Trashy Dynamic's Electromagnet Arduino Retractable Trashcan Helper (E.A.R.T.H.)

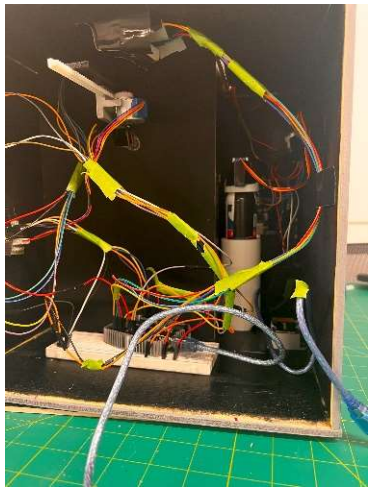
Martin Vince, Abi Strait
MEGN 200 Fall 2024

Problem Statement:

Traditional trashcans require manual handling for bag removal, replacement, and transportation, which can be inconvenient, time-consuming, and physically challenging for individuals with disabilities or mobility issues. An automated trashcan provides a hands-free solution, improving convenience, accessibility, and hygiene in both homes and shared spaces.

Value Proposition:

An automatic trashcan has only been created once before, by a company called Townew, however the cost per volume is expensive ($120 for a liter of trash) and the highest rating it received was 3.5/5 stars. The difference between Townew's trashcan and E.A.R.T.H., is that E.A.R.T.H. can be scaled up and manufactured at a fraction of the cost for higher performance and larger volumes of trash. ***E.A.R.T.H.: Because life's too short to take out the trash.***



●●●○○ 3.5 Good

THE BOTTOM LINE

The Townew Trash Can is an automatic garbage bin that can seal a full garbage bag and replace it with a new one with the touch of a button, but it can still use a few more smarts.

MSRP $119.95

$0.00 at Amazon

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PROS

- ✓ Automatically seals full bag and dispenses new one.
- ✓ Bags are durable.
- ✓ Lid opens with wave of hand.
- ✓ Rechargeable battery.

CONS

- ✗ No app.
- ✗ Bags can be pricey.
- ✗ Occasionally seals empty bag.
- ✗ Annoying battery alarm.

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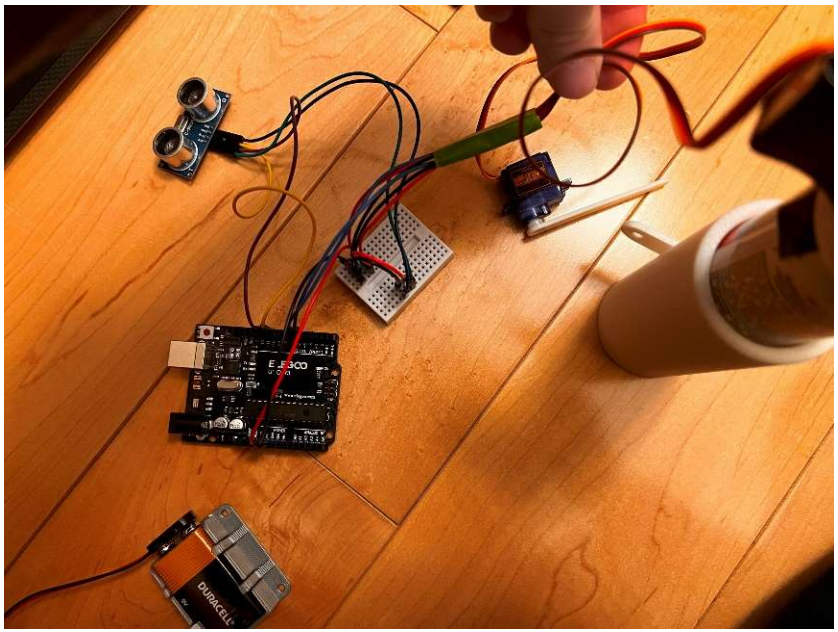
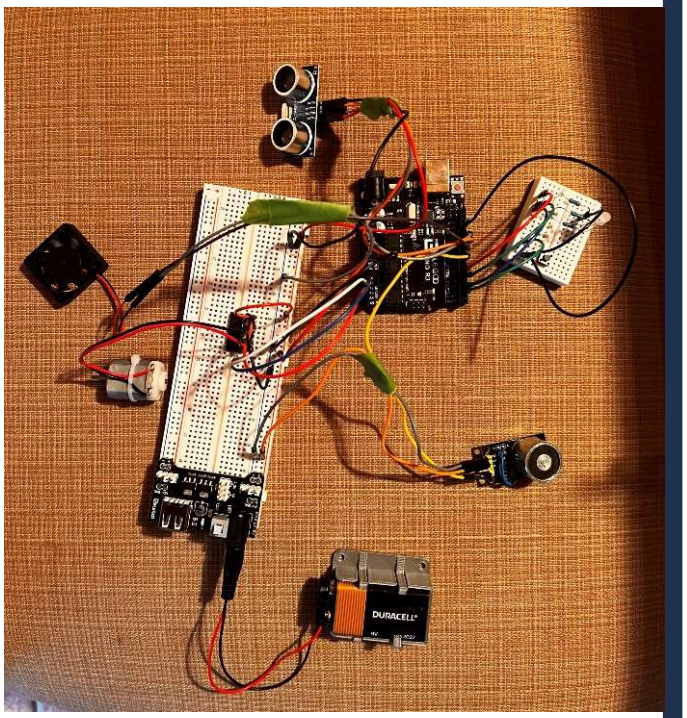
Prototype Subsystems Up-Close

