Implementing Automated Movement into an Electric Golf Cart

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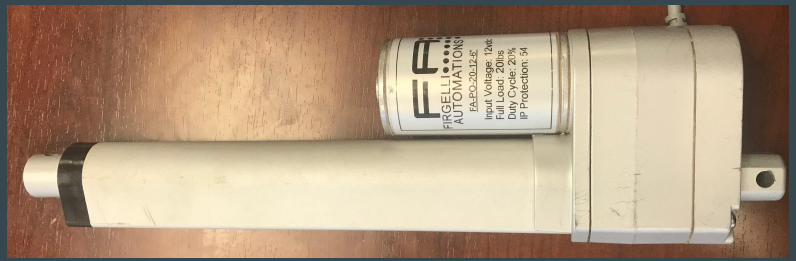
Project

Continuing transform the electric golf cart, I was tasked with gas pedal actuation. Essentially, my goal for the semester was to give the golf cart the ability to move without required input from a users foot.

Implementation Ideas

- Transistor Control of Motor
  - Use high current transistors to control direction of current through the motor, and change duty cycle to control the speed of rotation.

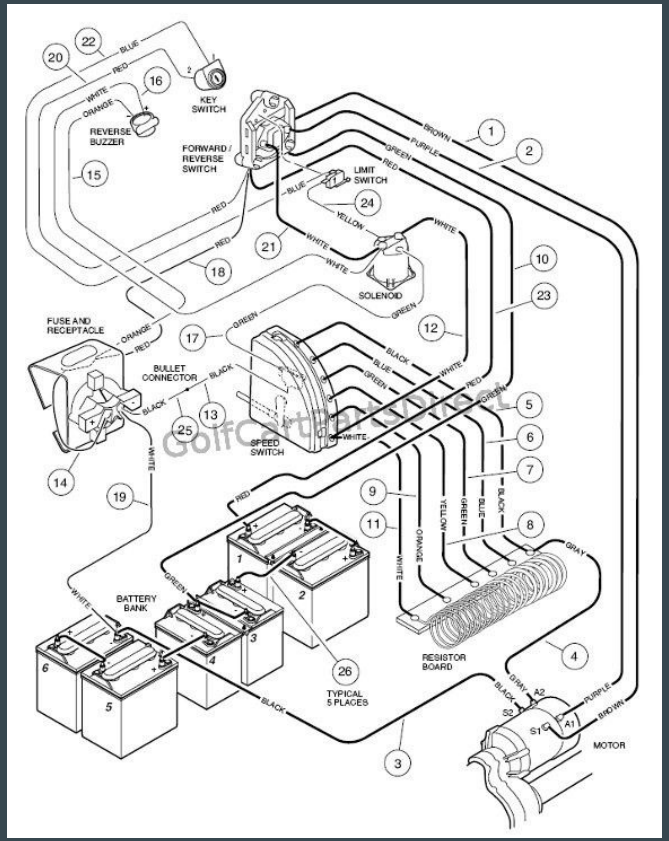
- Actuator Control of Pedal
  - Use a feedback linear actuator to physically pull/push the gas pedal to control the speed of the golf cart.



