TEAM J, LERNER EXOSKELETON II

Operation Manual

Ahmad Alharbi
Alroumi Alenezi
Khaled Alzafairi
Fahad Alhajri
Sayaf Almari
Mohammad Alrashidi

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Instructor : Dr. Sarah Oman
Project Sponsor : Dr. Zach Lerner
Client : Dr. Zach Lerner

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1- Introduction:

The purpose of this manual operation is to explain how to use the exoskeleton for 7-12 years old kids with neuromuscular disorders. The system will be working by using a motor to move the lower and upper steels roundly. The motor will be attached by using two green hinges. One will be attaching the upper steel to the motor and the other will be attaching the lower steel to the motor. The steels will be on the outside surface of the leg and there will be two bands made of thermoplastic and aluminum. One band will be used for the thigh and the other band will be used for the shank. Also, there will be a foot portion that is attached to the lower steel and can be inserted into normal shoes. This system fit various sizes and ages of normal kids from 7 to 12 years old. The electrical system will be attached to top upper steel and connected with a motor, the motor will attachment above the knee, and the force sensor will stick down to the foot and connected directly to the PCB.

2- Operation and Maintenance:

This Section covers how to use the system probably and how to make it works.

Figure 1, Lower steel

In figure 1, it shows the lower leg's system. The lower system is combined of the following: Lower steel, thermoplastic bands, reinforced aluminum and foot portion. The lower steel is made from aluminum and has 22 holes in it. Aluminum is used cause of its lightweight and strong property. The holes will be used to adjust the thermoplastic and aluminum bands. If the kid's shank is tall, you can use the upper holes and otherwise as shown in Figure 2. The screws for these holes are Button Head screws to adjust the bands to the lower steel as shown in Figure 3. The top two holes are smaller than the other 20 because they will be used to attaching the motor to the lower steel as shown in Figure 4.

Figure 2, lower steel

Figure 3, Button Head Screws

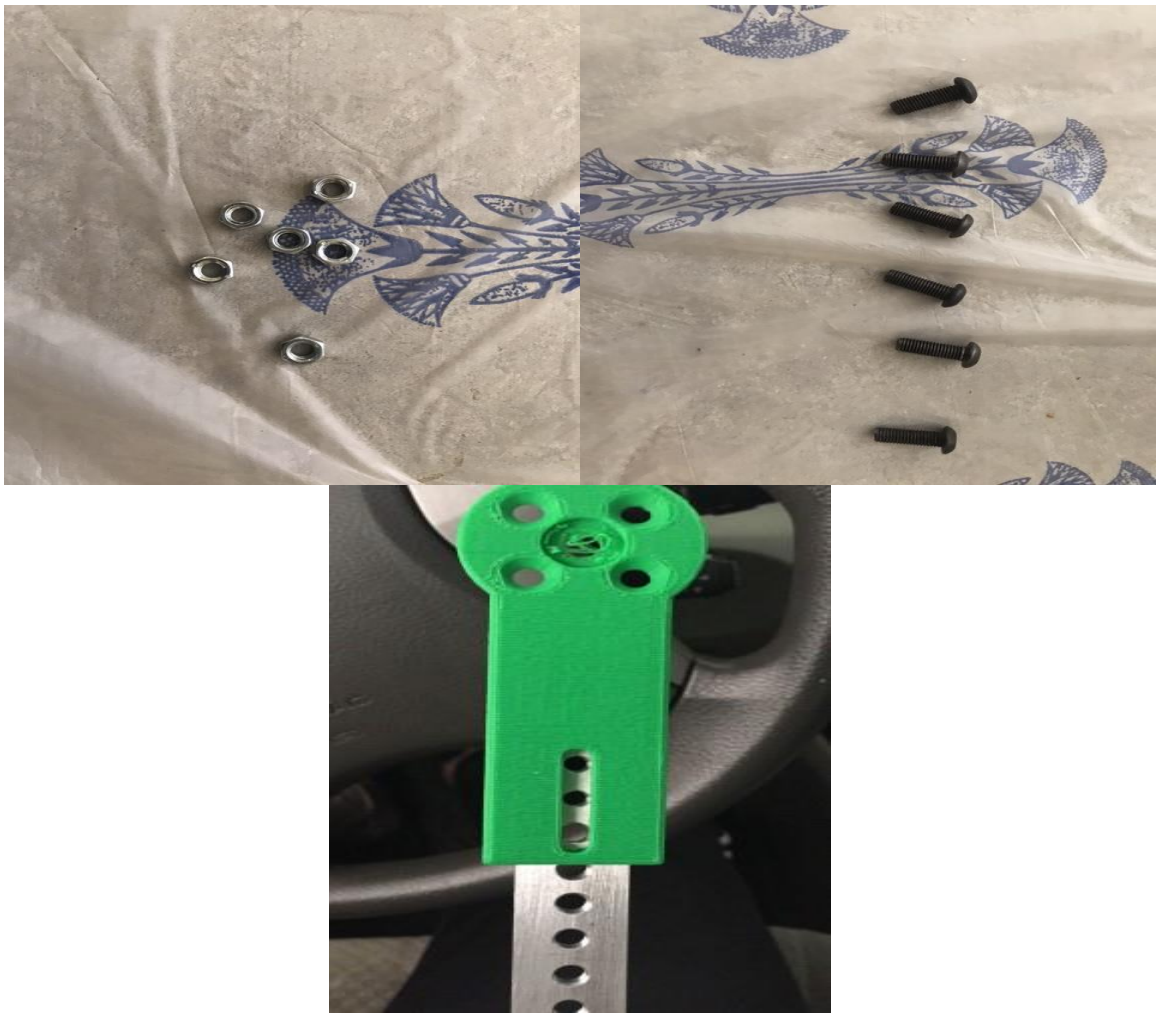


Figure 4, lower to motor with its screws

Figure 5, 6 show the bands separately. The bands can be attached together using button head screws also. The screws for attaching the bands are M5 x 0.8 button head. They are the same screws that will be attaching the bands to the lower steel. Also, knots are used to staple and adjust the screws in the steel and bands perfectly. Knots are shown in Figure 7. The screw driver for these screws are shown in Figure 8.

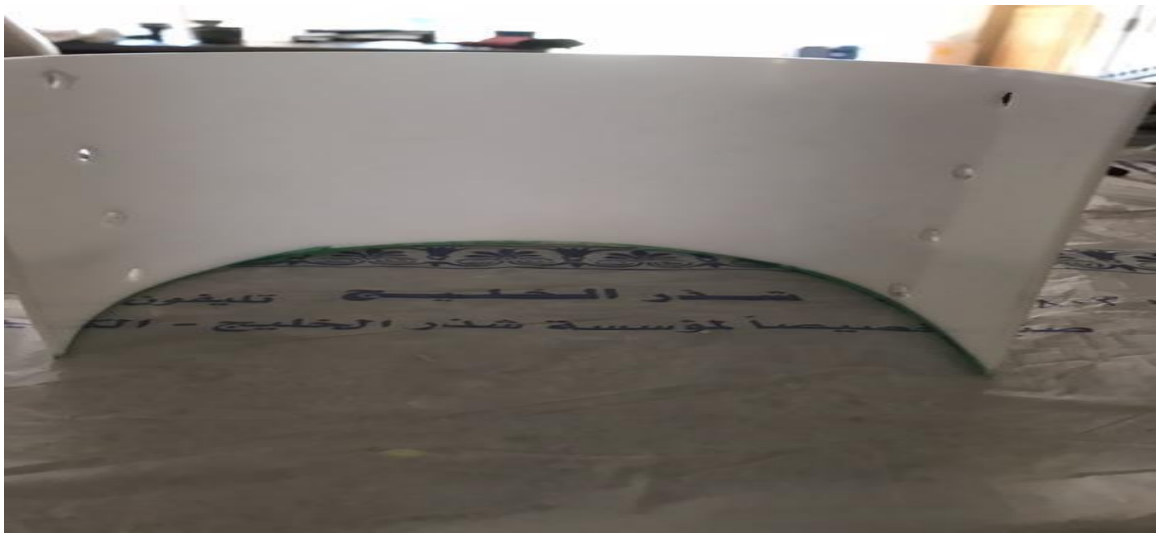


Figure 5, thermoplastic band

Figure 6, Aluminum band

Figure 7, Screw Knots

Figure 8, Button Head screw's driver

Velcro straps are used to tight and wide the bands depending on the kid leg's size. The straps are placed on the bands by using button head screws as well. Also, a latch is used to adjust the size of the straps. The strap will go inside the latch and out of the other side then goes back to where the parent's think its size fit for the kid's leg.

Figure 9, Velcro Straps

Figure 10, Latch

Figure 11, Velcro strap and latch

Also, there are 3 different sizes of the foot portion. The parent choose the one which fits the kid's feet perfectly. It's attached to the lower steel by using screw. The parent can easily remove the foot portion only by using screw driver and simply attaching the wanted foot portion. The screw driver also is used to tight and loose the foot portion's screw and by that, the foot portion can be 100% steady or 50% steady as the parents want. Also, the foot portion is low profile and can be inserted into normal shoes easily. The kid will wear and strap the whole system to his leg then wear his shoes easily.

Figure 12, foot portion sizes

Figure 13, foot portion screw driver

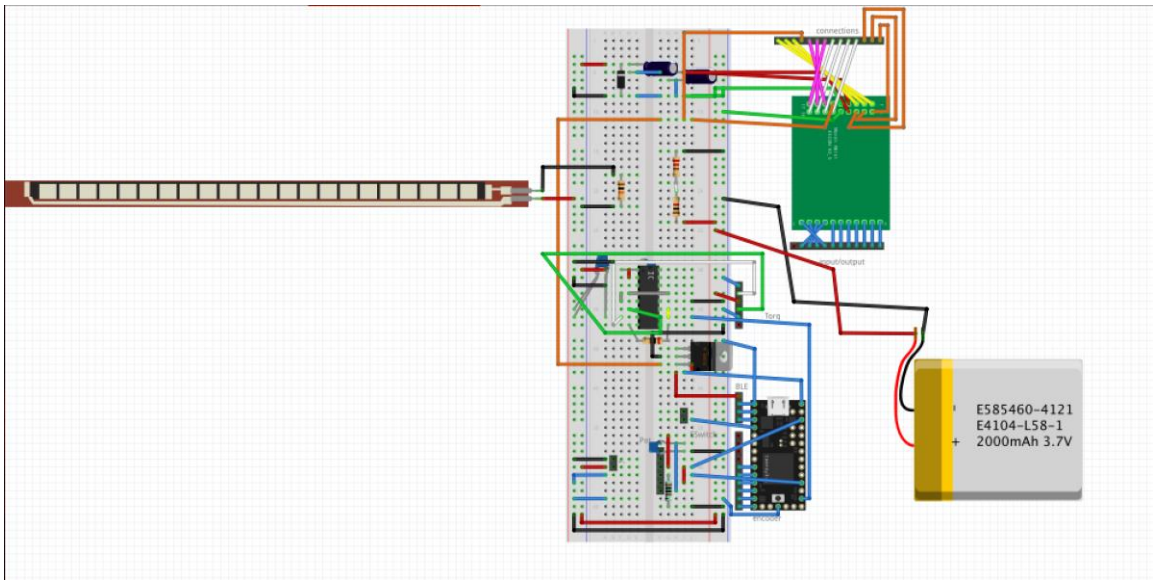
The upper steel is also made of aluminum and has the same number of holes. 22 holes. It will also be attached to a thermoplastic and aluminum bands. It will be attached using the same button head screws. Also, in Figure 14, it shows the two lower holes with it different sizes than the rest of the holes. That's because these two holes will be used to attach the steel to the motor as shown in Figure 15.

Figure 14, upper steel

Figure 15, Upper steel to motor

3- EE System

This section will explain what is the Electrical system that we will use in the project and how the electrical system will work. Also, this section will explain what the EE system is combined of and what is every component purpose.



