

ME 102B – Fall 2020

Final Project

The Package Pick-Up Mechanism (subsystem of delivery drone)

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Description of the product:

From a decade ago, people can easily purchase the drones in online stores and many tech-companies started to utilize and develop the function of the drone. Uber is researching food delivery drone and Amazon is researching package delivery drone. However, it is not commercialized yet and still has some problems with this method. I focused on the other point. Recently, we order the package more frequently than before there is Covid-19. In my case, I tried not to go outside and go shopping, so I usually ordered consumable supplies from Amazon (For example, shampoo, toothpaste, etc). Few months later, a lot of boxes and plastic bags were in my place and it is hard to reuse it. The reason that we need to use box is for making other people cannot check the contents inside of the box and protecting the contents. If the contents can be delivered in secured way without the box, that would be the best. So, I designed the package pick-up mechanism, subsystem of the delivery drone. Basically, for not wasting boxes, I was considering the box which has openable bottom plate, so the drone can drop the contents only at the destination. But in this project, I designed only pick-up mechanism.



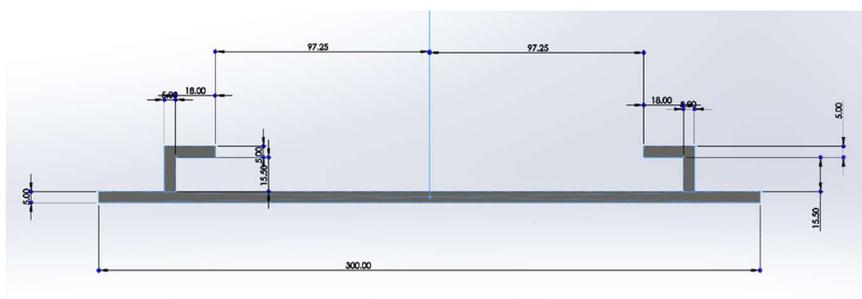
(Figure 1: Wasted boxes)

With this delivery drone system, delivery consists of some other utilities and steps. The reason that I designed this system was that I did not want to waste boxes. Even though the box can be opened and drop the package, people does not want to get the package outside. So, if we use this system, I think there should be the automatic opening window system as well. When the window is opened, the drone will drop the package on the opened window. For absorbing damage on package, using package slide or put some sponge underneath the window is also good idea.

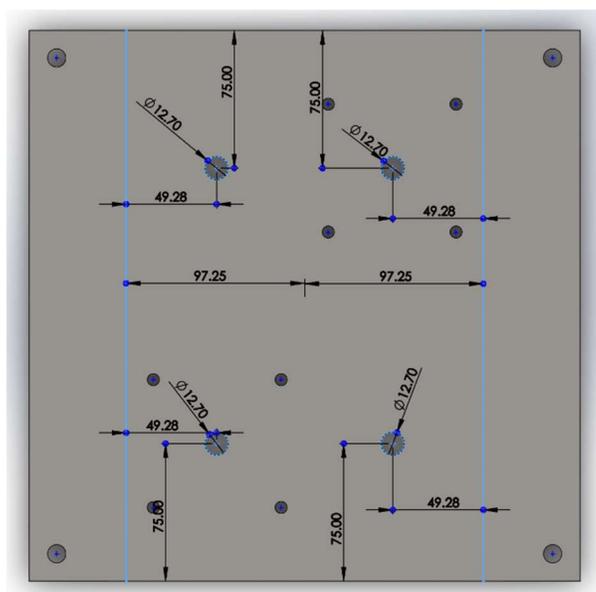
Complete list of parts:

- 4 Metal Gears with 1/2" hole
- 8 Cap Screw for Motor
- 2 Drive Shafts for Gears
- 4 Spacers
- 4 Gear Racks (150cm each)
- 2 Position-Control DC Motor
- 4 Cap Screws for housing
- 2 Self-Designed Housing

Engineering drawings and key dimensions:



