

# Levitating Hoverboard

## Midterm I Presentation

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# Presentation Overview

- ▶ Background
- ▶ Need & Goal Statement
- ▶ Objectives
- ▶ Constraints
- ▶ House of Quality
- ▶ Brainstorming
- ▶ Morphological Chart
- ▶ Design concepts
- ▶ Scheduling

# Background

- ▶ Hovercrafts
- ▶ Competitors:
  - ▶ Hendo Hoverboard
  - ▶ Lexus Hoverboard
- ▶ Homemade attempts



Figure 2 – Hendo Hoverboard

Figure 4 – Homemade hovercraft

Figure 1 - Hovercraft

Figure 3 – Lexus Hoverboard

# Need & Goal Statement

## NEED

Advanced hoverboards are very expensive and basic homemade hoverboards lack practical mechanics (e.g. steering) that make them viable.



## GOAL

Create a controllable hoverboard that can be used for recreation and/or short-range transportation. This hoverboard will use air as the levitating medium.

# Objectives

- ▶ Support a range of user weights
- ▶ Able to be steered
- ▶ Able to be propelled forward
- ▶ Able to slow down
- ▶ Untethered
- ▶ Durability and Reusability
- ▶ Consumer price must be relatively low

# Constraints

- ▶ May not be suitable for all terrains/slopes
- ▶ All components must fit and function on-board
- ▶ Balance of the board when all components and a load are placed
- ▶ Loud noise produced by blowers or air cushion coming in contact with the floor by accident.
- ▶ Wireless options might be expensive

# House of Quality

Legend		
⊙	Strong Relationship	9
○	Moderate Relationship	3
▲	Weak Relationship	1
++	Strong Positive Correlation	
+	Positive Correlation	
-	Negative Correlation	
▼	Strong Negative Correlation	
▼	Objective Is To Minimize	
▲	Objective Is To Maximize	
X	Objective Is To Hit Target	

