Week 3

Situation

The focus of this week's lab was the process of creative design thinking. As design will factor into multiple aspects of the AEV process, it was necessary to dedicate time to practicing this process. Creativity techniques were introduced, as well as possible obstacles to creativity for the team to look out for. A number of design considerations were also introduced in order to keep prospective designs within the requirements of the AEV project. The group began with an individual brainstorming session, where each member was given 10-15 minutes to create an orthographic sketch of a possible AEV design on their own. These sketches had to utilize either components already in the AEV kit or those which could be purchased easily. Next, the group brought their design ideas together in a longer brainstorming session for the purpose of creating one final synthesized design.

Results and Analysis

Four individual designs were produced from the lab, plus one final group design. Each concept was created with a different approach in mind. The concept drawn by Matthew was motivated primarily by light weight and simplicity of parts. A light weight would mean less energy is required for the AEV to reach its goal point, raising efficiency. The bare-bones nature of the design, however, meant it may have been lacking in possible advanced features that other designs could offer. The design was created by considering at all of the parts offered in the kit and trying to utilize those with a minimal footprint. This design used a single cross-shaped piece for its base, just big enough to fit all of the parts. A motor with propeller was fixed to each arm of the body, while the Arduino was mounted behind the wheel arm on the center of the body. These parts would require no outside purchases or 3D printing as all are contained in the AEV kit.

Tarun's concept featured an AEV design with trapezoidal wings and a t-shaped back, which was meant to hold the propellers. Primarily, the design was motivated by having the propellers in the upper parts of the design, applying a force that would push the AEV forward through the T-shaped part. This T-shaped part was meant to be bound to another part which would put it slightly higher. However, having the propellers towards the top of the AEV will likely hinder its ability to complete the given scenario. It will most likely be more efficient to have the propellers at the bottom. In this theoretical design, there is only one part which would need to be laser cut - the T-shape. The given T-shape is significantly bigger than the desired part.

John's idea of the AEV included the design of a cross-shaped base with wings attached on the shorter side to hold the propellers. The wheel mount is attached to the front of the model and the arduino is placed in the middle of the model to distribute the weight throughout the whole AEV. The trapezoid parts are placed down to let the propellers mount on the outside of the trapezoid for better turn movements and faster speed generation. The upside down trapezoid helps control wind and also make it more efficient. The propellers on the middle of the vehicle allows for steady movement and energy saving. There would be no need for 3-D printing or laser cuts as the vehicle consists of basic given parts.

The design created by Jake focused on the increase of the surface area of the AEV in order to create more room for the arduino to be placed. Previously, the team has struggled to find enough space for both the L shaped arm and the Arduino on top of the AEV. The arduino could only be screwed in one side, which did not allow the program to run correctly. Increasing the surface area will allow the program to run better, but it will also add weight to the AEV causing there to need to be more power put into the motors. It differs from the team design in that no new parts need to be created, and the body of the AEV remained rectangular in shape in Jake's design while the team's design had a T-shaped body that will be created using the 3D printer. Jake's design uses a 2" by 6" rectangle that will be laser cut to a shorter length as to not make the AEV too long, and will be attached to the end of the rectangular base that is part of the basic design. Other than that no other parts were used or created that were not apart of the basic design. In order to complete the design, a process of trial and error was conducted in order to find a design that could plausibly be drawn, constructed, and not weigh too much as to prevent the AEV from maneuvering around the overhead tracks. Ultimately the design created during the team meeting deviated greatly from the design brainstormed during lab.

The final design concept aimed to combine the strengths of the designs into one superior design. A T-shaped body was chosen, which would need to be 3D printed as its dimensions were chosen to make the design as small as possible. The motors were mounted to the top of the T while the base held the L-shaped wheel arm and the Arduino. The L-shaped arm was chosen as its mounting point on the back will result in even weight distribution throughout the AEV. As the design is lightweight, it will utilize less energy to complete the task outlined in the Mission Concept Review.

<u>Takeaways</u>

1) General-Team J was able to learn useful design thinking techniques that were applied to the AEV design. There was much collaboration when the team came together to combine each individual design into one team design for the AEV. It required much teamwork in order to give each other constructive criticism, and collaborate in an efficient manner.

