Project Deliverable D

Detailed Design, Prototype 1, BOM, Peer Feedback and Team Dynamics

Submitted by

Group Z13

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1. Introduction

We have determined the basic concept of our product and collected feedback from the client during our second meeting. Now, we will create our bill of materials, and begin building and testing our first prototype.

2. Updated concept

2.1. Physical prototype

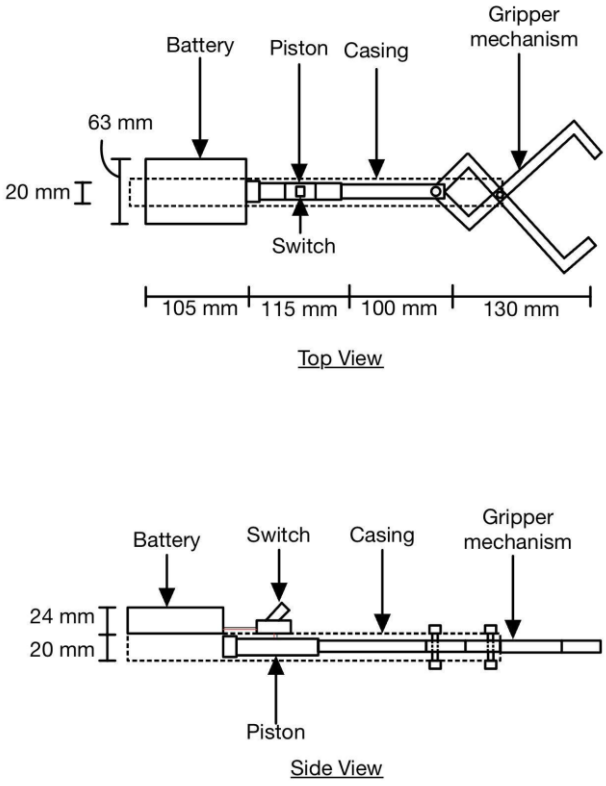


Figure 1. Sketch of our first prototype

3. Bill of materials for initial prototype

Table 1: Bill of materials

Item number	Part name	Description	Quantity	Unit cost	Extended cost
1	5 x ⅝'' mending plate	5 x ⅝ '' zinc mending plate	2	2.89	5.78
2	4 x ⅝'' mending plate	4 x ⅝ '' zinc mending plate	2	1.89	3.78
3	½ x ⅝ '' mending plate	½ x 5/8'' zinc mending plate	2	1.29	2.58
4	6 x ¾ '' mending plate	6 x ¾ '' zinc mending plate	2	3.69	7.38
5	Bolts and nuts	M6 x 20 metric bolts and nuts	2	2.99	5.98
6	Bolts and nuts	M6 x 35 metric bolts and nuts	1	2.99	2.99
7	Micro Linear Actuator	Stroke: 30mm Load rating: 20.3 lb Voltage:12V Weight: 70g Size: 17.7X14.6X3.6cm	1	38.55	38.55
8	Motor toggle switch	Voltage: 12V Size: 59X32.7X19.5mm	1	19.98	19.98
9	12V Battery	12V Battery	1	48	48

4. Critical product assumptions

a. Gripper design can hold items of various sizes
b. Gripper mechanism works and spring brings back in open position
c. Pull back distance needed for open/close position
d. Gripper should be easy to carry and hold
e. Weight of the mechanism (293 g)

5. First prototype and tests

First prototype:

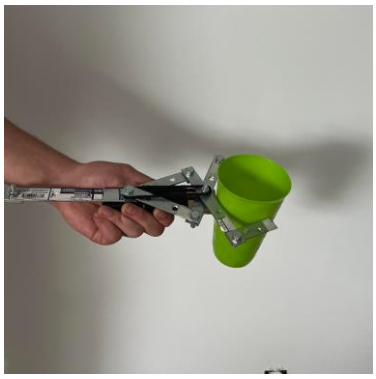
- The first prototype shows the proof of concept for the opening and closing of our grabbing end. The medium fidelity prototype consists of half of the final solution. In this design, the tongs can be closed when force is applied, and closed when the force stops.