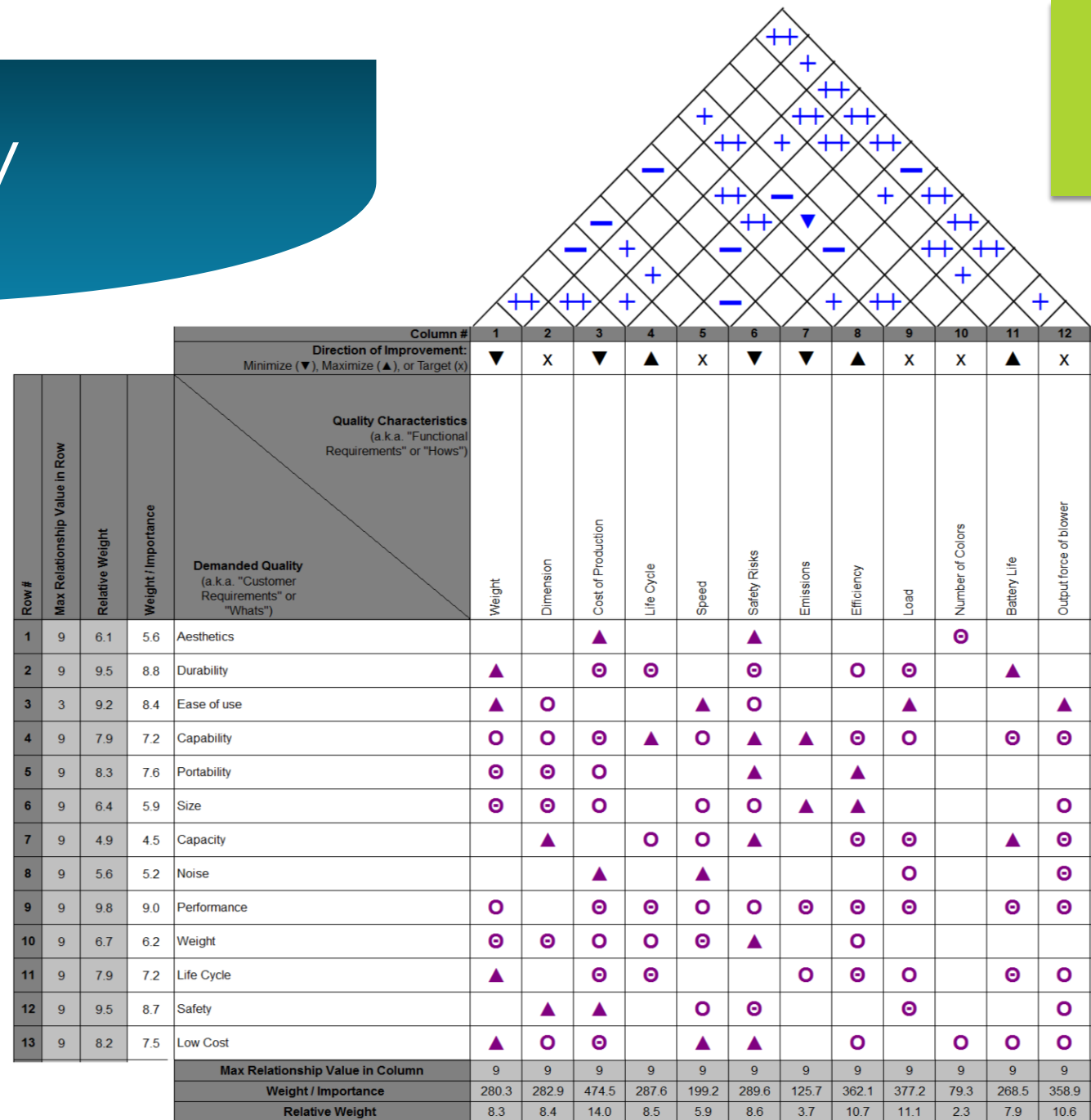


Figure 5 – House of Quality and its Legend

# House of Quality – Customer Requirements

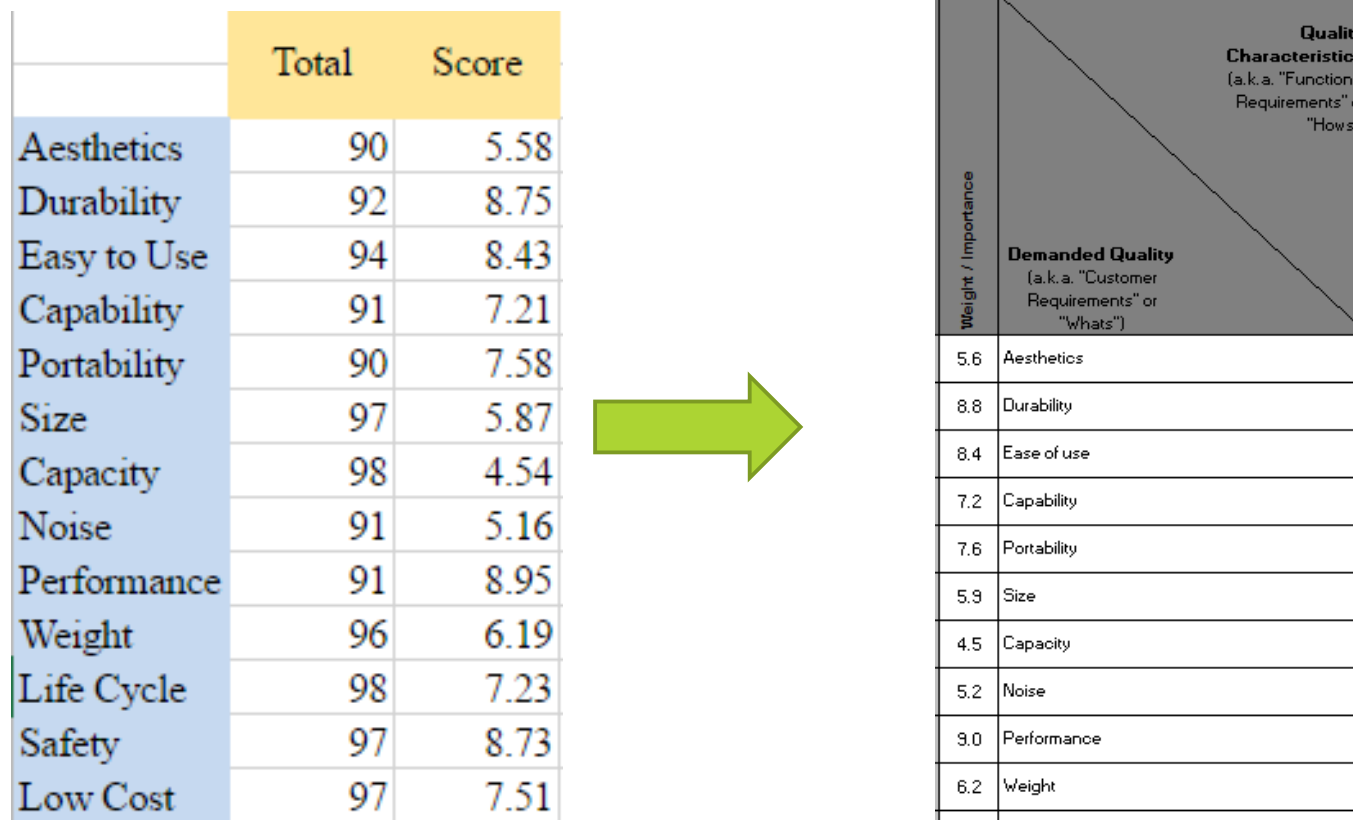


Figure 6 – House of customer Requirements



# House of Quality – Correlation Matrix

## Engineering Technical Requirements

- Weight
- Dimension
- Cost of production
- Life Cycle
- Speed
- Safety Risks
- Emission
- Efficiency
- Load
- Number of Colors
- Battery Life
- Output force of the blower

