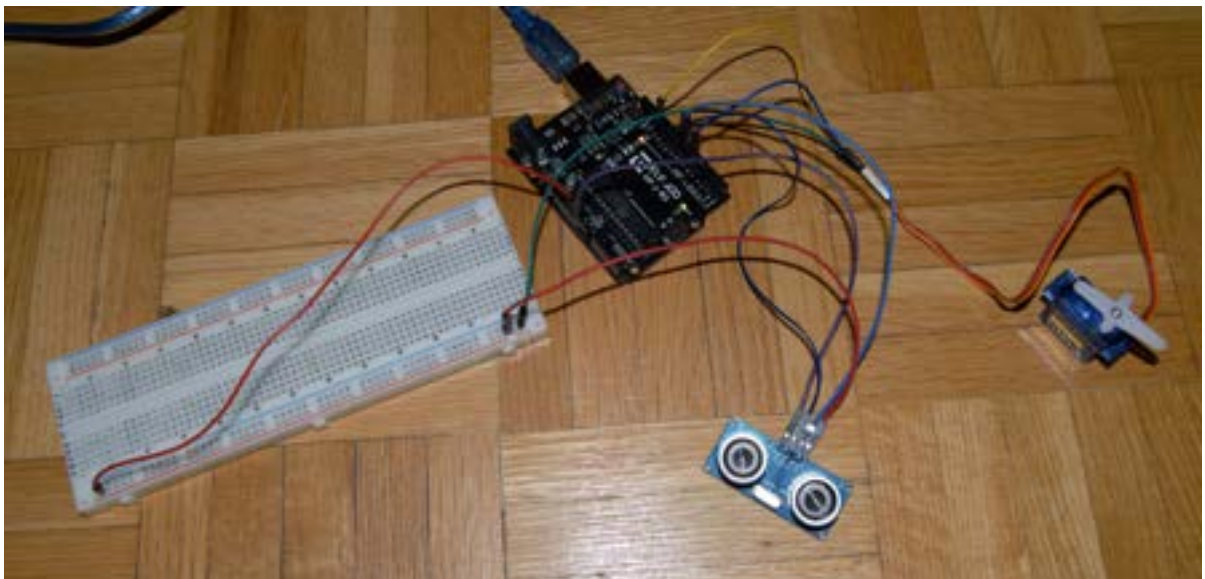
While creating this project, there were many problems that were present, some involving the functionality of components, some involving the attachment of the servo to the lid of the dustbin and etc… These problems will be mentioned in detail and their solutions or small fixes that were taken to mend as well.

Problem 1: Servo and ultrasonic distance sensor not working correctly

The problem was that I couldn't control the servo using the sensor although the servo was working fine. So I troubleshooted the problem and found out that both needed 5V. I was providing the wrong voltage for the sensor which did not make it work, and the servo already had 5V. The first solution was to connect both wire ends and put them in the same 5v power pin. That worked out but was quite bad looking and had the chance to come out and get loose. That was one solution, but then I used the breadboard as Mr. Edgar told me, and I found that this would be a safer and better option instead of connecting the same wire to the same port.

Bad Solution:


Good Solution:



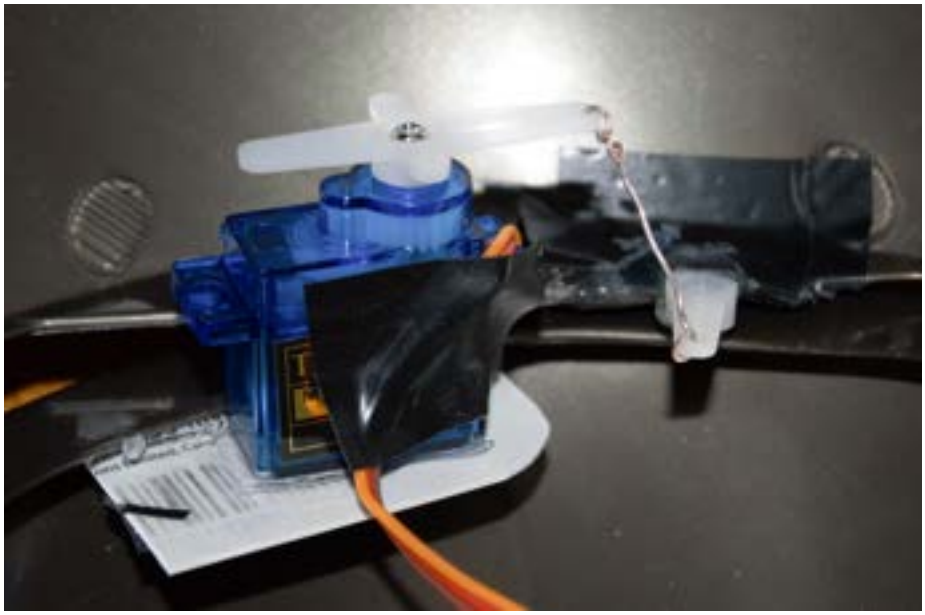
Problem 2: Attaching the ultrasonic sensor to the dustbin I bought.

I tried using the knife and used a lighter for heating it up to make holes inside the dustbin but that did not work, and I also did not also have a drill. Next I took the knife and held it up to my kitchen oven grill and that seemed to heat it better. I cut holes using the heat to melt the plastic

Problem 3: Problem with figuring out how to connect the servo to the lid

Fixed by adding an extra placement for the servo to be connected to the lid which made it work again, and made it stable enough to turn the servo so that it wouldn't touch the other parts of the dustbin causing blockage.

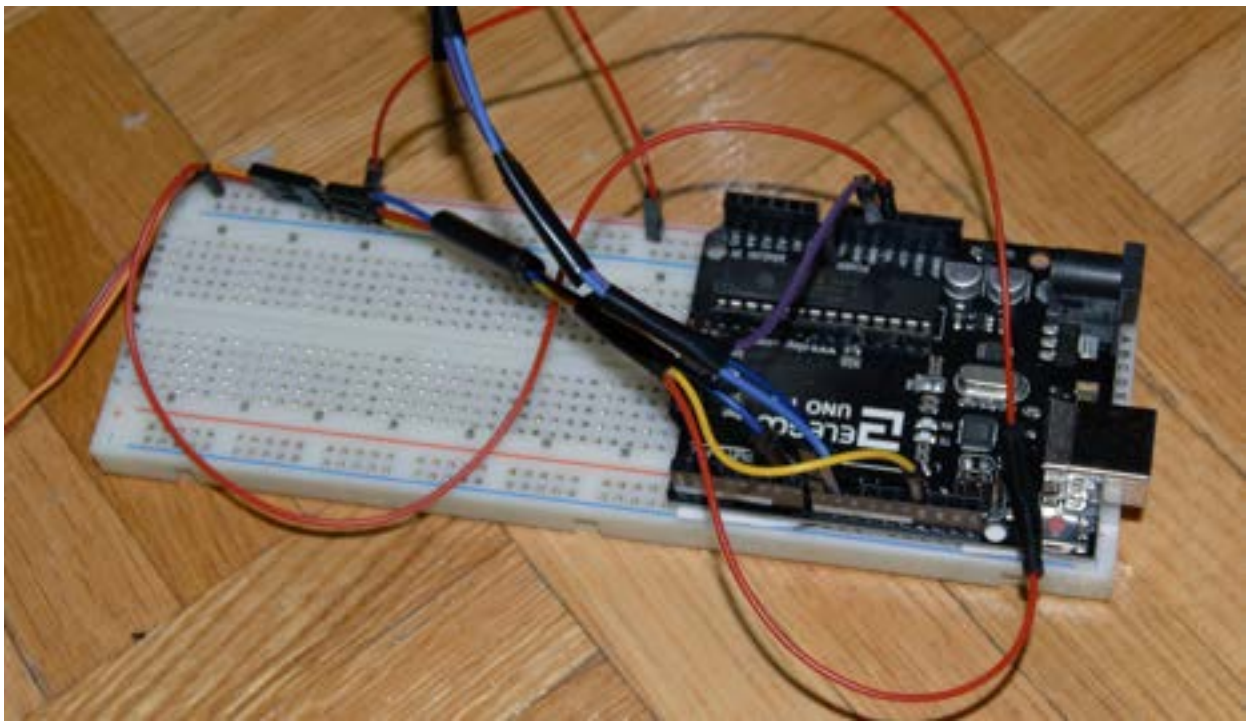
Many attempts were made to attach the servo to the lid, and then a second part was how to attach the servo armature to the lid to make it move. I couldn't make a whole in the lid due to some blockage that was present