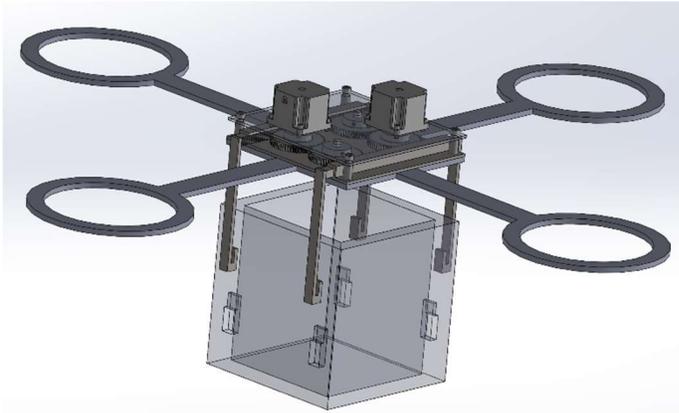
(Figure 2: Housing 1 key dimensions)



(Figure 3: Housing 2 key dimensions)

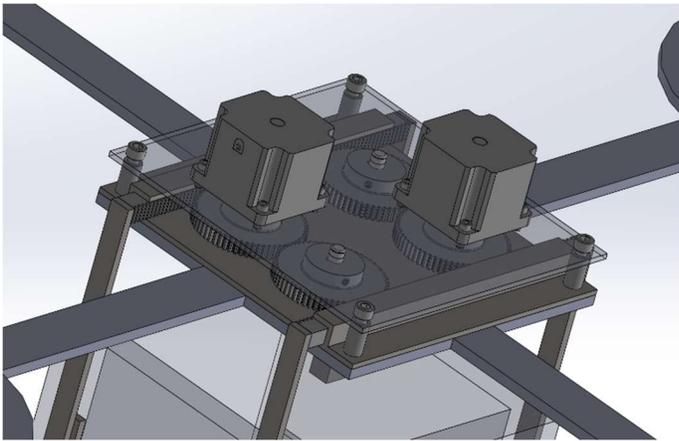
All base dimensions of the plates are set by 30cm by 30cm, it is because I set the box size as 30cm by 30cm. On the Housing 1, I made the path to hold gear rack as metal, so the gripper link can withstand the box weight. Gear rack path is designed a little bit higher than the size of the gear rack for moving of the rack.

Four thread holes around the base plate are M10 thread hole. M10 thread holes are designed for holding two housings in same location so it will not be wobbling. Also, four 1/2" holes in the middle of the Housing 2 will hold the motor shafts and driver shafts. Those will help to hold the positions of motor shafts and driver shafts.



(Figure 4: Overview of Assembly)

The package box is designed with four holes for gripper. When the drone attaches the gripper to the box, gear motor is on and make the distance wider between grippers. After the drone touches the box, gripper make the distance narrower between grippers. When the drone is lifted, gripper is perfectly attached to the box.

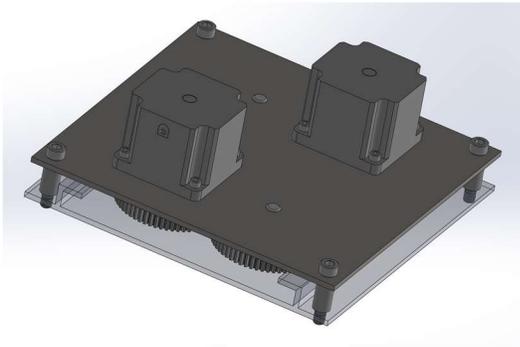


(Figure 5: Gear Box Overview)

Gear ratio is designed as 1:1, so the grippers on the same direction can move same distance from the body. Position-control DC motors can control precise location of gripper and grab the box.