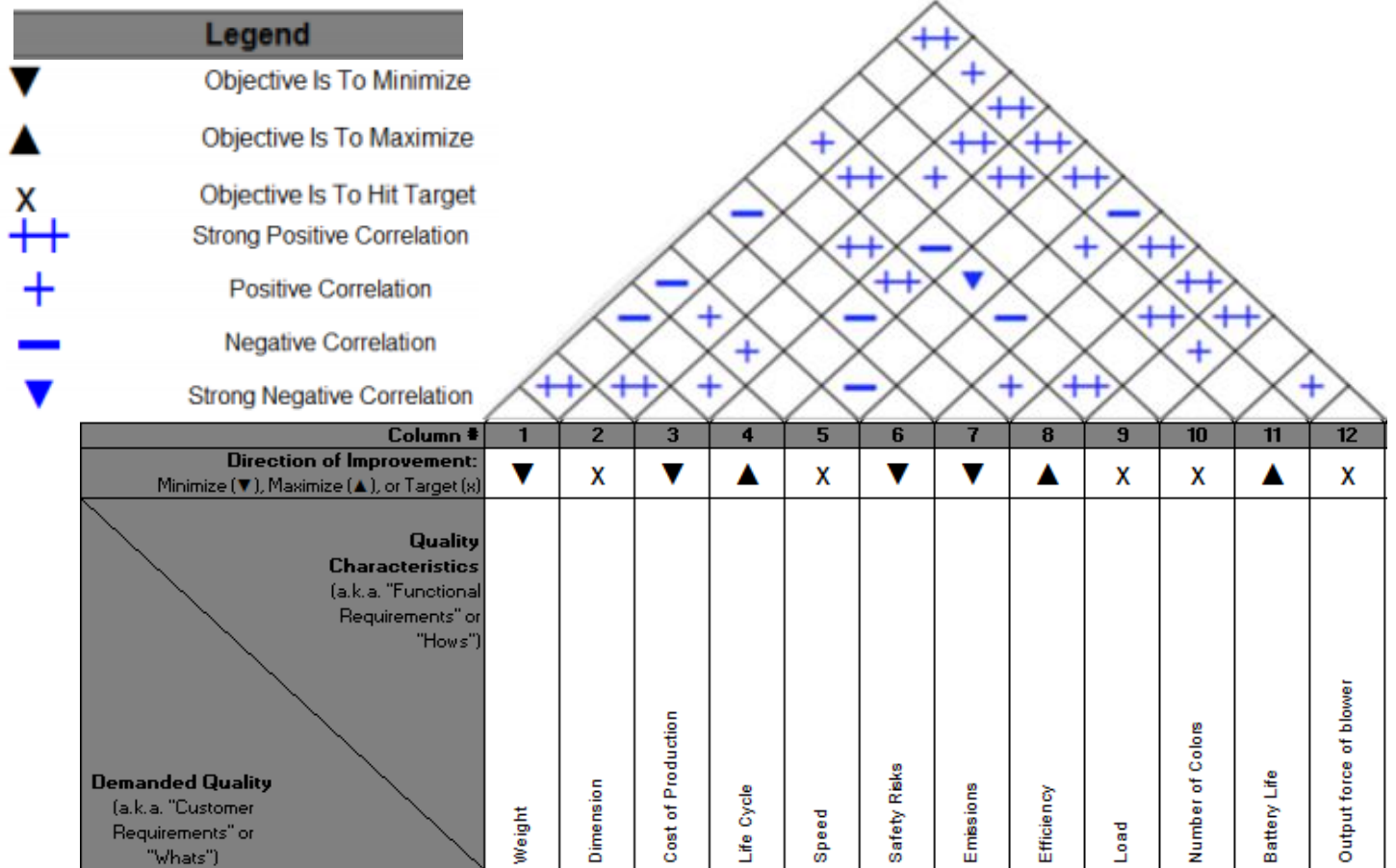


Figure 7 – House of Quality Correlation Matrix and its Legend

# House of Quality – Relationship Matrix

Legend		
	Strong Relationship	9
	Moderate Relationship	3
	Weak Relationship	1

Row#	Max Relationship Value in Row	Relative Weight	Weight / Importance	Demanded Quality (a.k.a. "Customer Requirements" or "Whats")	Quality Characteristics (a.k.a. "Functional Requirements" or "Hows")	Weight	Dimension	Cost of Production	Life Cycle	Speed	Safety Risks	Emissions	Efficiency	Load	Number of Colors	Battery Life	Output force of blower
1	9	6.1	5.6	Aesthetics				▲			▲				○		
2	9	9.5	8.8	Durability		▲		○	○		○		○	○		▲	
3	3	9.2	8.4	Ease of use		▲	○			▲	○			▲			▲
4	9	7.9	7.2	Capability		○	○	○	▲	○	▲	▲	○	○		○	○
5	9	8.3	7.6	Portability		○	○	○			▲		▲				
6	9	6.4	5.9	Size		○	○	○		○	○	▲	▲				○
7	9	4.9	4.5	Capacity			▲		○	○	▲		○	○		▲	○
8	9	5.6	5.2	Noise				▲		▲				○			○
9	9	3.8	3.0	Performance		○		○	○	○	○	○	○	○		○	○
10	9	6.7	6.2	Weight		○	○	○	○	○	▲		○				
11	9	7.9	7.2	Life Cycle		▲		○	○			○	○	○		○	○
12	9	9.5	8.7	Safety			▲	▲		○	○			○			○
13	9	8.2	7.5	Low Cost		▲	○	○		▲	▲		○		○	○	○

Figure 8 – House of Quality Relationship Matrix and its Legend

# House of Quality - Targets

Table 1- House of Quality Targets

<b>Max Relationship Value in Column</b>	9	9	9	9	9	9	9	9	9	9	9	9
<b>Weight / Importance</b>	280.3	282.9	474.5	287.6	199.2	289.6	125.7	362.1	377.2	79.3	268.5	358.9
<b>Relative Weight</b>	8.3	8.4	14.0	8.5	5.9	8.6	3.7	10.7	11.1	2.3	7.9	10.6



Table 2- Relative Weight Results

Relative Weight Results			
Engineering Characteristic	Result (%)	Engineering Characteristic	Result (%)
Weight	8.3	Emissions	3.7
Dimension	8.4	Efficiency	10.7
Cost of Production	14.0	Load	11.1
Life Cycle	8.5	Number of Colors	2.3
Speed	5.9	Battery Life	7.9
Safety Risks	8.6	Output force of the blower	10.6

# Brainstorming



Directed Vents      Gas      Built-in Battery      Water      Brake lines

Electric      One Dedicated Blower      One Motor

Internal Motor      Rudder/Lever      Two Dedicated Blowers      External Motor

Rectangular Board      Circular Board      Two Motor      Three Motors

Land/Water      Elliptical Board      Custom Board      Interchangeable Battery

Foot Controls      Land

# Morphological Chart

Table 3 – Morphological Chart

Attribute	Alternates			
<b>Board Shape</b>	Circular	Rectangular	Elliptical	Custom
<b># of Motors</b>	1 (inflate and propel)	2 (1 initial to propel)	3 (1 to inflate, 2 to propel)	3 (1 inflate/propel, 2 to steer)
<b>Motor(s) Location</b>	Internal	External	Internal	External
<b>Energy Source</b>	Electric	Gas		
<b>Power Bank Type</b>	Built-in	interchangeable batteries	Gas Tank	
<b>Propulsion Method</b>	Directed Vents	Blowers	2 dedicated blowers	
<b>Steering</b>	Over/Roller	Foot Controls	Brake Lines	Level Pivot
<b>Terrain</b>	Land	Water	Land	Water
<b>Riding Style</b>	Standing	Seated		