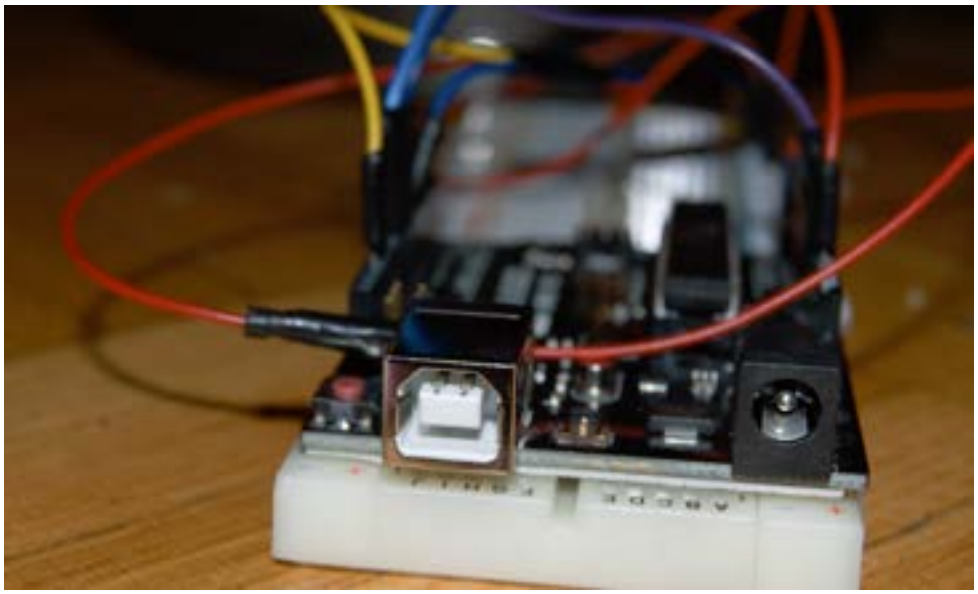


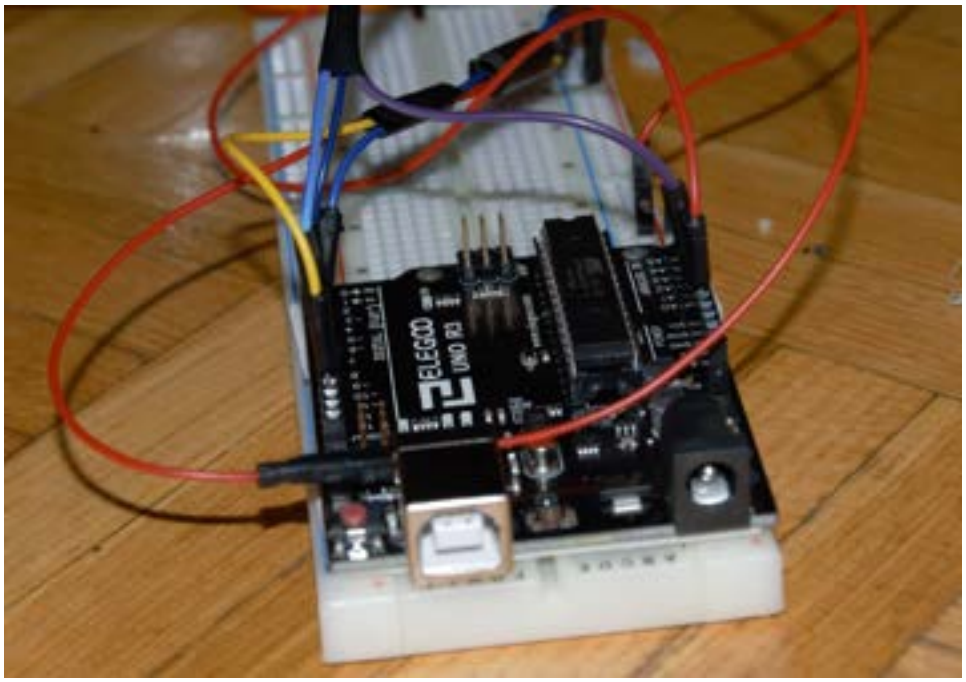
In the figure, an extension had to be made because the servo didn't have a spot in sit. I also didn't have a drill to make the whole in. I also considered if the armature would be able to pull the lid down to open it, if it had enough strength or power.

Solution -> connect another external part to make a whole in , and connect a thin flexible wire to hold both parts together, once attached the servo will turn and the lid will come down as a result of the other piece turning as well.

Problem 4: Problem with connecting the arduino to the inside of the dustbin and the breadboard. I thought why not just put the arduino on the breadboard so that it connects together. Note that the arduino is not connected to the breadboard, just double sided taped for efficiency purposes. And for saving space. Tape is added to the wires for better wire/cable management.








Problem 5: Problem with getting the right angles to work out

I had to do trial and error to get the servo to turn just the right amount of degrees so that it wouldn't get stuck or wouldn't jam up.

```
if (distance <= 30)
{

  servo.write(0);
  delay(1500);
}
else
{
  servo.write(100);
}
```

### 1.4 - What are the restrictions?

There were quite a few restrictions which were not that much of a problem because I had found other alternatives to combat those restrictions. One restriction was the unavailability of a drill. A drill would have been proven to be a safer, more useful, and very effective way of making clean cut holes to fit my components. Now, heating up an exacto knife and making holes that way is not that much of a safe option, but it did the job for me and made a really good hole for my sensor.

Limited materials, especially tools, had a few restrictions, although I bought tools later to solve the problems. Other restrictions included space and the dimensions of the dustbin in complement with the dimensions of the components. Working with such small components without tweezers proved to be a pretty daunting task, but was managed (with taking a lot of time to fit components without them falling apart). I was working in a pretty small space which resulted in many things falling over or me not being able to move around that much. Another restriction was light, I was working and did not have any light because there were no windows to give light and I did not have a table lamp as well. I needed to use the limited light that was available because I was doing it in an enclosed space. All in all, there were not many restrictions, but these gave me quite a few uncomfortable problems, but I was able to get through them and produce a great result (dustbin) in the end.

### 1.5 - Safety

Safety is a very important and crucial part of any building project especially related to electronics, electrical device handling, and etc… In this project, safety was maintained and kept in order to ensure no one got hurt, nothing burnt, electrocuted, or broke. I had worked in a safe environment where I had nothing to catch on fire, electrocute me, or hurt anyone else. It was a clean area where I could see everything and monitor everything. Precautions were taken to keep everything safe, like wearing gloves when working so that I do not static any of the parts even though it was not necessary I wanted to take extra care to work with my components. I also made sure to not keep any water near me or anything that could catch on fire. In all, safety was very highly maintained and ensured to successfully complete the project and accomplish the project's goals. As for the arranging of wires, using electrical tape to bind common wires together instead of them splattering around was also a safe and efficient approach to organizing components, and making sure that they are not partially or fully sticking out (wires).

