Project 3

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CSE321 Fall 2020
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Lab Closes: December 11, 2020, 11:59pm

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Introduction

My project is a trash can that is activated with an IR sensor. When the IR sensor is triggered the lid will open up and the trash can is full a led will turn on indicating that it is full. This project is meant to help with accessibility support. This helps by making it easier to open the lid of the trash can.

Project Requirements

I created a trash can that opens up with an IR sensor. It also has a LED that turns on when the can is full.

Features

I used 2 LEDs as my old output peripheral. One of the LEDs just turns on if there's power in the system but the other turns on when the trash can is full. I used two different IR sensors for this project. One on the front with more range to detect if there is someone Infront of it. The other IR sensor has less range and determines if the trash can is full. For my new external peripheral, I used to servos to open the lid.
When the Front IR sensor is activated the servos should activate and open the lid. When the inside IR sensor is activated the red LED will turn on to indicate that the trash can is full.

Specifications

The trash can will open up when the front IR senor is activated. When the trash can is full the red LED will turn on to indicate that it is full. There will be two modes to the trash can, Watchdog mode and IR mode. Watchdog mode is on by default, when the front sensor is triggered the lid will opened up. This lid will stay open until the front sensor has had not activity for 3 seconds. In IR mode the lid lifts up when the IR sensor is triggered and closes when it's not triggered. The mode can be switched by pressing the user button on the Nucleo.

Design Process Review

Most of my project is run through interrupts. The main method only initializes the program and interrupts. The most important sections are the fall and rise interrupts for the front IR sensor. There are two modes in the for the front IR sensor Watchdog mode and IR mode.

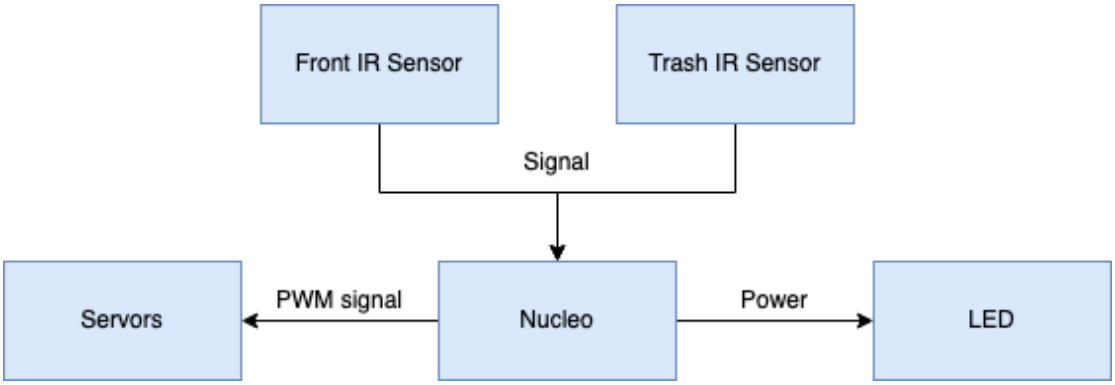
IR mode

In IR mode the lid is lifted on the rise handler and closed on the fall handler. There is a mutex lock in case the interrupt is triggered during the opening or closing sequence of the lid. If it is triggered during this point it adds the handler to a queue to be run through after the opening or closing sequence is done.

Watchdog Mode

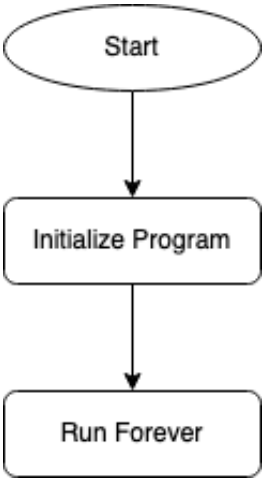
In Watchdog mode the on the rise sequence the lid is lifted and on the fall the watchdog timer is activated. If the rise is triggered again it will kick the timer and schedule another rise handler until another fall interrupt. After 3 seconds of inactivity the program will restart in watchdog mode.

