Engineering Design - GNG1103C

Deliverable E

Project Plan and Cost Estimate

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Lab C01 Group 5

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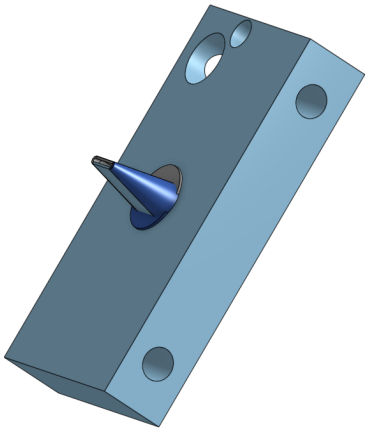
Problem Statement

Design a 3D printed mechanical arm with three degrees of movement that can perform manual tasks to a navy ship's hull, while only being operated by one person.

Introduction

Deliverable E is the project Plan and cost estimate for semester long design project in GNG1103. Our goal, as stated in our problem statement, is to design a robotic arm. In this deliverable we will record what kind of equipment we will need to create and design this product. We will also create a statement of what costs we will need to account for when designing and prototyping the arm and end effector. The **BUDGET** that will be assigned for this task will be $50. We will then create a plan for how we will test our prototypes. Finally, we will brainstorm potential risks we may face during this project as well as what contingency plans we will perform if these risks do indeed occur.

Chosen Concept Design Drawing



Version 1 (By Igor K.)

CAD Drawing

https://cad.onshape.com/documents/d57fc1b6c8e8c3cf6cec49c8/w/9d344798e8409a1a4e884ce5/e/e2c392cb6e6b1f9935d72b26

Project Cost Plan

Item Name	Description	Quantity	Cost
ESP32 micro-controller with 2mp camera	as description	1	$11.99 (No shipping cost)
PLA Plastic	For 3D printing	unknown	$0
Water Pump	USB connection	1	$14.98
Tubing	water tubing approx. ½' diameter	2'	$3.23
Wire	For circuits and power delivery (not including pump) (pump has a usb cable included)	100ft, 100ft not necessary but couldn't find smaller amounts that weren't sets	$13.53
Labor	The people incharge of making this project a reality.	4	$0

white = ready or low priority

red = priority for ordering

Equipment List

The main equipment that we will need for this project is an arduino or alternate module. For example, we will potentially go with the cheaper and smaller option of the ESP32 Micro-Controller. This controller requires soldering, but one of our group members has experience with this skill, and can perform this task properly. We will also need a 3D printer for printing prototypes of the arm and its end effector. The printer will preferably print PLA plastic. Finally, we will need a 3D design software to design our end effector. The program that we will most likely use due to this group's competency in it, will be OnShape.

Project Risk

A potential risk that we might face is the possibility of a prototype that fails. A failing prototype could be a prototype that collapses unexpectedly under added weight, or its own weight. Failed electronics could also lead to an unhelpful or failed prototype. Due to the need to have many conceptual designs and prototypes, it is likely that we will have to prepare for the potential risk of a failed prototype.

Contingency Plans

A simple way to reduce the risk if a prototype fails, is to not put a lot of resources into any one prototype in case of potential unforeseen problems that could arise. Each failed prototype should be studied to make sure that the same result does not occur again, when performing similar tasks and designing new prototypes.

Project Plan And Schedule

This table will list all the tasks each member of this team is responsible for and for what duration of time.

Tasks	**Duration**	**Responsibility**
1- 3D printing- Print out the parts that will be needed for us to complete our first prototype	February 24th , 2022 / February 25 2022 [For Prototype I]	**Andrew Edginton and Osaigbovo Ogbeide**
2- Using a Coding IDE for coding testing and code implementations	March 6th to March 13th [Prototype II]	**To be decided**
3- Assembling of the parts of the Robot	March 6th to March 13 [Prototype II]	**To be decided**
4-Assembling electronics	March 6th to March 13 [Prototype II]	**To be decided**
5- Making of an almost complete robot. (80% functioning)	March 6th to March 27 [Prototype III]	**To be decided**
6- Assembling water pump/tubing	March 6th to March 27 [Prototype III]	**To be decided**
7- Presentation of final design	March 30th [Design Day]	**Entire Team**

Prototyping Test Plan

The purpose of this table is to list out various testing plans and ways we are going to achieve them.

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1. **Making Predictions**	Before we start with building our prototype we will plan on the different outcomes This will allow us to see what our testing will accomplish Making predictions will ensure us to prepare adequately for any possible results we will get from testing.	Using application such as microsoft excel, word document and wrike are going to help us in this phase because we can use them to write down our prediction and also track down everything we have done so far	Word Document- This software will allow us to list out our thoughts and plan out various testing strategies. This will also be used to get results from our work and if our predictions were true or not. Excel- This application will allow us make quick calculations and list various cost, various quantitative aspect of our prototype	The start date of this process will be the first time we did the very first deliverable since that was the first time we made predictions of water our robot should do. **Jan 23, 2022 to March 6 2022** Yes this time frame is reasonable because all the way to our very first prototype our predictions are just predictions since we are not going to have any concrete prototype to test our predictions.