Initial Attempt: Transistor Implementation

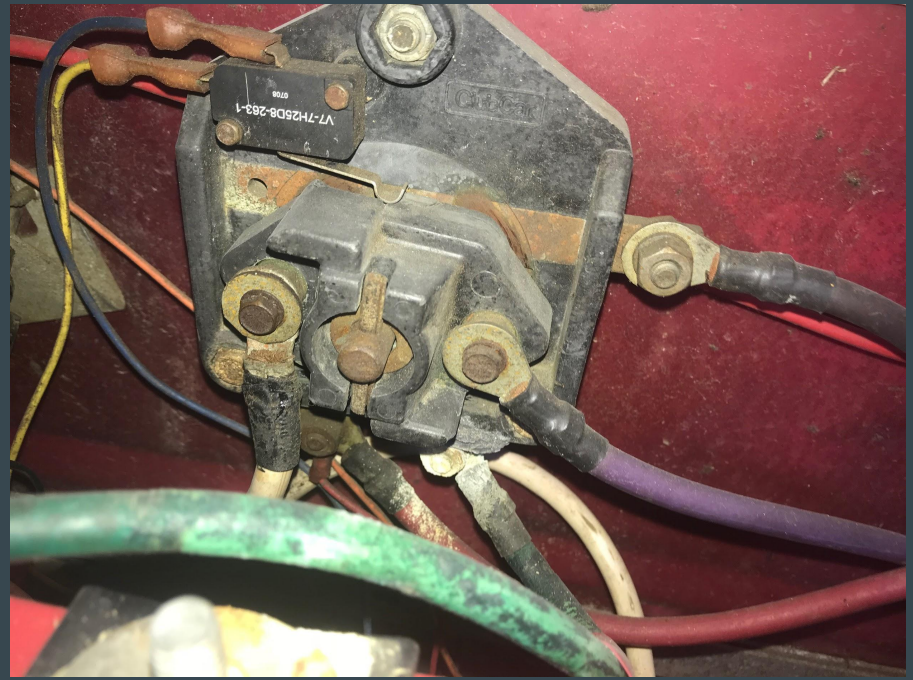
- After discussion, we believed that the cleanest option would be to integrate transistors into the motor connections to control its motion

- Once this option was chosen, I did background research on the wiring of electric golf cart, and found that the system to the right was the most similar to our golf cart



Initial Attempt: Transistor Implementation

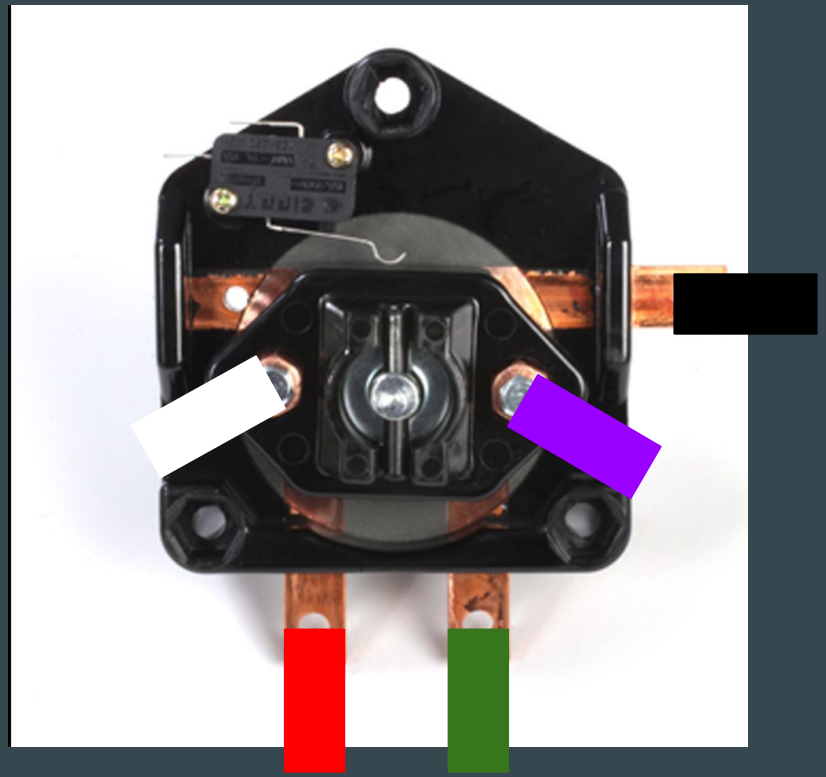
- This is the inside view of the forward/reverse switch on the golf cart
- Rotating clockwise puts the cart in reverse and activates the limit switch which activates the buzzer
- Decided this was the optimal location to integrate the transistors



