GNG 2101

University of Ottawa: Faculty of Engineering

Project Deliverable F: Prototype II

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Group Z-22

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Table of Contents

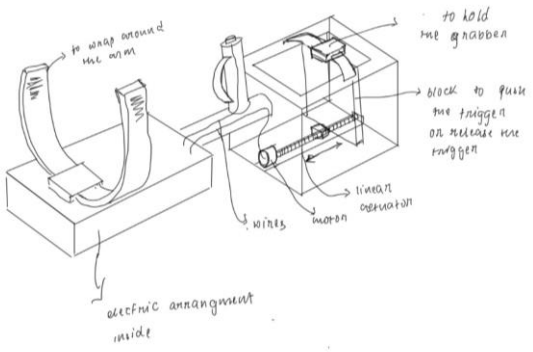
Introduction

The objective of this deliverable was to obtain feedback from the client proceeding the client meet 3 presentation and incorporate his feedback into our future designs. This deliverable has a summary of the feedback provided by the client which includes improvements and the aspects he liked. This deliverable also contains prototype II and its subsequent tests that come along with the prototype, which also discussed the improvements and flaws of prototype II and areas of improvement based on the metrics that were previously made. The team also updated the most critical assumptions to match the progress of the prototypes and the feedback received on them. Moreover, the team has provided the next steps they will take to improve for prototype III which will include updates, changes to design and incorporating the client feedback obtained in the most recent client meeting.

Summary of Client Meeting

Our client liked our design for the most part. Because of the linear actuator, he enjoyed how straightforward the design was to use. He likes how the forearm helps to support the design. He advised that an easy hold (strap) should be added to the handle near the button to make it more stable in the hand. He mentioned that most people use the grabber at about 45 degrees down and that the box that would hold the grabber should be able to vary its angle position. He introduced the use of a ball-and-socket joint to alter the angle. He was concerned about the linear actuator because it requires 12v and 12v rechargeable batteries are tough to come by. He gave us websites that would assist us to get the items on our bill of materials. He discussed the linear actuator's location, whether it would be at the bottom of the box or on the sides. In general, our client is pleased with our design, particularly the price and material.

Updated sketch



Critical Product Assumption

It is assumed that the handle is lightweight, safe and will allow the user to use grabbers without needing any grip strength. The grabber is required to be ergonomic and comfortable to use while allowing the user a sufficient range of motion to use the grabber at various angles. It is assumed that users of the handle have limited grip strength and limited finger dexterity. The handle must accommodate the users. In the group's case, the handle is designed for someone with arthrogryposis. However, the handle will ideally be usable for people with below-average dexterity and strength in general.

Furthermore, the group is assuming that the grabber will be functional with the handle. This means that not all grabbers available on the market will work with the group's handle. Specifically, only grabbers whose handles have a simple triangle-like handle will work. Grabbers which have a C-shaped handle are not compatible with the group's design at this stage. Also, the group assumes that the user will not need to use the grabber to lift up items heavier than a water bottle. This was confirmed by our client throughout our meetings. Lastly, the team has assumed that the user will be able to lift the grabber to pick up the object.

The table below shows some of the metric values our handle should have. Both the marginal and target values are shown. Keep in mind that the table only considers quantifiable needs.

Table 1: Target Specifications

Metric #	Metric	Unit	Marginal	Target
1	Weight of the Handle	Pounds	0.8	0.4
2	Grip Force	Newtons	4	2
3	Force applied to object	Pounds	1	3
4	Object Weight	Pounds	1	3
5	Battery Life	Hours	5	8
6	Cost	Canadian Dollars	150	100

Prototype II

The purpose of the development of prototype II was to begin creating code that would simulate the movement of the linear actuator that would be used in our final prototype. The creation of the code would be verry similar to the code of our linear actuator in the team's handle

grabber device, thus, the prototype would allow the team to test the code and verify that it would be feasible to use for the linear actuator. The function of the prototype is to use a microcontroller, bread board, button and a small stepper motor to test our code using a similar device that will be used in our final product. The code will be sent to the Arduino to make sure the mechanical functions correctly work with the code. The function that the stepper motor should do is to be user controlled. The motor is initially not moving, then when the user presses the button, the motor begins turning. When pressed again the motor begins turning, with the next user input the motor would stop. When pressed again the motor turns in the reverse direction, then when the user presses the button, it stops. The cycle repeats and is based on the user inputs.

