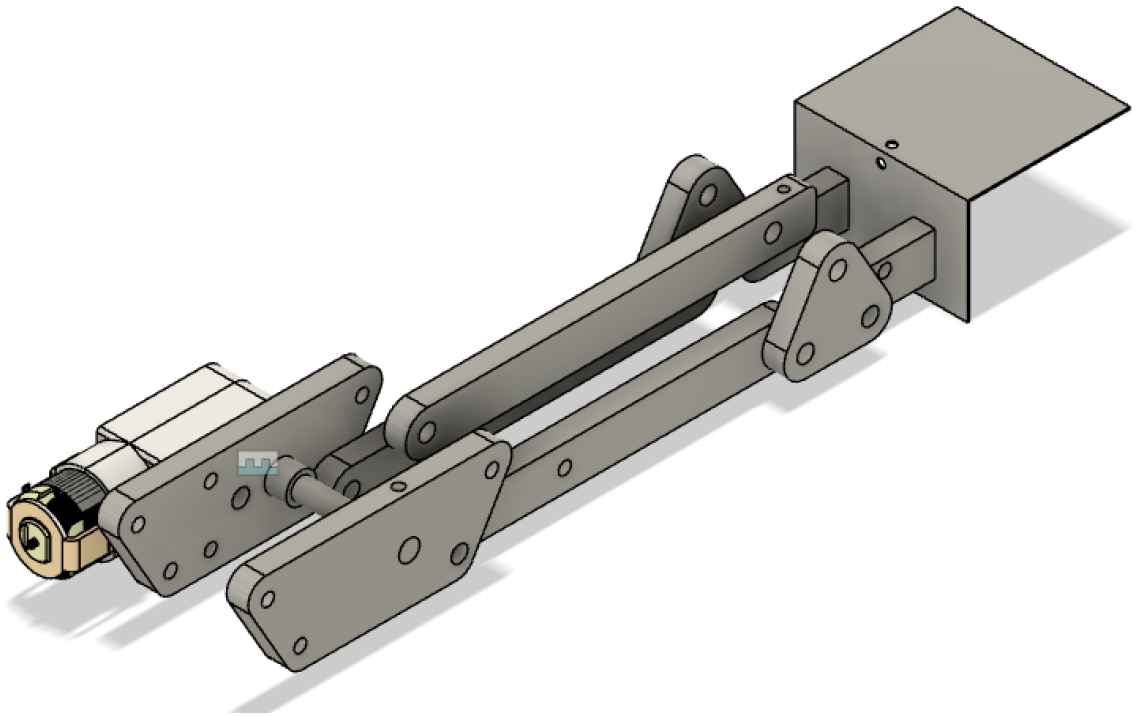
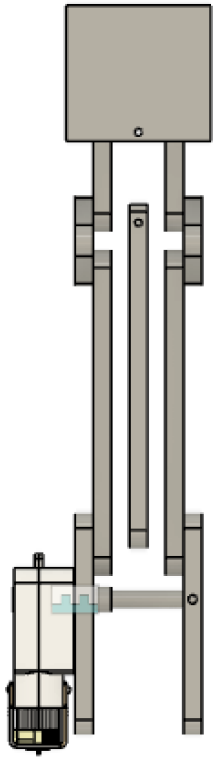
Upper Arm Design v1

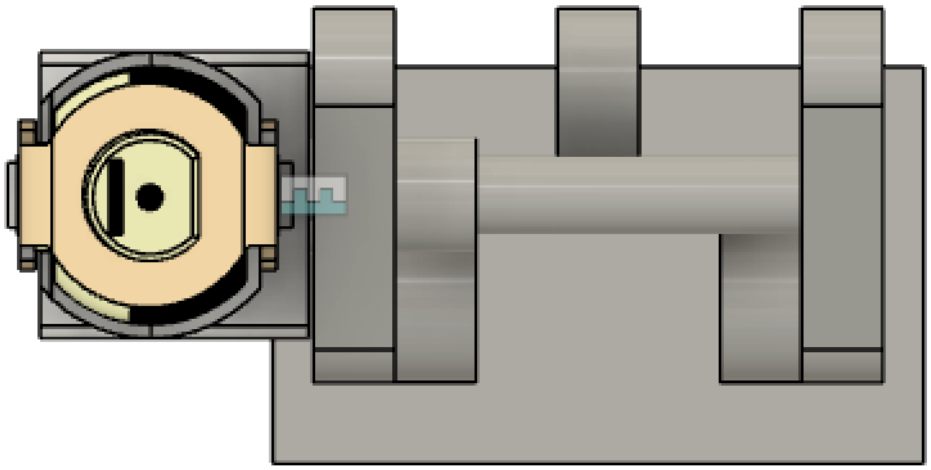
Written By: Roger Nguyen



(isometric and right view)



(top view and front views)



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[1] Abstract

This is the initial design that was made for the upper arm of the robotic arm. The parts are made entirely of acrylic besides the aluminum shaft that connects the trapezoidal mounts and the geared motor itself. The arm utilizes springs as suspension to keep the arm more rigid and less prone to wobble.