Initial Attempt: Transistor Implementation

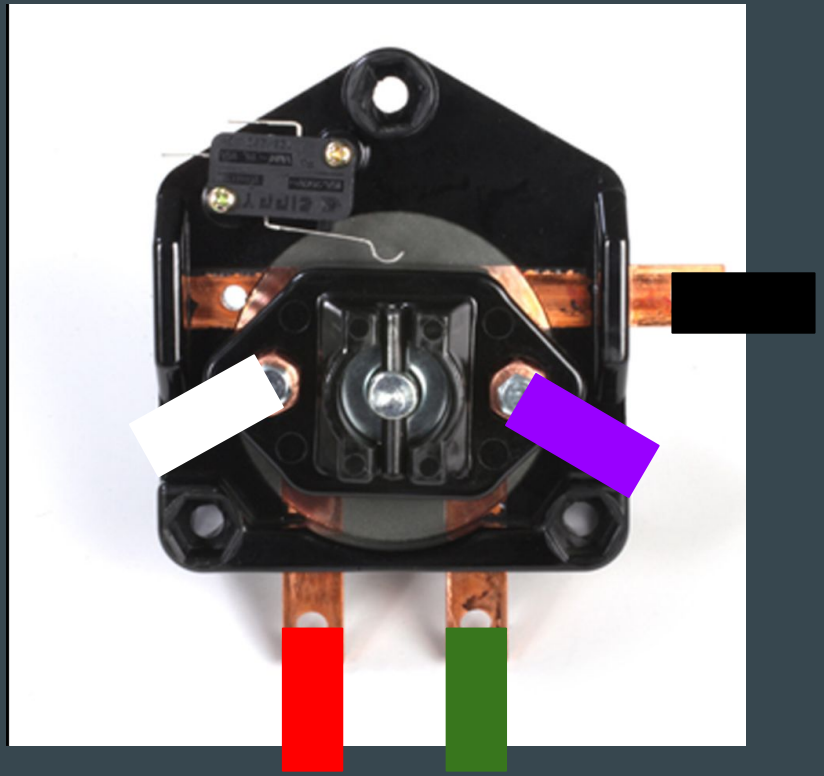
- The first thing that needed to be done was figure out what connections of the wires moved the cart forward and reverse

- There were five wire connections to the switch: purple, white, black, green, and red, all connected as follows.



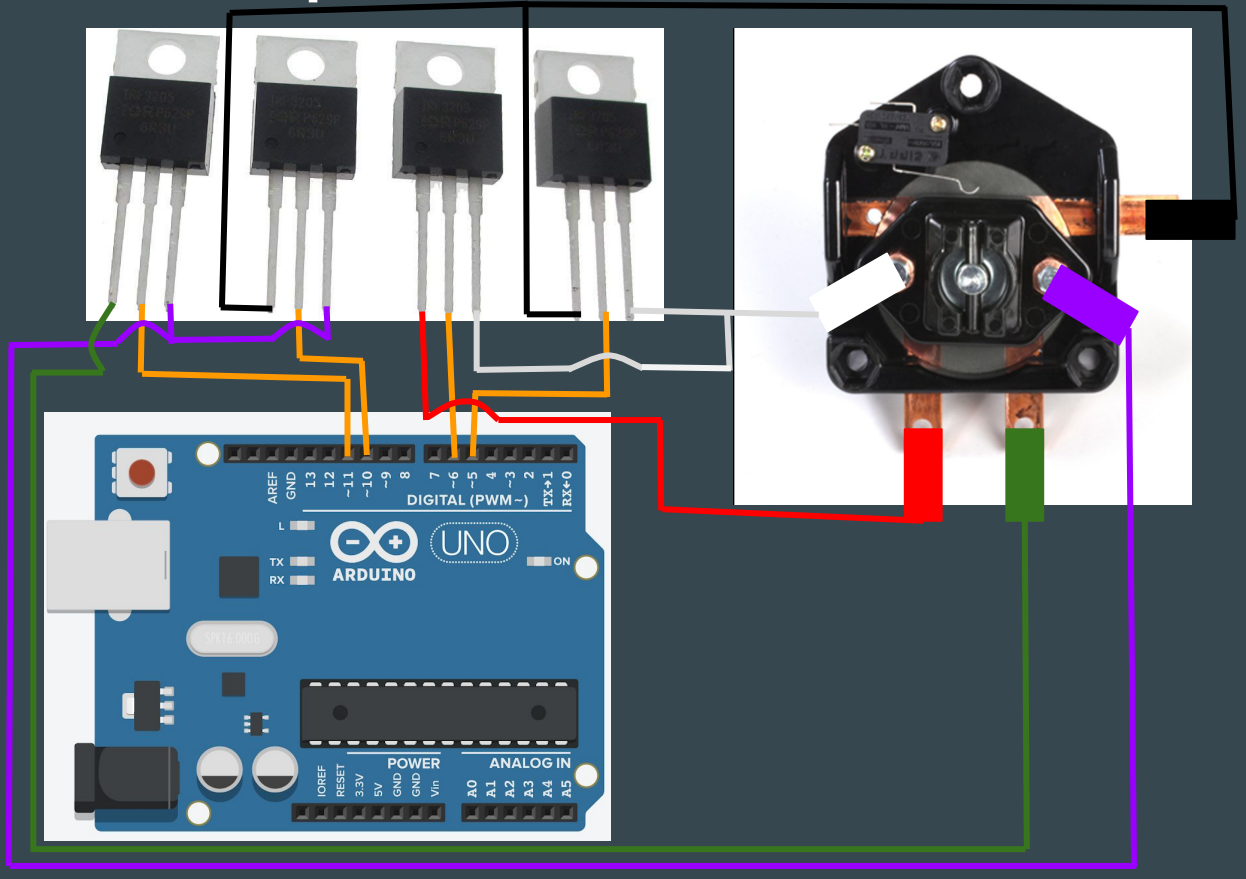
Initial Attempt: Transistor Implementation