2) AEV Design- The final design for the AEV was decided upon by Team J. Elements from all group members' designs were taken into consideration and the team learned the usefulness of combining ideas from all members to form a consensus that maximizes the strengths of each contribution.

Week 4

Situation

In the following week, the group will proceed to learn more about system and design analysis. The lab will be split up into two parts, Lab 04a and Lab 04b. The first part will be focusing on downloading and analyzing data collected through the AEV's controller, while the second half will demonstrate a MATLAB GUI capable of efficiently downloading data, executing calculations, and plotting results.

Lab 04a will involve the creation of a program, which will be used to run the AEV and analyze and convert the gathered data. The data will be in the EEPROM format, which is the Arduino Nano's data system. Learning how to manipulate and interpret this data will assist the group with the design process in the future. Therefore, learning how to do so in this lab will be sure to ensure future success in improving the AEV. The created program in the lab should cause the AEV to travel to the first stop. After demonstrating the program to a TA and running the AEV, the gathered data will be extracted and stored inside a MATLAB function file, in the EEPROM format. Once all data has been stored, the group will proceed to convert these EEPROM values to standard physical parameters. After the conversions, multiple values will be calculated to further analyze the AEV's performance. After the values are calculated, a graph of the supplied power with respect to time will be created, and broken up into different phases that represent the different aspects of the program code. Then, the used energy will be calculated, as it is defined as the area under the curve of supplied power vs. time.

Lab 04b will then introduce a MATLAB GUI program which will execute actions that were performed in Lab 04a. However, the GUI will perform calculations and plotting in a much more efficient manner. Repeatedly completing calculations and graphs can be time-consuming; that time can be better spent elsewhere. Hence, learning of the GUI will allow the group to save more time in the future. The group will use the MATLAB GUI from this lab forward. Lab 04b will start by having the group download the analysis tool used to analyze AEV data. This application features different options which the user can choose from. Users have the option to open EEPROM files, download data directly from the AEV controller, export figures or view raw data. In this lab, the group will download data directly from the Arduino. That data will then be

stored into a MATLAB file in order to be analyzed. In the future, the MATLAB GUI will help greatly with the design cycle, as it provides an efficient method of data analysis, which will allow the group to make design-based decisions.

Weekly Goals

1) Thoroughly prepare for the lab next week by reading the lab manual and completing the quiz on Carmen.
2) Finish the progress report for lab 4 during the second team meeting, and submit it before the deadline on February 7th.

Weekly Schedule

Task	**Teammate(s)**	**Start Date**	**Due Date**	**Time Needed**
Progress Report for Lab 4	All	2/3/17	2/7/17	3 Hours
Prepare for Lab 4	All	2/6/17	2/7/17	30 minutes

Appendix A

Date: 2/3/17
Time: 3:00 P.M.
Members Present: Tarun Pilli, Matthew Caldwell, & Jacob Phillips
Topic Discussed: Progress Report for Lab 4

Objective:
Group J met on Friday, February 3rd in order to start the Progress Report for Lab 4 in order to disperse the workload of the progress report over a series of days before the completion deadline.

Tasks:
-Progress Report for Lab 4
The team members present swiftly completed as much of the Progress Report for Lab 4 as possible. The report was started during the team meeting but not completely finished.

To Do/Action Items:
-Finish the Progress Report for Lab 4(All Members)
-Prepare for Lab 4(All Members)
-Add the Progress Reports for Labs 2 and 3 to the project portfolio on U.osu.edu(All Members)

Reflection:
The Progress Report for Lab 4 was started during the team meeting, but was not completed. Team J worked well and fluently as many shorter parts of the report were completed and the format for the entire was laid out. What was completed of the Progress Report for Lab 4 was not revised and edited, but that will be completed at another team meeting before the completion deadline.

Date: 2/6/17
Time: 5:30 P.M.
Members Present: Tarun Pilli, Matthew Caldwell, Jacob Phillips, & John Kim
Topic Discussed: Progress Report for Lab 4

Objective:
Group J met the Monday before the Progress Report for Lab 4 was due in order to complete it before the deadline.