The motor turns a shaft that is press-fit into the mount holding the entire upper arm. When the motor rotates, the entire arm should rotate with it. The entire design is based on a four-bar linkage that allows the gripper at the end to remain parallel to the ground even when the upper arm is moving.

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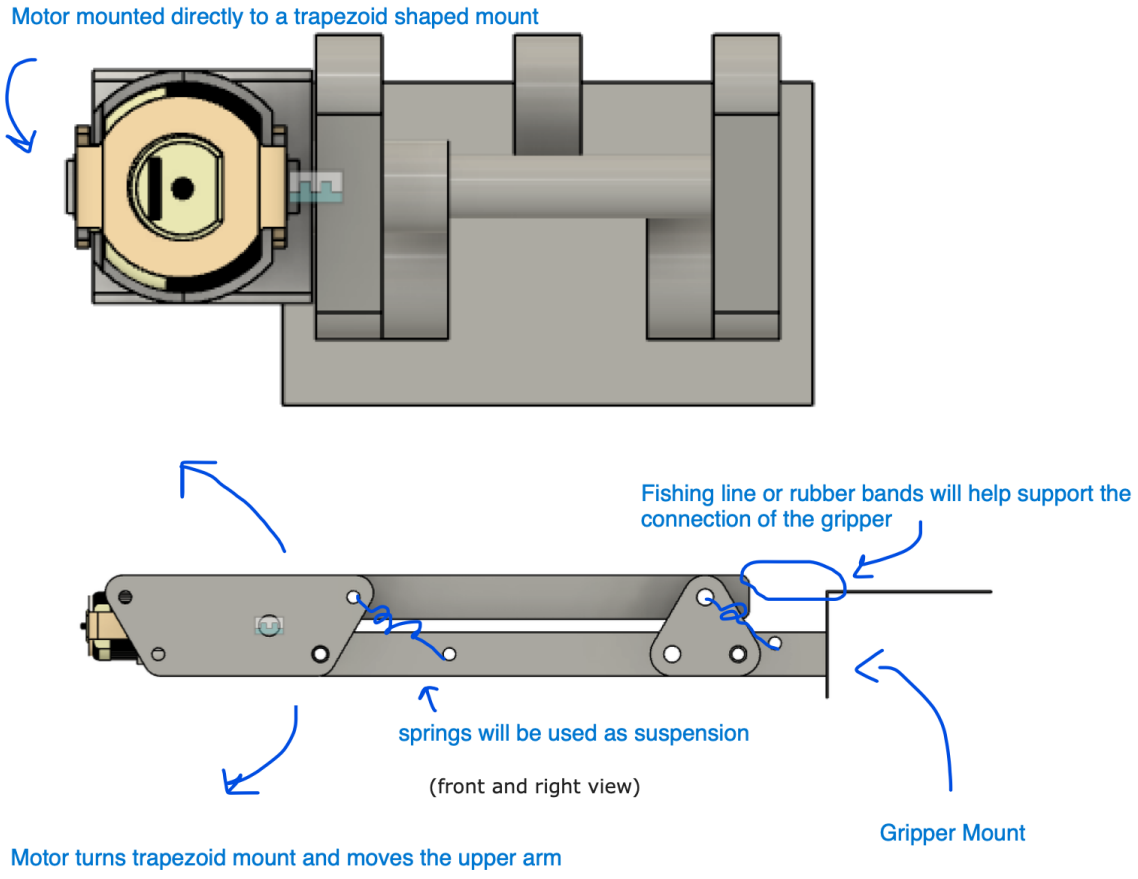
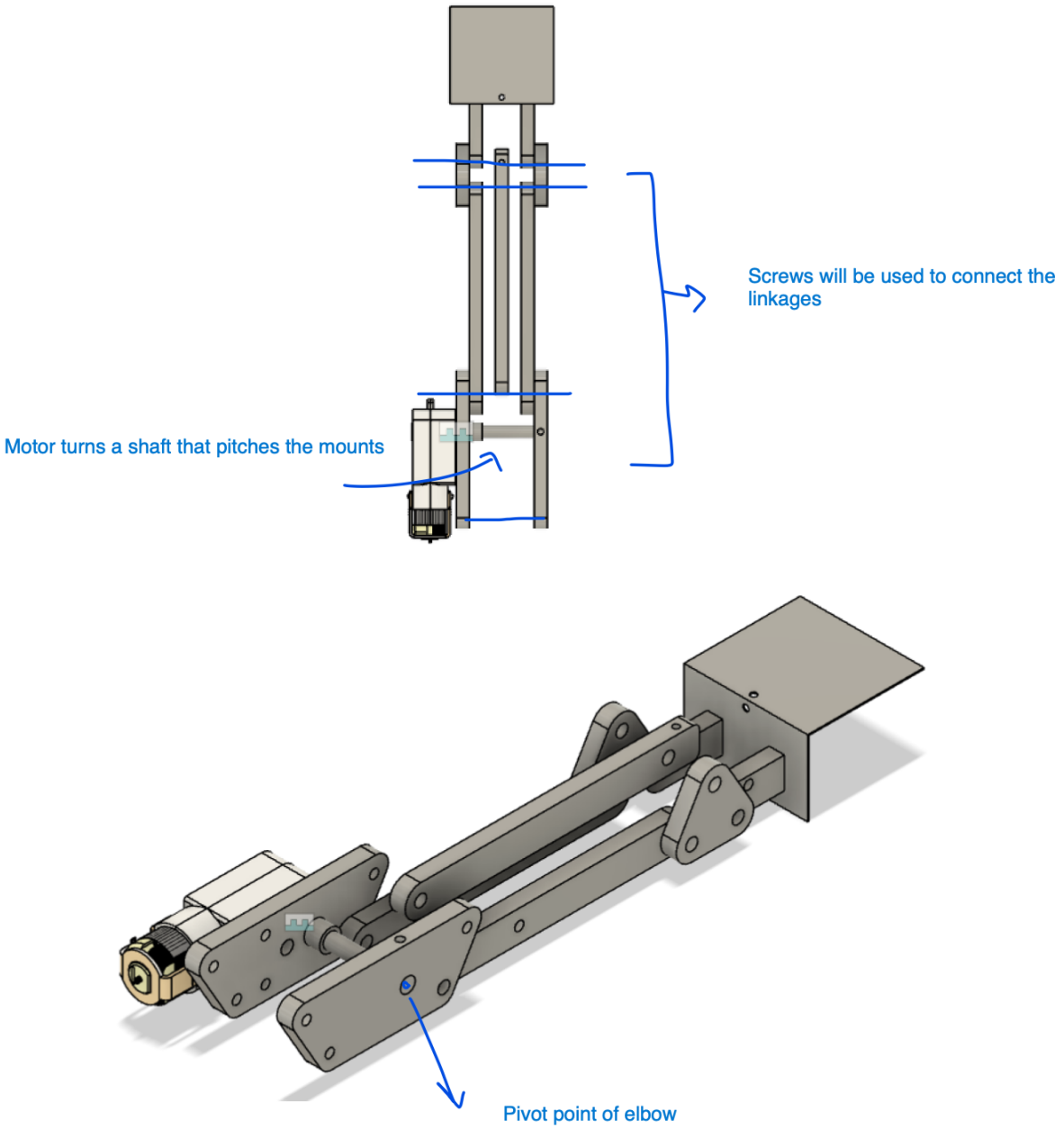
[2] How it Works