- We know that counterclockwise motion puts the cart in forward, and clockwise puts it into reverse
- From this knowledge, we could easily figure out that
  - Forward Motion:
    - Red → White
    - Black → Purple
  - Reverse Motion:
    - Green → Purple
    - Black → White



Initial Attempt: Transistor Implementation

To the right is the final transistor implementation wiring:



Initial Attempt: Transistor Implementation

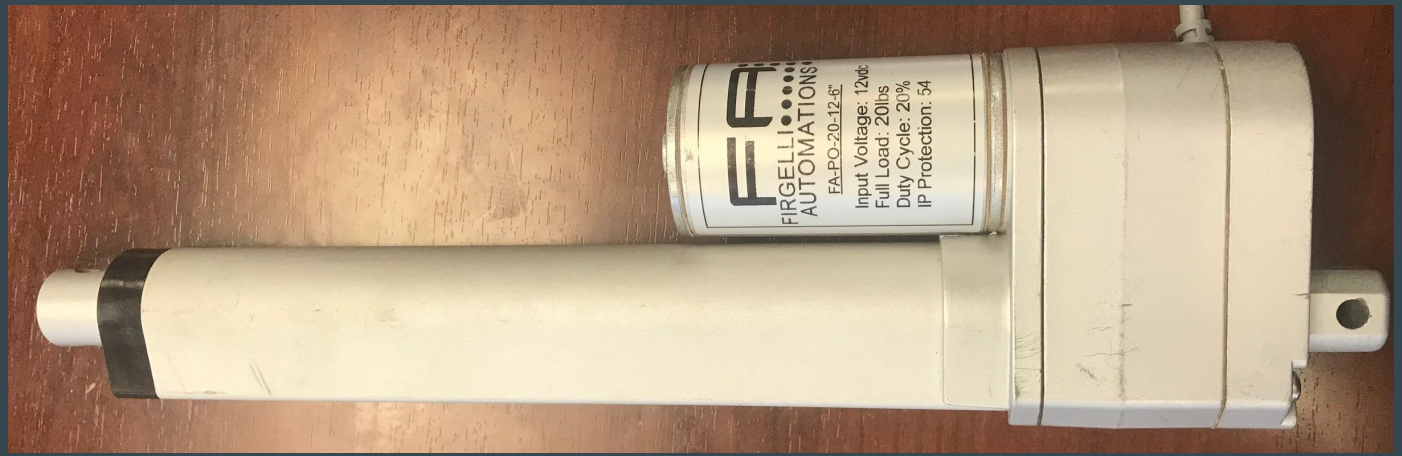
- After soldering 6 gauge wire onto the transistors along with a smaller wire to connect to the arduino, I hooked up all transistors to the wiring on the golf cart

- It appeared that no current was running through the transistors whether they were told to allow current or not

- Due to the ability of wires to easily come in contact with the batteries in their attached state to the transistors, the transistor setup was deemed a fire hazard and no further action on the transistor path was taken.