Tasks:

-Progress Report for Lab 4

The progress report was completed swiftly as much of it had been completed the prior team meeting.

To Do/Action Items:

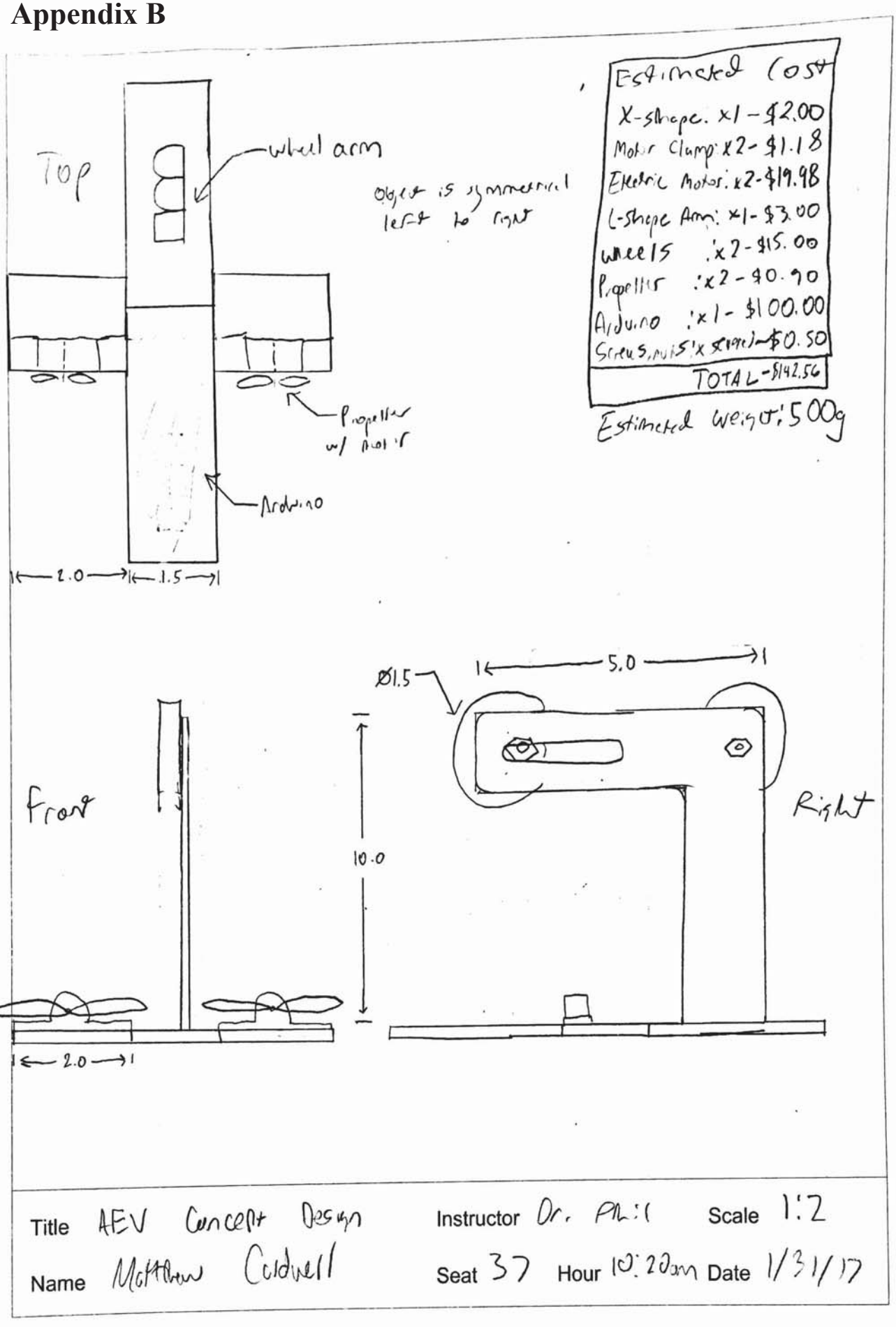
-Prepare for Lab 4 by reading the lab manual and completing the quiz on Carmen(All Members)