### 1.6 - What must be completed - How?

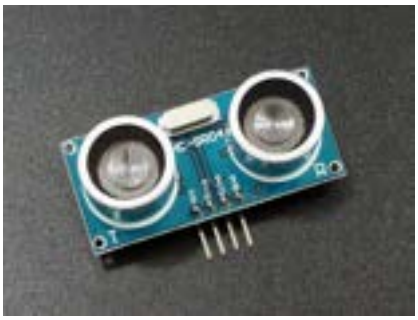
To complete this project including the written component, physical design/implementation, and presentation, a series of steps and methods were devised to complete the project

efficiently, effectively, and as quickly as possible without missing on important details. According to Mr. Edgar's instructions, the journal should be completed every day or whenever we are working on our project. This should be completed with a good overview of what went on while working on our project for that time period or session. This will allow Mr. Edgar and me to view what I have done, accomplished for that work session, and what I should do next to further forward myself in completion of the project. Next, the design of the circuit should be created to ensure that everything is working properly and correctly in TinkerCAD so that it will work in the physical implementation. There was one problem, which was connecting the 5V power pin for both the servo and the ultrasonic distance sensor to the same pin of the Arduino board. This problem was fixed, as mentioned in beforehand sections with adding a breadboard making everything easier for wire management and power supply production. The circuit design in TinkerCAD should also be mentioned when writing entries for the journal, which will describe what the circuit does and how it would be implemented in the physical scheme of things. A physical working implementation has to be formulated and created which will allow the servo to move. This is our goal, to make the servo to move, which will ultimately serve as the purpose for making the dustbin lid to move. Those were our main goals. The first goal, making the servo to move, could only be completed through thoughtful design, and implementation of both the virtual circuit and physical circuit. Next, after this we could focus on the final goal which was making the servo to make the dustbin lid to move. Making sure that the code would work was the mission after this. Fixing up and tinkering around with the code would ensure best and prime performance of our circuit. After that, a dustbin should be brought to house all the components together, but in that housing step, critical thinking should be applied to see where the components should fit to optimize everything and make sure that any wires are not falling apart or nothing is hitting the lid of the dustbin causing blockage of any sort, etc…

### 1.7 - Materials Required/Supplied

This following table will outline the components/materials which were required, their functions, and the materials which were supplied by the teacher. These materials are crucial for making our circuit work. Materials include the electronic components required, tools that

were required, and the dustbin itself. Any tangible materials that were used in making of the product will be listed. Intangible objects such as software used to write code will not be mentioned, but the Arduino IDE is still an integral part of this project, even though it is intangible. Other required software components that went into developing the project are also automatically integrated.

| Materials Required | Picture | Function |
|---|---|---|
| Arduino UNO R3 Microcontroller |  | The Arduino UNO R3 is used in this project as the main microcontroller for automating the process of the dustbin, and controlling the servo. Arduino.cc developed an open-source microcontroller board based on the Microchip ATmega328P microprocessor. The board has a number of boards equipped with sets (I/O) pins that may be used to connect to other expansion boards (shields) and other circuits. |
| Ultrasonic Distance/Proximity Sensor (HC-SRO4) |  | The Ultrasonic Distance/Proximity Sensor is a typical arduino component that is used to sense a nearby object to trigger something to happen in the circuit. In this case the ultrasonic distance sensor sends ultrasonic sound waves and when an object is identified it reflects the wave back. The sensor calculates the distance from the sensor to the object and based on some code does something. In this case, the hand determines the distance and opens the dustbin. |

| | | |
|---|---|---|
| Micro Servo |  | The Micro Servo is a common component when designing arduino circuits which need to move certain things. This is a type of electromechanical motor which does a variety of tasks, like moving the lid of a dustbin, rotating something, and other purposes. It is powered by the arduino and controlled by the program that the user writes. In this case, the servo is given the task to open the lid and close the lid of the dustbin depending on whether the user removes or places his hand in front of the ultrasonic distance sensor. |
| Wires |  | Wires are the most essential component in this entire project. Wires connect the arduino to other components making sure that data gets transferred to ensure the program works correctly. In our case, actually in any case, wires serve as the base building blocks for transporting electrical signals and data to make our project work. Without wires, this project, or as a matter of fact any project would not have been complete, no matter how complex it is. |
| Breadboard |  | The Breadboard is primarily used in this project to distribute the 5V power across a series of pins that make it easier for the servo and the ultrasonic distance sensor to receive power from. This makes |

| | | |
|---|---|---|
| | | organization of the circuit much cleaner and stops it from destroying the unfortunate 5V pin on the arduino. There is only one pin on the arduino which limits one or more components that require 5V to connect, therefore the breadboard serves as the best “way” to connect multiple components, or for power source applications such as our case here. Also, this had solved one of the problems that was present as explained in the previous sections. |
| 9V Battery and Battery Power Jack |  | The 9V Battery and Battery power jack are used as the main power source for the smart dustbin. This is crucial for providing power to all the components (electricity flow) which will allow our components to function properly. |

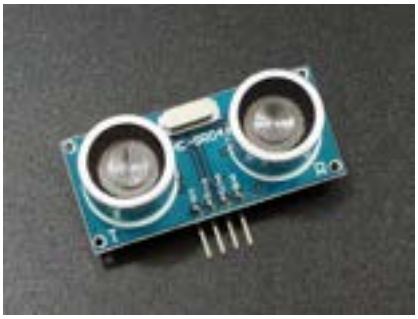
| | | |
|---|---|---|
| Electrical Tape |  | The electrical tape is a prime material in our project involving the organization of wires by taping, binding wires together (copper ends), etc… |
| Hot Glue (Hot Glue Gun) |  | The hot glue and hot glue gun were used to bind components and stick components together permanently which needed strong adhesive. It was also used to stick the ultrasonic distance sensor together to the dustbin, as hot glue is a great insulator and very good for electronic projects. |
| Double Sided Tape |  | This material was also extremely useful for sticking multiple components on surfaces and other components on other components. Its function is to make things stick on both sides of the tapes. |

| | | |
|---|---|---|
| Screwdriver |  | A very small head screw driver was used to screw in the armature of the servo in place correctly so that it could function. The screwdriver proved to be helpful in attaching things firmly. |
| Wire Stripper (Cutter) |  | This wire stripper and cutter tool proved to be useful in this project for stripping wires, cutting wires, cutting anything that could be cut actually, and also attaching small components which the normal hand could not reach. |
| Thin flexible wire |  | The thin flexible wire was used to connect the armature of the servo to the other armature of the servo connected with the lid. So this was crucial in moving the lid back and forth. |

| | | |
|---|---|---|
| Dustbin |  | These types of small dustbins prove to be best for anywhere. Primarily its function is to sit on a computer desk, maybe someone is eating a candy bar and decides to throw out the wrapper inside the bin, without touching the bin, as this stops germs as well. |

**Materials Supplied (Mr. Edgar)**

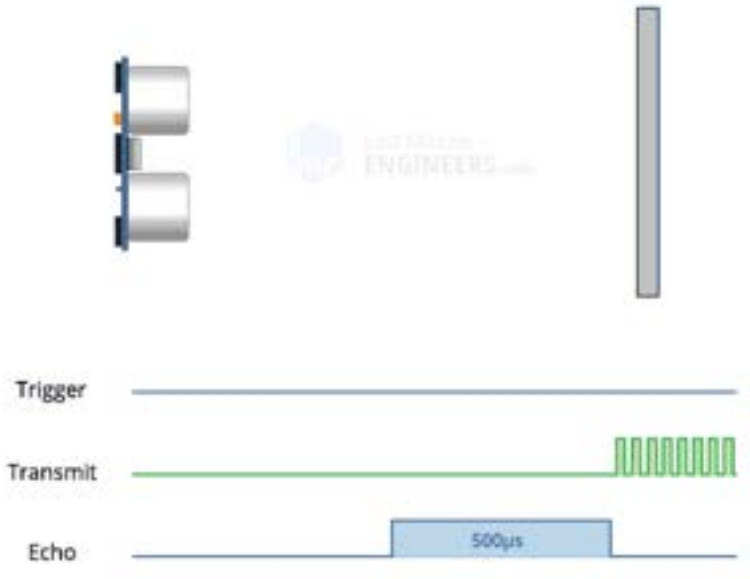
These are all supplies which were provided by Mr. Edgar. These components are all the electrical components which were supplied. The other materials or tools not mentioned in the following table are materials/tools that were personally bought/provided.

| Materials Supplied | Picture |
|---|---|
| Arduino UNO R3 Microcontroller |  |
| Ultrasonic Distance/Proximity Sensor (HC-SRO4) |  |