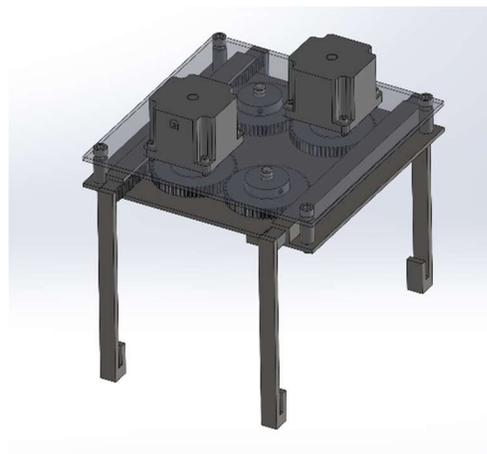
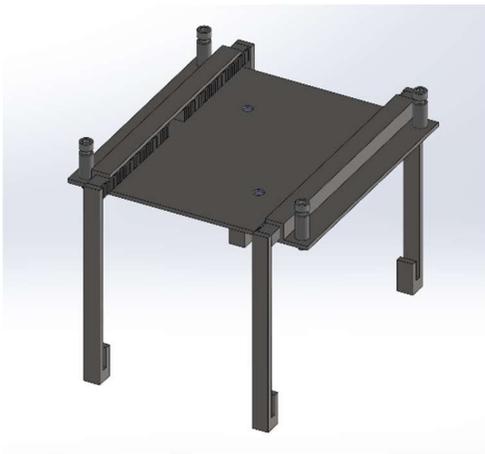
Other controllers can be mounted next to the motors with another housing. Batteries can be mounted together as well, or it can be mounted on the drone propeller shaft.

Other specific dimensions are listed on the appendix A as well.

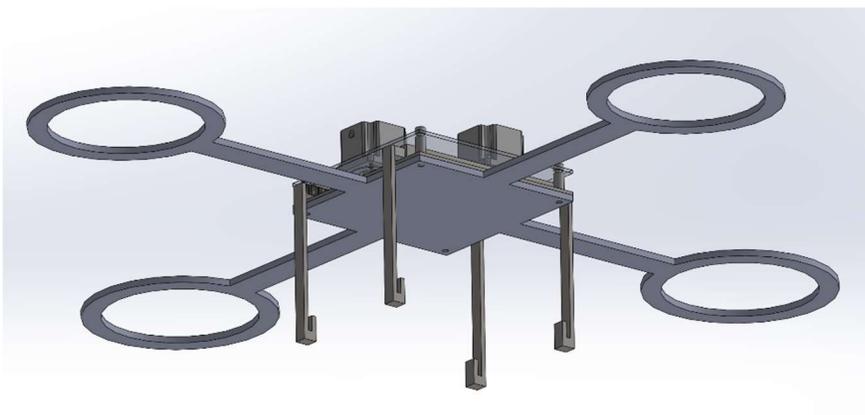
Descriptions of Fabrication and Assembly Processes:

Step 1: On housing 2, fix the motors with set screws and put together with gears.

Insert the drive shaft and put together with gears as well.



Step 2: Gear rack and gripper are connected and molded at the same time. Locate the gear rack and gripper on the path. Put the spacer on set screws and stack together with step 1.



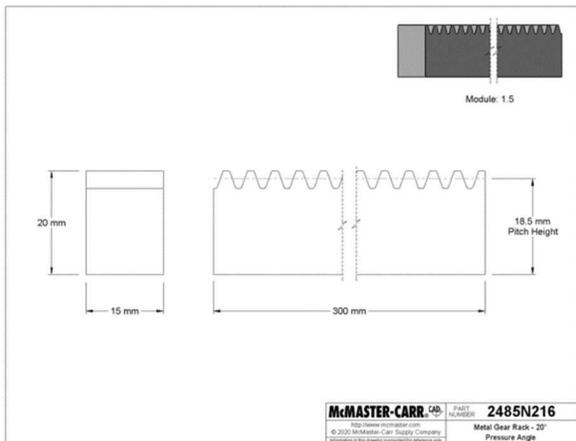
Step 3: Attach on the drone.