Block Diagram

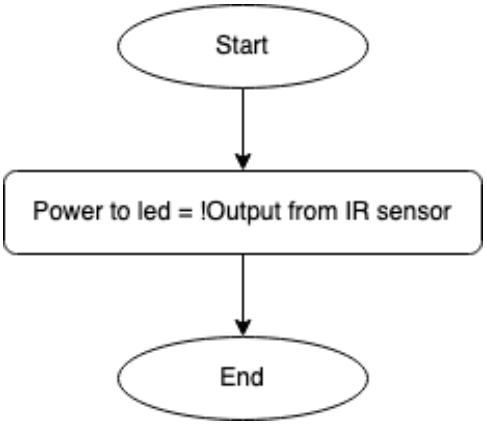


System Diagram

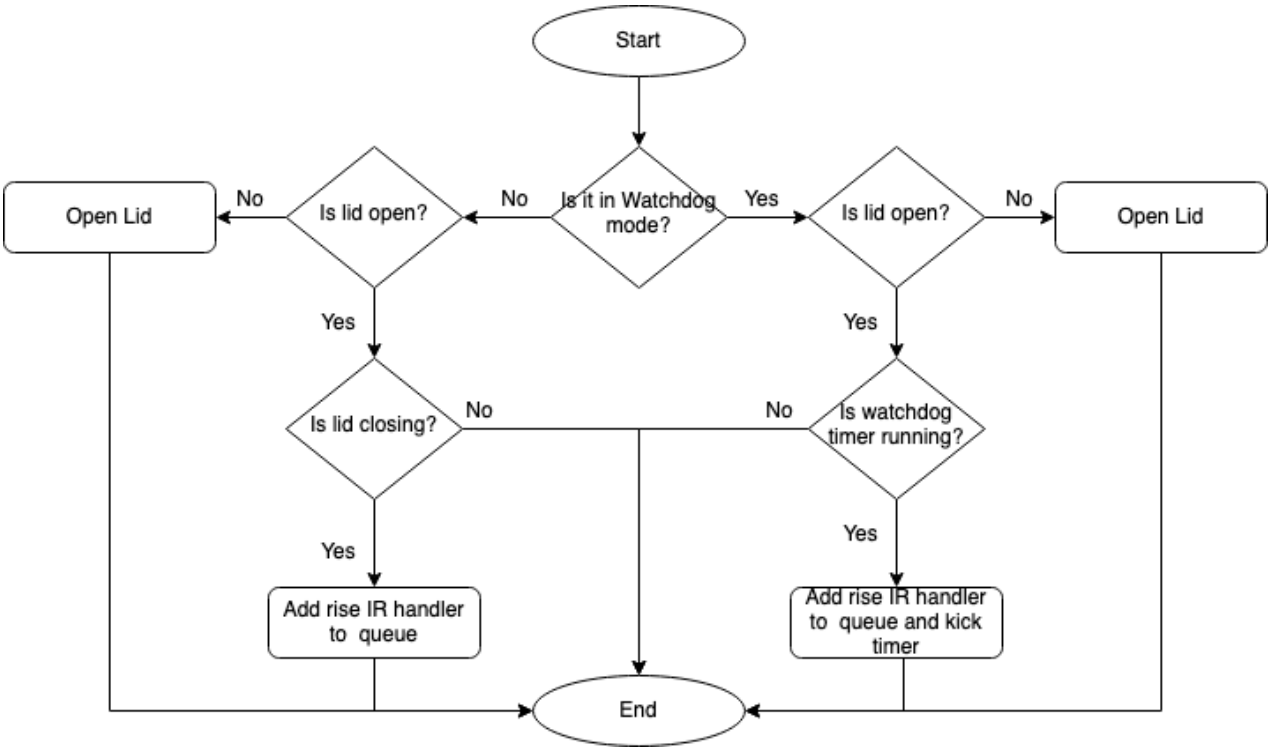
Main



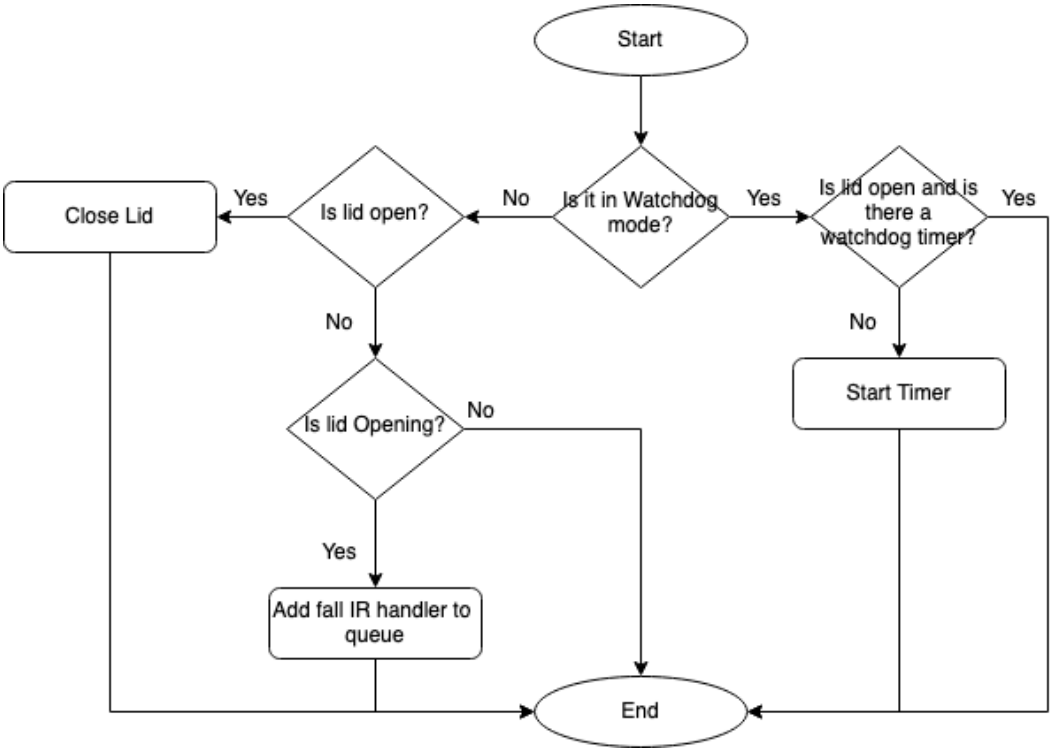
Trash IR Handler



Lid IR Handler Rise



Lid IR Handler Fall