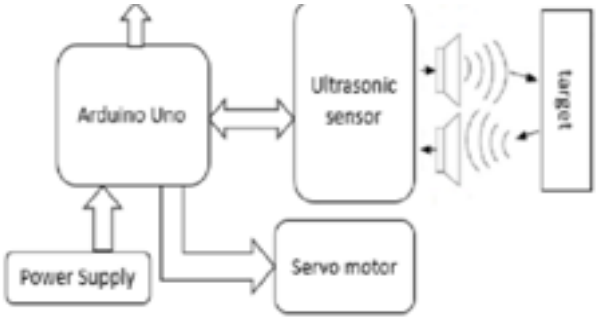
| | |
|---|---|
| Micro Servo |  |
| Wires |  |
| Breadboard |  |
| 9V Battery and Battery Power Jack |  <br>  |

### 1.8 - Notes/Sketches/Diagrams

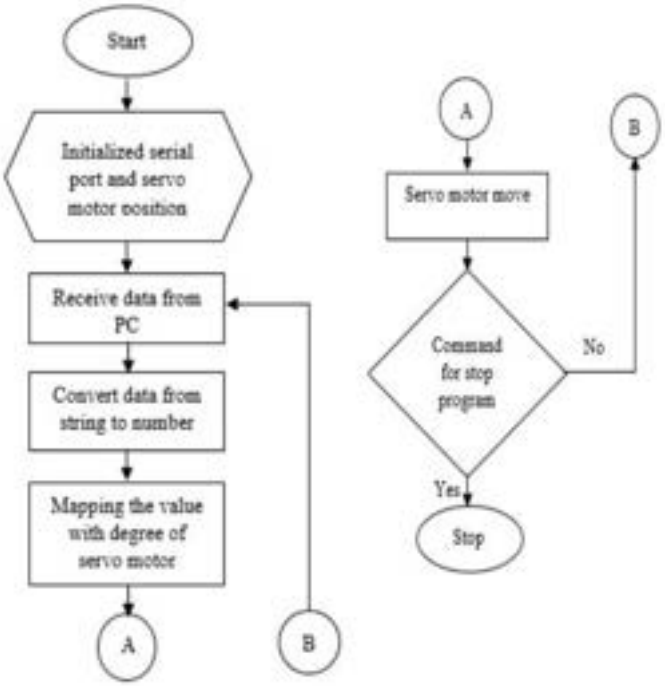
For extra notes, sketches, and diagrams please refer to these pictures, which might prove to be a supplement for this section. All in all, to conclude this section, we have talked about our problem description, safety, problems, restrictions, materials, components, and other thoughts related to our base problem description and how we will combat it and how we will create our solutions to solve our problems. Pictures were shown to illustrate in a deeper way where each component is placed and how it is placed to make our functionality for our project smoother.




Brainstorming Block Diagram - What I started out with




Flowchart - of how the scientific process behind arduino and components work




# 2.0 - OVERVIEW OF SOLUTION

## 2.1 - What is the solution?

To understand the solution, first we need to understand the objective. The objective of this project is to specifically just “automate a dustbin’s lid” to make it move when the “sensor senses motion”. It is a simple objective but must be approached with the best solution that is both efficient and effective. The solution now will be to create a circuit, with the arduino microcontroller, an ultrasonic sensor (sensing motion), and a servo (to move the lid). Our two main sub objectives are “to move the lid” and “to sense motion” which are both dealt with two distinct components, all connected to the arduino. That is the solution in a nutshell. The design process of this solution, as we go in more detail, will be discussed in later subsections.

## 2.2 - Why select this solution?

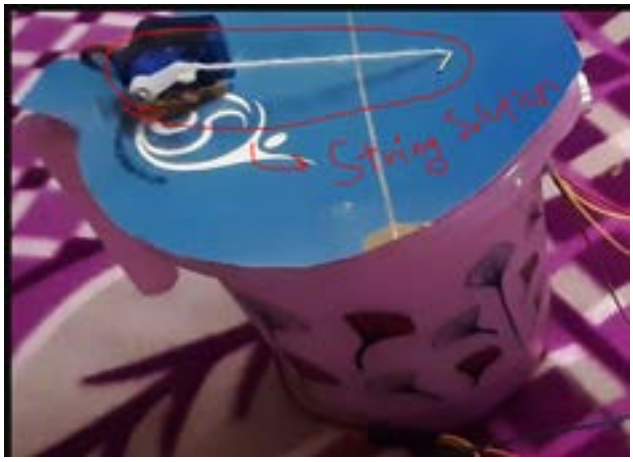
This solution is one of the most approachable, easy, and efficient solutions that can be formulated especially for these types of mini small dustbins. Connecting the servo armature to the dustbin lid, and making it move will be the best way to put as less stress on the

armature of the servo as possible, because considering the factors such as how much weight the servo can pull, power needed, etc… This solution provides a guarantee that all components will be used to their full potential without overstressing components in terms of factors discussed. Also, this solution was selected because of the time it would take to build it. It took a maximum of 1 days to build this solution (continuous building for over 3 hours); other solutions that were thought of might have taken longer. After looking at the alternatives, I decided that this was the best choice, in terms of time, materials, space, and how effective it would be to move the lid of the dustbin, and sensing of the motion, considering our objectives. The only downside to this solution, is that because all the electronics are inside, although it is stores pretty well from any garbage, some garbage could interfere with the electronics, but I don't think that will cause a problem because the arduino is placed in an area where it won't come in contact with most garbage, especially because this dustbin is so small it's not designed to be like a conventional dustbin. It's like a table dustbin, mainly targeted for those who need a quick place to put their garbage in while working on their computer or etc… And who doesn't want the hassle of kneeling down to open the dustbin etc…

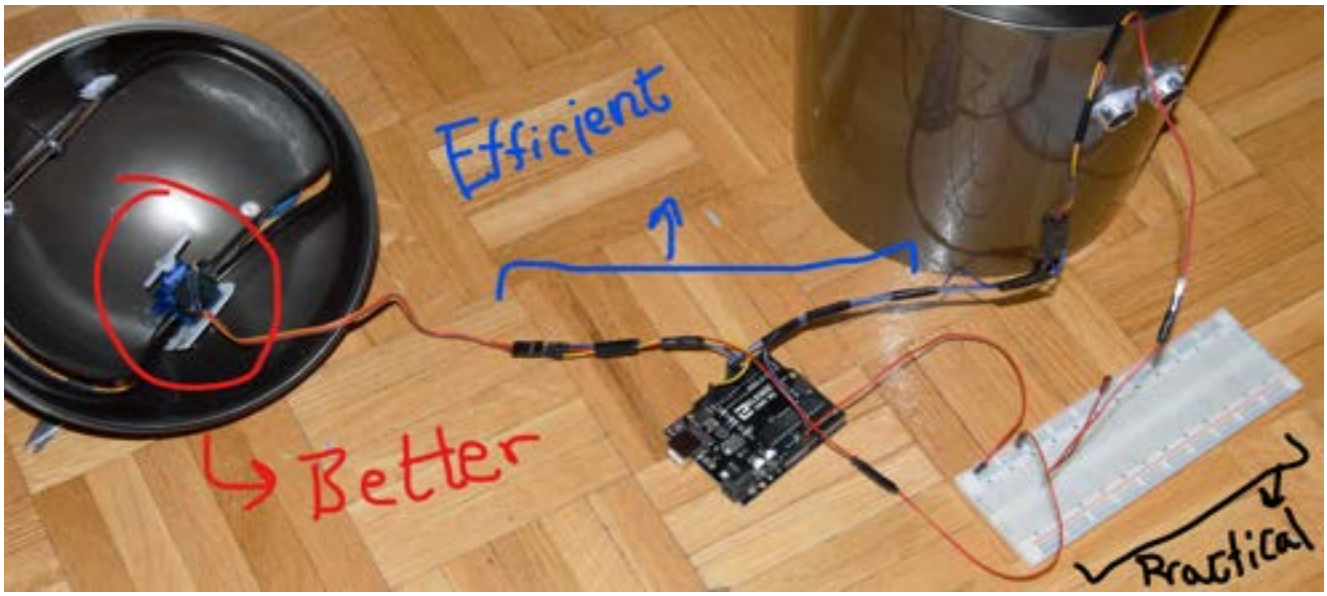
Other solutions:

Putting the servo - connecting with the string at top
Downsides: - shows the components - doesn't look appealing or professional

- Prone to breakage easily



OUR SOLUTION: Practical, efficient, and better in every way. This is just before putting the components together inside the bin. No components are exposed, except the battery, which is outside because it is practical to change the battery from the outside not from the inside by opening the top of the dustbin to do so.