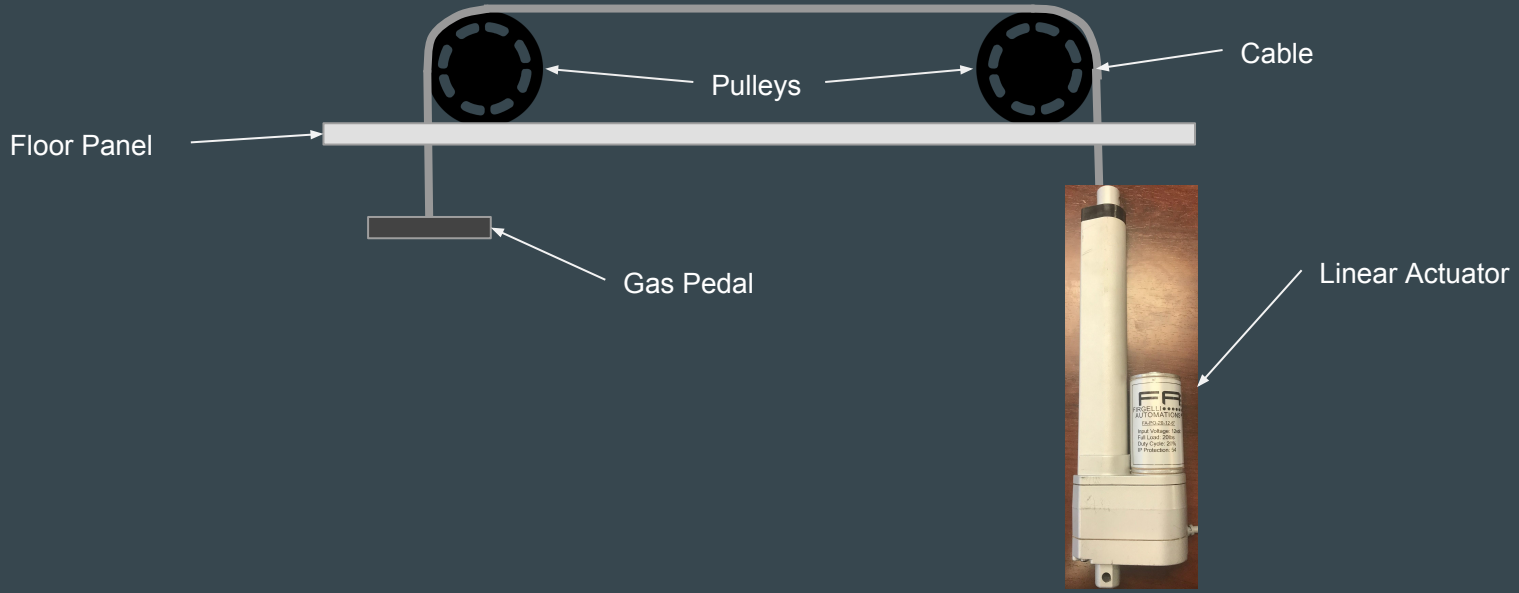
Second Attempt: Feedback Actuator Integration

- Luckily, we had an alternative to the transistors, instead we will use a Linear Feedback Actuator to physically move the pedal



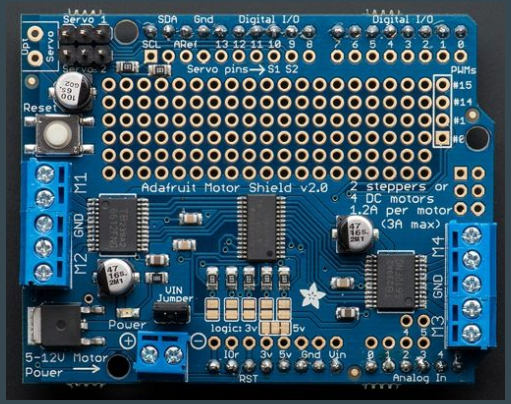
Second Attempt: Feedback Actuator Integration

