Project Deliverable F

Prototype 2

Submitted by

Group Z13

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1. Introduction

The objective for this deliverable is to create and receive feedback for a second prototype. We have created an updated version of our first prototype following the client's feedback from our second meeting. In short, our second iteration has removed the grabbing element and instead, a 3D printed hook attached onto a linear actuator pushes the grabber's trigger. This modification ensured our product lines up with the clients vision. The next step will now be to test out our current prototype and present the results to the client in the third client meeting. Following this, we will take his feedback and apply it to our nex prototype.

2. Critical assumptions

2.1. Acceptable values

- Grabber will be able to hold items of 1 kg.
- Weight of the handle needs to stay below 3 kg.
- Mechanism works adequately as planned
- Mechanism is strong enough to push the trigger mechanism of the gripper

2.2. Availability of material

One of the critical assumptions related to the availability of material is that the components will all arrive in time with no postage delays.

2.3. Critical functionality

One of the critical functionality assumptions is that the velcro straps will be strong enough to prevent the battery and linear actuator from sliding freely on the shaft of the handle.

3. Second prototype

3.1. Updated concept design

The updated design uses the same main components but are arranged in a different configuration. The battery and the linear actuator are mounted in front of the handle with the help of velcro straps and the linear actuator will push the handle when extending. The switch will be movable to accommodate the different users. A wrist strap will also be attached on the shaft to help the users hold the gripper.

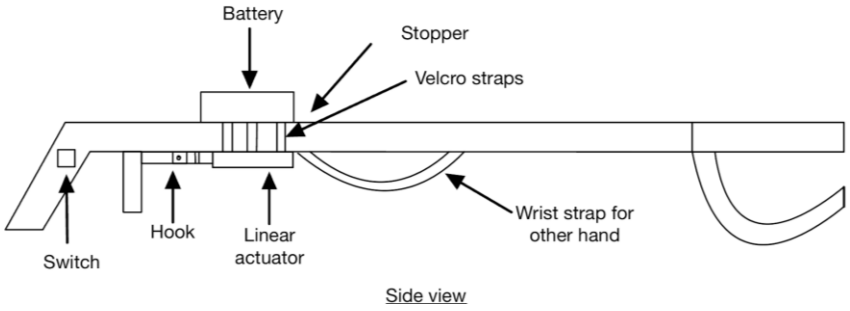

Figure 1 - Power grabber attachment mounted on gripper

The hook will be designed in a CAD software and 3D printed and made of plastic to reduce its weight. The hook will be designed to fit the majority of grippers. The figure below shows the shape the hook will have.

Figure 2 - 3D printed hook

The wiring diagram will help us when we connect the linear actuator to the switch and battery. The following figure shows the wiring.

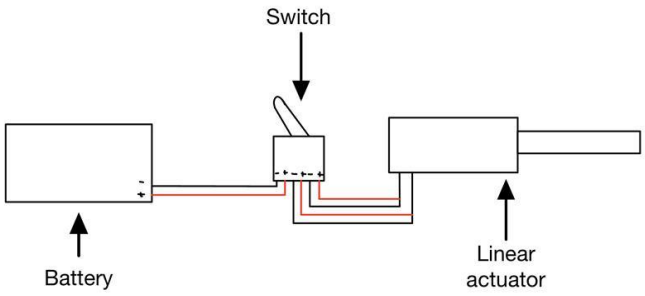

Figure 3 - Wiring diagram

3.2. Physical prototype

The physical prototype is a focused physical prototype and consists of the mechanism that will be used to press the trigger. Also, the hook has been designed to fit on the linear actuator.

3.3. Testing of prototype and results

The goal of the testing stage is to demonstrate a proof of concept and test out critical functions. Also, the critical assumptions will be tested to make sure that they are valid.

- Test 1: Is it stable when installed on an existing grabber?
    - Even though the battery was the smallest one available on the market at an affordable price, it is still big and heavy and it will be hard to mount it on the gripper with velcro. It holds but isn't stable

Figure 4 - Test 1: Stability

- The linear actuator is very light and is stable when installed with velcro

Figure 5 - Actuator stability with velcro

- The switch was stable when it was zip tied on top of the handle.