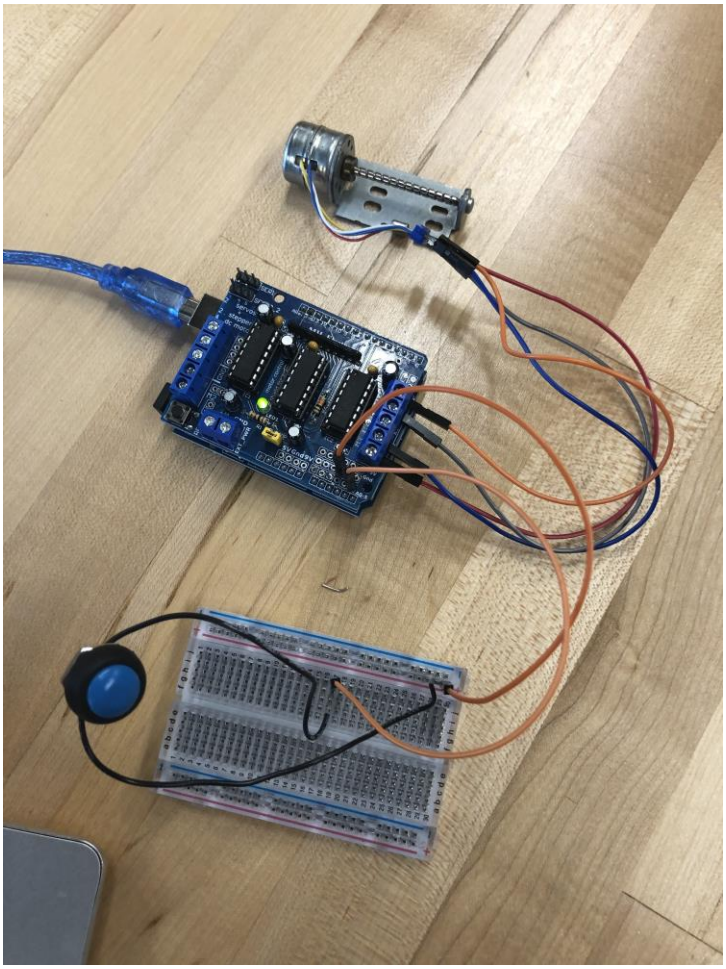


Figure 1: Circuit setup

Figure 2: Stepper Motor

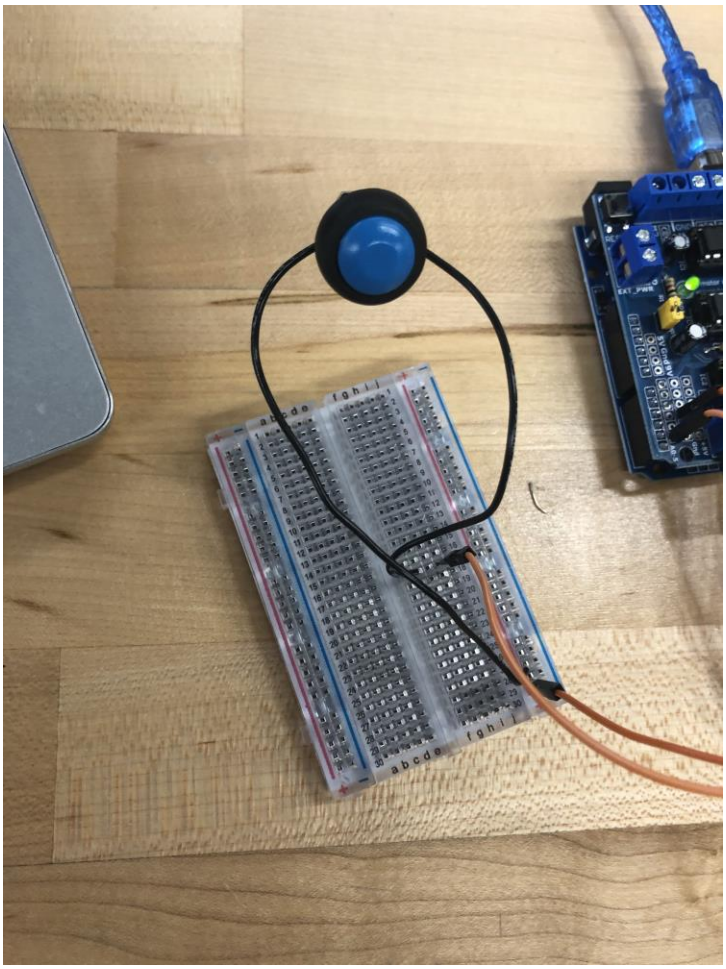


Figure 3: Bread board and button

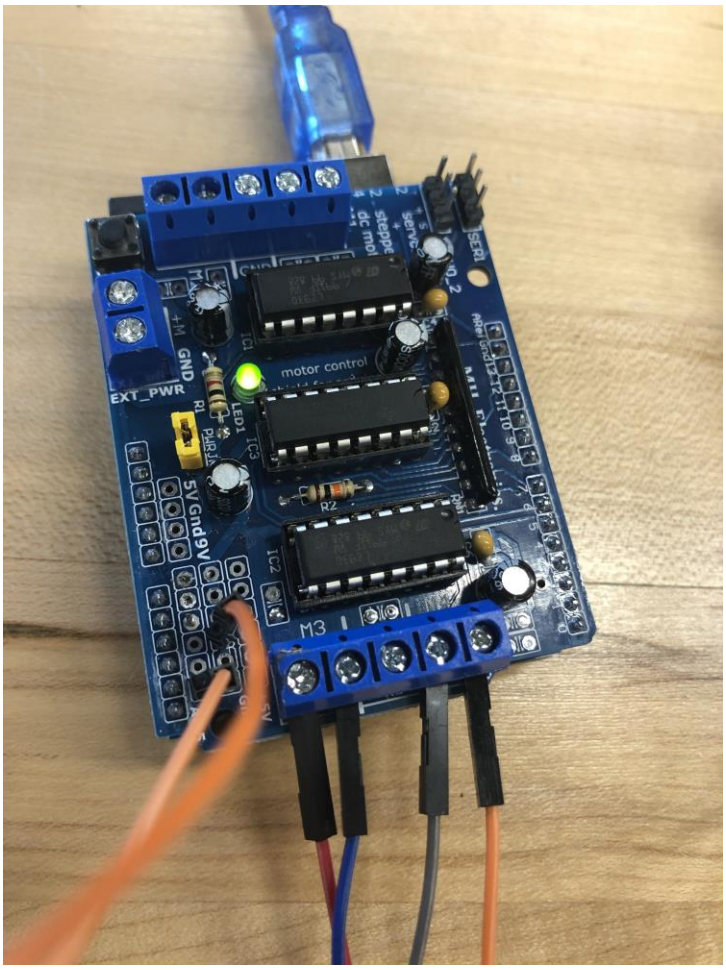


Figure 4: Arduino Uno and Motor Shield

Testing

The testing using the microcontroller and stepper motor prototype was to test the mock code that is similar to the code that will be used in the final product. The test was performed to observe the function that is desired in the final product. This was a qualitative test, so a metrics table is not able to be constructed, however the test was successful for what the team was attempting to achieve. The test was to make the motor rotate in one direction then stop, then rotate in the reverse direction, then stop again all processes based on the user's input; the press of the button. After evaluating the results, it was concluded that the test was successful, however there are minor flaws that will need to be corrected in the next prototype, such that if the user holds the button, it will skip a step of the process. For instance, the sequence will go from rotating in one direction then rotating in the reverse if the user were to hold the button for too long. This skips the step where the motor is stopped, this can be fixed by altering the code. The next step for the third prototype is to implement this system for a linear actuator and update the code accordingly to fix the software errors.

Wrike

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=Olzzoz5AFTbjmnTetrBCmh85kpZ7QTox%7CIE2DSNZVHA2DELSTGIYA

Conclusion

To conclude, following the creation of prototype II as well as client meeting 3, the team is happy with the state and progress of the project so far. The client was happy with our progress and the new designs that the team produced, the feedback he provided has been implemented into some new designs that the team has developed. The main concern with the feedback was the addition of a wrist adjustment to tilt the grabber in the vertical plane while keeping the forearm and wrist of the user straight, the team will develop the idea and test its feasibility in the given time constraint for the next prototype. However, the client had few changes for the design of our current prototype. The team's most recent prototype was successful for its purpose, the team was able to establish a mock code that is very similar to the final code that will be used. The stepper motor was able to perform the desired function with few faults. The team's next steps are to further develop the function of the grabber handle with the linear actuator and make the design of the grabber with proper supports.