Sample animation is on my YouTube: https://youtu.be/0_KqCtH7nMo

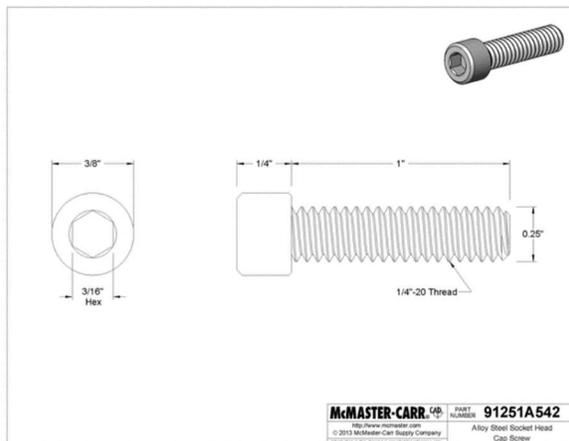
Appendix A

- List of Parts

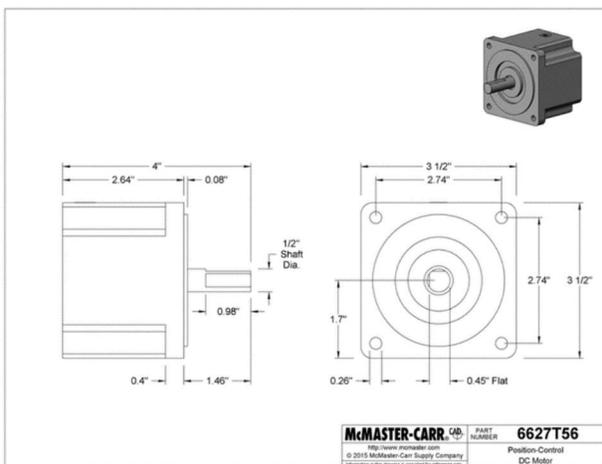
Gear Rack (4 pieces) It was cut in a half.



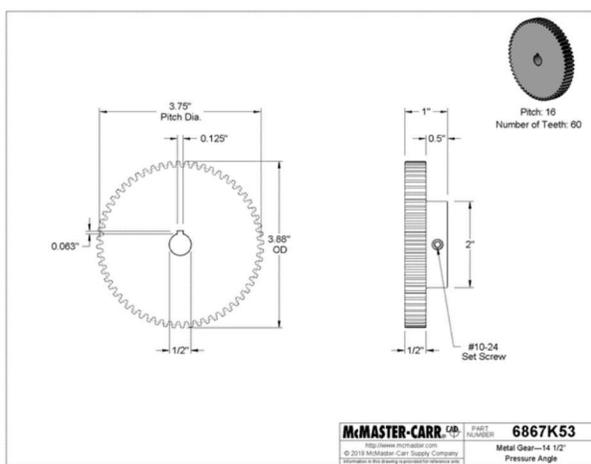
Cap Screw for motor (8 pieces)



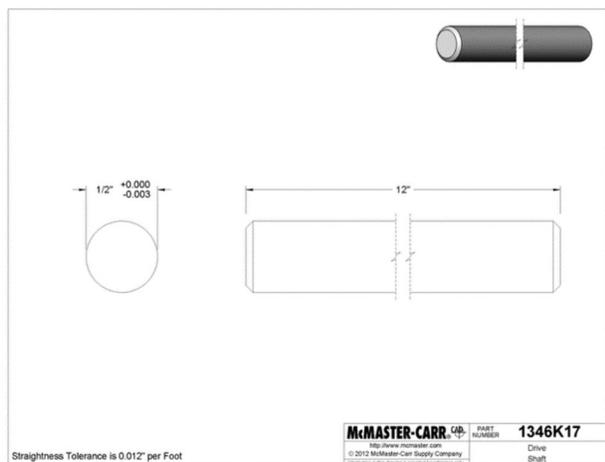
Position-Control DC Motor (2 pieces)



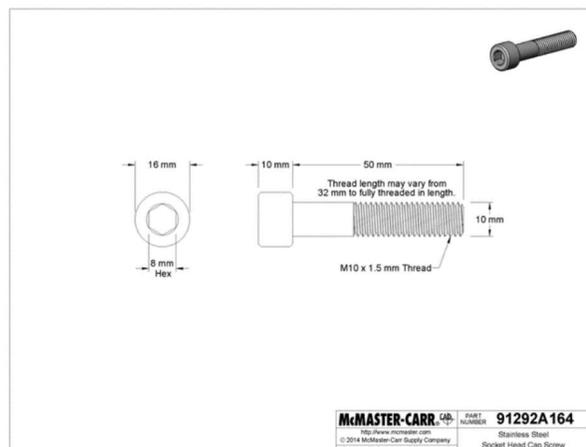
Metal Gear (4 pieces)