2 **Scheduling**	The team will create a detailed plan listing out the deadline we have and using that to plan on ways to achieve various milestones.	Using wrike By using wrike planning for different test dates and the type of test will be very easy. Since the whole team will be able to view this list and see what they are supposed to do and the deadlines	Wrike We can turn the status of each task done to completed on wrike. And if there are milestones we have completed we can list it on the wrike application also (e.g design day). Assignment Section Of Brightspace This will allow our project managers, teaching assistance, client and professor to give us feedback on the work and will allow us to plan properly.	The scheduling phase of our test will continue to be in progress until design day where we can show our product to the client. **Jan 23, 2022 to March 30 2022** In general this time frame is reasonable but for the individual tasks in this time frame they might be subjected to change or re-scheduling.
3 **3-D Printing**	This is when we are going and printing out various parts needed to build our various prototypes to feel how our ideas work in real time.	By going to makerspace to 3D print components needed for our project. By following the instructions and guidance of the staff at marker we can print out materials needed to accomplish and test them out	A way to track our result would be by making a list of parts I need to print out. And whenever we completely print out a part wer check it off the list	**February 24** and **February 27** Yes this timeframe is reasonable since those are the day marker lab is available for 3-D printing
4 **End Effectors**	The end effector is a key component of our machine because it will allow us to accomplish the main task we have been	Ways To Test the end effectors i. A weight test This will ensure that the end effectors will	Placing all the findings we made on a microsoft excel sheet and comparing all the figures.	**February 24 -27**

	assigned.	be able to hold the required weight for the job. We can do this by placing Weight on the End Effector to test its limits. Test movement of arm Observe stress on arm and end effector joints	This will allow us view all the strength and weakness of our robot	
5 **Tubing**	The tube that will be used to pass water from the water source to outside the robot is completely safe and will not cause any leakage into the electrical component of the robot or other areas of the robot. Also we should also make sure the tubing is completely visible to ensure that any form of damage to the tube is easily noticed.	When the tubing is bought we are going to pass a constant stream of water through it to make sure that there are no sign of leakage of anyform and the water coming from the tube allows for enough pressure to form that will clean the ship	The result will be determined by how long it takes from water to travel through the tube. To do this we will require i. Stop watch ii. constant stream of water	The time frame is dependent on when we receive the money assigned for this project and how long it takes to get the tube from the supplier.
6 **An Electrical Circuit Test**	The robot arm is based on Arduino hardware and software however ideally we plan to replace that with an ESP32 micro-controller which has much more processing	The Arudino, micro controller and other electrical components need to be connected properly. To see how to connect Arduino and for more info on	Result will be determined by how the installation goes.	March 6 to March 30 This is also determined by when we receive funding for the project

	power, is cheaper and has superior wireless capabilities allowing for wireless control and future development of live camera feeds	micro controllers view LAB 3- Arduino Process Control AND LAB 5- Project Specific Lab		
7 **The code**	This is what will allow the robot to function and this will be what will be used to control the robot. Our client wants us to code in a popular language such as python, C or C++.	We already possess an open source code that acts as the skeleton of the coding operation. So the job would be to add to the code more functions we want to carry out and also make sure that the code is working properly. A code editor will be needed for this task e.g code blocks e.t.c	The way the result will be measured is if the code actually compiles and runs properly.	**March 6, 2022 to March 30 2022** This part of the task is the most challenging part but with the open source material we have at our possession this would be possible in this time frame.
8**Finding Out What Our Prototype Excels A**	After the analysis has been completed the team should make a comprehensive list on what the prototype was able to excel at. And use this information to see if our robot would be able to complete its task	This should be done on a google document and shared to the entire team allowing them to see what we have accomplished with the timeframe assigned to us.	Results will be imputed on google documents.	This is dependent on if all the previous tests are a success. The idea timeline for this would be **March 25-30**

Analyzing Test Results

From the various conducted tests and the various conducted tests , the teams need to collect all the data and info from the various experiments/ tests and analyze them to see what went well with them and what needs to be improved upon. If there were any design challenges that we might have faced during the testing we should see if those challenges can be correct within the period of time given to us. And if this is not possible we should ask ourselves if the rest of the robot could survive without this feature. Asking ourselves this question will allow us to know if we are going to make important scheduling adjustments to ensure we will get that feature to work effectively.

Wrike Update

Wrike has been updated for Deliverable E.

References

Bernier, C. (2013, July 15). Challenges of Dexterous End Effectors. Retrieved February 19, 2022, from blog.robotiq.com website: https://blog.robotiq.com/bid/66051/challenges-of-dexterous-end-effectors

Test Plan Contents - What Should be Included (with Examples). (2018, February 7). Retrieved February 19, 2022, from QA world website: https://qa.world/test-plan-contents/