-Add all progress reports that have been completed to the project portfolio on U.osu.edu(All Members)

Reflection:

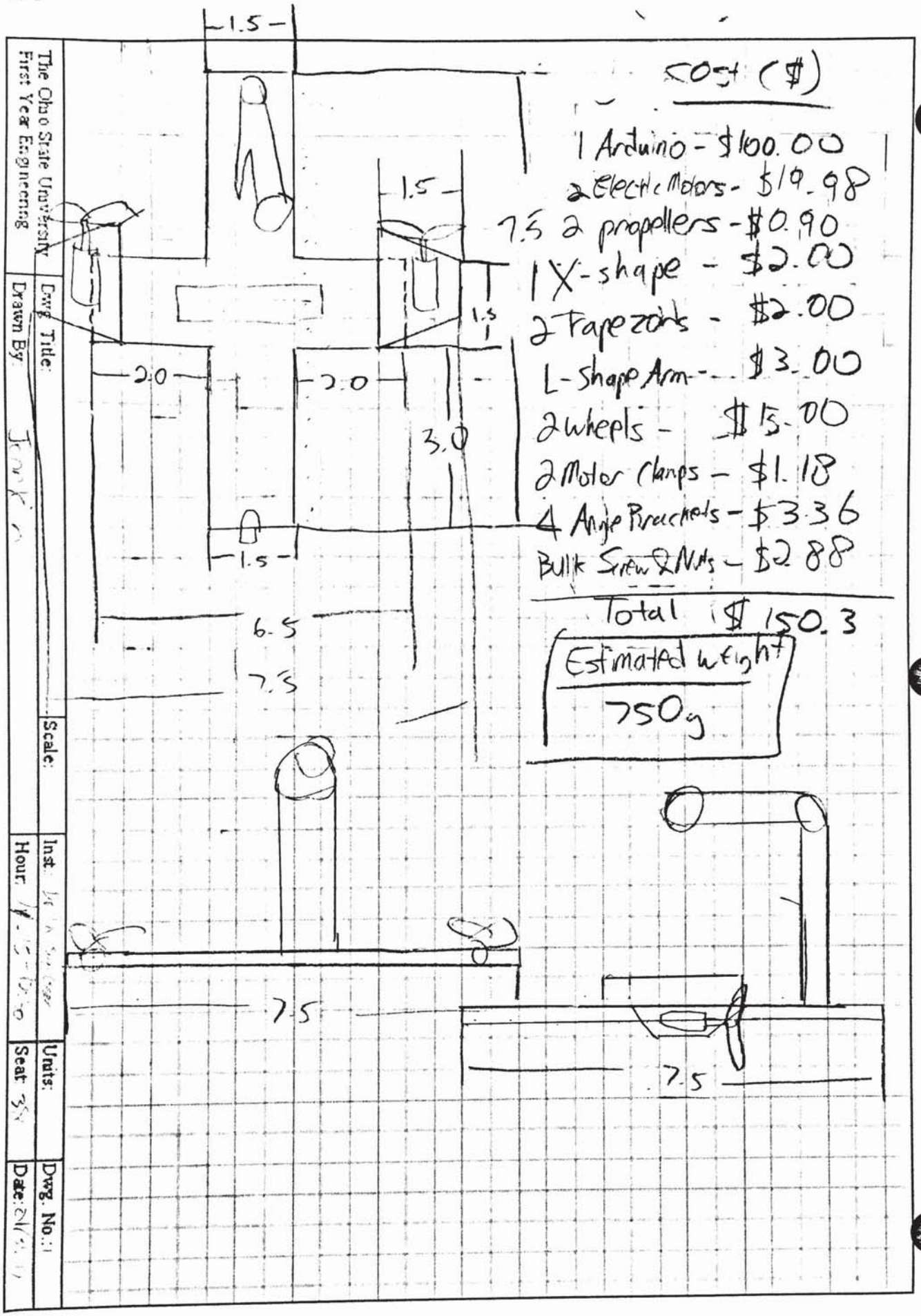
Team J was able to complete the Progress Report for Lab 4 on time the night before the deadline. Each team member not only completed their individual parts, but also worked on the overall report and completed each section at an accepted quality bases on team standards.