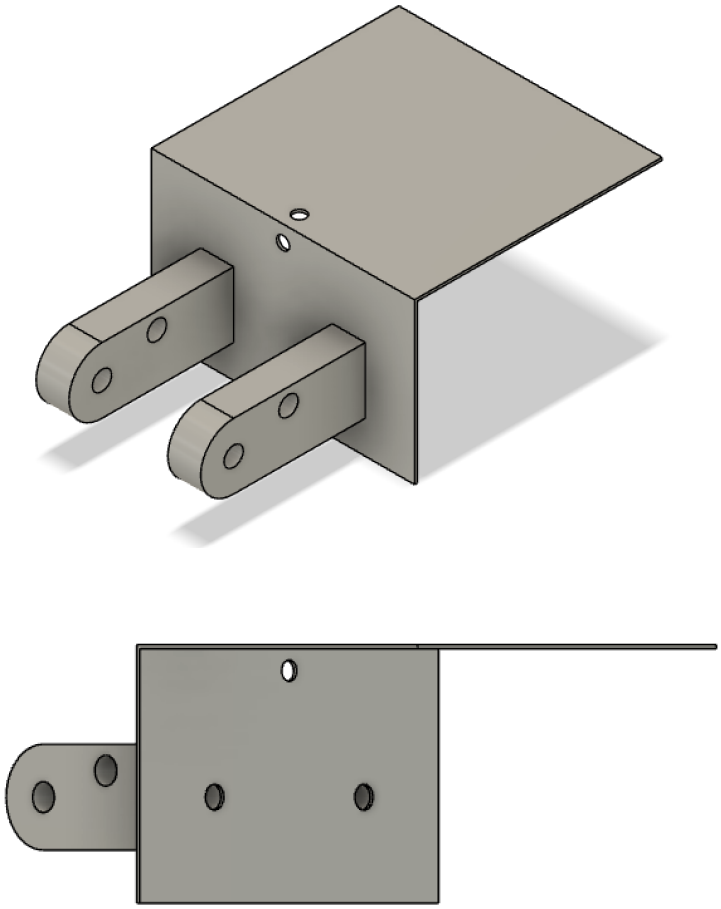




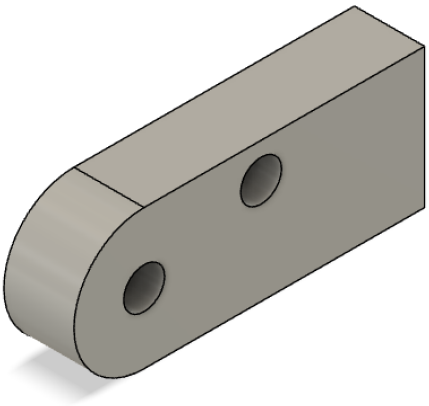
(top and isometric views)

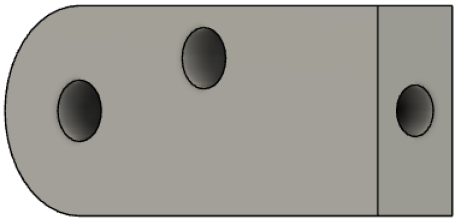
[3] Parts

[3.1] Gripper Linkage



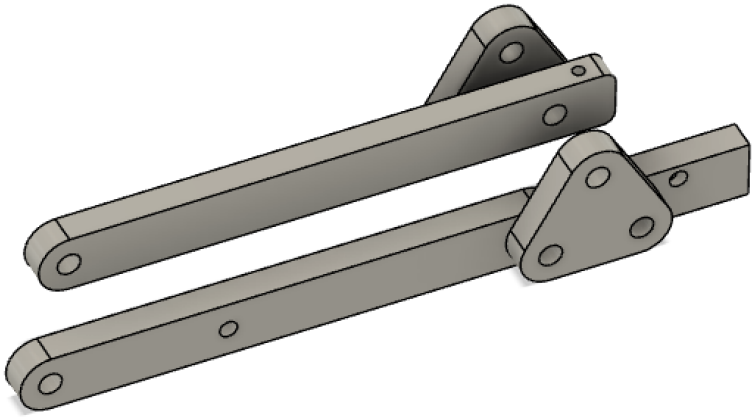
- The gripper linkage is how the upper arm is going to connect to the gripper.



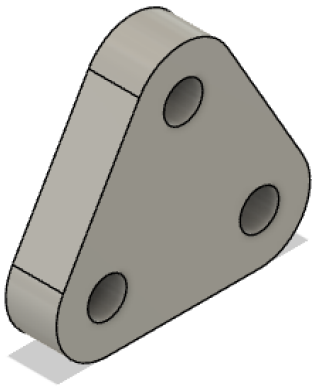


- The gripper linkage uses a 8-32 screw to connect to the gripper mount. This hole is tapped so no nut is needed and is on the rectangular face.
- The gripper linkage uses a 10-32 screw to connect to the triangle mount and is a tapped hole on the end to ensure it doesn't freely rotate around the screw.
- The gripper linkage uses a 10-32 screw to hold the spring in place with the help of a washer and is a tapped hole off center so no nut is needed to hold the screw in place.

[3.2] Triangle Mount

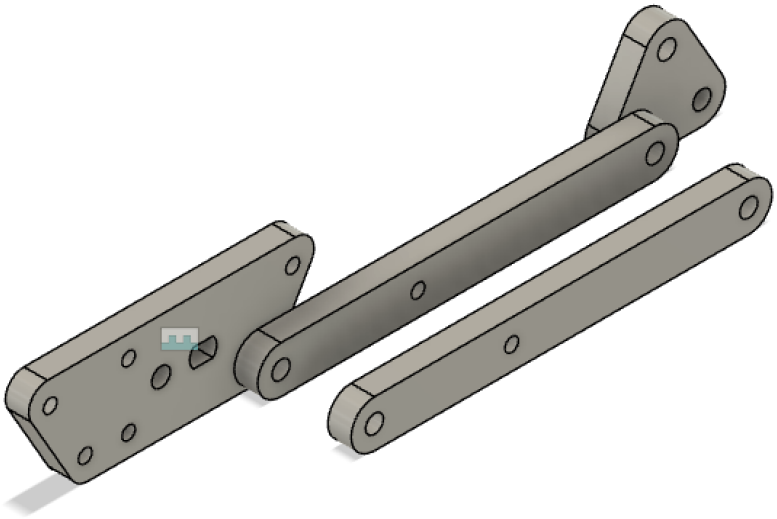


- The triangle mount is used to connect the grip linkages to the upper linkages. It acts as the wrist, albeit it is rigid.