Arduino #1:



Arduino #2:



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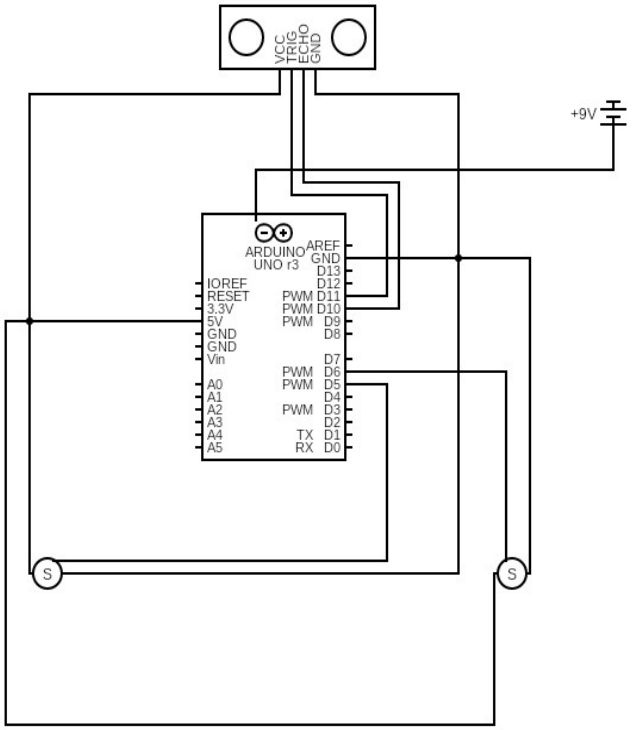
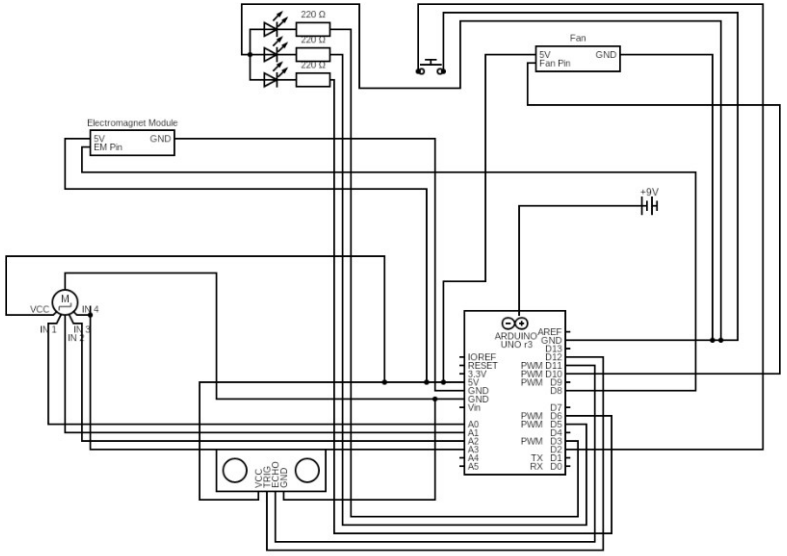
Prototype Documentation