Appendix B



Title AEV Concept Design Instructor Dr. Phil Scale 1:2

Name Matthew Coldwell Seat 37 Hour 10:20am Date 1/31/17



The Ohio State University
First Year Engineering

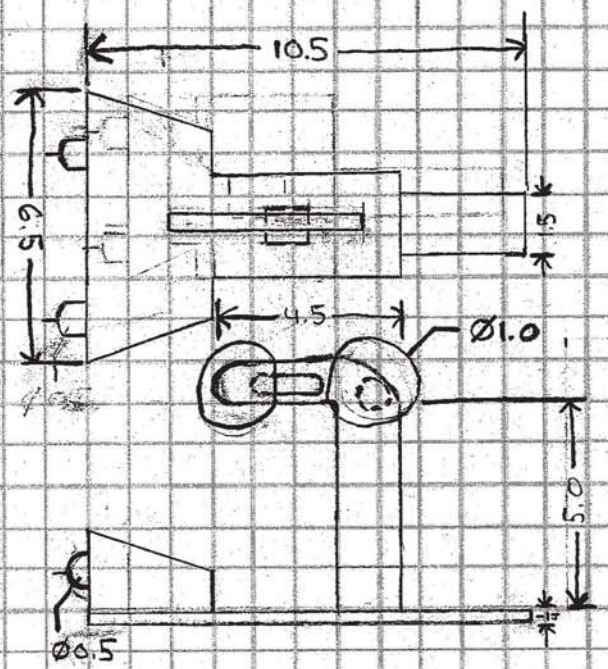
Dwg. Title:
Drawn By:
Scale:
Inst.
Hour
Units:
Seat
Dwg. No.:
Date:

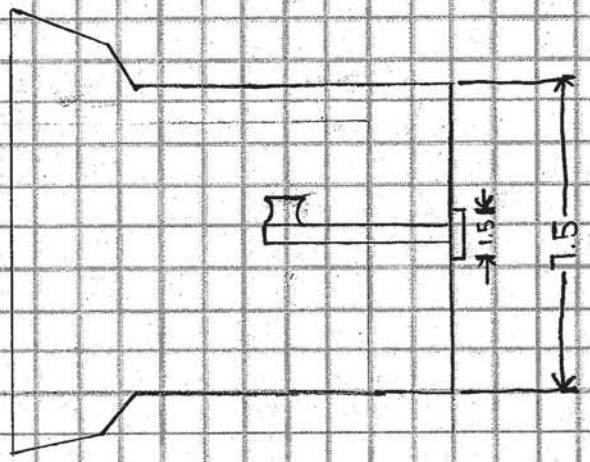
Cost ($)

1 Arduino - $100.00
2 Electric Motors - $19.98
2 propellers - $0.90
1 X-shape - $2.00
2 Tape zorts - $2.00
L-Shape Arm - $3.00
2 wheels - $15.00
2 Motor clamps - $1.18
4 Angle Brackets - $3.36
Bulk Screw & Nuts - $2.88

Total $150.3

Estimated weight
750g



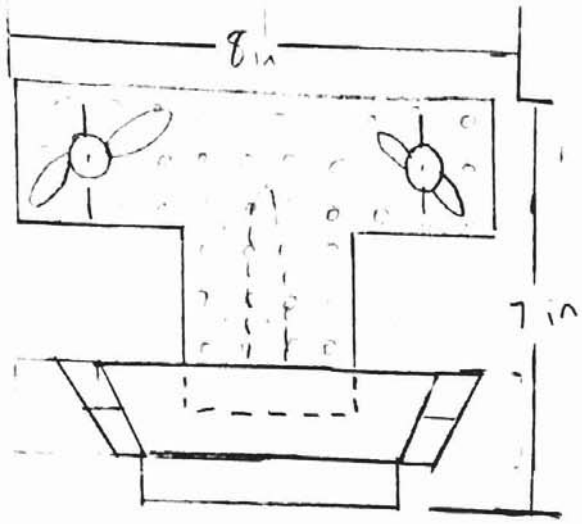


Bill of Materials

item	Description	Cost	QNTY
1	2.5" x 7.5" rectangle	$12.00	1
2	2" x 6" rectangle	$2.00	11
3	wheels	$15.00	2
4	electric motors	$19.98	2
5	propellors	$0.90	2
6	L arm	$3.00	1
7	bolt screws and nuts	$2.88	1