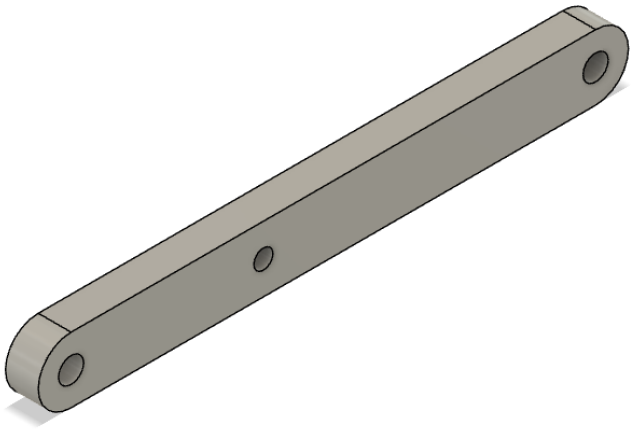


- The triangle mount uses 10-32 screws to connect to the linkages and these holes are clearance holes.

[3.3] Upper Linkage 1

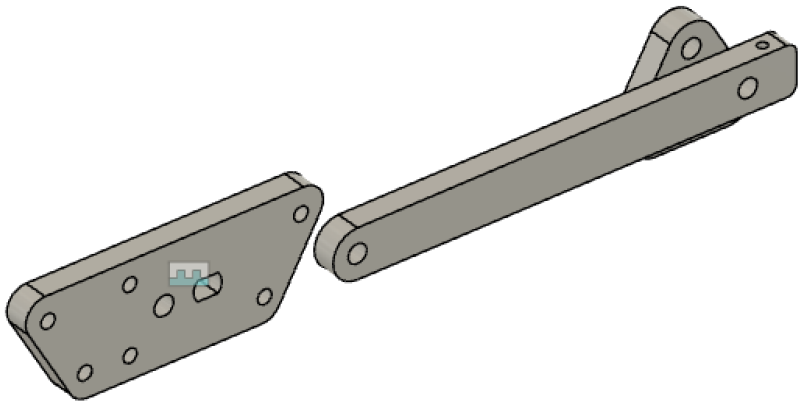


- The upper linkage 1 connects to the triangle and trapezoid mount.

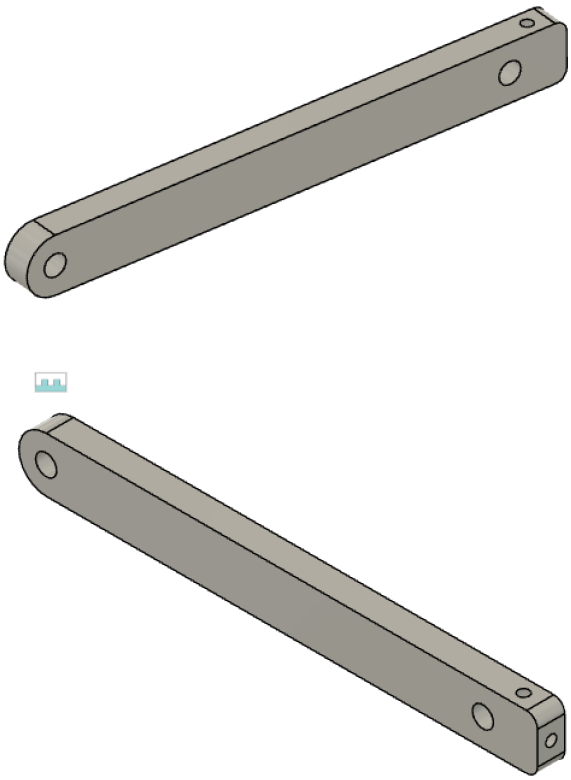


- The upper linkage 1 uses a 10-32 screw to connect to both the triangle and trapezoid mount. These are tapped holes at the ends because this link needs to be able to rotate with the screw.
- The upper linkage 1 uses a 10-32 screw to hold the spring in place with the help of a washer and has tapped holes in the center so no nut is needed.