Arduino #1:



Arduino #2: Stepper Motor



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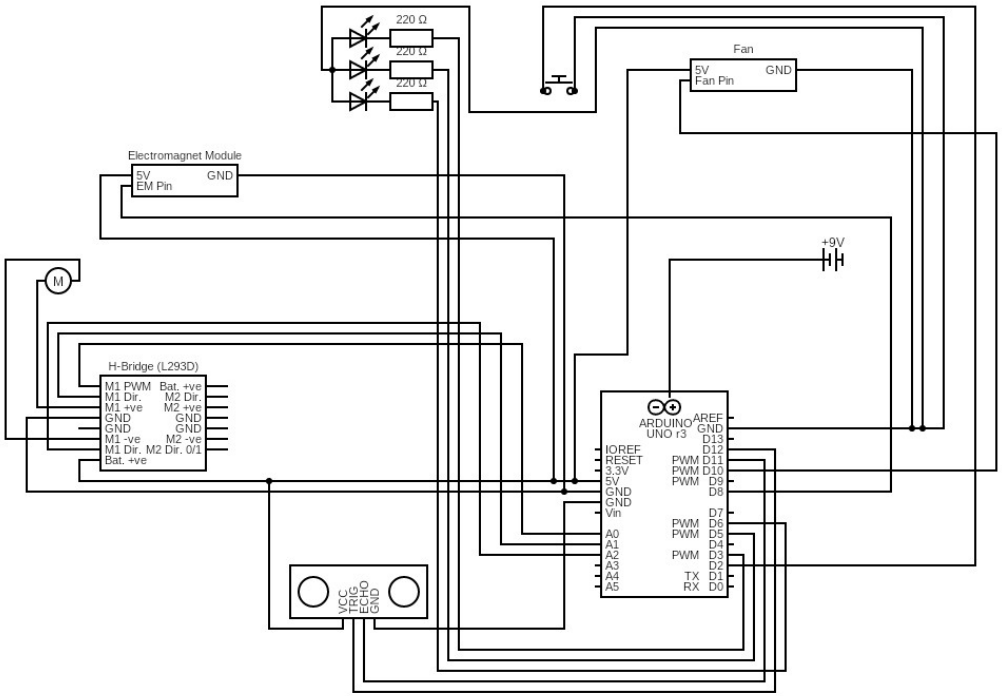
Prototype Documentation (Continued)

Arduino #2: DC Motor



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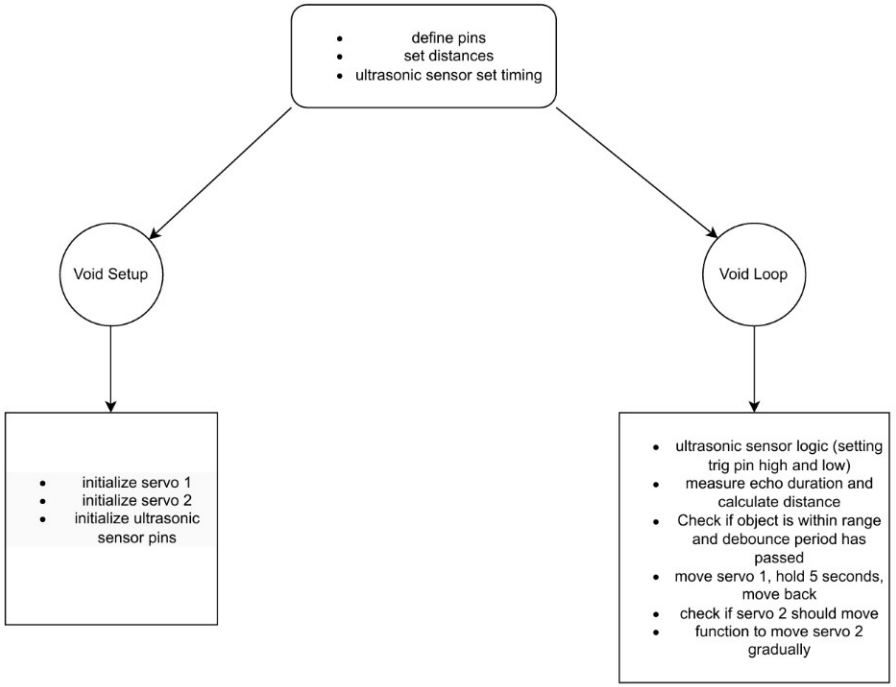
Coding Flowcharts