Estimated Weight:	Estimated Cost:
1.5 lbs = 680.39 grams	$45.76

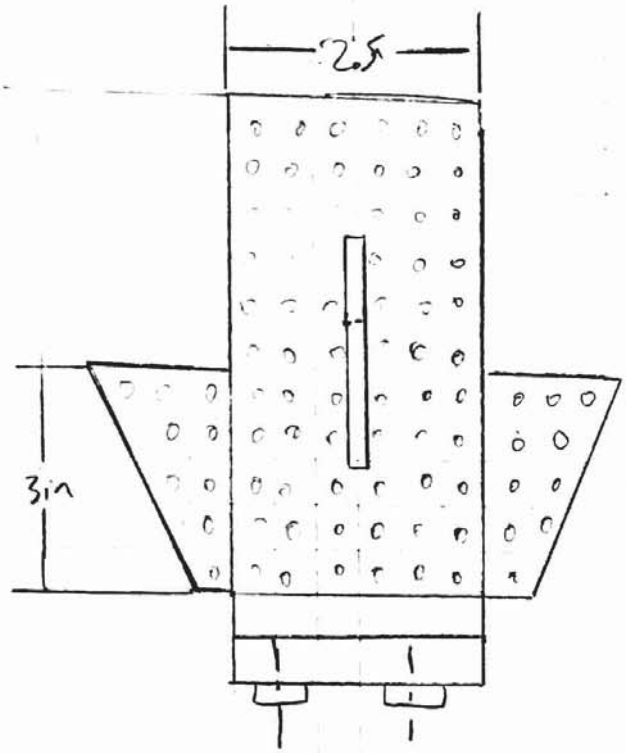
The Ohio State University First Year Engineering	Dwg. Title: AEv	Scale: 1:1.5	Inst.: Dr. Phil	Units: Inches	Dwg. No.: 1
	Drawn By: Jacob Phillips		Hour: 10:20-11:15 A.M.	Seat: 39	Date: 2/7/17