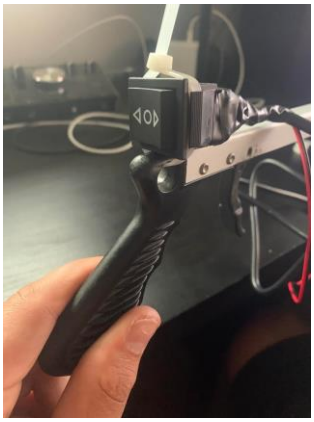

Figure 6 - Switch stability

- Test 2: Can it be installed on different grippers? (i.e different shape of triggers)
    - The trigger of the original gripper that was chosen obstructs the movement of the linear actuator when in closed position.

Figure 7- Versatility of installation

- Test 3: Are the controls easy to operate?
    - Yes, the controls are easy to operate. With the press of the button the linear actuator starts extending and when it is released the linear actuator stops moving. The same process happens when the linear actuator needs to be retracted.

Figure 8 - Ease of control operation

- Test 4: Does the mechanism work well?
    - Does the linear actuator work with the switch and battery?
        - Yes, the linear actuator works with the switch and battery.

Figure 9 - Mechanism efficiency

- Does the hook fit on the linear actuator and is it able to press the trigger?
    - The hook fits on the linear actuator but we will need to wait for our other gripper to arrive to make sure it is able to press on the gripper handle.

Figure 10 - Interlocking of pieces

- Can the grabber still grab things?
    - Before this test can be performed, the new gripper will need to arrive since the trigger is in the way of the linear actuator when changing in a closed position.

- Test 5: Is the length and weight in our target specifications?
    - The total weight of the mechanism is about 310g and the total length of the mechanism is about 28 cm, which is below our target specification.

Figure 11 - Weight and length restrictions

In conclusion, the test that was performed validated our wiring diagram and that the linear actuator works as intended with the switch and battery. Also, the length and the weight

were in our target specification. The next steps are to get the new gripper and make sure our mounting methods work while the actuator is activated.

3.4. Expected vs actual specifications

Table 1: Target vs actual specification

#	Metric	Units	Target values	Actual values
1	Length of handle	m	< 0.508	0.28
2	Weight of handle	kg	< 3	0.3092
3	Maximum load of the grabber	kg	> 1	N/A
4	Gripper as a percentage of the entire handle	%	< 20	20
5	Trigger angle to horizontal part	degree	> 30	0
6	Force needed to press the trigger	N	< 90	N/A
7	Budget	CAD	< 100	120
8	Size of wrist strap	m	< 0.3	N/A

The maximum load of the grabber and the force needed to press the trigger will be determined in our next tests on the following prototype since the trigger tests could not be performed because a different gripper will be used. The wrist strap has not been designed yet and will be determined in the following prototype. The rest of the specifications meet our target values except for the budget which was a little bit over our targeted value.

4. Feedback from client meeting 3

The customer approved of our new design. Our new idea is to use the linear actuator to push the trigger of the gripper, so that the gripper can sufficiently grasp the item to meet the customer's needs. On the other hand, our next step is to figure out how to control the amount of force output from the actuator so that our product doesn't damage the targeted object by applying too much force. In addition, the customer emphasized that we needed a way to hold the battery in place and balance the weight of the entire handle.

Finally, since there are different types of trigger for grippers, the horizontal force that the linear actuator provides sometimes cannot push the gripper effectively. So, the TA suggested angling the actuator downward to make sure it pushes the trigger as needed.

5. Conclusions and Recommendations for Future Work

In summary, this deliverable tasked us to update our initial prototype using the client’s feedback from the second meeting. After making the modifications, we began testing our focused physical prototype to make sure that our parts worked well together. Unfortunately, we encountered problems regarding the mounting of our device onto a gripper, and as such we were forced to purchase a different gripper. Next, we presented our build to the client during the third client meeting. He was impressed with the simplicity and reliability of our design but had a few concerns regarding the mounting of the battery. For future work, we will fix our components on a different gripper and attempt to solve our mounting problems. In addition, we will further test its capabilities by seeing how well it can grab objects of different weights and sizes.