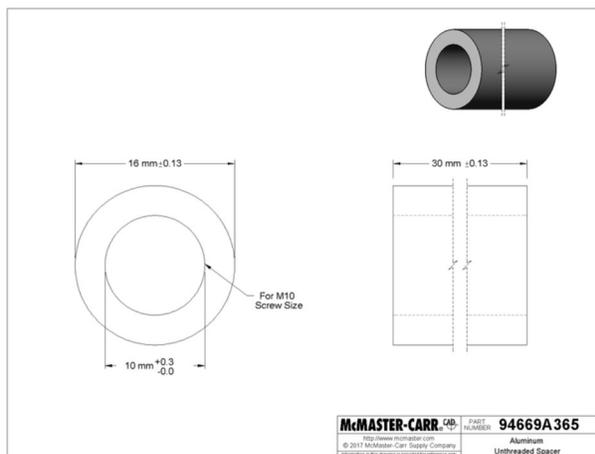
Drive Shaft (2 pieces)



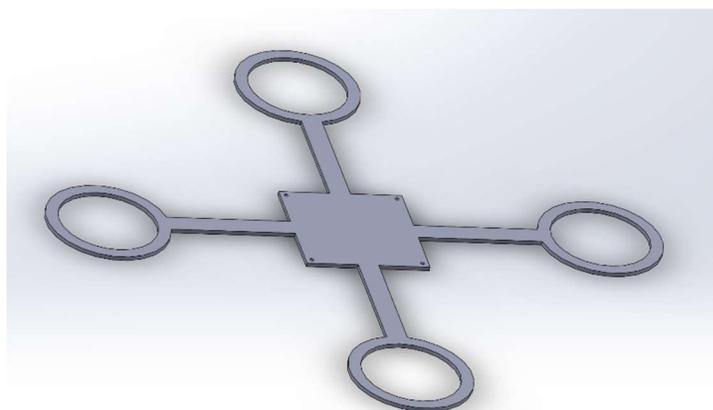
Cap Screw for housing (4 pieces)



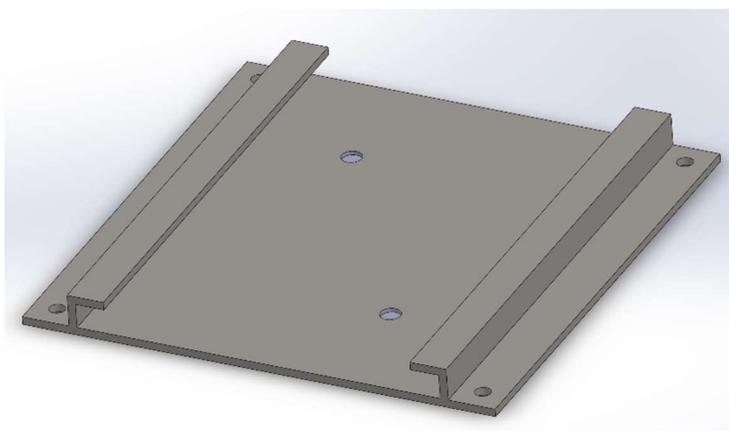
Spacer (4 pieces)



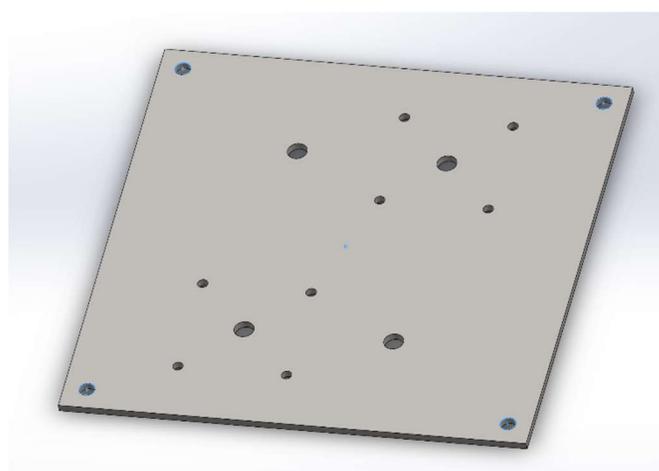
Simple reference drone (1 piece)



Housing 1 (1 piece)



Housing 2 (1 piece)



Appendix B

- *Sample Hand drawings*