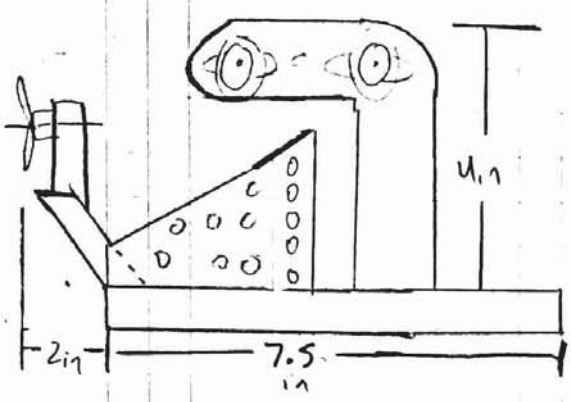


Bill of Materials

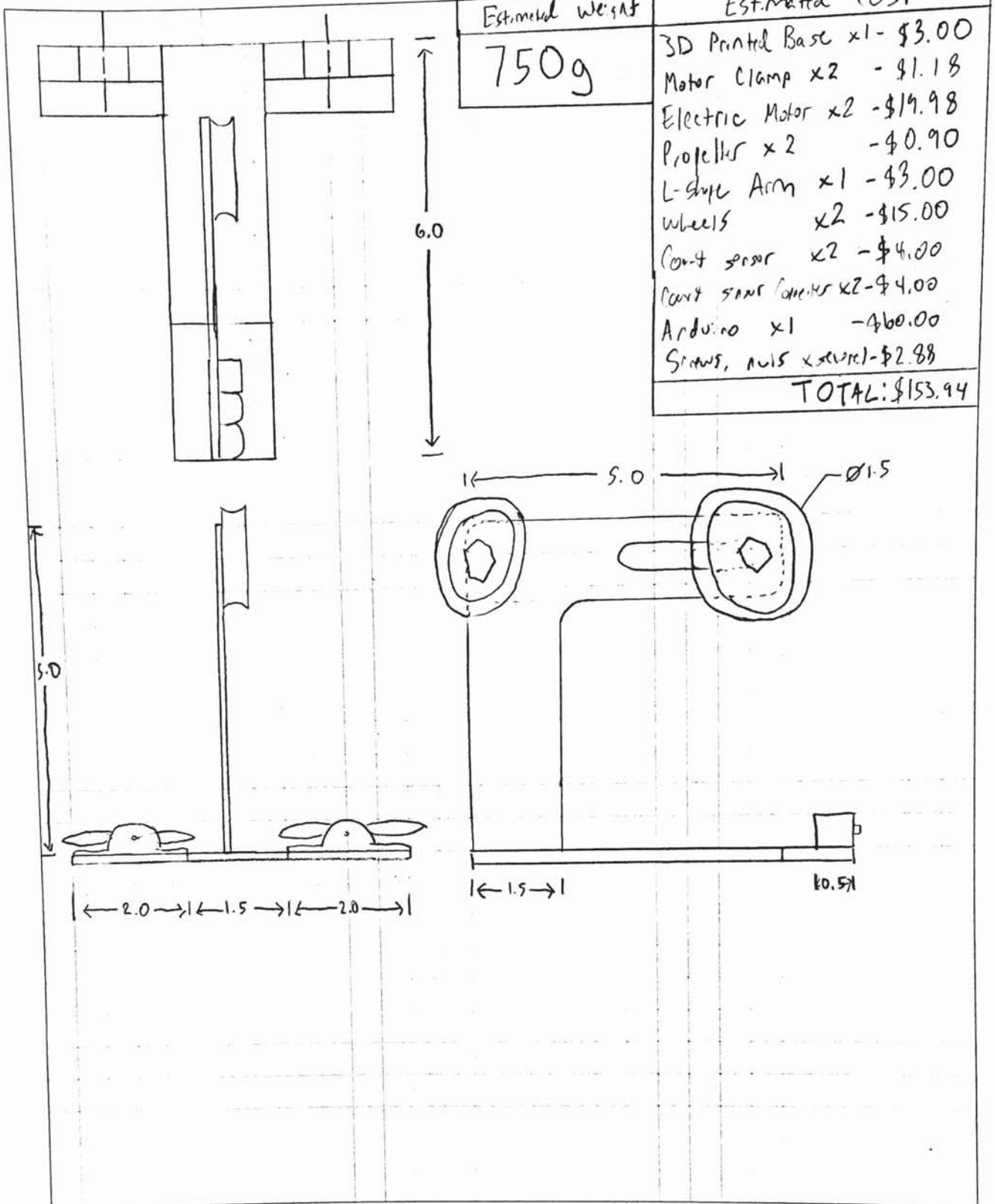
T-Shape	$2.00
2.5" x 7.5" Rectangle	$2.00
Trapezoids 3x	$3.00
Propellers 2x	$0.90
L-Shape Arm	$3.00
2 Motor Clasps	$1.18
Angle Brackets 6x	$5.04
2 Electric Motors	$19.98
Arduino	$100.00
Bulk Screws & Nuts	12.88
Total	$139.98

Estimated weight
690 grams





Title	Creative Design	Instructor	Pr. Pli	Scale	1: 1.5
Name	Tevin Pilli	Seat	J'10	Hour	11:10
				Date	1-31-17



Estimated Weight	Estimated Cost
750g	3D Printed Base x1 - $3.00
	Motor Clamp x2 - $1.18
	Electric Motor x2 - $19.98
	Propeller x2 - $0.90
	L-style Arm x1 - $3.00
	Wheels x2 - $15.00
	Cliff sensor x2 - $4.00
	Camera x2 - $4.00
	Arduino x1 - $60.00
	Screws, nuts x several - $2.88
	TOTAL: $153.94

Title AEV Concept Design Instructor Dr. Phil Scale 1:2

Name Group J Seat 37-40 Hour 10:20am Date