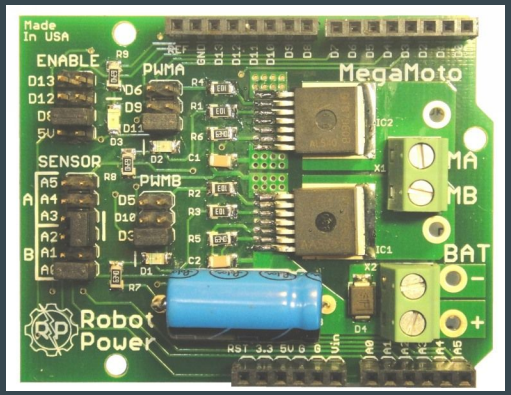
- The original idea was to mount the actuator over the pedal to have it push it downwards, but I believed a better option would be to use a pulley system so that the actuator could pull the pedal to the floor panel instead.



Second Attempt: Feedback Actuator Integration

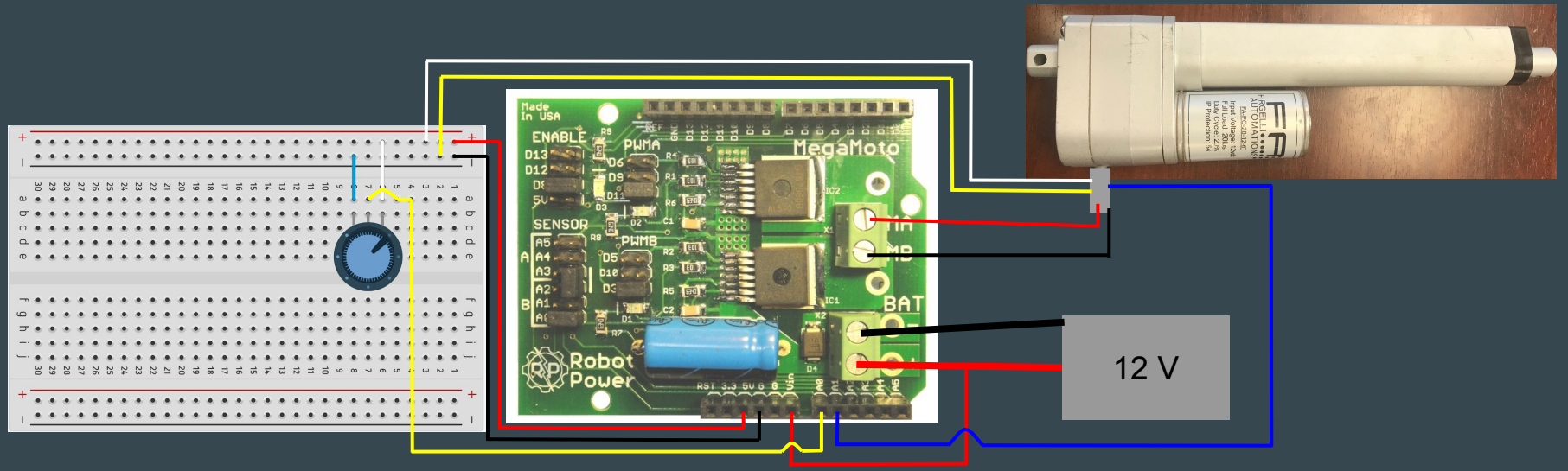
- Before mounting the pulley setup onto the golf cart, I made sure that I could control the motion of the actuator with a potentiometer.
- A motor shield was stacked on top of the arduino so that the golf cart batteries could be used as an power supply for the system. I originally used an Adafruit Motor Shield V2, but later switched to a Robot Power MegaMoto as it gave less erratic responses