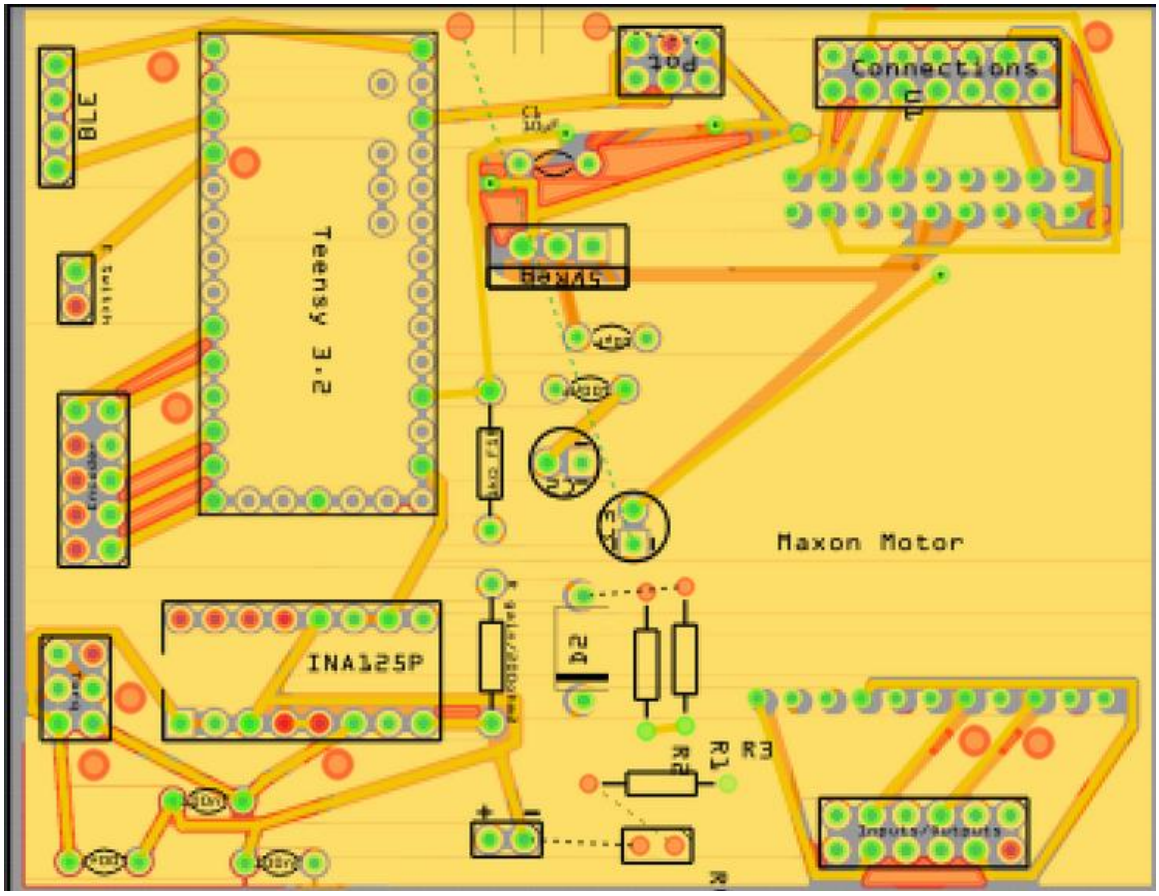


Figure 16, PCB

In figure 16, it shows PCB. The PCB is combined of the following: input for FSR, resisters, Micro-controller, Blue-tooth, input for Torque Sensors, input for Li-Po Battery, input for EC-4-pole DC motor, motor controller (Escon Module 50/5). The PCB will work based on the coding that will be on micro-controller.

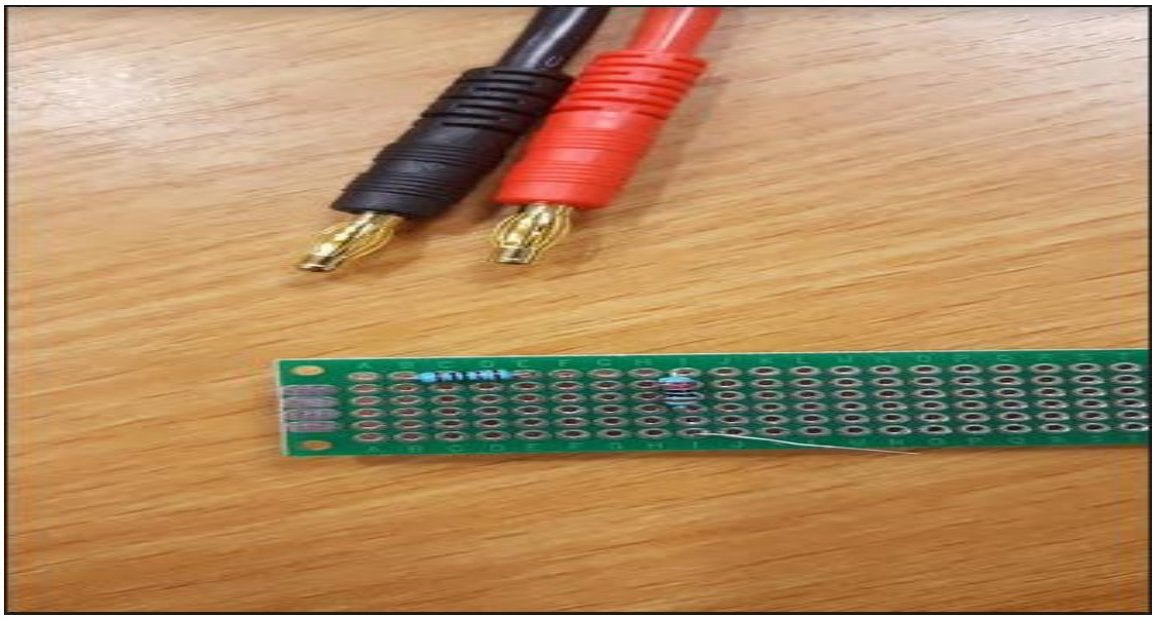
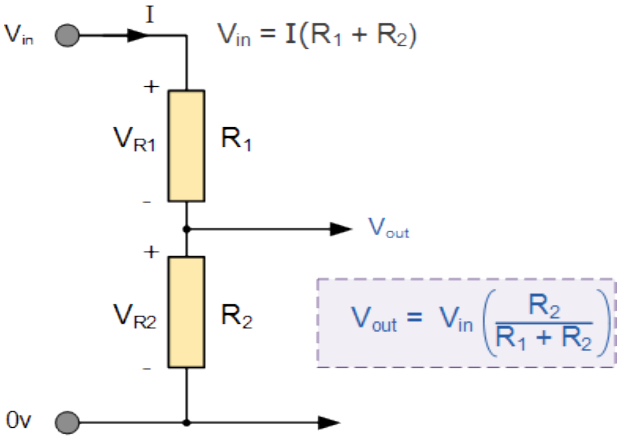


Figure 17, Li-Po battery 22.2V & resistors

Figure 17 show the power source and the resistors. So our power source is 22.2V and our PCB need from 3.3V to 5V, so we add two resister 1kΩ and 220Ω to protect our PCB from the battery. This is how it work:



$$V_{PCB} = 22.2V\left(\frac{220\Omega}{1000\Omega+220\Omega}\right)=4.0V$$

Figure 18, FSR

In figure 18 we have 2 feet force sensitive resistor it stick under the foot and when the child stand on it will give command to PCB to raise the leg up and when the leg there is nothing stand on the FSR so the PCB will let the go down so it will be loop commend.

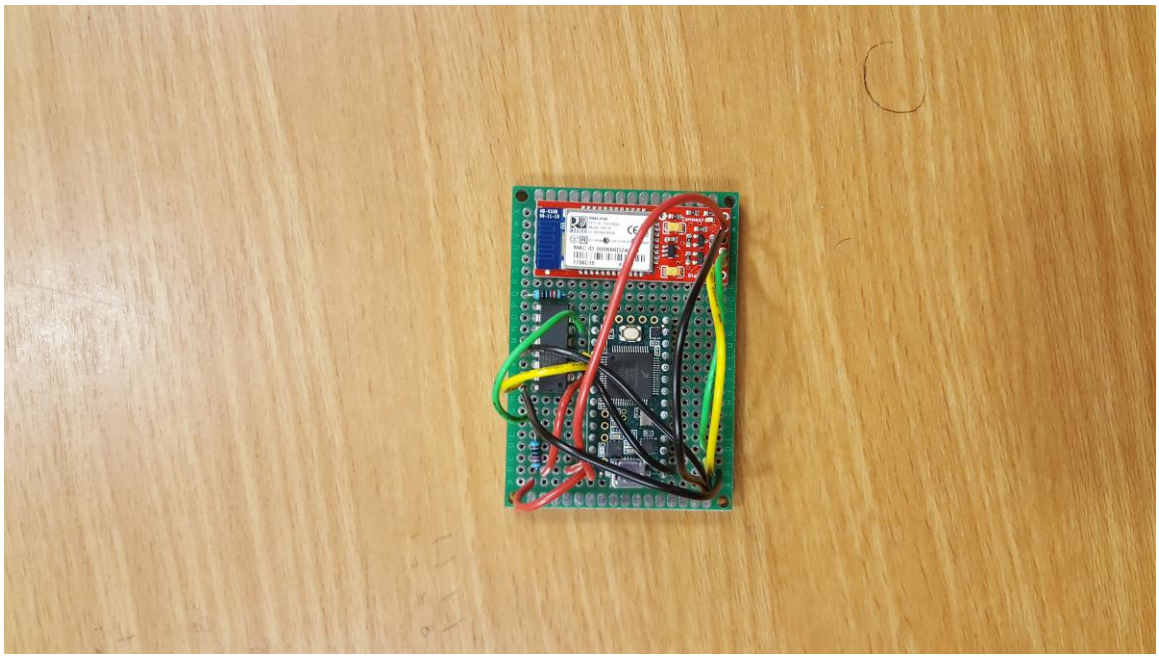


Figure 19, PCB

In Figure 19 show the parts that we have and we build it in (http://fritzing.org) and then we order it. So, we just waiting for the PCB

Figure 20, Connected PCB with FSR

APPENDIX

The following CAD designs are of the Exoskeleton mount.