# Design Concept 1

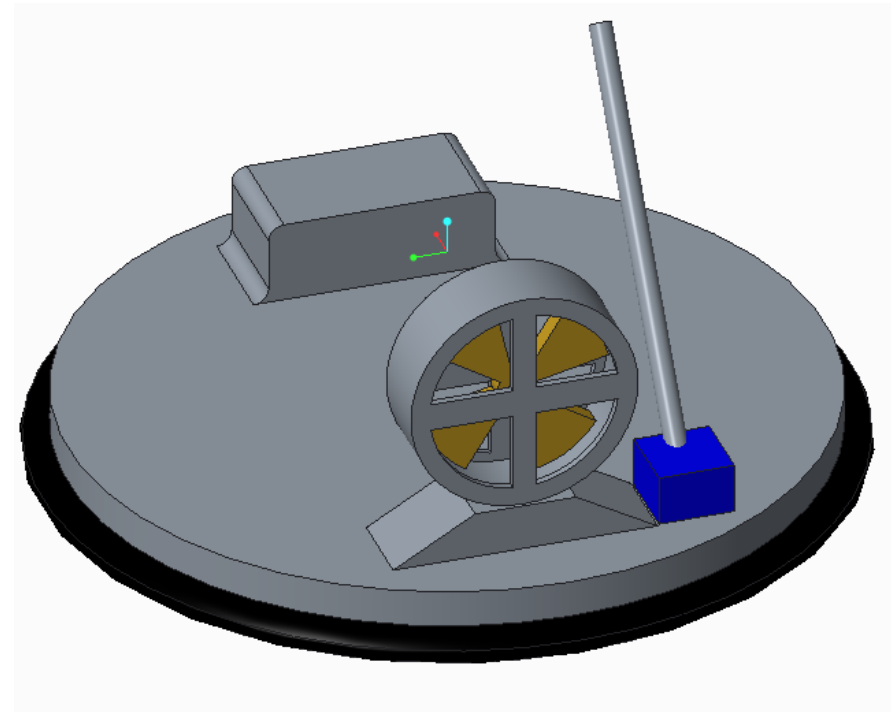
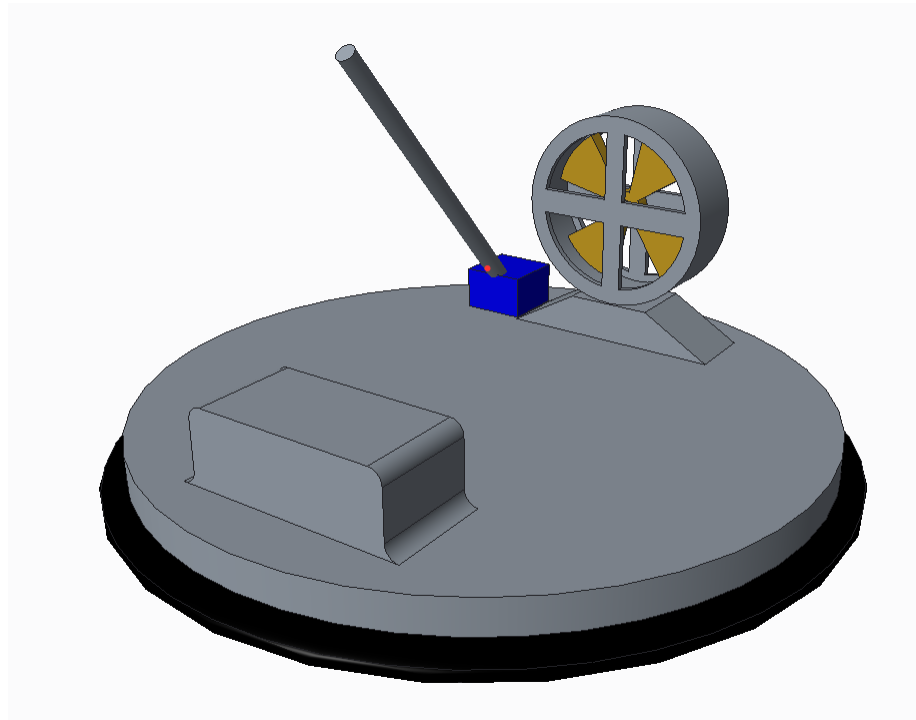