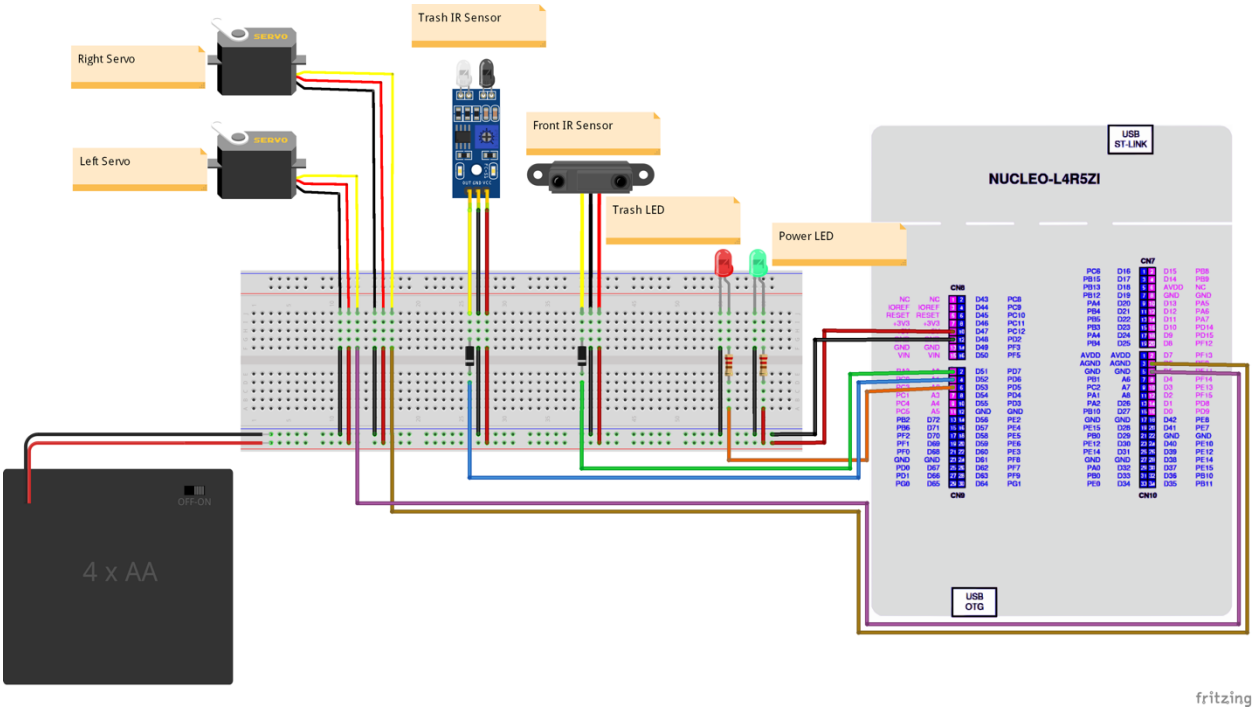


User Instructions

Bill of Materials

- Nucleo
- Trash can
- Wires
- Jumper cables
- Breadboard
- AA batteries
- 2 LEDs
- 2 Resistors
- 2 Diodes
- 2 Servos
- Front IR sensor
- Inside IR sensor
- Battery holder