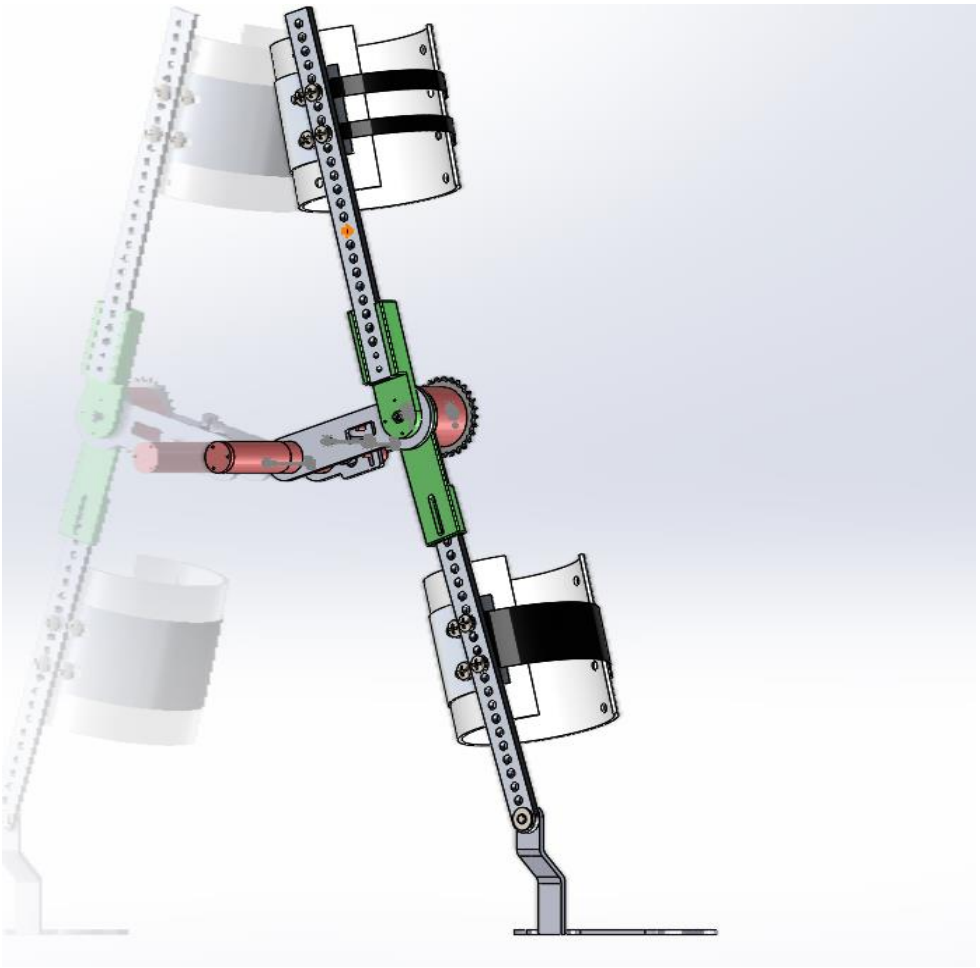


FIGURE 1: ISOMETRIC VIEW OF MOUNT

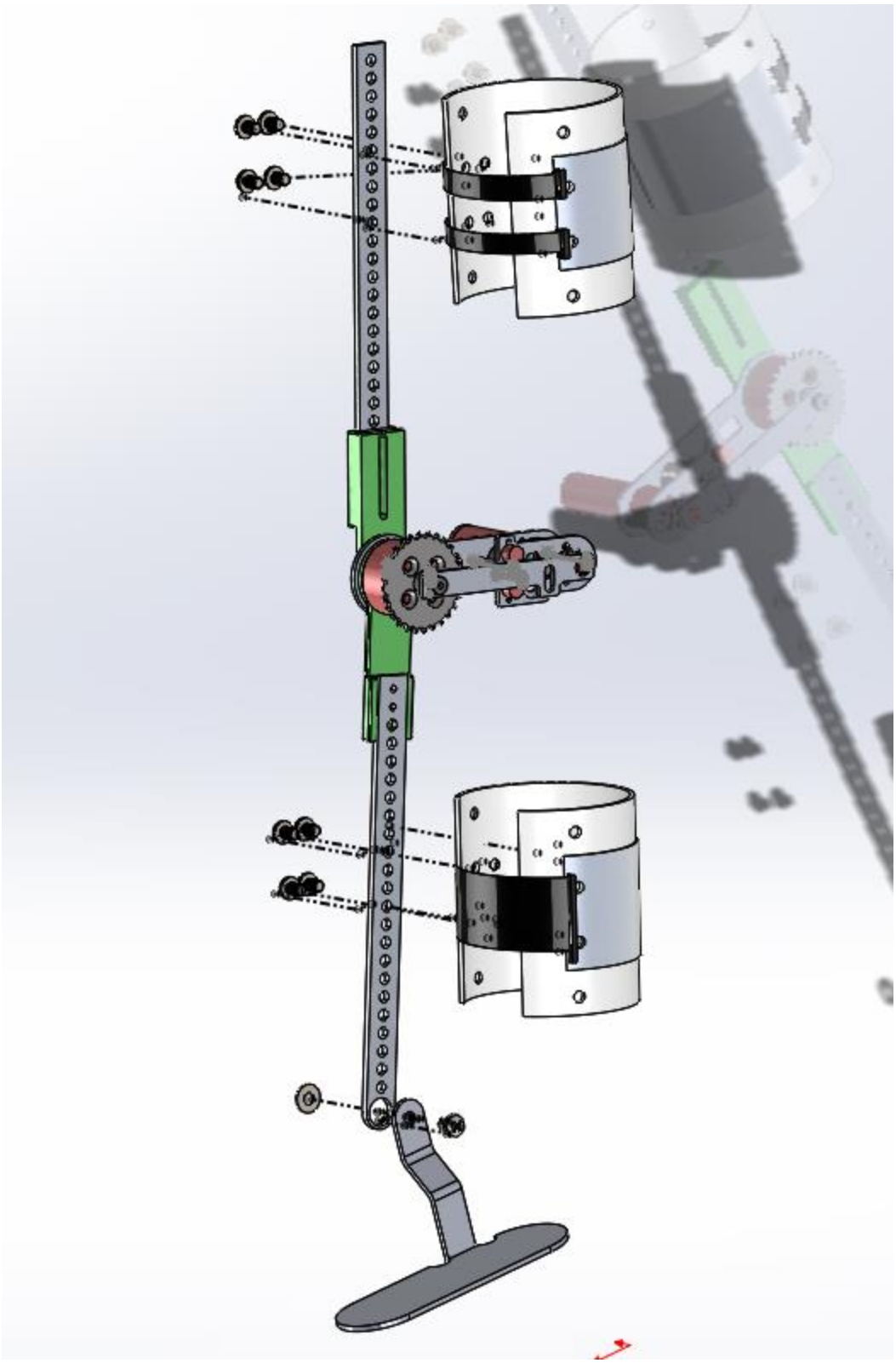


FIGURE 2: EXPLODED VIEW OF MOUNT

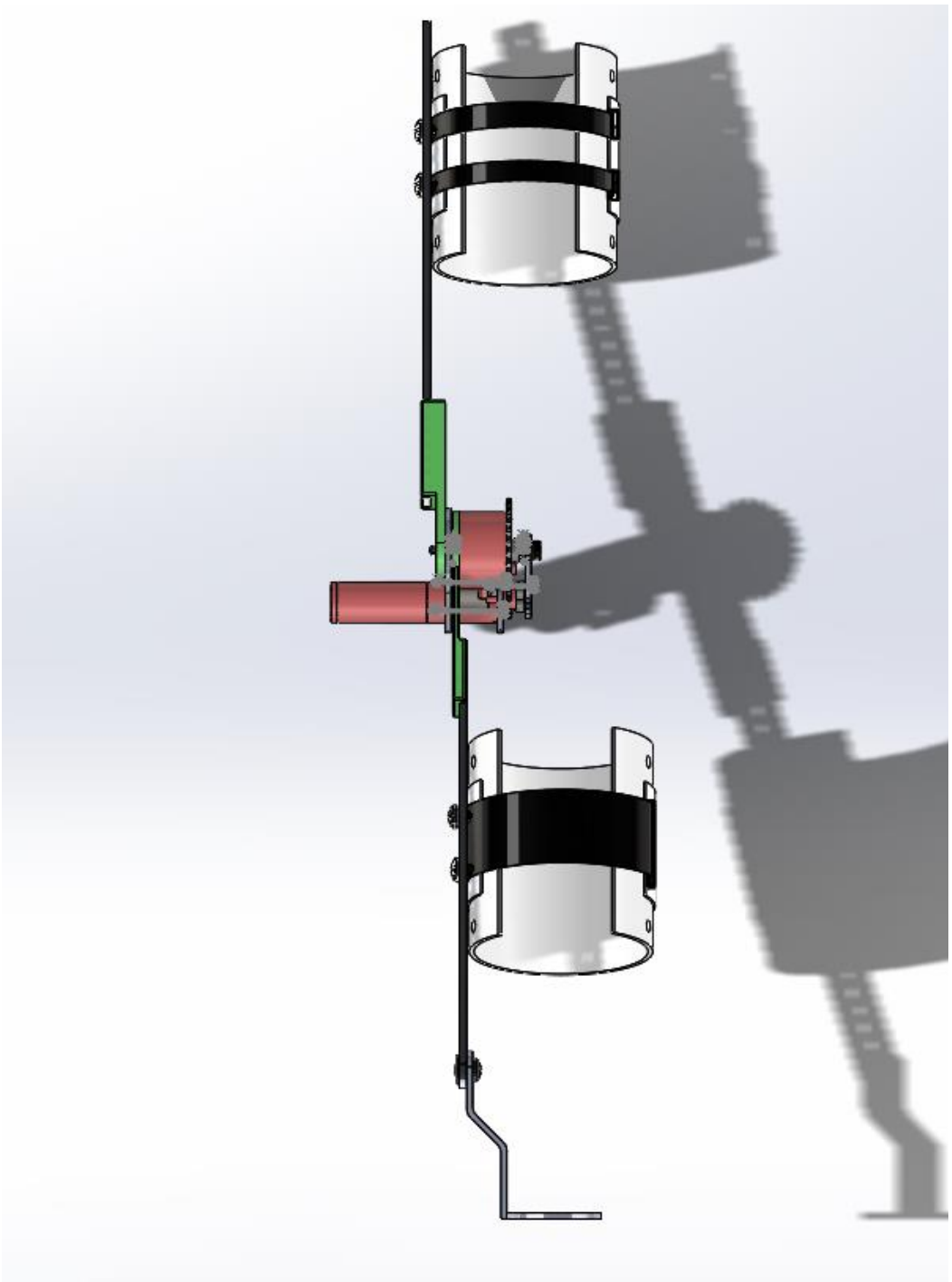


FIGURE 3: FRONT VIEW OF MOUNT

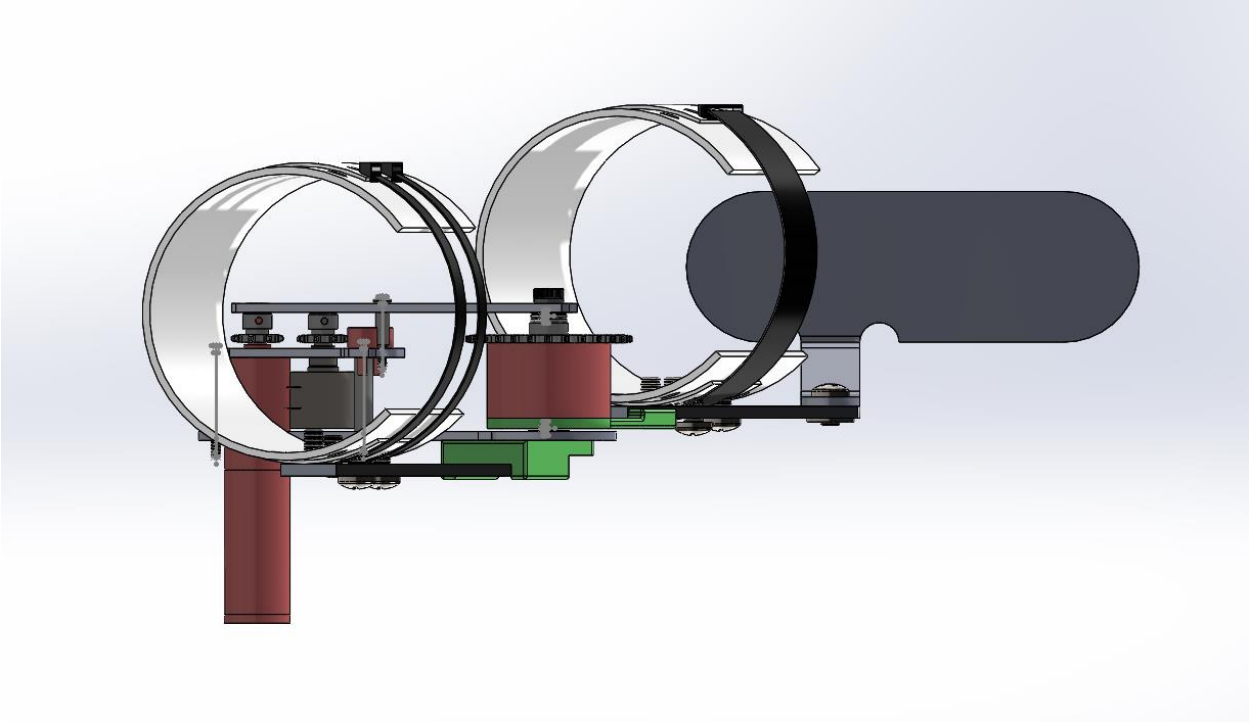


FIGURE 4: TOP VIEW OF MOUNT