Arduino #1:



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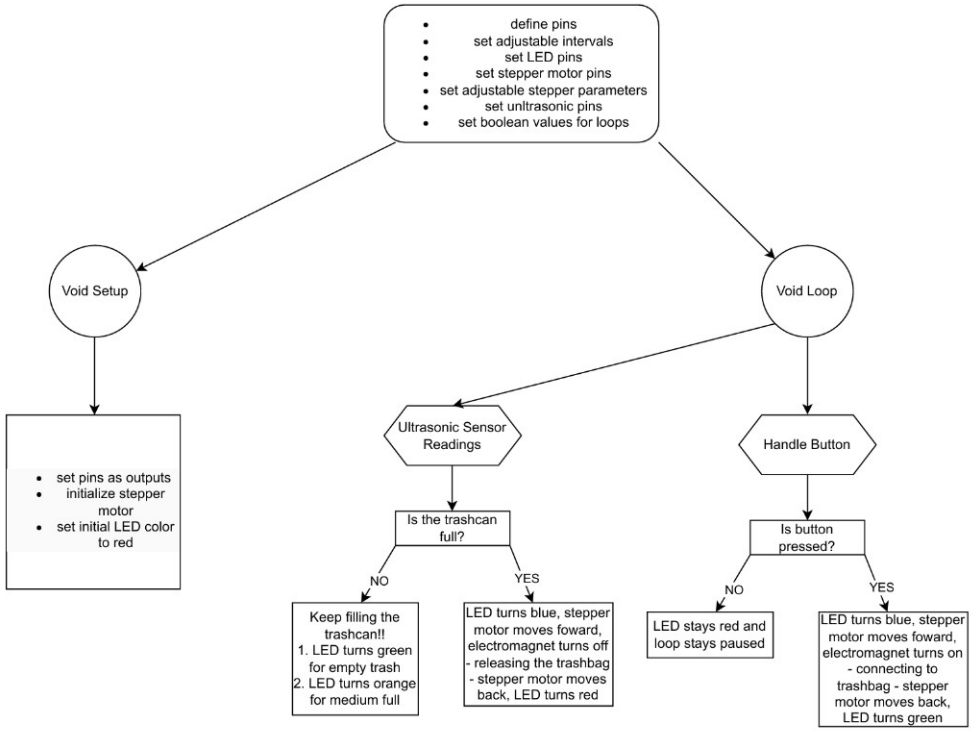
Coding Flowcharts

Arduino #2:



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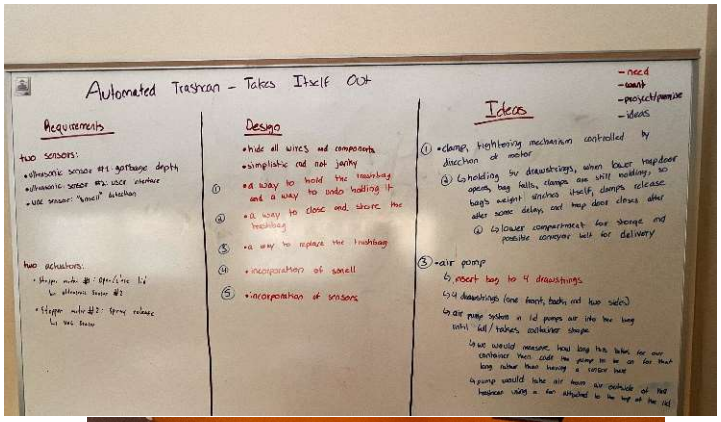
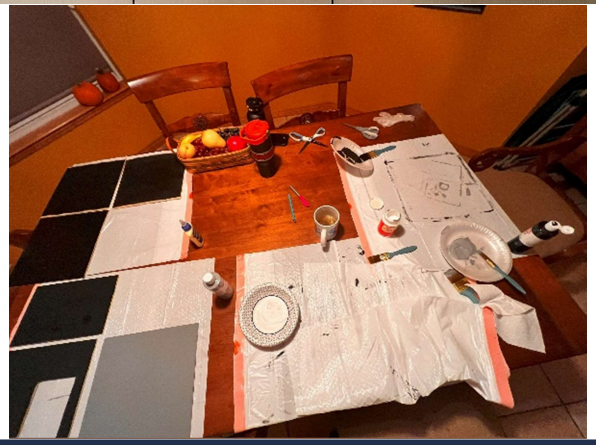
Prototype in Progress