### 2.2 - Pros/Cons of this solution?

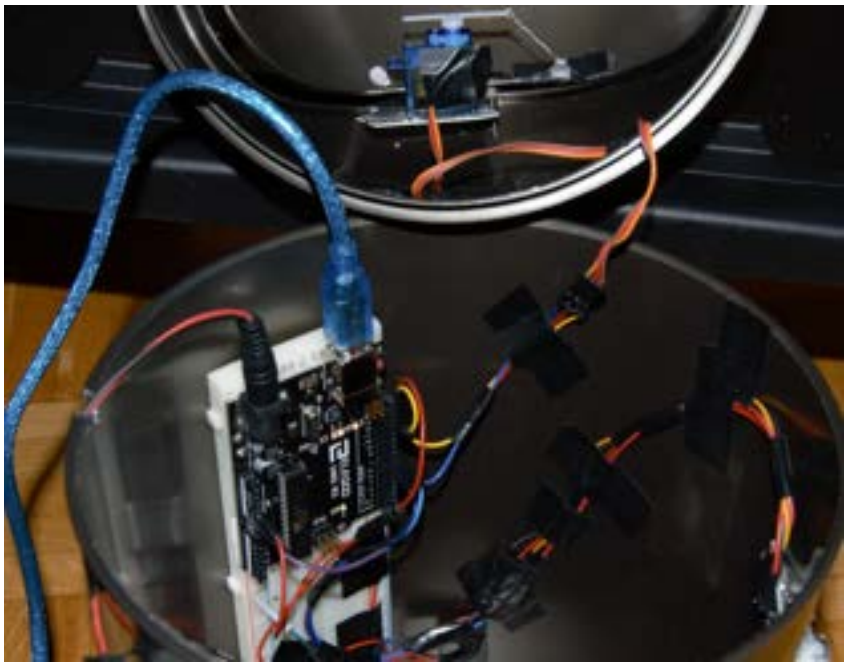
Pros:

- No exposed components, fully looking like a normal dustbin with the sensor exposed for sensing and the battery outside for replacement.

- Efficient placement of components, where they will not be disturbed and can function

- Mini dustbin, which provides extreme portability, serving as a desk dustbin on top, or a normal dustbin

- Easily lid can be taken off, and reprogrammed using usb



- Very fast response rate to motion, doesn't take long to open the dustbin and close it, - partly due to efficient utilization of delay when coding

Cons:

- Big con is that everything is inside of the dustbin, even though it does not take that much space, too much garbage **may cause inconvenience.**

**Solution for Improvement:**

- Some sort of covering in the interior which would limit the touch between garbage and electronics, a simple plastic bag which people mainly use for normal garbage disposal can be used.

- If mishandled, the lid might get jammed and the person might have to fix it, as it is very delicate.

### 2.4 - How efficient is this solution?

This solution is efficient in many ways. First, it gets the job done, cleanly, and precisely. Our main objective - create a arduino project that helps me learn and apply my skills learnt in tech class (smart dustbin), and our sub objectives which were to “move the lid of the dustbin (make the servo work)”, and “make sure the ultrasonic distance sensor is working (detecting motion)” is being efficiently combined together to create a product and working implementation that is fun to use. In terms of efficiency, it focuses on the important tasks. There is no extra addition to this project, which deals with other objectives, but only focuses on moving the lid based on motion. It is also very efficient in terms of wire organization and spacing. The electronic circuit, in terms of cable management and space is very well placed and organized not to cause any harm to both the user and the electronics. Again, safety and space are also a big part of efficiency. The size of the dustbin, an important factor in determining the productivity and efficiency of the solution. The smaller size makes It is more efficient and portable, which also means less stress on the servo as it needs to only move with a very small amount of force to pull the lid up. The cost of the dustbin is another factor. This dustbin was only bought for 4 dollars at the dollar store, so this would mean that the entire project was completed with 4 dollars. Other projects might have taken more money to do, especially with the fact that the electronics were not bought but kindly provided by Mr. Edgar himself. This solution was also very easy to implement, time being another factor. It took just 3-4 of continuous non-stop building, with water breaks in between, to finish the project. Other solutions might have taken longer depending on the complexity, even though complexity does not matter because the simple philosophy of moving a servo with a motion sensor should not be taken in a complex way.

### 2.5 - Solution Design Process/Project Outline

In the following, I will discuss how I thought about this design and the project outline (what I did - stages)

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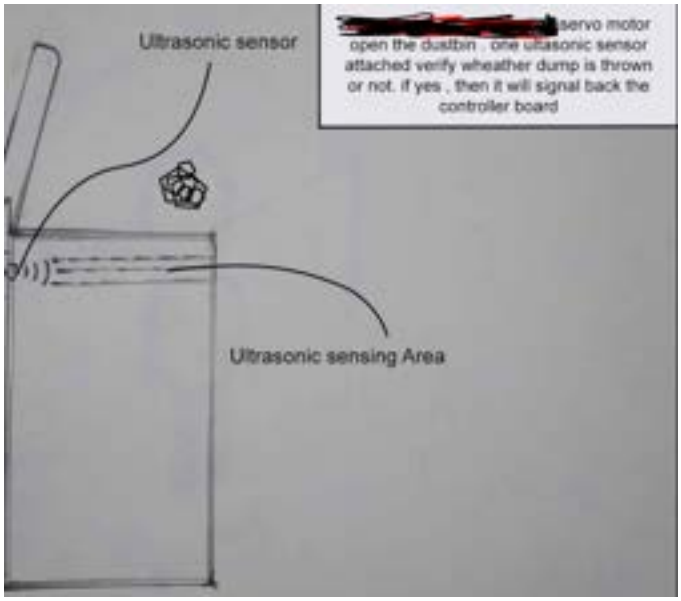
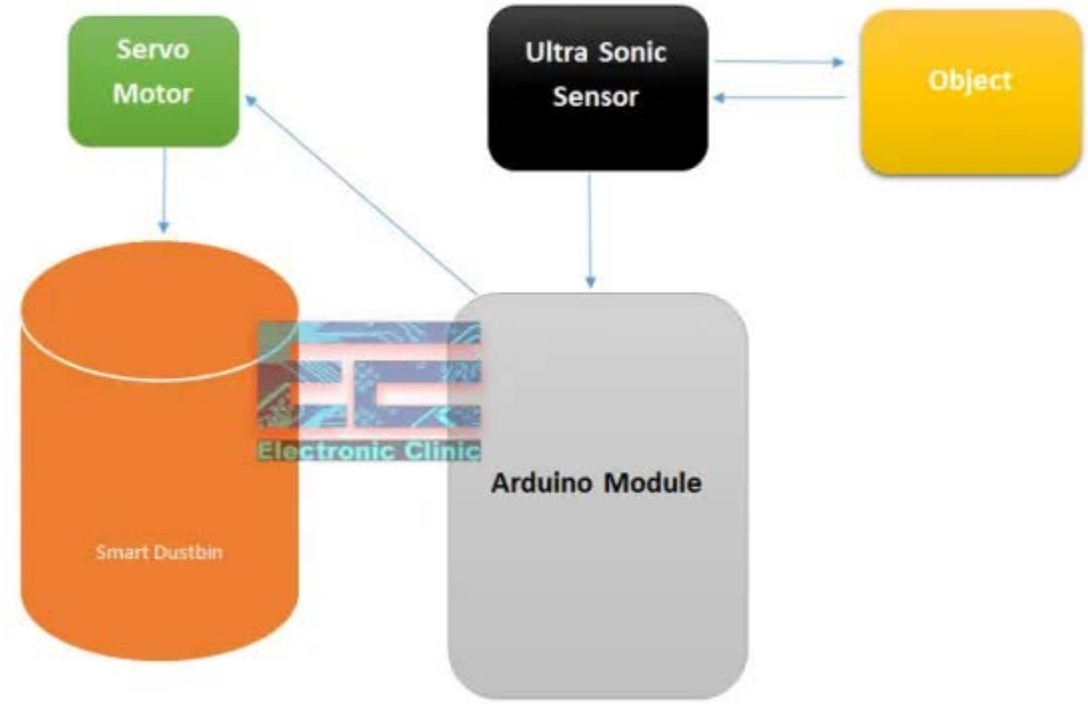
Design Process:

During this process I had a very rough outline of how my project would work and what it would look like. I saw many examples which had the ultrasonic distance sensor sticking out of the dustbin, so I knew that this would be the best choice of action for the sensor, but I was unsure about the lid of the dustbin, and very much unsure of how I could place the components. Whether that be inside or outside.