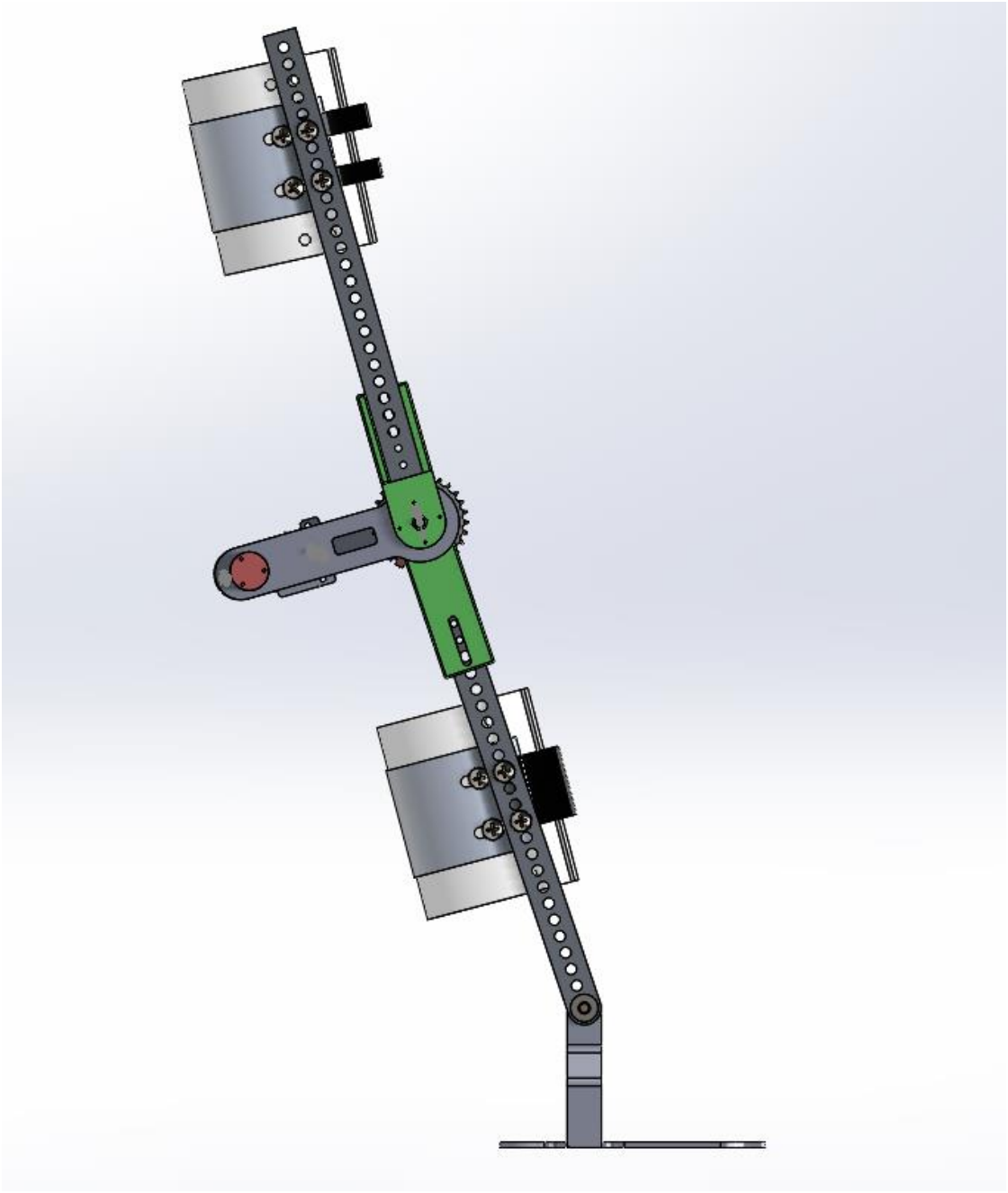


FIGURE 5: RIGHT VIEW OF MOUNT

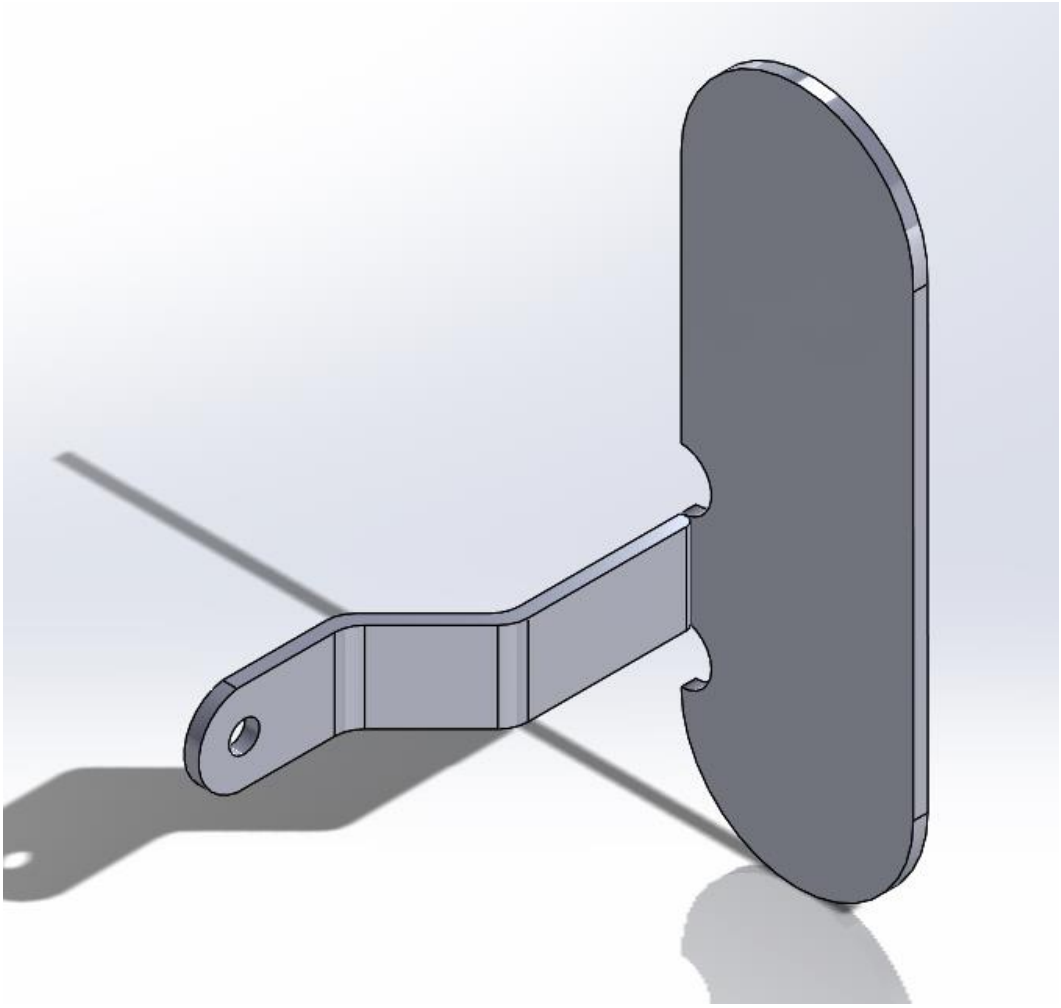


FIGURE 6: FOOT PORTION ISOMETRIC VIEW OF MOUNT

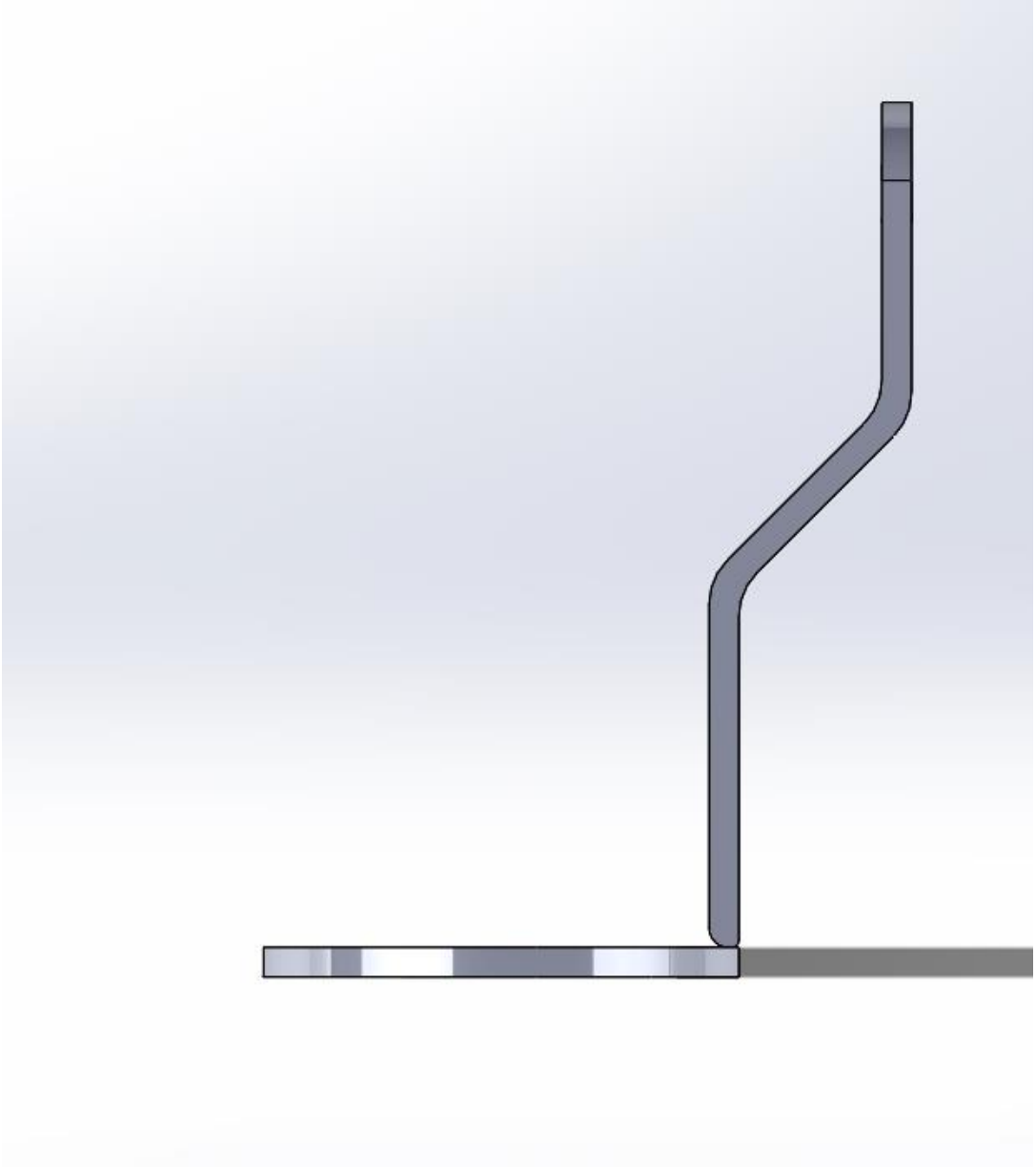


FIGURE 7: FRONT VIEW OF FOOT PORTION

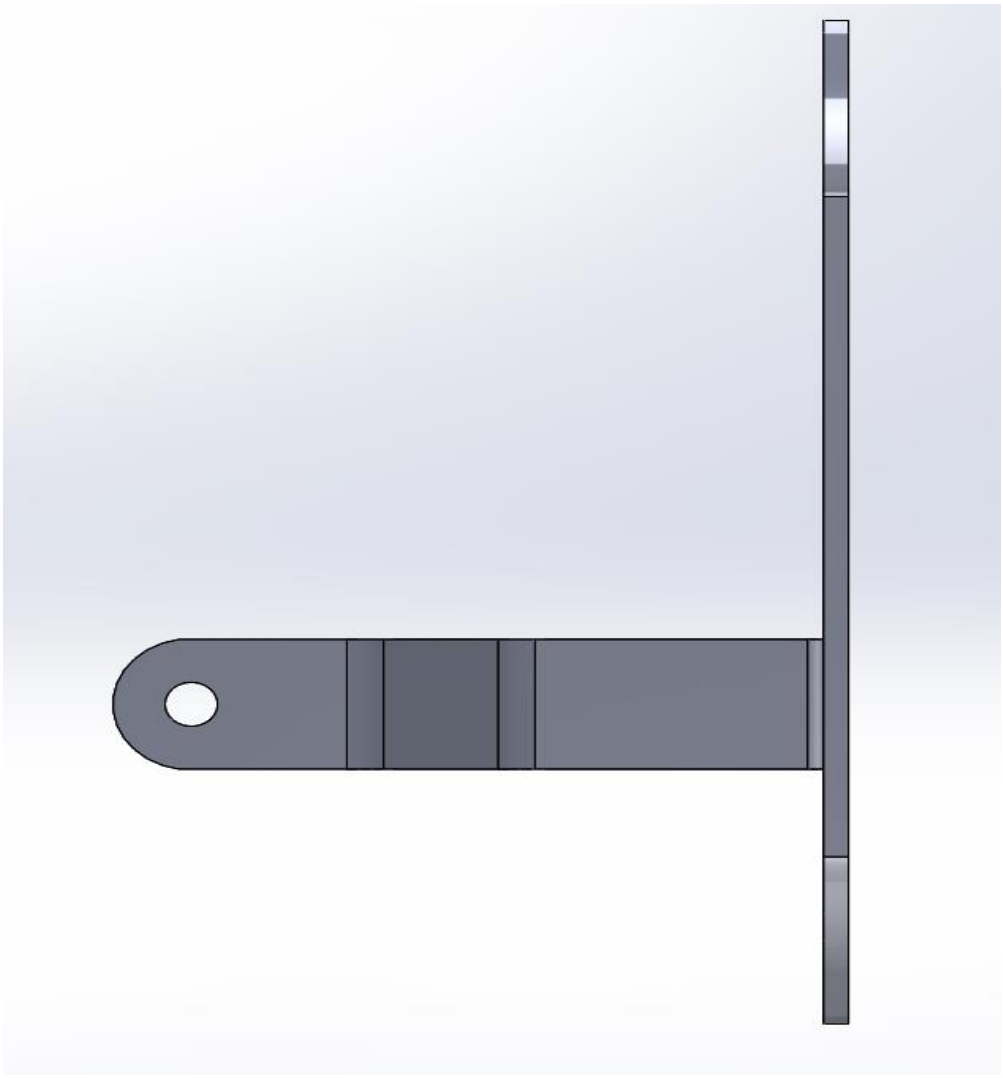


FIGURE 8: RIGHT FOOT PORTION