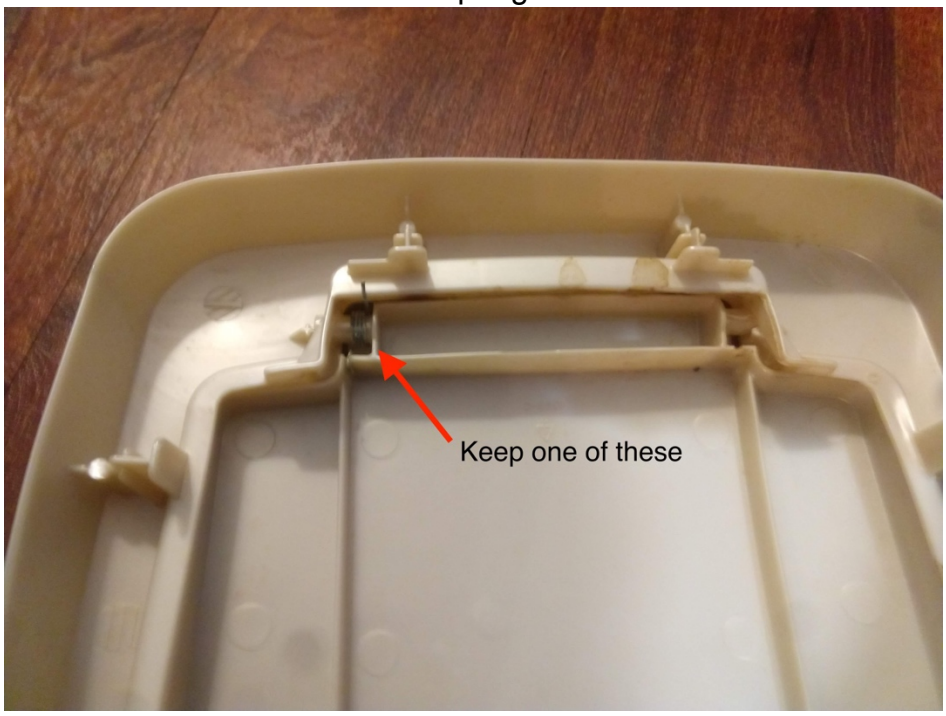
Schematic



Setup Instructions

Prep the lid

1. Take out one of the torsion springs from the lid.



2. Remove the opening button from lid.

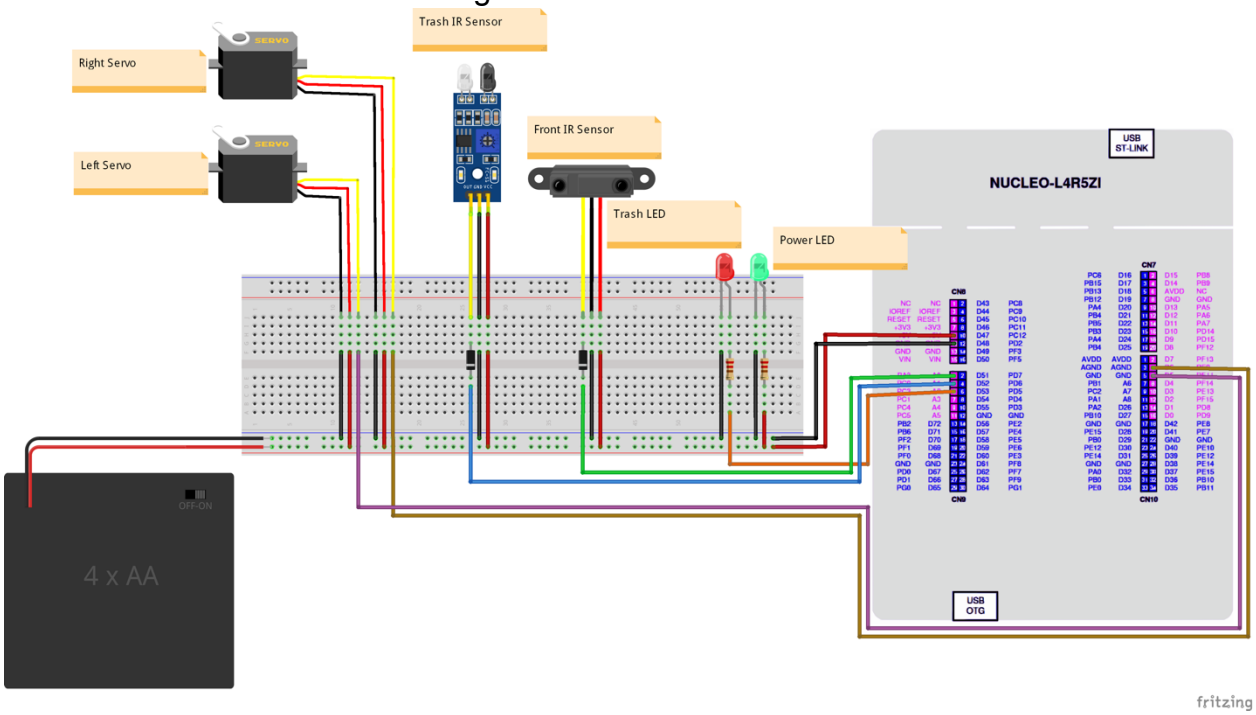
3. Remove the numbs where servos are going to go.