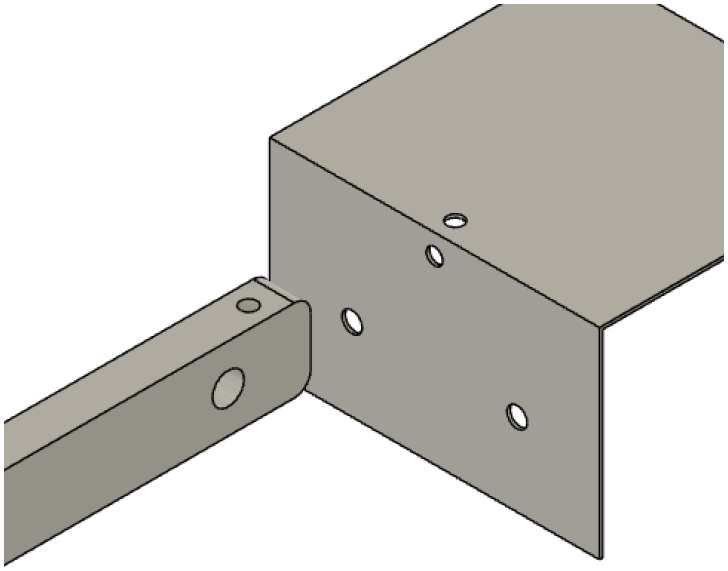
[3.4] Upper Linkage 2



- The upper linkage 2 connects to the trapezoid and triangle mount as well.



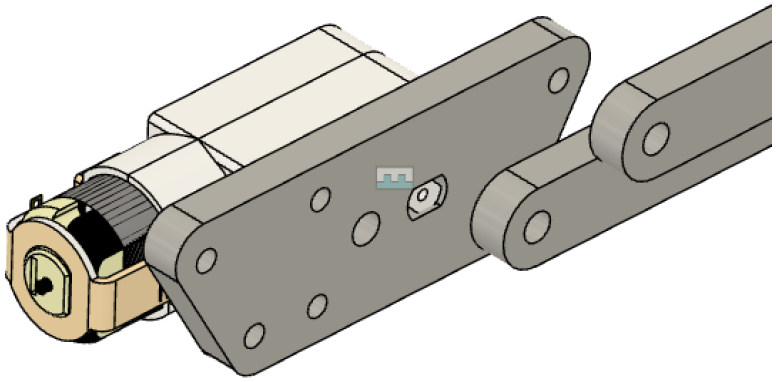
- The upper linkage uses 10-32 screws to mount to both the mounts and these are tapped holes at the ends to allow the linkage to rotate with the screw



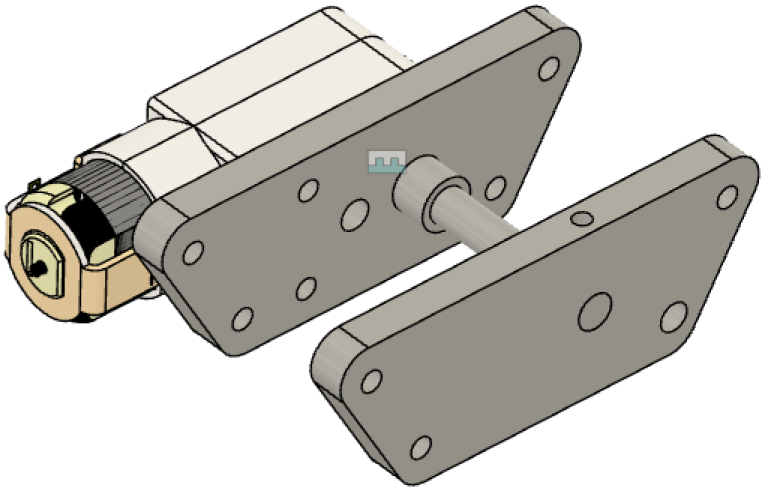
- In order to offer extra support for the gripper linkages, holes are cut out of the upper linkage 2 and sheet metal to allow either a fishing line or thin rubber band to connect these two parts to reduce load on gripper

linkages. The hole size depends on which material is used, but a smaller hole is preferred to reduce the change the piece breaks.