So the rough design process (very very rough) - included me brainstorming about a dustbin that had a lid that was something like my current dustbin that I have now.




Then, I thought about adding the sensor on the front of the dustbin as seen in the pictures above. So that thought stuck in the final implementation. Never did I think about putting a breadboard inside my dustbin, so that was not part of the design process for me. But, later I decided that due to the 5V pin power problem, and also way later, that I could actually stick the arduino on the breadboard, it would be a great idea. So these little things, after refining the design process multiple times, came out with a great solution for my dustbin. I also always like to map out pseudocode inside my mind, before I actually started coding. I thought about how to code the ultrasonic distance sensor and connect it with the servo, and what distance I should be using, and which delay would maximize the efficiency, effectiveness, and output of the ultrasonic distance sensor and the servo to open the lid. These took quite some time to process and map out in my head and later when I was ready to start, I thought about them and started. Although many things changed on the way which was unexpected, I still ended up with a working project. At the end of the day, it's all part of experimentation, and testing to see if everything works and nicely fits.

# 3.0 - PROJECT PLAN AND TASK DETAILS

## 3.1 - Project plan - dates

The project plan was mainly decided upon the duration of how many hours or how much time I would put into making the project. There was no hard and fast rule on when I should sit and complete the project, but I just went with the flow and completed tasks on the way. Nevertheless, here are some dates which I thought were important “milestones” if you will in completing the project.

May 25, 2022:

Thought about what I wanted to do, then inspiration struck in automating a dustbin using arduino.

May 26 - 30:

Brainstormed, brainstormed, brainstormed about materials, ways to open the dustbin, types of dustbins to consider, components, etc…

June 1-2:

Built the tinkercad version of the circuit, and formulated the code

June 3-5:

Build the entire project from scratch and make changes accordingly.

June 7 - Current:

Worked on the technical report, which will be finished by June 20 - the due date

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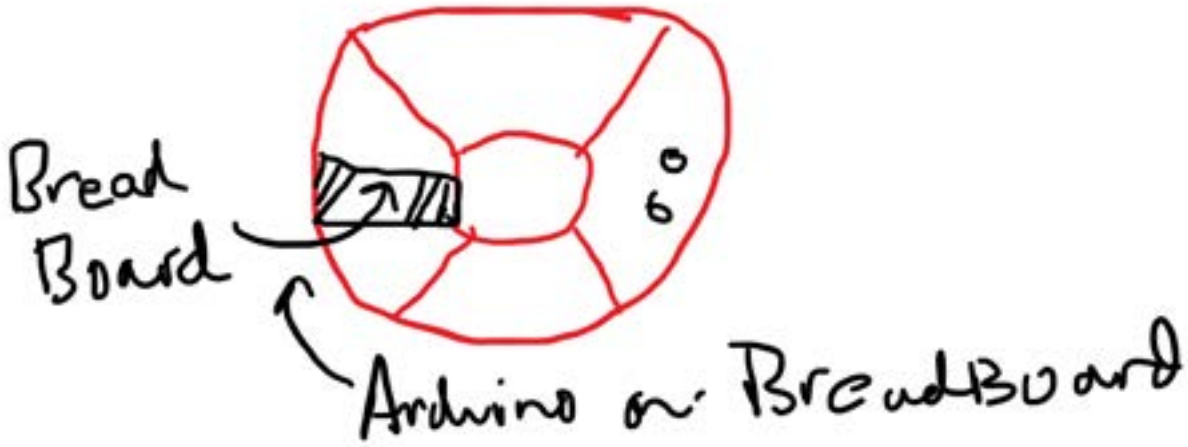
Above was the basic overview or timeline of tasks that need to be done, and it is also structured which allows me to not stress, or think too hard about this project (procrastinating) and allows me to complete the project efficiently, and effectively on time.

### 3.2 - Task/Action Plan

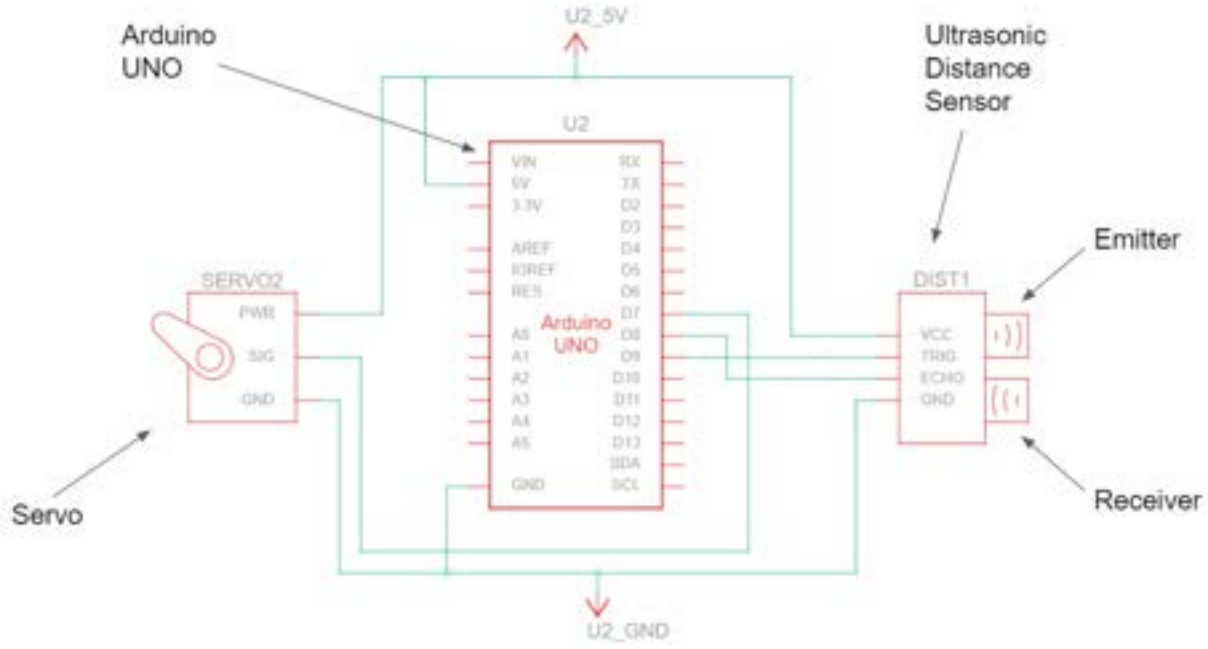
The task and action plan will be to first and foremost start with the journal. Starting with the journal allows me to jot down everything that has happened in the day I was working on. Then on the next day, I can go over what I did yesterday and work towards my new goal on a new day. Then the action plan will be to build my project and complete the technical report.