4. Hot glue holes in lid hinge so the servos can be glued to the hinge well.

5. Cut a small indent in back of lid for wires.

Put Servos in the closed position

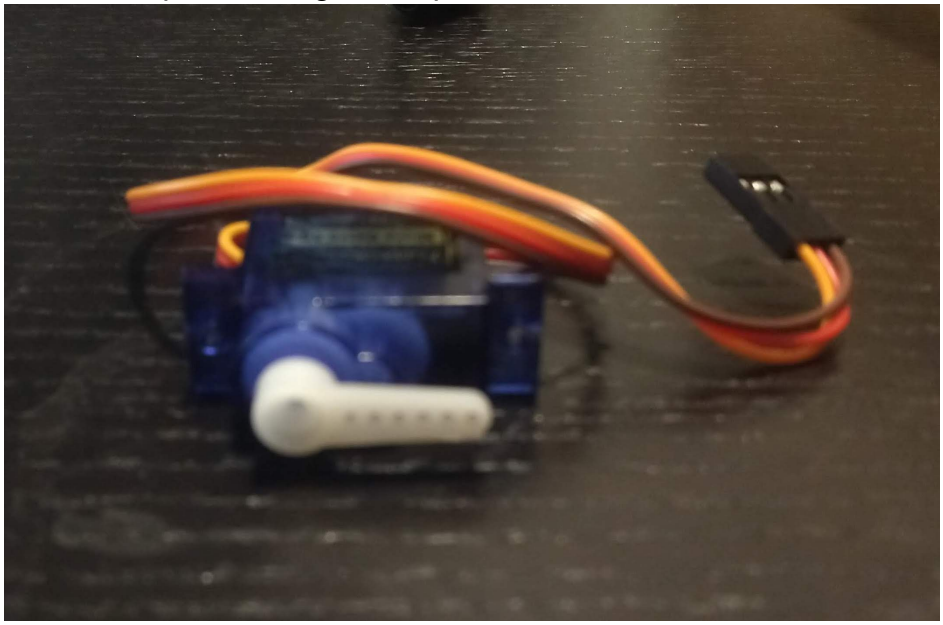
1. Wire the breadboard according to the schematic.