Figure 2: The first medium fidelity prototype.

Tests:

- The tests we have conducted consisted of assessing the ability to hold objects with differing weights and sizes.

Gripper mechanism grabbing keys



Gripper mechanism grabbing cup

Gripper mechanism grabbing wallet

Gripper mechanism grabbing small plastic box

Figure 3: Proof that the gripper can hold various items

The prototype helped us determine the displacement needed for the mechanism which will help us in the selection of a piston.

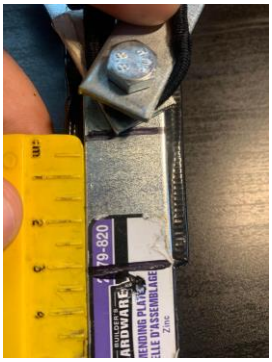


Figure 4: Displacement needed for mechanism

The gripper mechanism was weighed/measured and the chosen components had the weight/length written in the specs which helped us determine the approximate weight and length

of the final prototype. The following table represents the estimated weight/length of the different parts and of the prototype.

Table 2 - Estimated lengths and weights

Part	Weight (g)	Length (mm)
Gripper mechanism	293	230
Linear actuator	190	115
Battery	70	105
Switch	40	N/A
Total	593	450

The total estimated weight is about 0.6 kg and the total estimated length is about 450 mm which are both well under our target specification. These specifications also confirm that the gripper will be easy to hold.

6. Clients feedback

Clients agree with our idea on functional decomposition and concepts. However, we misunderstood the client's request. What the client wanted was a device to assist the user in pressing the gripper's switch that could be purchased on the market, rather than designing a new fully electric gripper. Additionally, the client re-emphasized the need for functionality that could be held, durable, and recommended us to make adjustments based on our current existing concept and prototype.

6.1 Updated design based on client feedback

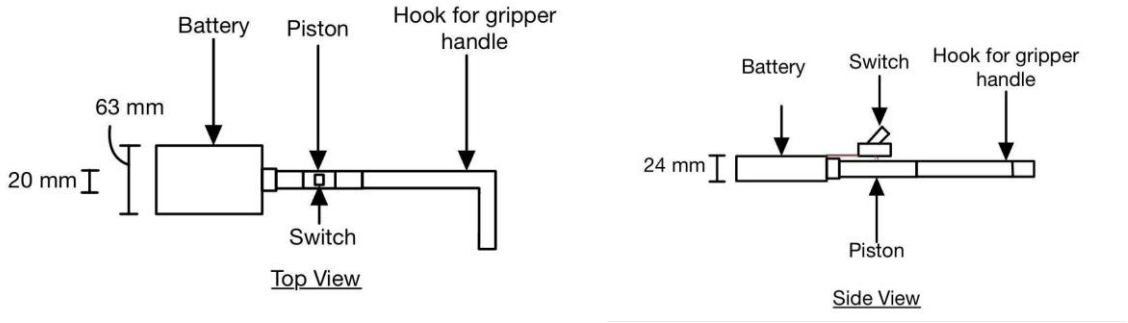


Figure 5: Sketch of updated concept

6.2 Updated bill of materials

The updated design will use the same materials as the initial prototype, but in a different format.

6.3 Updated prototype 1

Prototype 1:

- The updated prototype 1 consists of rearranging the mending plate to do a hook which will be able on different types of gripper. The medium fidelity prototype consists of half of the final solution. This hook will need to be pulled back with a linear actuator.

Figure 6:Medium fidelity prototype of the hook

Tests:

- The updated prototype will be tested to see if the hook fits on a standard gripper. Also, an estimated pullback distance for grippers will be determined with its weight. This will give an estimated size/weight of the gripper attachment.