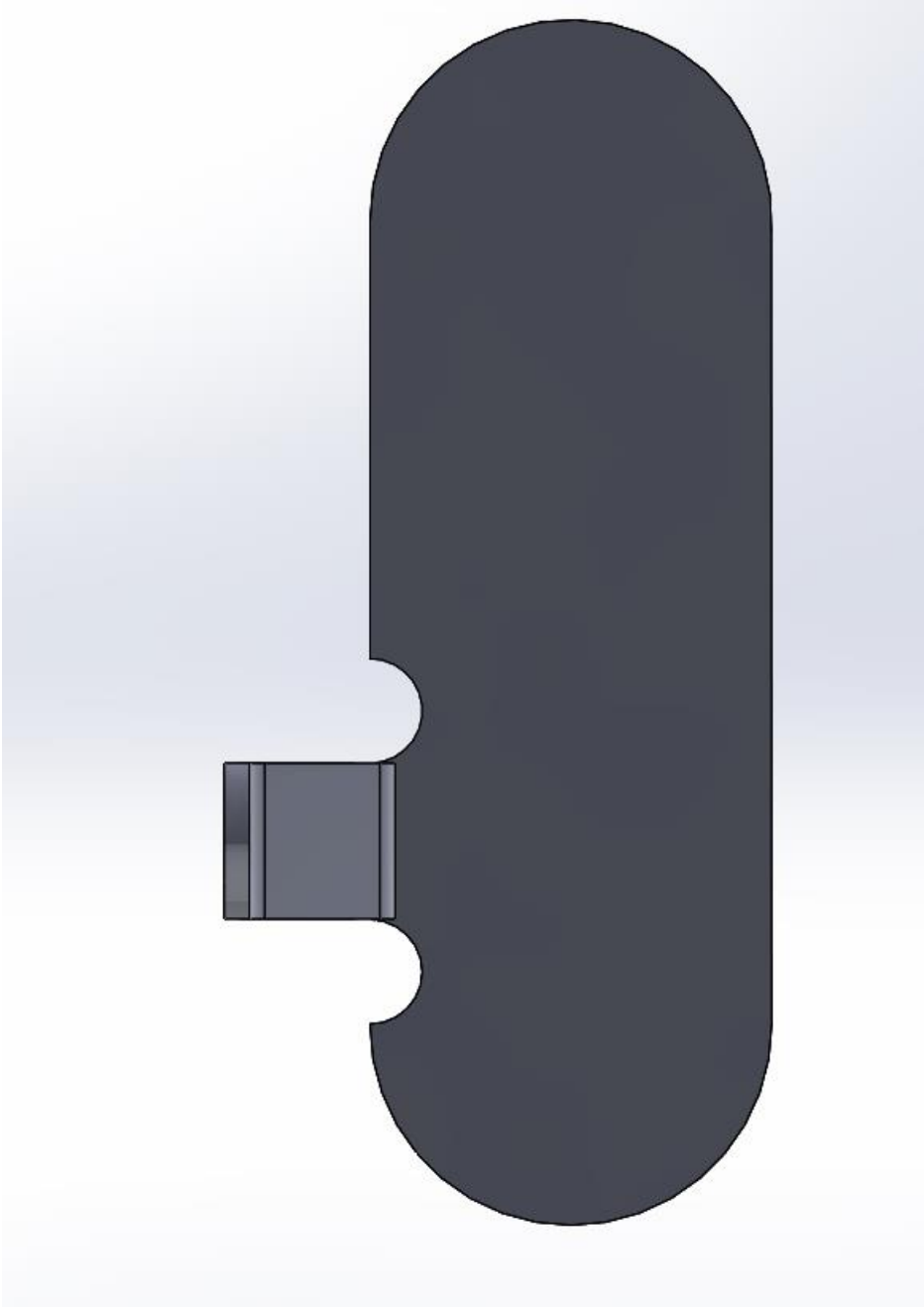


FIGURE 9: TOP FOOT PORTION

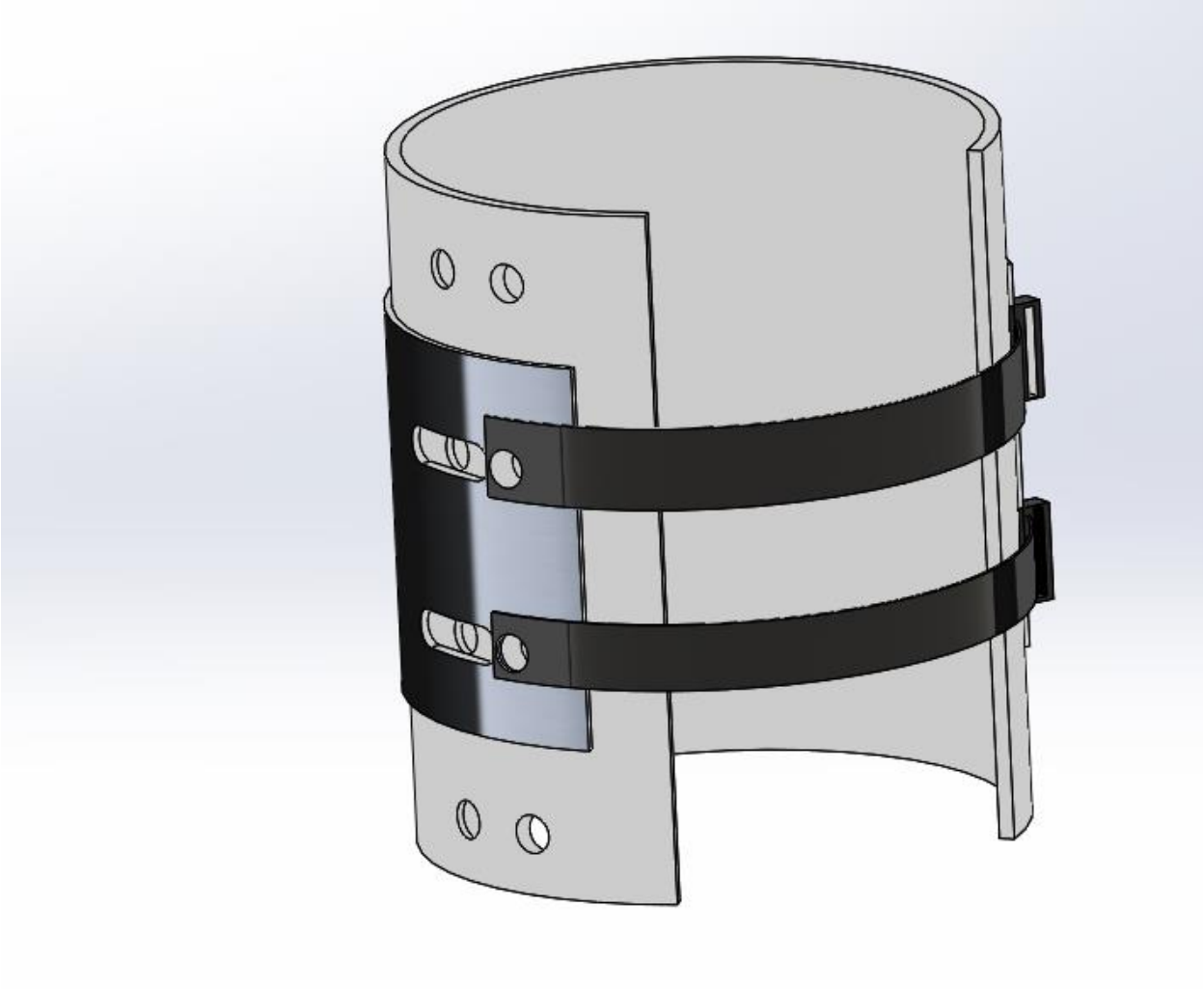


FIGURE 10: THERMOPLASTIC UPPER PORTION ISOMETRIC

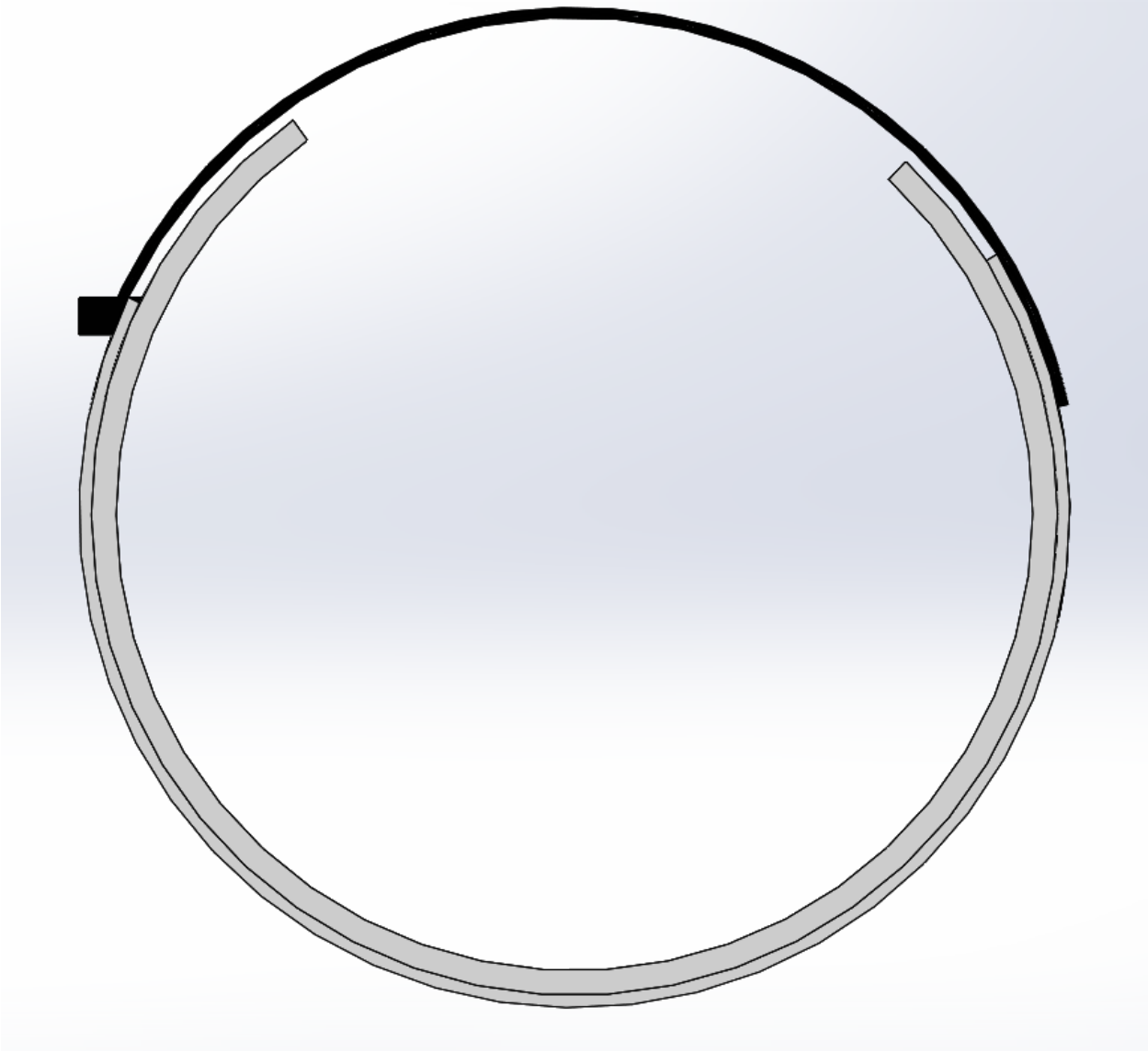


FIGURE 11: THERMOPLASTIC TOP PORTION

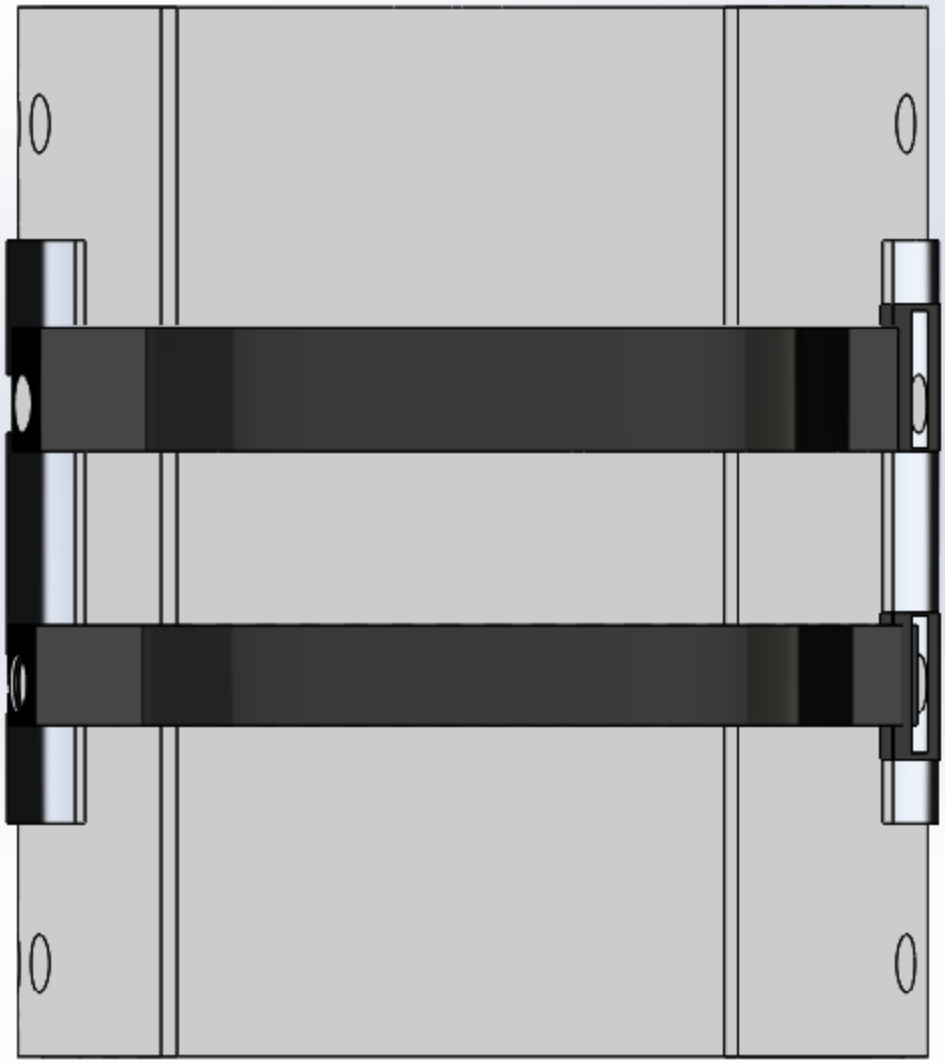


FIGURE 12: THERMOPLASTIC FRONT PORTION