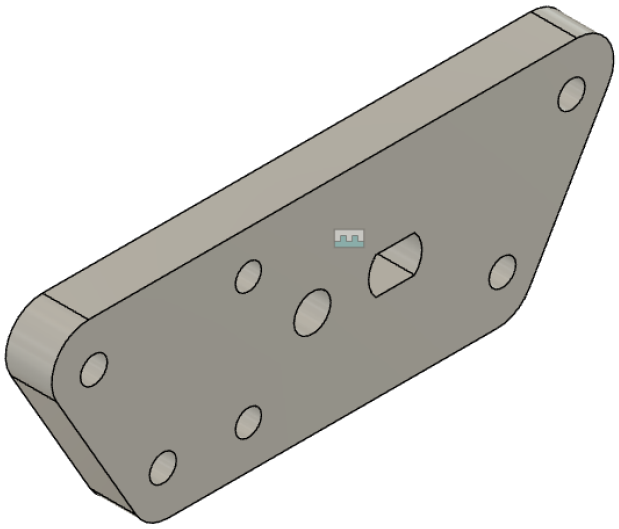
[3.5] Trapezoid Mount (Motor Side)



- This trapezoid mount mounts the motor and connects the upper arm to the lower arm. It acts as the elbow of the robotic arm.

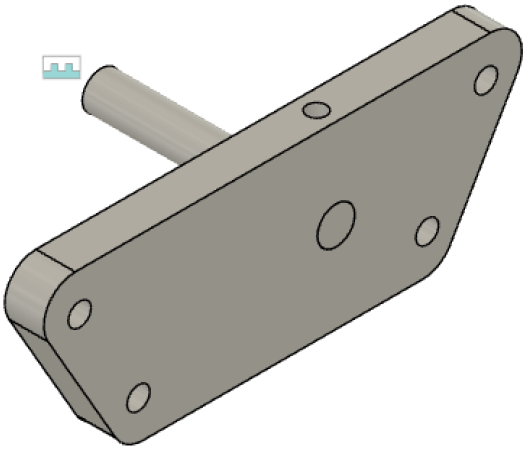


- The motor-side trapezoid mount connects to the other trapezoid using a shaft cover and a shaft.



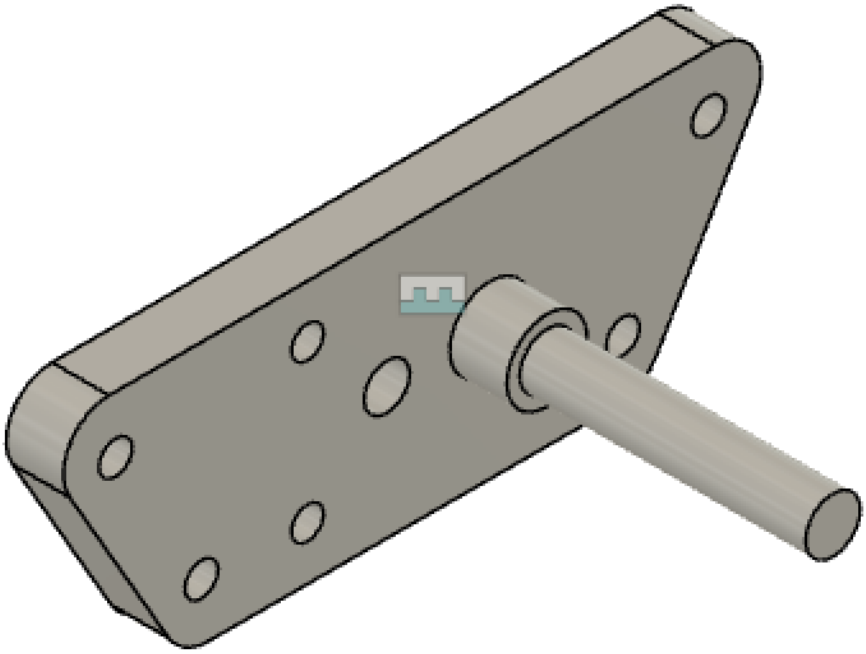
- The motor side trapezoid mount uses 10-32 screws to connect the upper arm and lower arm together. These holes are clearance while the linkage holes are tapped holes and are located at the corners.
- The motor-side trapezoid mount also has other holes near the center to mount the motor. It uses a 6-32 screw to mount the motor and this is a clearance hole.

[3.6] Trapezoid Mount (Non-Motor Side)



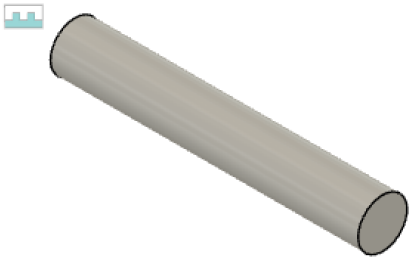
- The non-motor side trapezoid mount is connected to the other mount with a shaft.
- It uses a 10-32 screw to connect the linkages and is clearance at the corners.
- At the top of the mount is a hole to use a set screw to ensure the shaft is secure to the mount.

[3.7] Shaft Cover



- The shaft cover is used to connect the trapezoid mount to the shaft. The shaft will be pressed into the shaft cover.
- The shaft cover will be glued to the mount with acrylic glue.