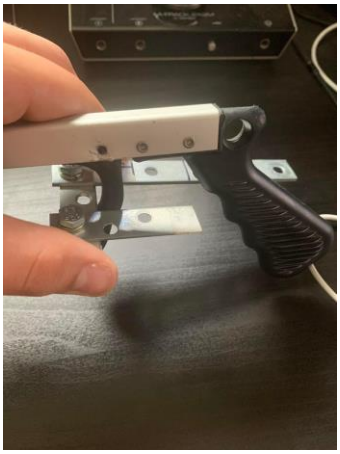


Figure 7:Test for the hook

Using the hook on a grabber, the estimated pull back distance needed for the mechanism was determined. To fit a bigger variety of grabbers, this distance will be multiplied with a factor of 1.2. The measured distance was about 2.5 cm, so our linear actuator will need a pull back distance of about 3 cm to fit most grippers.

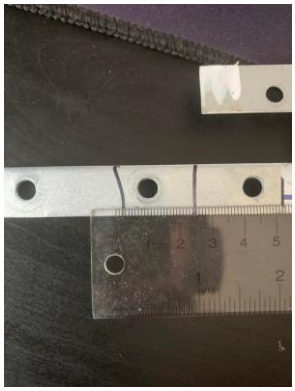


Figure 8: Pull back distance

The hook was weighed/measured and the chosen components had the weight/length written in the specs which helped us determine the approximate weight and length of the final prototype. The following table represents the estimated weight/length of the different parts and of the prototype.

Table 3 - Estimated lengths and weights of new prototype

Part	Weight (g)	Length (mm)
Hook	100	125
Linear actuator	190	115
Battery (on top of linear actuator)	70	N/A
Switch	40	N/A
Total	400	240

The total estimated weight is about 0.4 kg and the total estimated length is about 240 mm which are both well under our target specification. These specifications also confirm that the gripper will be easy to hold.

6.4 Another design idea

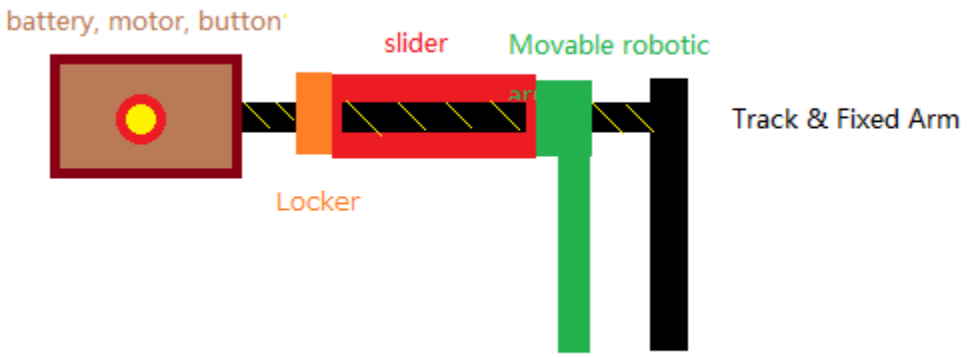


Figure 9 - Sketch of another concept

6.4 Description of Mechanism

The mechanism of this concept is to use the spiral track in the middle of the motor to move the slider up or down, and the slider will push the movable mechanical arm so that it can squeeze the switch of the gripper rod, which plays an auxiliary role. Also, the locker prevents the slider from being too backward to secure the gripper bar.

7. Next client's meeting

The next client meeting is the 17th of June. At the time of this client meeting, we will have created a new prototype and will reconvene with the client to make sure our modifications were appropriate. We will then go over again what we did to modify the original idea and how we implemented his specifications. Using his feedback, we will proceed with our idea, or apply additional modifications.

8. Conclusions and Recommendations for Future Work

During this deliverable, our team began organizing the design and prototyping of our physical product. We updated and refined our chosen concept to include an electrically-controlled piston rather than a cord and motor. We then created our bill of materials, listing the components we have bought and intend to buy to complete our final product. After creating a list of critical product assumptions, we created our first prototype and began testing it. The tests included using the prototype – a medium-fidelity grabber – to pick up and hold objects of various shapes and weights. Our future work will be centered around modifying our current concept to reflect the feedback we received from the client during our second meeting.

9. Bibliography

Switch

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Piston

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Battery

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Cables

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