Figure 9 – Front and Back Sketch of Design Concept 1

# Design Concepts 2

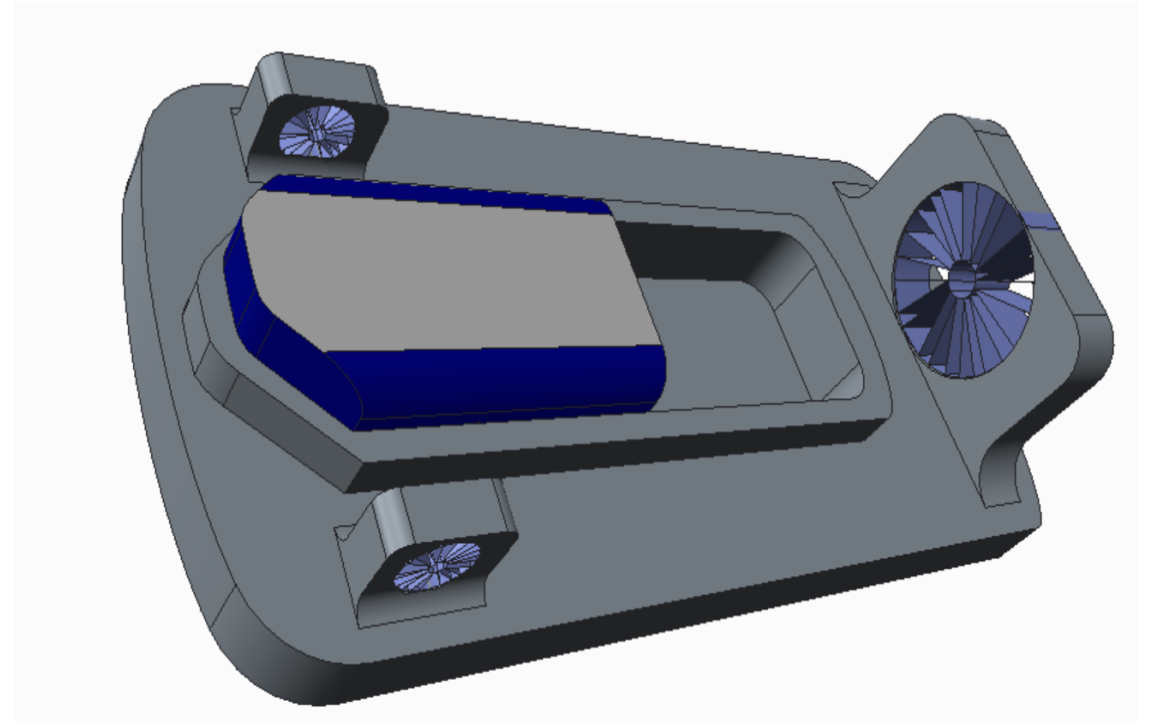
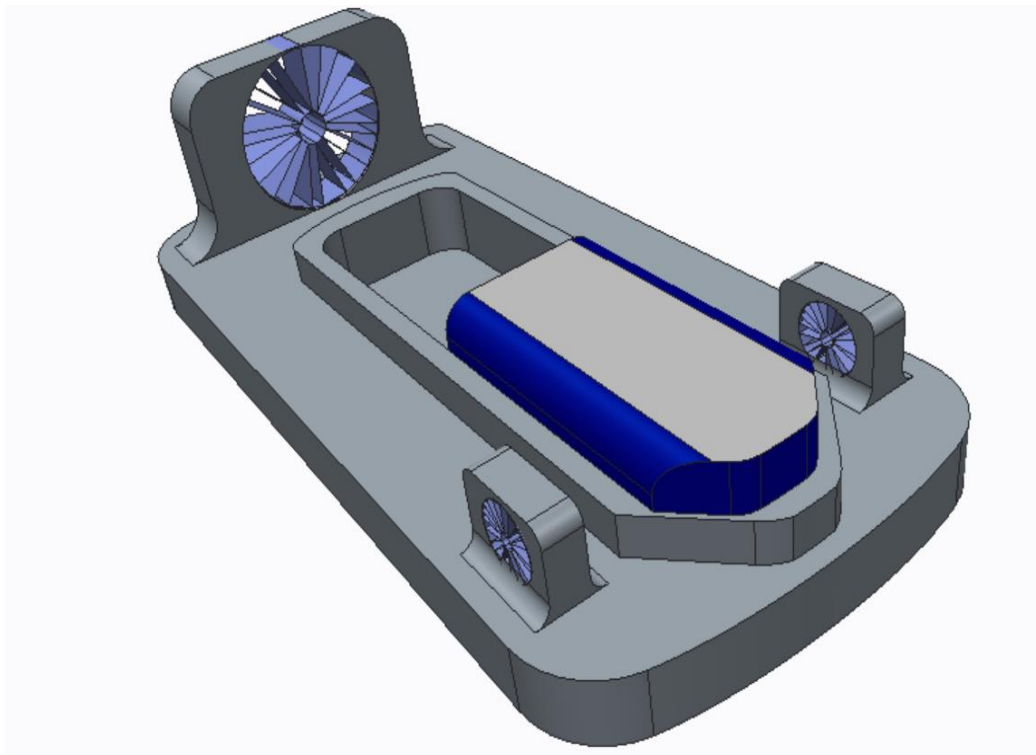
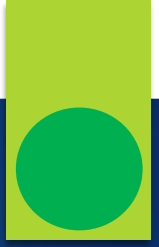