[3.8] Aluminum Shaft



- The shaft is 1.5 inches in length and is used to connect the mount together to make sure they both rotate simultaneously.

[4] Potential Problems

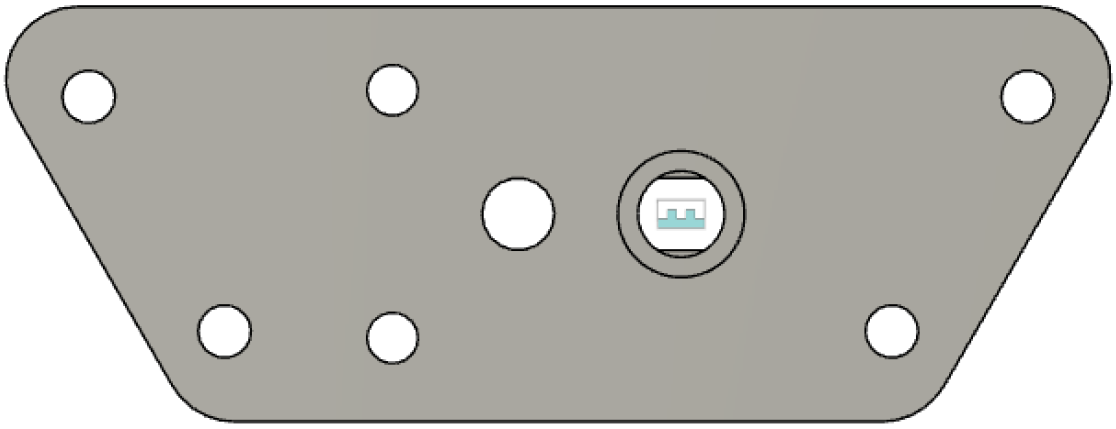
[4.1] Holes

- A lot of the holes are tapped and this makes it time-consuming to assemble. Some holes should be changed to clearance holes. Not only that, but the longest screw length is 2 inches, which means that very little space would be left for the nut.

[4.2] Linkage Lengths

- The optimal length of the linkages hasn't been decided yet and should be tested when making the final design.

[4.3] Shaft Cover Connection

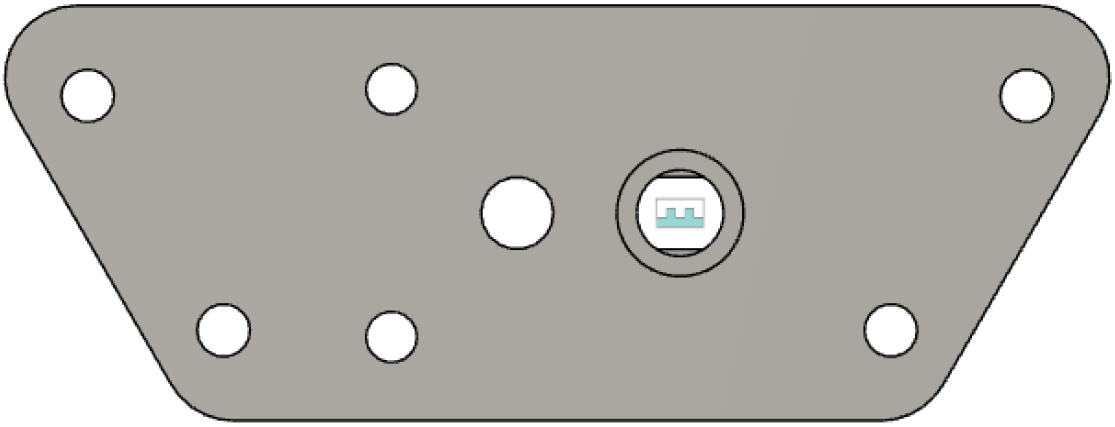


- The shaft cover is just a cylinder without a top and bottom. Connecting the shaft cover to the trapezoid mount is very difficult and this needs to be changed.

[4.4] More Torque

- There is a lot of friction in the movement of the arm, so more torque is needed. A mechanical advantage of 3 gives a factor of safety above two. This will be accomplished with either a gear or belt drive transmission.

[4.5] Can’t Rotate



- When designing this mount, I put the axis of rotation at the center of the mount and mounted the motor onto the mount itself. The problem is that I expected the mount to rotate relative to the motor but the motor was mounted onto the mount itself, so the motor would rotate with the mount, which is not supposed to happen. As a result, the axis of rotation should be moved to a different location.

[4.6] Springs

- The suspension springs could make it harder for the arm to rotate due to the opposing spring force. When a lot of the holes are tapped, the springs are useless because there is enough friction to prevent the free movement of the links. If more holes are clearance, the springs can be used.