2. Run the program and test your parts.

3. Once done testing unplug the servo when it's in the closed position.

4. Put the plastic thing in this position on the servo.



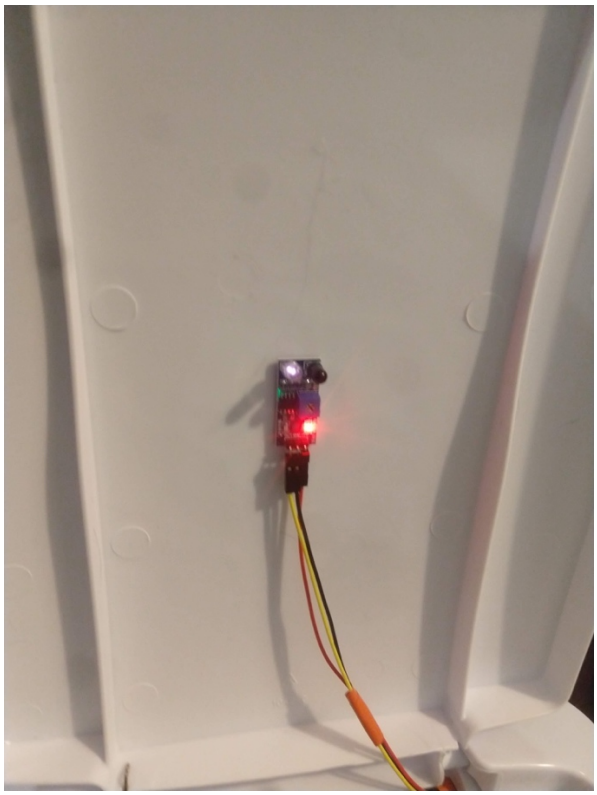
Put everything in the lid

1. Disconnect the Nucleo from the breadboard.

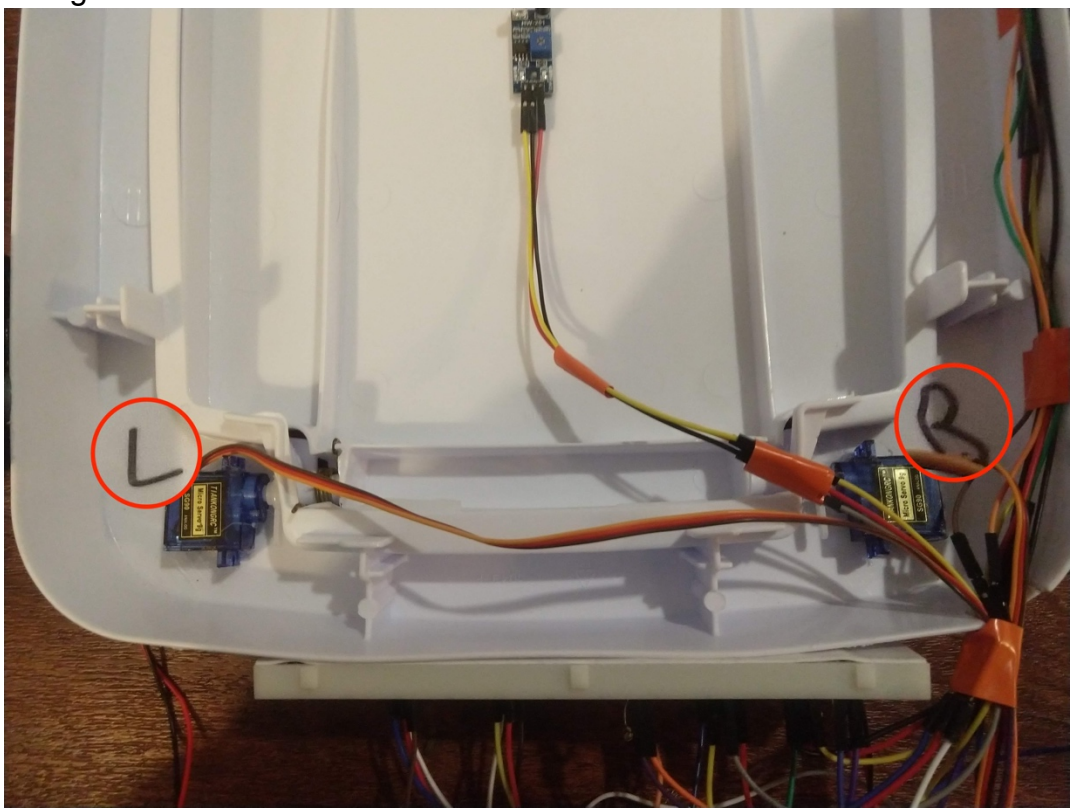
2. Glue the Front IR sensor to the front of the trash can.