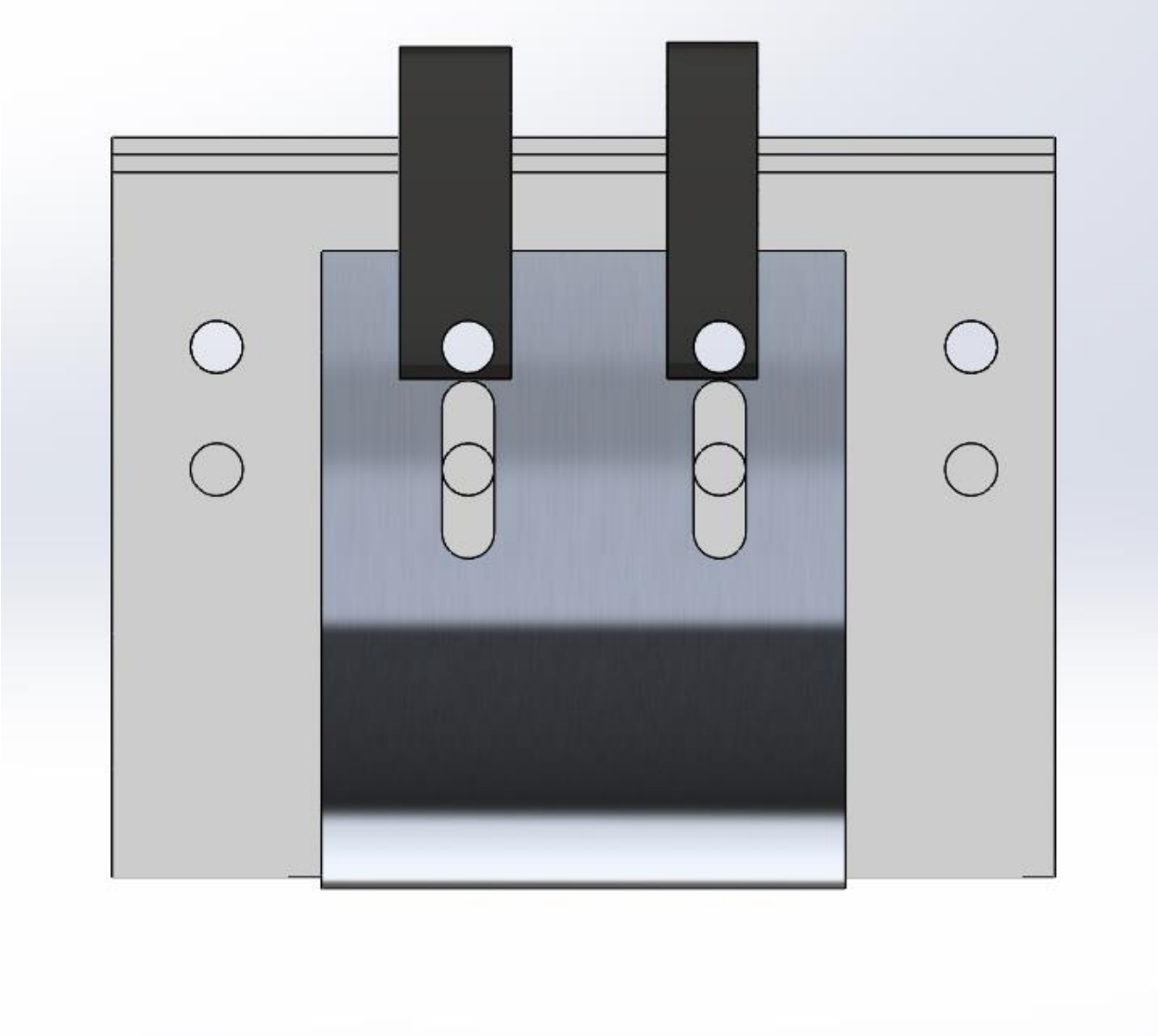


FIGURE 13: THERMOPLASTIC RIGHT PORTION

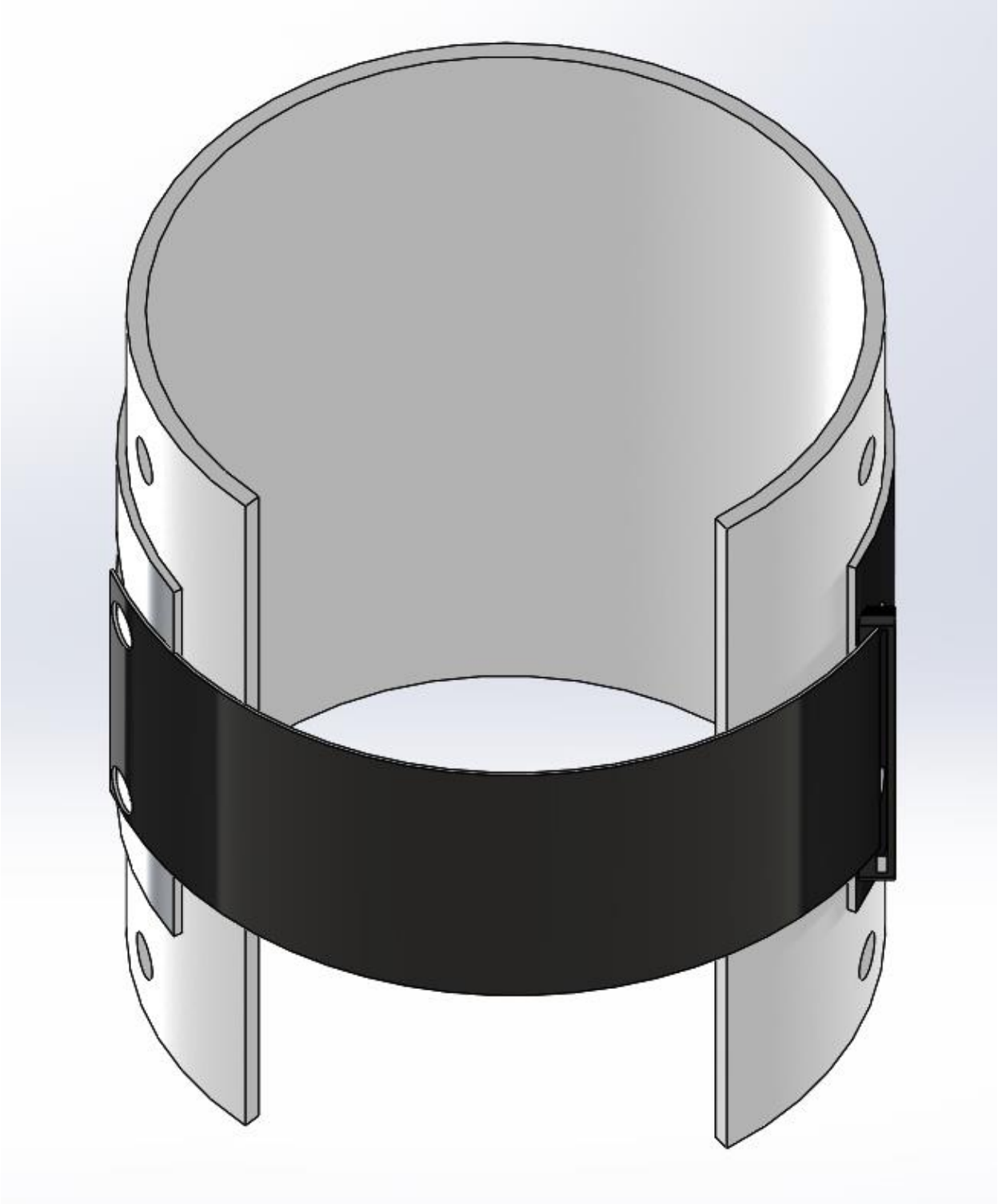


FIGURE 14: THERMOPLASTIC BOTTOM PORTION ISOMETRIC

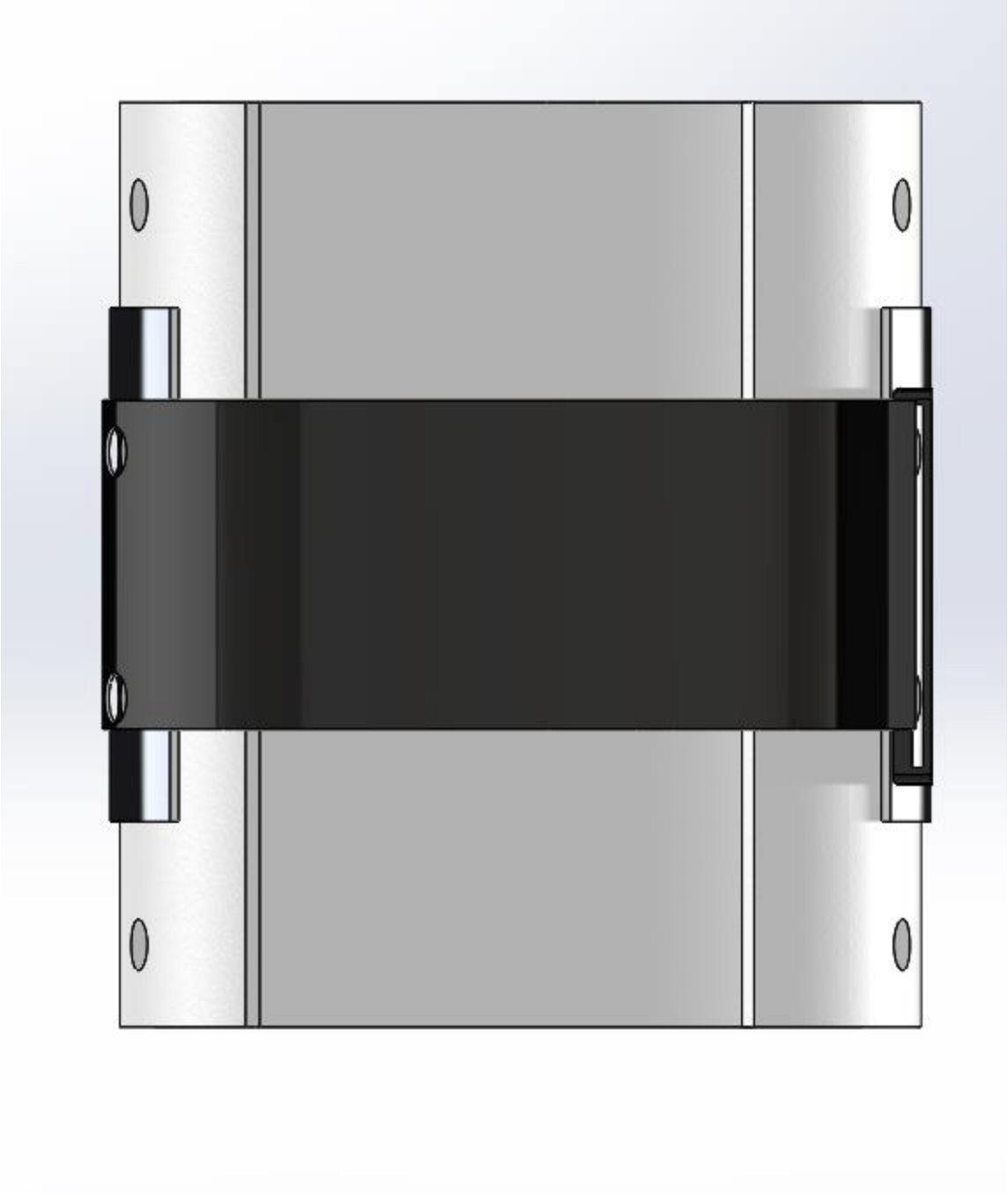


FIGURE 15: THERMOPLASTIC BOTTOM PORTION FRONT

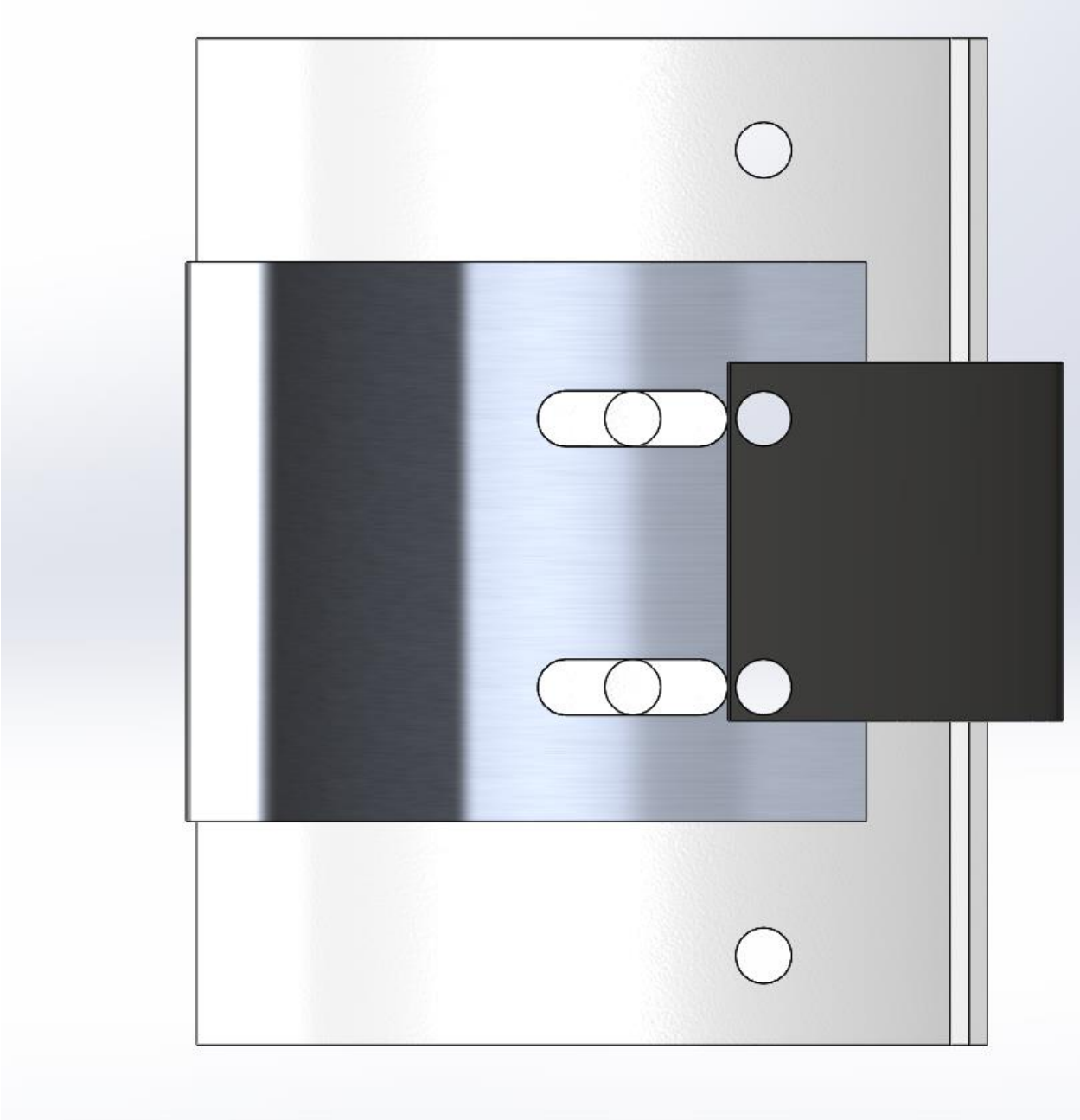