## 4.0 - DRAWINGS/SCHEMATIC DIAGRAMS

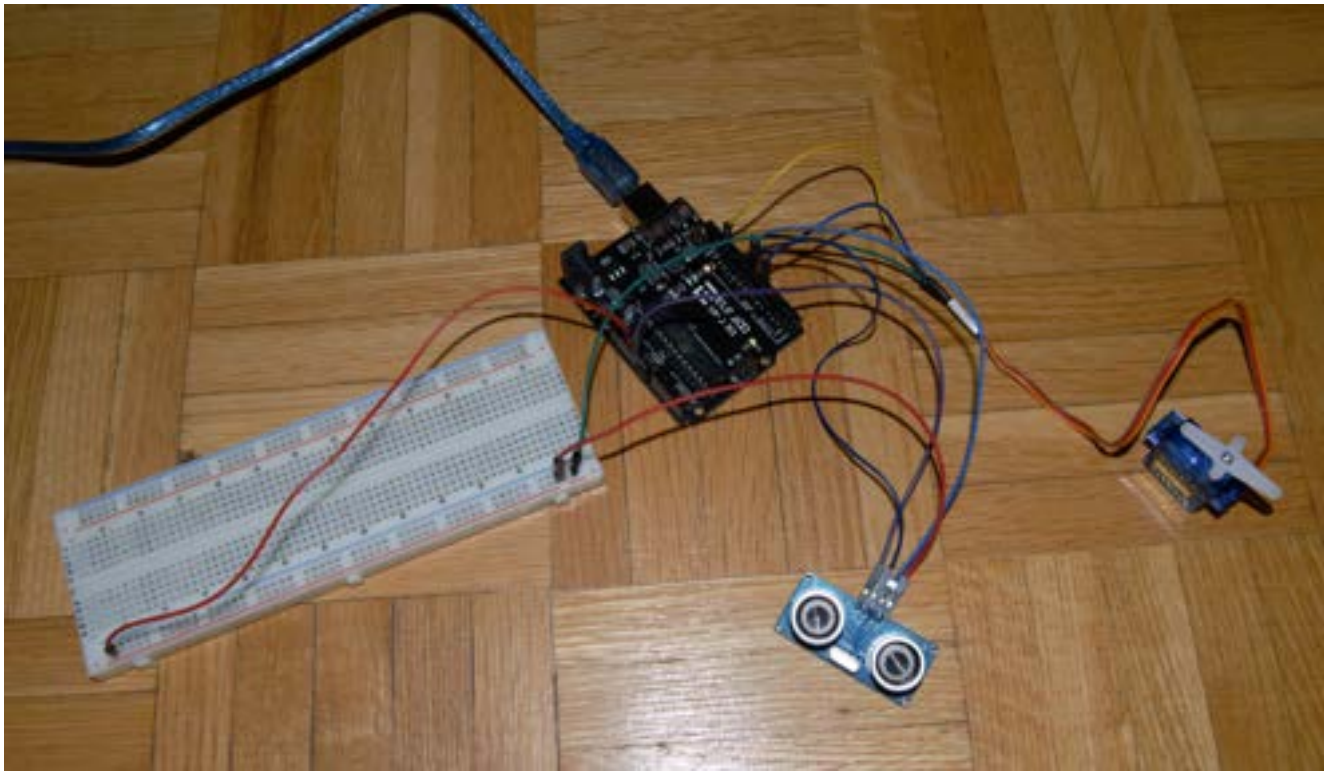
### 4.1 - Component placement sketches

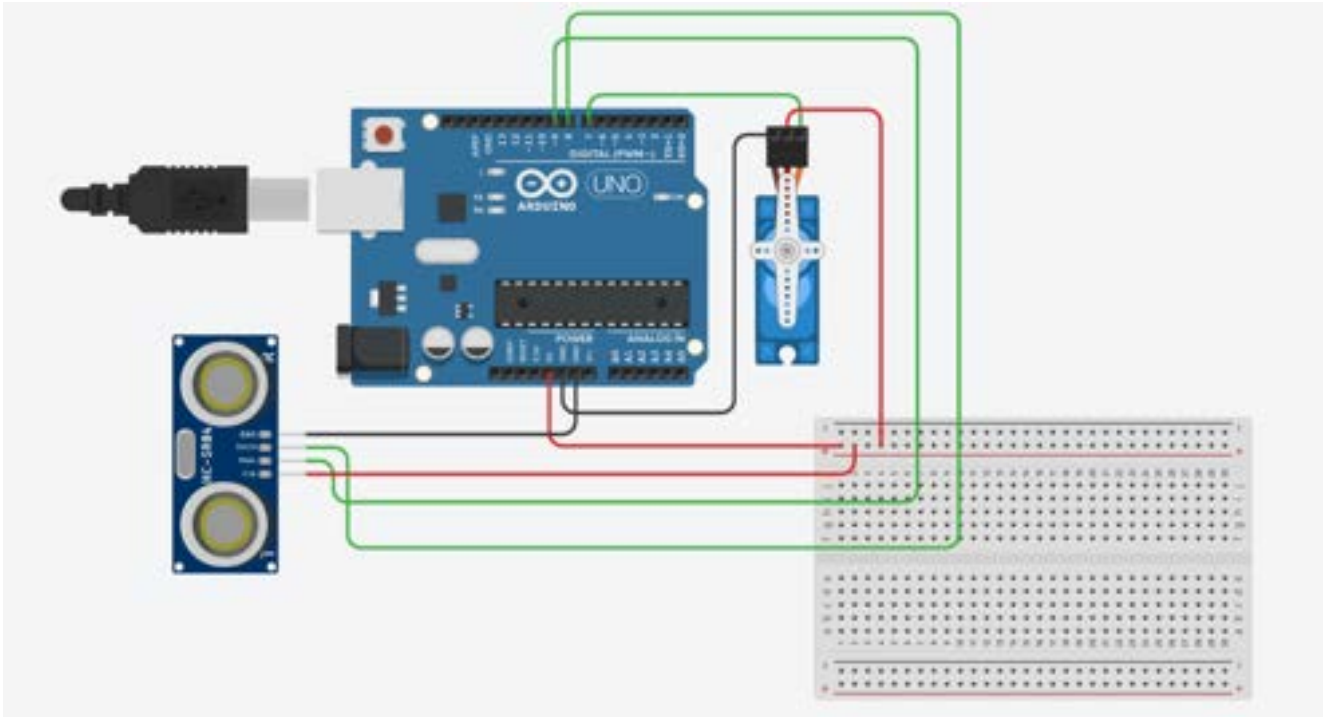




### 4.2 - Final schematic diagram



### 4.3 - Final Wiring Diagram






Label the same components as schematic.

## 5.0 - PROGRAM CODE (IF APPLICABLE)

```
// define Pins
#include <Servo.h>

Servo servo;

int trigPin = 9;
int echoPin = 8;

// defines variables
  long duration;
  int distance;

  void setup()
  {
    servo.attach(7);
    servo.write(0);
    delay(1000);

    // Sets the trigPin as an Output
    pinMode(trigPin, OUTPUT);
    // Sets the echoPin as an Input
    pinMode(echoPin, INPUT);
    // Starts the serial communication
    Serial.begin(9600);
  }
  void loop()
  {
```

```
28.    // Clears the trigPin
29.    digitalWrite(trigPin, LOW);
30.    delayMicroseconds(2);
31.    // Sets the trigPin on HIGH state for 10 micro seconds
32.    digitalWrite(trigPin, HIGH);
33.    delayMicroseconds(10);
34.    digitalWrite(trigPin, LOW);
35.    // Reads the echoPin, returns the sound wave travel
  time in microseconds
36.    duration = pulseIn(echoPin, HIGH);
37.    // Calculating the distance
38.    distance = duration * 0.034 / 2;
39.    // Prints the distance on the Serial Monitor
40.    Serial.print("Distance: ");
41.    Serial.println(distance);
42.    if (distance <= 30) // Change Distance according to
  Ultrasonic Sensor Placement
43.    {
44.
45.      servo.write(0);
46.      delay(1500);
47.    }
48.    else
49.    {
50.      servo.write(100);
51.    }
52.  }
```