3. Glue the two LEDs to the front of the trash can.

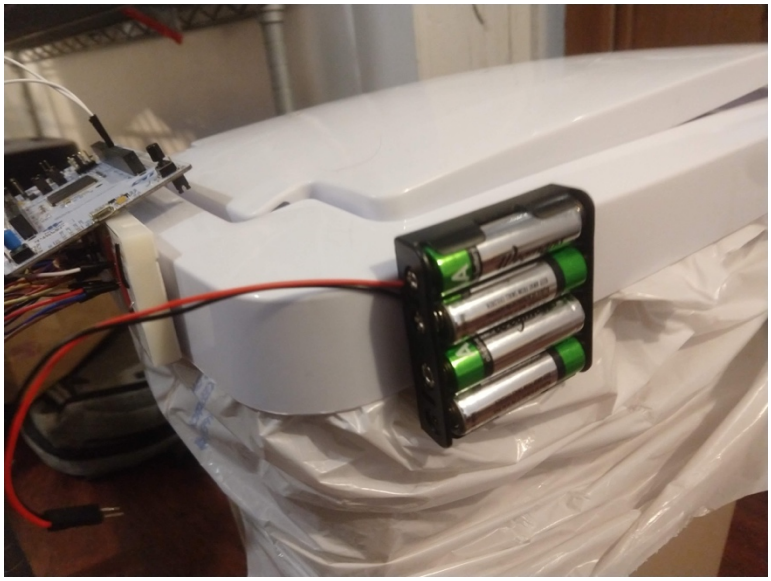
4. Glue the trash IR sensor to the bottom of the lid.



5. Glue the left servo the left side of the trash can and the right one on the right side.



6. Glue the batteries to the side of the lid and the breadboard to the back.



7. Connect all your components back the breadboard.

8. Connect the Nucleo back to the breadboard.

9. Test the program.

10. If everything was done correctly it should work.

Guide to use the system

- The front sensor opens the lid stand in front of it or wave your hand in front of it to open the lid.

- When the Trash can is full the red led will turn on.

- There are two modes to the trash can press the onboard user button to switch between mode.

Watchdog mode (default)
Watchdog mode keeps the lid open as long as there is activity Infront of the lid and closes after 3 seconds of inactivity

IR mode
IR mode opens the lid when you are Infront of it and immediately closes when there is nothing Infront of the lid.

Test Plan

- If the front IR sensor is activated the lid should open.
- If the front IR sensor is inactive for 3 seconds it should close the lid.
- If the inside IR sensor is activated the red LED should turn on.
- If the onboard user push button is pressed the mode should change. Then when you activate the IR sensor it should open and when it's deactivated the lid should immediately close.

Future Design Considerations

Shortfalls for System Design

My design was meant for accessibility support and it does make opening the lid easier but that's about it. One short fall is that it runs on batteries and they are going to runout fast.

Memory Management

In my design I add functions like openLid, closeLid, and my rise and fall handlers to the queue. To save on memory and to stop it from crashing I only allow one of each type of function to be in the queue at a time. I control this by adding locks to each of the functions.

Improvement Recommendations

Some future improvements that could be made is adding a solor panel and rechargeable batteries so that the system can run longer. Upgrading the servos would be good to because the trash can has trouble closing all the way because they don't produce enough torque.