FIGURE 16: THERMOPLASTIC BOTTOM PORTION RIGHT

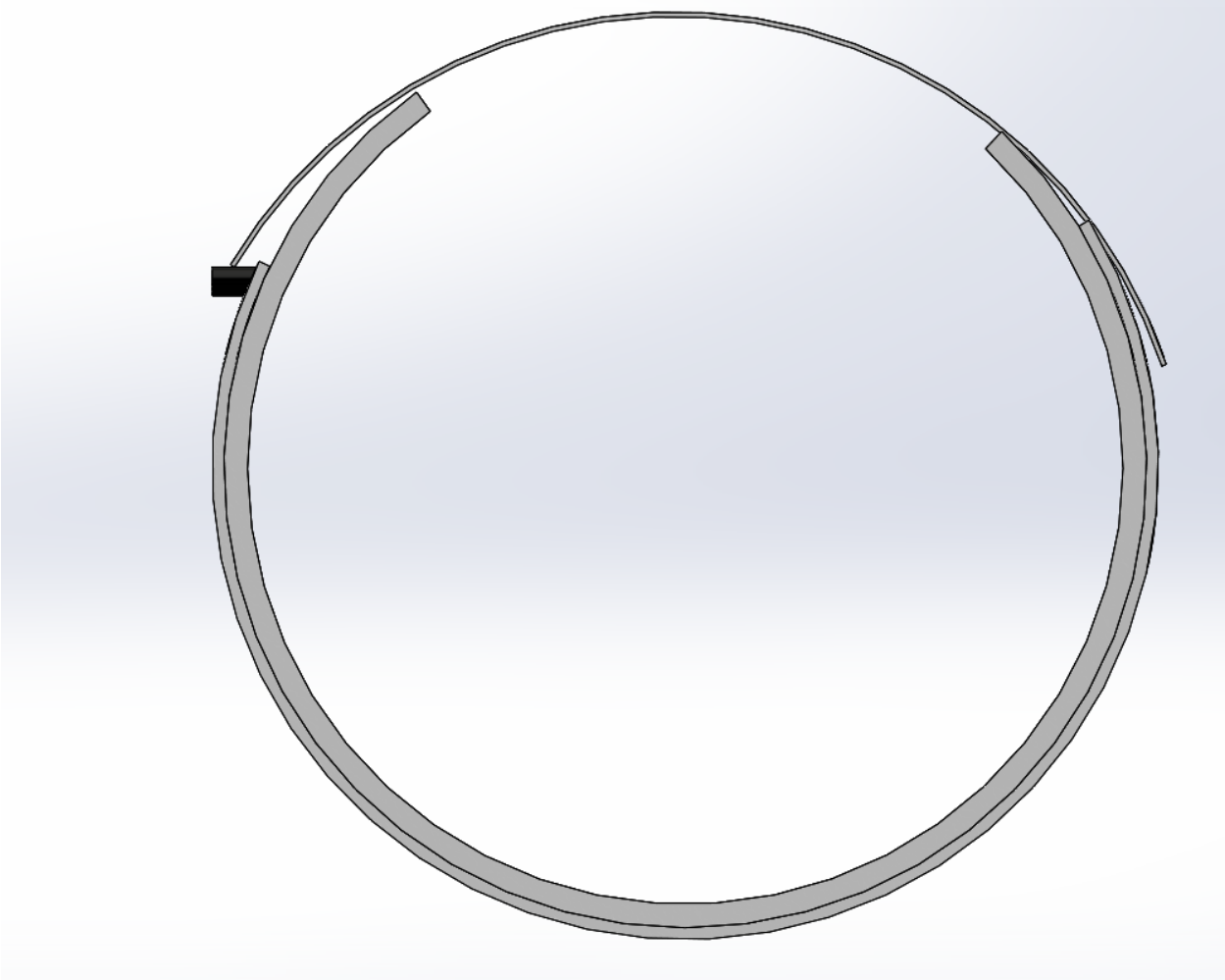


FIGURE 17: THERMOPLASTIC BOTTOM PORTION TOP

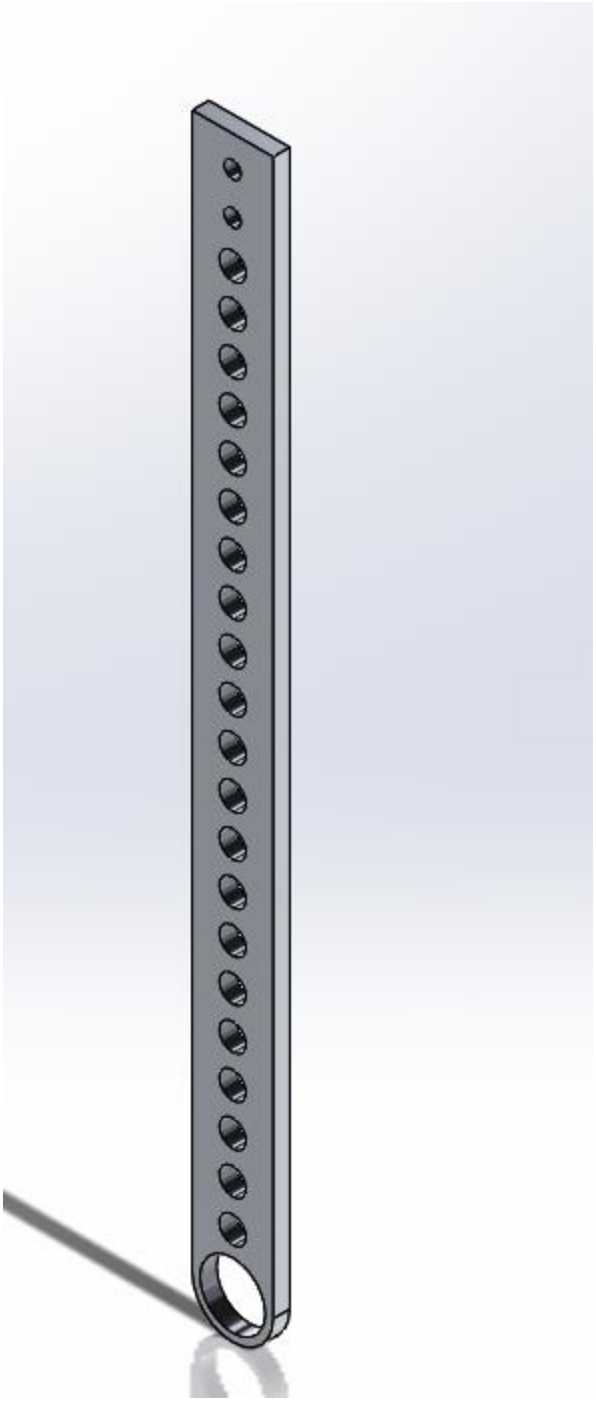


FIGURE 18: ISOMETRIC VIEW STEEL

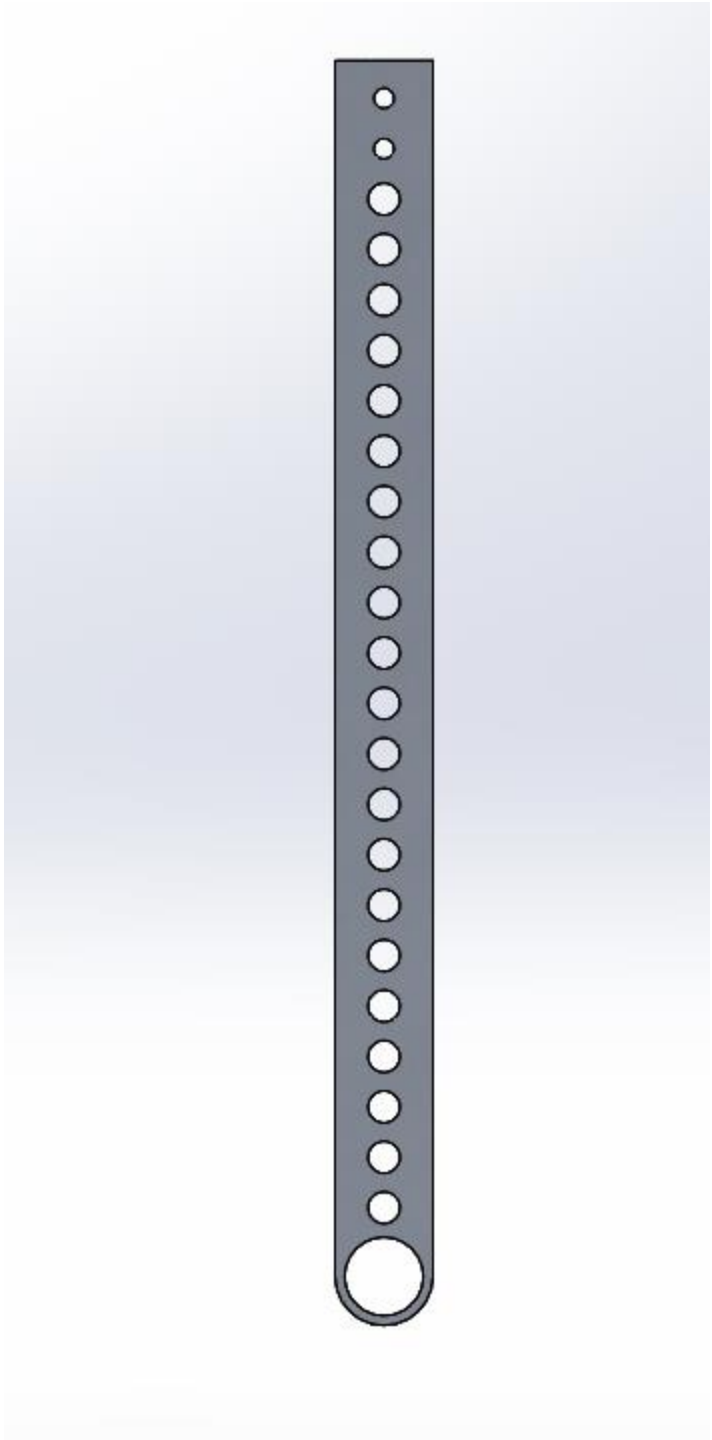


FIGURE 19: FRONT VIEW STEEL

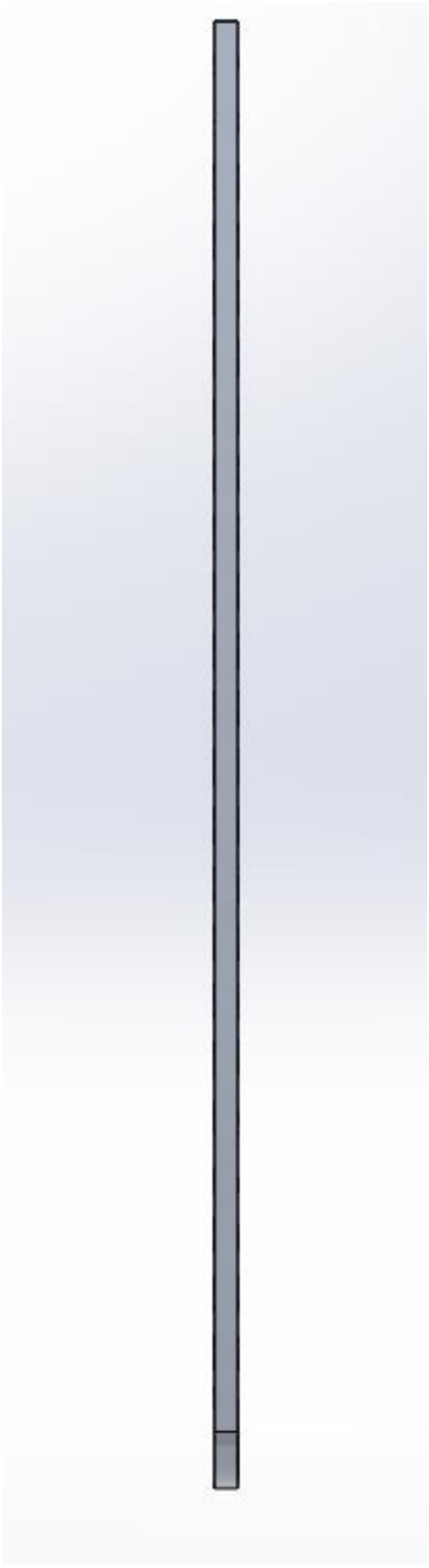