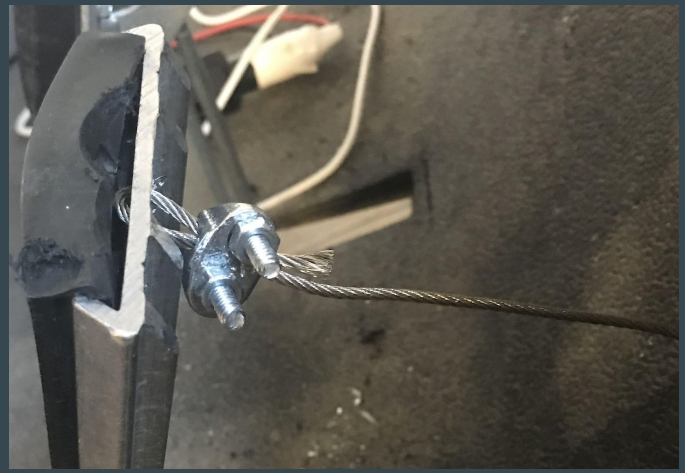
Second Attempt: Feedback Actuator Integration

- Below is the wiring between the golf cart, arduino, potentiometer, and actuator.



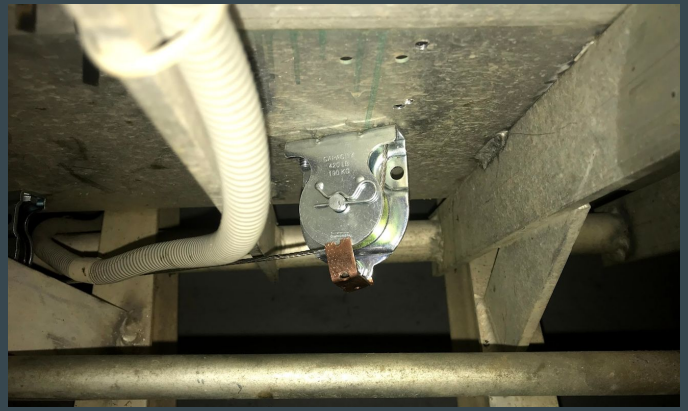
Installing the Pulley System

- The first step was to attach the cable to the gas pedal
- This was done by drilling two holes into the pedal and threading the wire through, then clamping the wire together at the back of the pedal
- A hole was then drilled through the floor panel and the wire guided through that hole



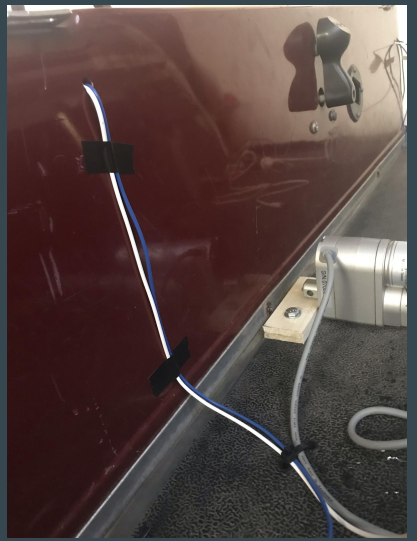
Installing the Pulley System

- A line was drawn from the initial hole that leads down to the bottom of the floor panel for the linear actuator
- This line was used to drill additional holes for the two pulleys that would be used in the system
- It was not an easy task due to the confined space, but the pulleys were then screwed and tightened into place
- The wire was then threaded over the pulleys and back into the interior of the golf cart
- A metal plate was used to block the wire from coming loose when the pedal is pressed manually