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Problems and Mitigation During Testing and Assembling

1. Electromagnet would always attach to the magnet; it did not seem to turn on and off.
    - We decided to attach a piece of metal (not magnetic naturally) to the side of the trash bag that would be grabbed by the electromagnet, and a magnet to the other side, so that the electromagnet could still release the bag, and the bag could close.
2. Linear actuator would not fully extend, it would only extend halfway.
    - The servo motor could only rotate 180 degrees, which was not enough for the gear to pull the arm out 4 inches, so instead of a servo motor, we recoded Arduino #2 using a DC motor that could rotate both directions (using an h-bridge) for as long as we needed. We then used some equations such as $v=d/t$ where d the length of the arm would equal the circumference of the gear rotating it.
3. VOC sensor was broken when it arrived!!
    - We changed the code so that the servo motor pressed the spray down every 5 times the hand motion ultra-sonic sensor is used, which also helped for demo purposes
4. Servo motor could not press down hard enough to activate spray
    - The 3D casing for the spray canister and servo motor were tapped together tighter so that the servo motor could press the spray down with enough force to activate it.
5. DC motor would not turn if electromagnet was on because there was not enough power from just 5V for both to run at the same time
    - We used the Arduino Power Supply Module to add a secondary 5V power supply to breadboard, additionally we used a TIP120 transistor, diode and resistor and V-in pin
    - Both of the previous solutions did not work so we switched to a stepper motor, which worked better for the torque on the linear actuator gear, and solved the power issue

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Changes if E.A.R.T.H. was a Manufactured and Marketable Product

- Material the box to be made from some type of composite carbon instead of sanded plywood (lighter, stronger, cheaper, and easier to manufacture). Ecofriendly materials would be preferred for manufacturing and marketing.

- The storage compartment would be < 1” all around (except for spray canister section) by using smaller, more professional, and higher end Arduino parts that can be sauntered, and the linear actuator would be a retractable arm (much like a retractable antennae on a walkie talkie or old cell phone) to reduce storage space needed right of the trash wall.

- Bags the size of the trashcan would be created and sold separately to the trashcan, due to the uniqueness of the trashcan ability, not just any trash bags can be used. However, cost for these trash bags would be relatively similar to other trash bags so that customers are not derailed from buying the product.

- Different exteriors, including customizable options, would be offered so that the trashcan can match the interior of the customers house, since trashcans are often hidden under sinks or in cabinets.

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Sources

- Extra power for electromagnet
- Electromagnet/ TIP120 transistor information
- Electromagnet Spec Sheet
- 3D Printed Linear Actuator??? Surprisingly Strong!
- Arduino UNO R3 case for 3d printing | 3D CAD Model Library | GrabCAD
- Spray case
- Smart trashcan — SunFounder Ultimate Sensor Kit documentation
- OpenAI, “OpenAI,” *OpenAI*, 2024. https://openai.com/

References

- retractable antennae for marketable product
- 4 Pcs Self-Adhesive Hinge Clear Plastic Hinges Acrylic Hinge Continuous Piano Folding Hinges for Crafts, Aquarium Lid, Cabinet, Furniture, Display Stand 65x40 mm - Amazon.com

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Video Backup Showing Functionality of Current Prototype

https://youtu.be/6dcelG5nZFk?si=9WKaiSa23a66tryd