FIGURE 20: RIGHT VIEW STEEL

FIGURE 21: TOP VIEW STEEL

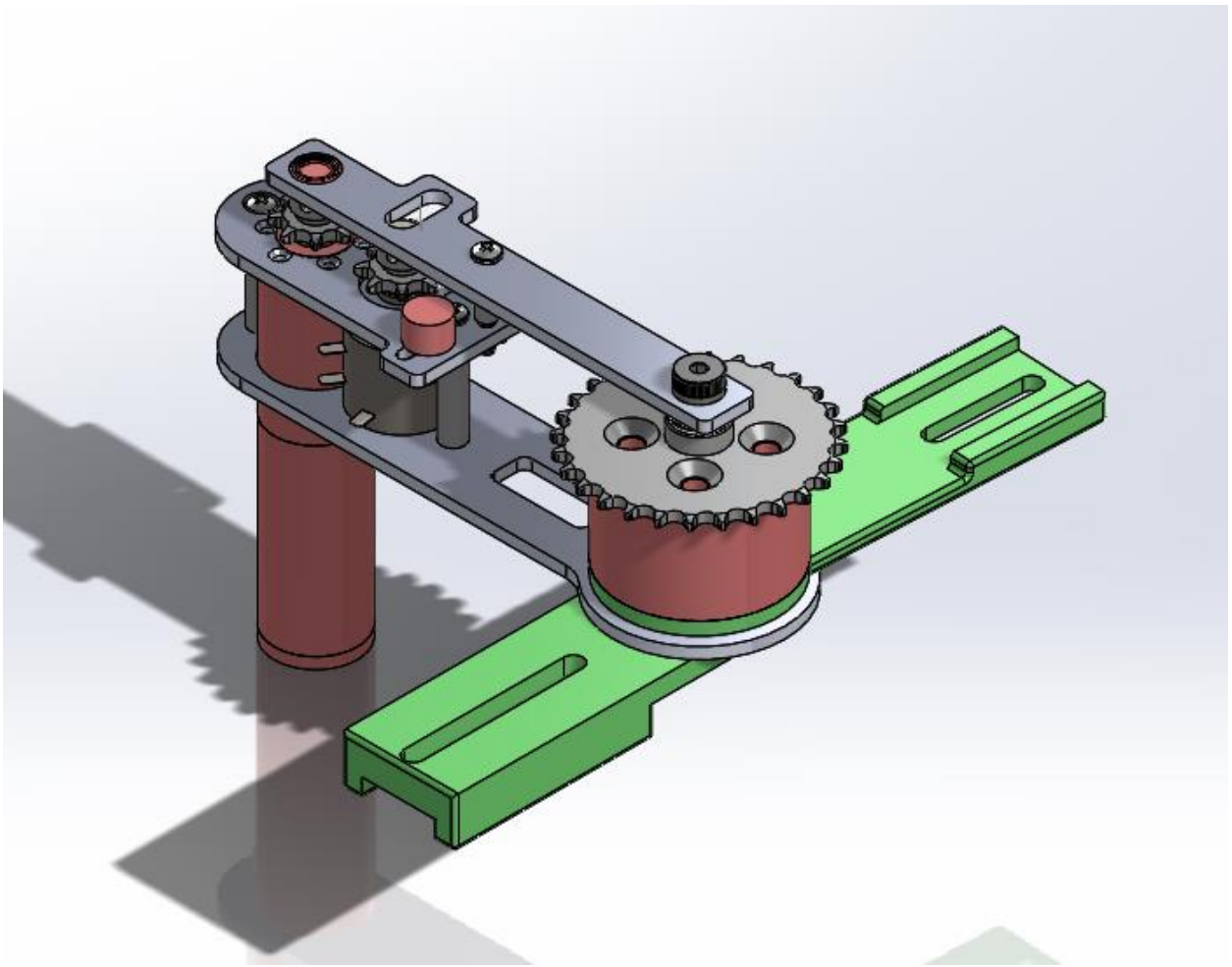


FIGURE 22: ISOMETRIC MOTOR

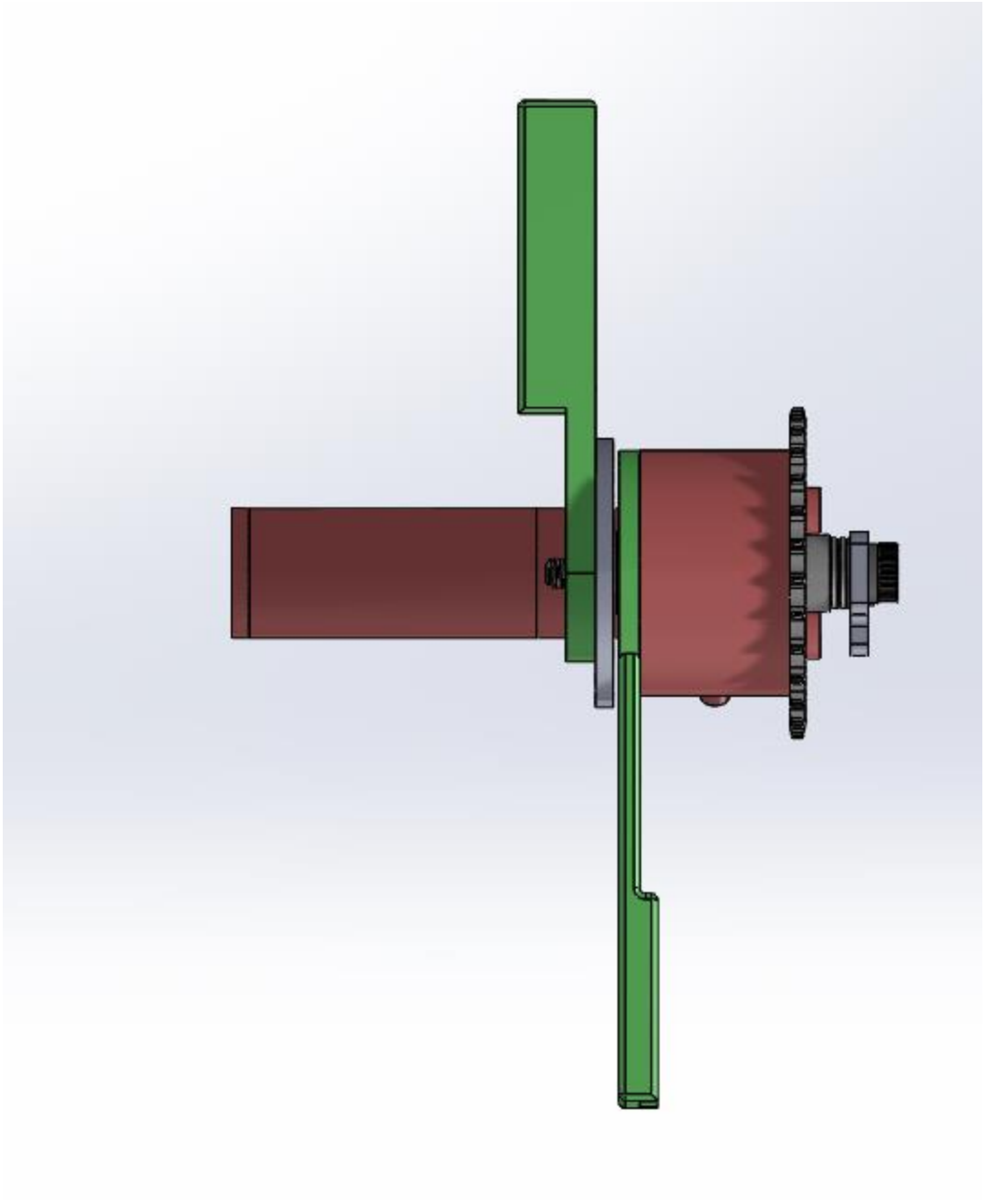


FIGURE 23: FRONT MOTOR

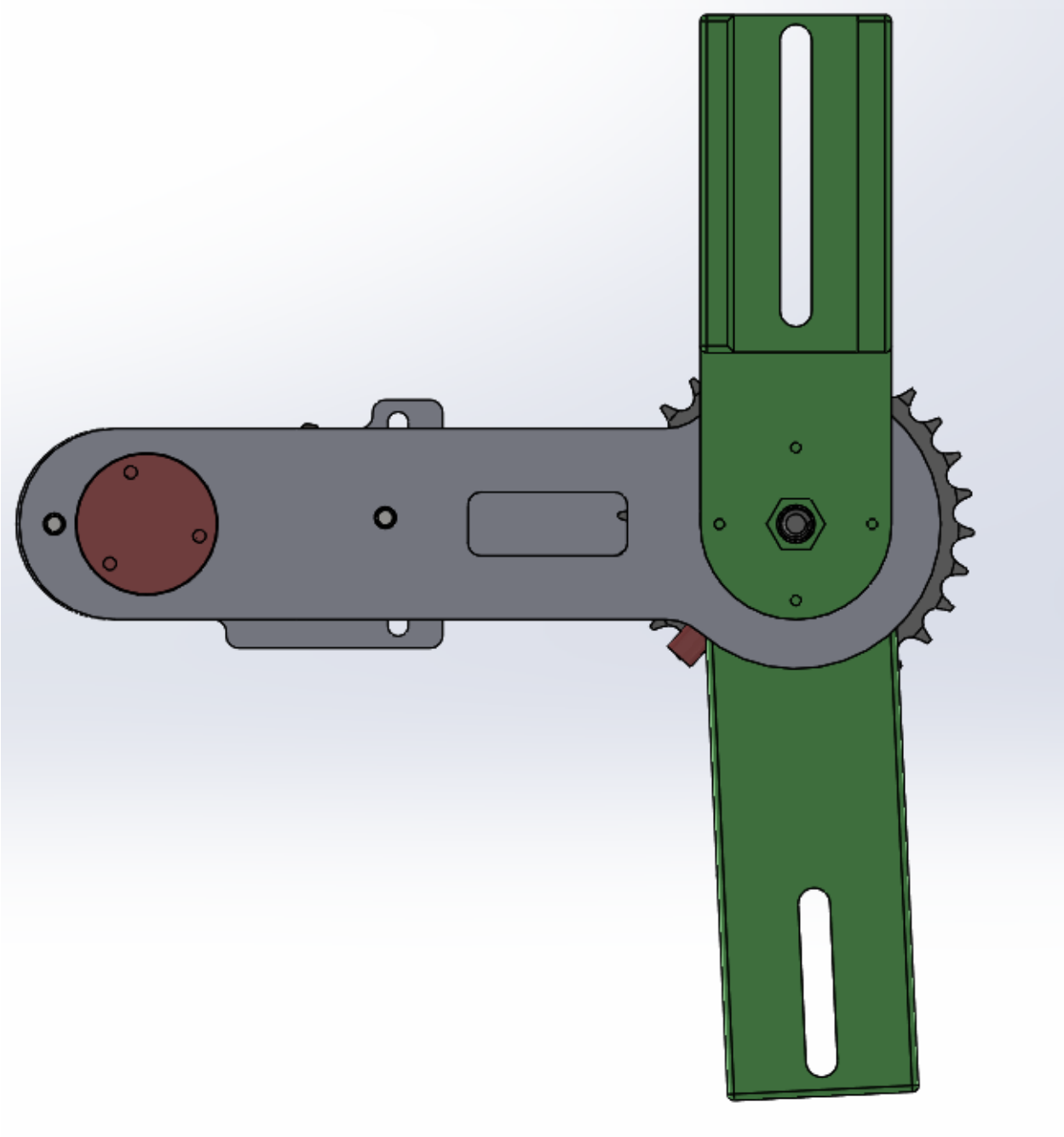


FIGURE 24: RIGHT MOTOR

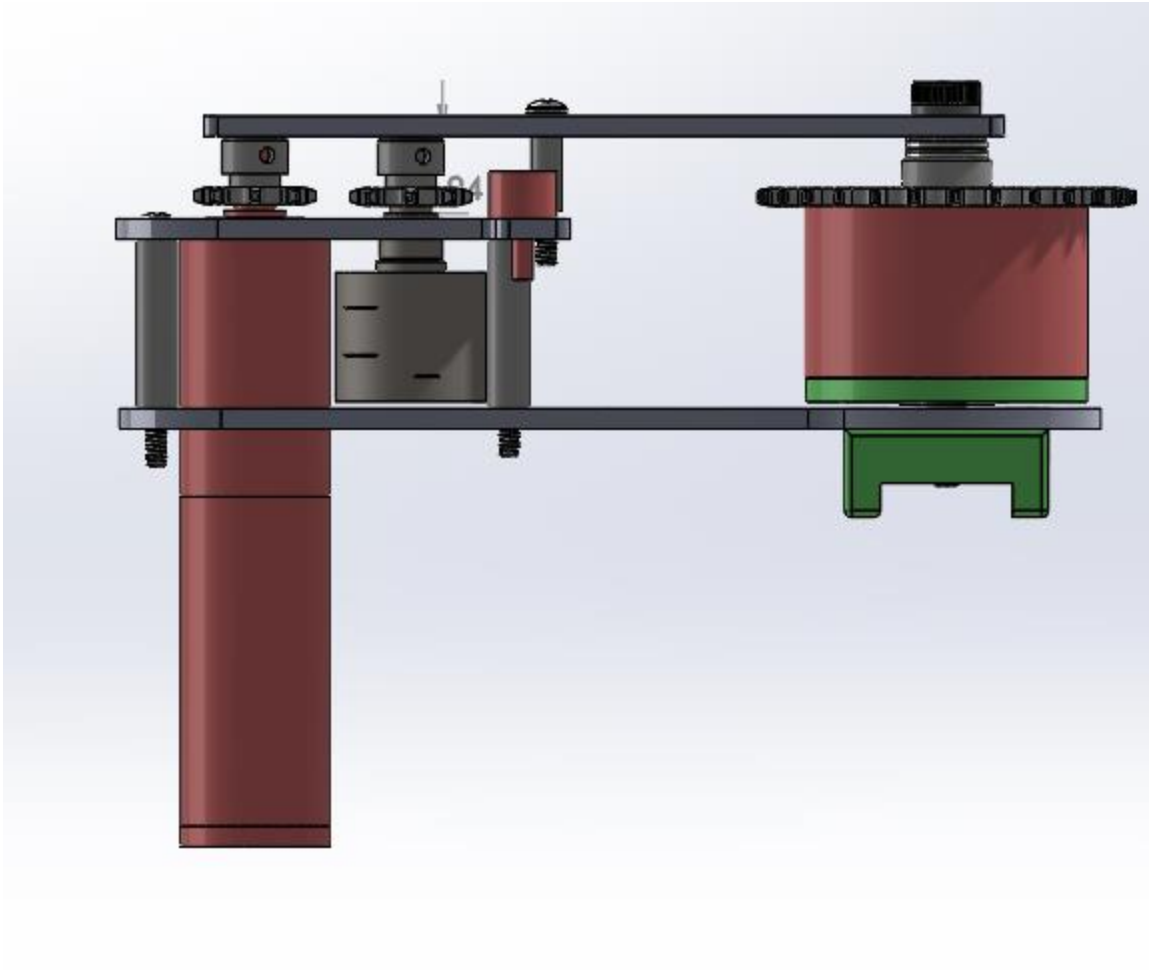


FIGURE 25: TOP VIEW MOTOR