## 6.0 - DAILY JOURNAL

| Date | Hours | Description |
|---|---|---|
| May 25 | 1 | - Noted down materials in google doc for electronics<br>- Noted down tools<br>- Noted down what external resources/materials I might need |
| May 26 | 1 | - Design the circuit in TinkerCAD<br>- Make sure the servo is working<br>- Download Schematic Diagram |
| May 29 | 3 | - Bought the dustbin<br>- Researched about the components |
| May 30 | 2 | - Received kit<br>- Formatted the technical report<br>- Tested code, but didn't work |
| May 31 | 3 | - Figured out the problem with sensor and servo - now working correctly due to power problems with 5v<br>- Started Sections on Technical Report<br>- Marked places where the electronics would need to go inside the dustbin |
| June 1 | 1 | - Get hot glue, electrical tape, and flexible wires to assist with building of the dustbin<br>- Rebuild the entire circuit using the breadboard<br>- Think about how to put the breadboard inside the dustbin |
| June 2 | 2 | - Made table of contents for the technical report, organising everything<br>- Made outlines to cut out where the battery should be and how I could plug the usb from the outside<br>- Also, figured out placements for each of the components in the dustbin |

| | | |
|---|---|---|
| | | - Brainstormed how to attach the servo to the lid of the dustbin |
| June 3 | No work | Was injured by ankle sprain did no work this day |
| June 4 | 6 | Completed the entire circuit, finished the entire dustbin - functioning |
| June 5 | 3 | Technical report work |
| June 6 | 2 | Technical Report Work |
| June 7 | 1 | Adding image to technical report - first section almost done |
| June 9 | 1 | Almost finished first section of technical report |
| June 10 | 1 | Working on technical report |
| June 11 | 1 | Technical Report 25% complete - worked on first topics of first section |
| June 12 | 2 | Worked on technical report - technical report complete 35% - worked on a little bit on the second section |
| June 13 | 0 | Took a break |
| June 14 | 2 | Completed the second section, now added pictures and moved on to the third section |
| June 15 | 1 | Third Section almost complete - Technical report 40% finished |
| June 16 | 2 | Onto fourth, fifth, and sixth section - technical report 55% done |
| June 17 | 2 | Done fourth fifth and sixth section - technical report 70% done |
| June 18 | 1 | Worked on last section - technical report 90% complete |
| June 19 | 1 | Technical report references complete and checked over technical report and submitted everything. 100% complete |

# 7.0 - SELF EVALUATION

## 7.1 - What went right?

Well quite a few things went right in this project, and some were expected by me initially. First, the thought of connecting both power pins to 5V was expected by me, and in the latter stages worked when I connected it to the breadboard. I was misguided before thinking that the servo or the sensor needed only 3.3V to function on. Organizing the wires to save space went right because I used electrical tape to secure everything. The code was all correctly written, which was another thing that went right and also worked with the servo as well. The ultrasonic distance sensor was able to detect motion and open the lid fast enough. Those are the things which went right by my standards and I was very happy that they did.

## 7.2 - What went wrong?

There were a few things that went wrong, but later they were all solved. There was one major issue, not really an issue but a disturbing thing. The lid would not open all the way even after major tweaks were made. The servo did not have enough power to move the lid all the way, but it moved it to a substantial degree where operation was still valid. So that was a buggy little thing. All the things that went wrong were mainly problems that were discussed in previous sections of this report such as the 5V power problem, spacing problems, but nothing in particular. Therefore we can say that nothing went wrong because we had already solved the problems that were present in our project.

### 7.3 - What could you have done better?

Ultimately what I could have done better leads me to what I should have done differently, to maximize the effectiveness of this project. I could have bought a better dustbin if I knew that the lid would not open all the way, that would allow me to maximize the angle when the lid opens. Also, I should have done more research into how the servo works and angles regarding servos. Other than that, I don't think I could have done anything better as I already have thought of ways that are inefficient and already optimized them. I don't think anything needs to be further optimized.

### 7.4 - What did you do well?

There are quite a few things that I did well. Reflecting back, I managed, organized, and structured my project very well while making it. I updated my journal and kept it clear and concise with what I was doing. I diligently prepared the technical report and added as much detail as I could. For the physical implementation of the project, I worked on it responsibly and dutifully. I planned and brainstormed where the components should go, how it should connect. I solved the problems regarding my project which were discussed in previous sections, and provided well made solutions that were very efficient and effective.  These were most of the things that I really did well.

### 7.5 - What were your biggest challenges

My biggest challenges were already described in the problems description and previous sections. My biggest problem, if you will, was the 5V Power pin problem. I literally had no idea about why it was not working and did not know until two days later that they both needed to be 5V and using the breadboard would help. My other biggest challenge was where to put the servo.

I had to attach another external piece to the lid so that I could make the servo sit. That was one challenge. Then followed up attaching the servo to the lid of the lid. I didn't know how to do that so it took some time to figure out. I added the extra armature and then another challenge was to figure out how to connect that armature with the servo armature. I used a thin flexible wire for that, and that seemed to do the job. So mainly the lid part with the servo was the main challenges, that were ultimately solved by simply taking it one step at a time and solving challenges to solve the main challenge.

### 7.6 - What "Ah ha" moments did you have?

There were a lot of Ah ha moments I had. Mainly, when I figured out the problem regarding the 5V power pins, was one "Ah ha" moment for me. It felt pretty good to solve the problem and figure it out. Next was how to put everything together regarding the lid and the servo. I loved this part as it was stretching my thinking and allowed me to think about what I should do, look at different solutions and options. I really enjoyed the problem solving process and the confidence boost I got when I solved a problem.

### 7.7 - Did you discover or research beyond the scope of the initial requirements?

I have done a lot of research and discovered many things beyond the initial requirements. I spent my time understanding the entirety of the code I was writing by looking at the Arduino documentation and found it very interesting when I could put together facts and combine them into a product I could be proud of.  I also researched about the science behind how the ultrasonic distance sensor works, how it uses sound waves to detect motion, and how the servo also works.

### 7.8 - If you had more time what would you have done differently?

If there was more time, I would have mabey tried to improve the wiring inside of the garbage bin. Maybe I would have tried to implement different designs and possibly spent way more time perfecting the servo placement on the lid and tested different dustbins to create the “ultimate sensor dustbin” per se. I would also try to further optimize my code and also find if there are any loopholes that might obstruct my goal of making this project more efficient. Other than that, there would not be much changes made.

### 7.9 - How well did your plan match the actual object?

I actually matched my object very precisely. I have explained this in previous sections, but when I started brainstorming I had everything planned out in my mind,and everything went according to plan because I thought of a practical approach to complete this project. I brainstormed a certain plan which would work and that I could formulate. Later, I applied those skills and created an object that was very functional and good. My component placement, organization of the servo and sensor was all placed very constructively and nicely.

### 7.10 - What did you add to your plan that was initially not determined

The idea of putting the arduino board onto the breadboard was an idea that I had not planned out before. My dad actually gave me the tip to put the arduino board on the breadboard to save more space and increase wire management. That was a great idea. Another idea that I added to my plan was the extension of the lid to fit the servo. I initially thought that I could put the servo on the interior lid surface without thinking about it too much, but later found out that it wouldn’t work that way. I also added the battery holder at the back that I created myself, to remove and replace the battery. First I thought about putting the battery inside the dustbin, but then thought that it would be way better to put the battery outside so that people can replace it, if we are talking about practically.

### 7.11 - What did I learn that I did not know before?

I learned many new things that I never thought I'd be able to do or learn. I learned more about arduino programming and about the arduino board as well. I learned how ultrasonic distance sensors work and how servos work. I also learned about the SPICE model, how to create a technical report, and all in all learned about the process behind creating a full project, such as this one.

### 7.12 - What is one thing I am most proud of?

To be frank, I am proud of everything and want to share this entire project with other people, but because of the restriction of this question I would have to choose connecting the servo with the sensor and the brainstorming I needed to do to connect the servo armature to the lid with another servo armature using a flexible wire. This was one of the hardest parts of this project and also one of my most happiest times because I felt very good when I completed this specific part of the project and figured it out.


***A match made in heaven***

## 8.0 - REFERENCES


1. Cook, Jeremy. “Ultrasonic Sensors: How They Work (and How to Use Them with Arduino).” *Arrow.Com*, 30 Sept. 2020, https://www.arrow.com/en/research-and-events/articles/ultrasonic-sensors-how-they-work-and-how-to-use-them-with-arduino#:~:text=Ultrasonic%20sensors%20work%20by%20emitting,return%20after%20hitting%20an%20object.

2. “How Servo Motors Work.” *Kollmorgen*, 9 June 2022, https://www.kollmorgen.com/en-us/blogs/how-servo-motors-work/#:~:text=How%20does%20a%20servo%20motor,device%20to%20close%20the%20loop.

3. “Arduino Docs.” *Arduino Documentation*, https://docs.arduino.cc. Accessed 19 June 2022.