Figure 10 – Front and Back Sketch of Design Concept 2

# Design Concepts 3

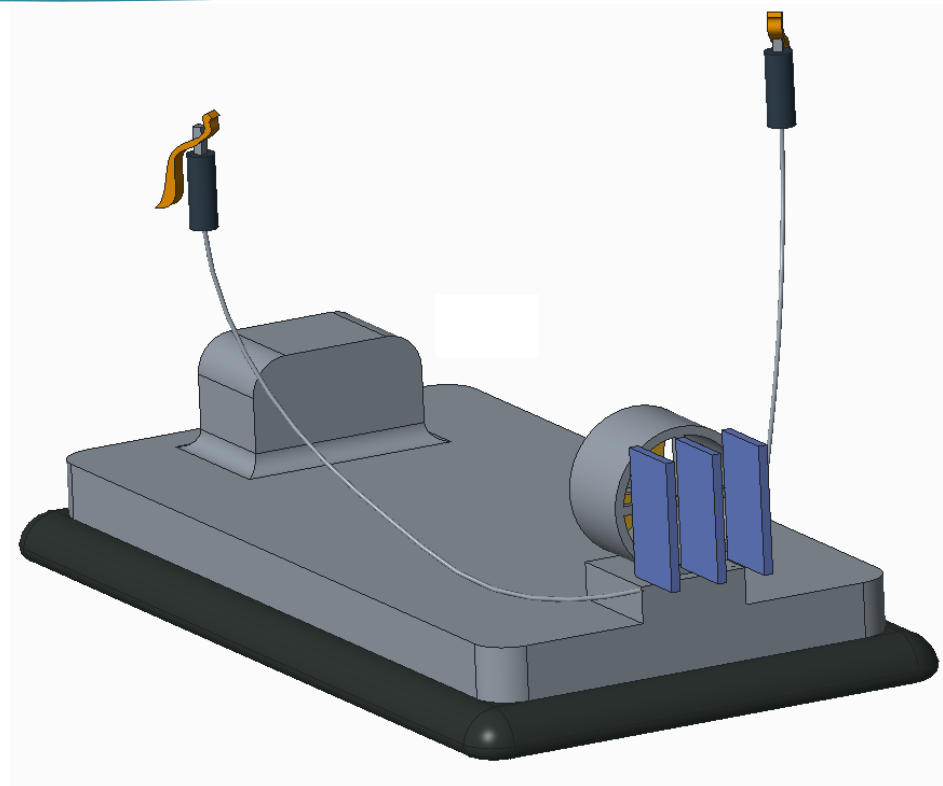
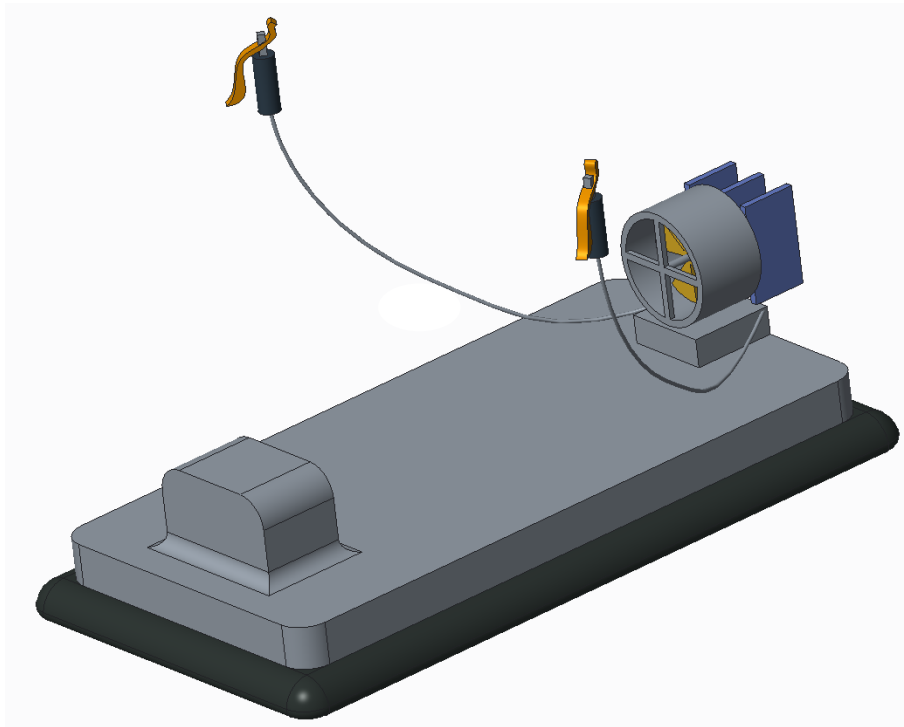


Figure 11 – Front and Back Sketch of Design Concept 3

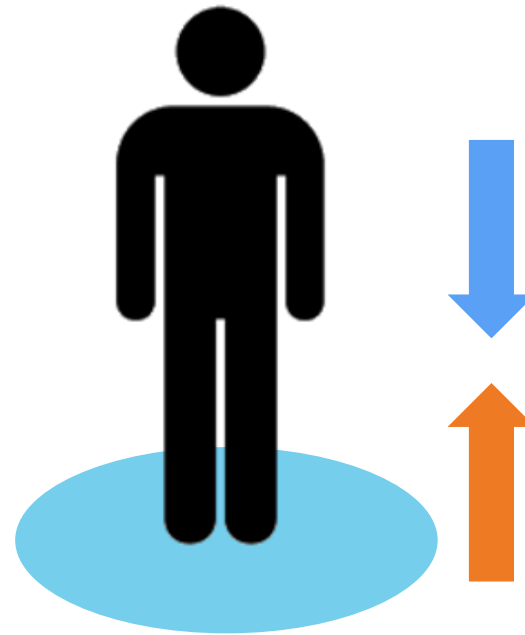


# Operation Factors

To Hover:

Upward Lift = Downward Weight

- Weight -> Lift
- Lift -> Blower
- Blower -> Power Bank
- Power Bank, Blower -> Weight