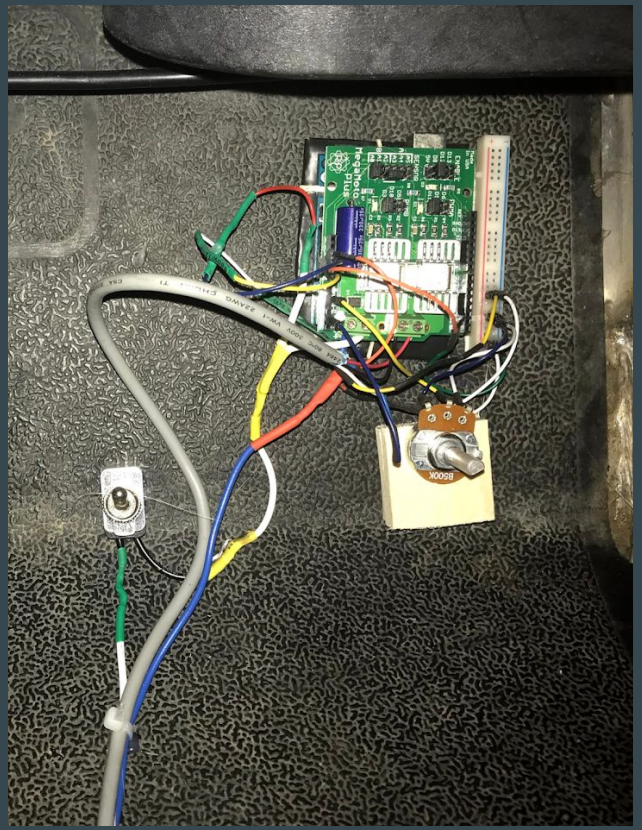
Installing the Linear Actuator

- At the exit hole of the wire cable, the linear actuator was attached to the floor panel
- Wood planks were used to keep the actuator from pulling/pushing itself, and zip ties were used to hold the actuator down the floor panel
- This was also a good time to install the wires that would draw 12V from the golf cart batteries



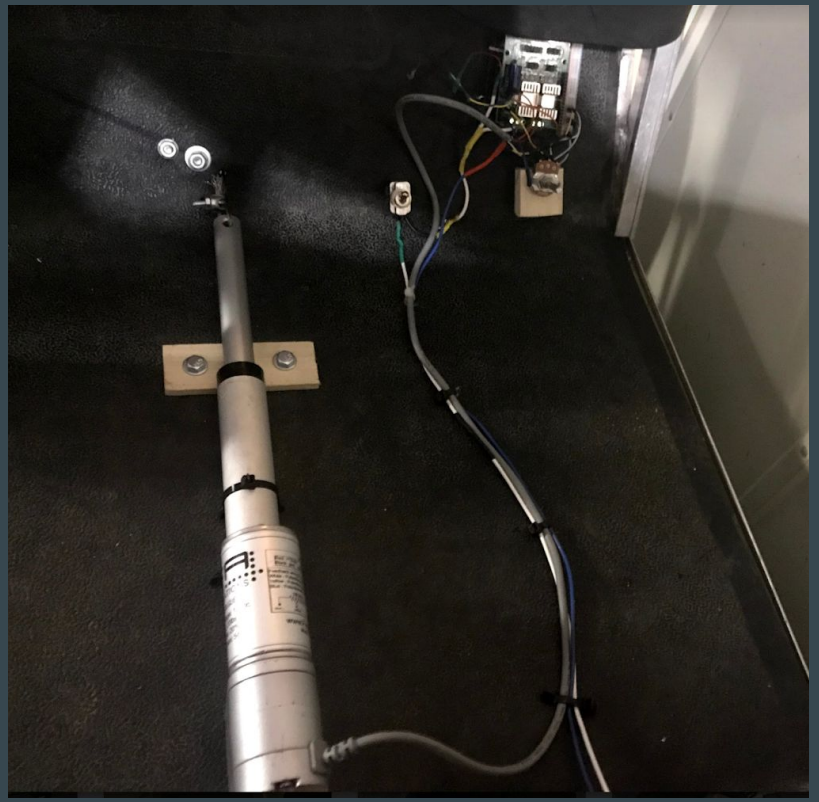
Installing the Linear Actuator

- The next step was the attach the arduino and motor controller to the golf cart
- A switch was added between the battery and arduino so that disconnecting the power could be easier
- The arduino was glued under the cup holder, and the wires were fastened down



Linear Actuator Installed!

- The linear actuator system was finally installed, the wiring for the potentiometer may need to be lengthened in the future to use as a controller.
- Now it was just time to test the actuator pulling the pedal



Linear Actuator Successful!

- As predicted the linear actuator is able to pull the pedal with ease

- The linear actuator responses quickly to the input of the potentiometer, which, and is limited to the range that the pedal can move

Final Thoughts

- If we were to transition back to using transistors and controlling electronically, it might be better to try using relays instead
- The Arduino should be moved to a more protected area to keep it from becoming damaged, and also extend the wires on the potentiometer so the user can sit down while controlling it
- We could possibly consider switching from using potentiometers to controlling the actuators via a bluetooth module and a mobile device