# Materials

## ▶ **Board**

- ▶ Plywood
- ▶ Carbon Fiber
- ▶ ABS Polymer

## ▶ **Air Cushion**

- ▶ Urethane-Coated Nylon Fabric
- ▶ Vinyl
- ▶ Polyethylene

# Types of Air Cushion

- ▶ Bag Skirt
- ▶ Finger Skirt
- ▶ Bag and Finger Skirt



Figure 14 – Bag and Finger Skirt Example  
Figure 12 – Bag Skirt Example

Figure 13 – Finger Skirt Example

# Types of Air Blowers

- ▶ Jet Powered Air Blower
- ▶ Gas Powered Air Blower
- ▶ Electric Powered Air Blower
- ▶ Electric Powered Centrifugal Fan



Figure 15 – Blower example

# Battery info

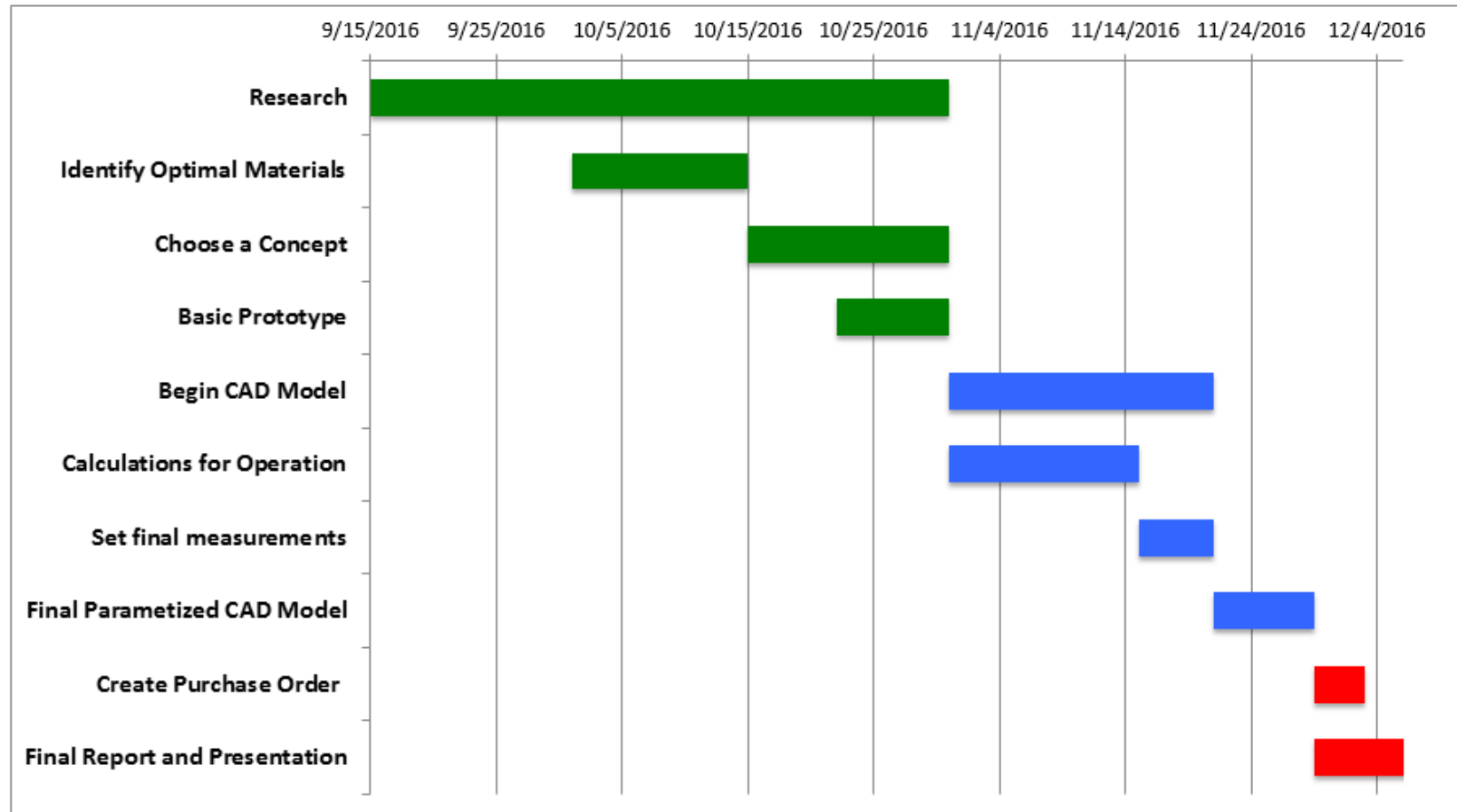
- ▶ Uninterrupted Power Supply (UPS)
- ▶ Power Tool Battery Packs
- ▶ Power Bank
- ▶ Household Batteries



Figure 16 – Batteries Examples

# Semester Overview

Table 4 – Gantt Chart



# References

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# Questions?

THANK YOU FOR JOINING US!