



FAMU-FSU
College of
Engineering

Virtual Design Review 2

Team 515 – Controllable CVT Device

Kemani Harris, Aaron Havener, Jacob Hernandez,
and Aliya Hutley

November 14th, 2024

Sponsor & Advisor

Florida Agriculture & Mechanical University and Florida State University



Dr. Carl Moore Jr.
Associate Professor



Meet Team 515



Kemani Harris
Dynamics Engineer



Aaron Havener
Controls Engineer



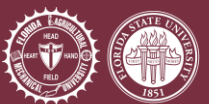
Jacob Hernandez
Design Engineer



Aliya Hutley
Test Engineer & POC



Cade Watson
Materials Engineer

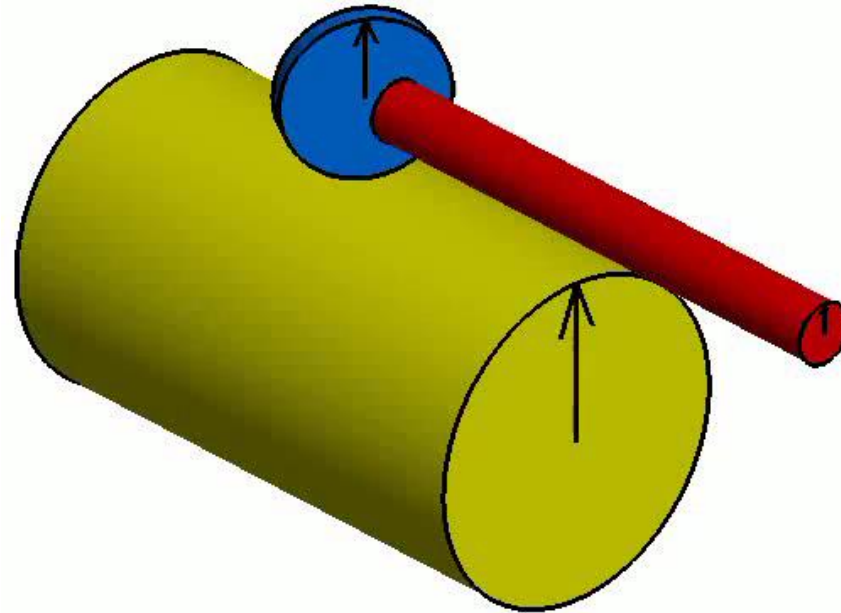


Objective

The objective of this project is to enhance the education of haptic robotics by creating a device using continuously variable transmissions (CVTs). The device is intended to utilize computer control and move through various positions to produce accurate output motion.



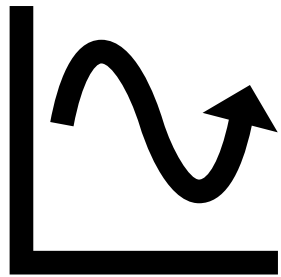
Background



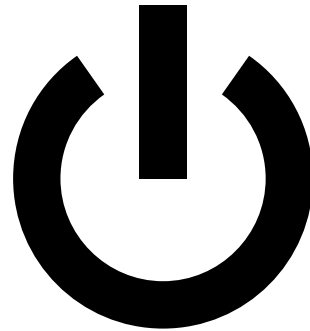
What makes this a CVT?

What make this device a CVT is that it rely on the change of the steering angle to determine the change variability translational motion.

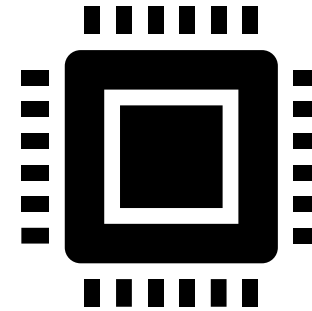
Assumptions



Three-dimensional motion is not required.

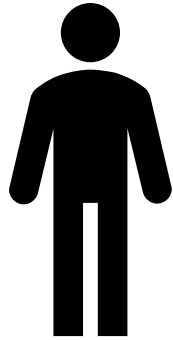


Common sources of power are accessible.



Existing motor and control hardware is allowed.

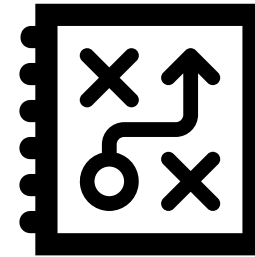
Understanding Functionality



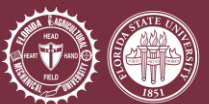
A target high school audience



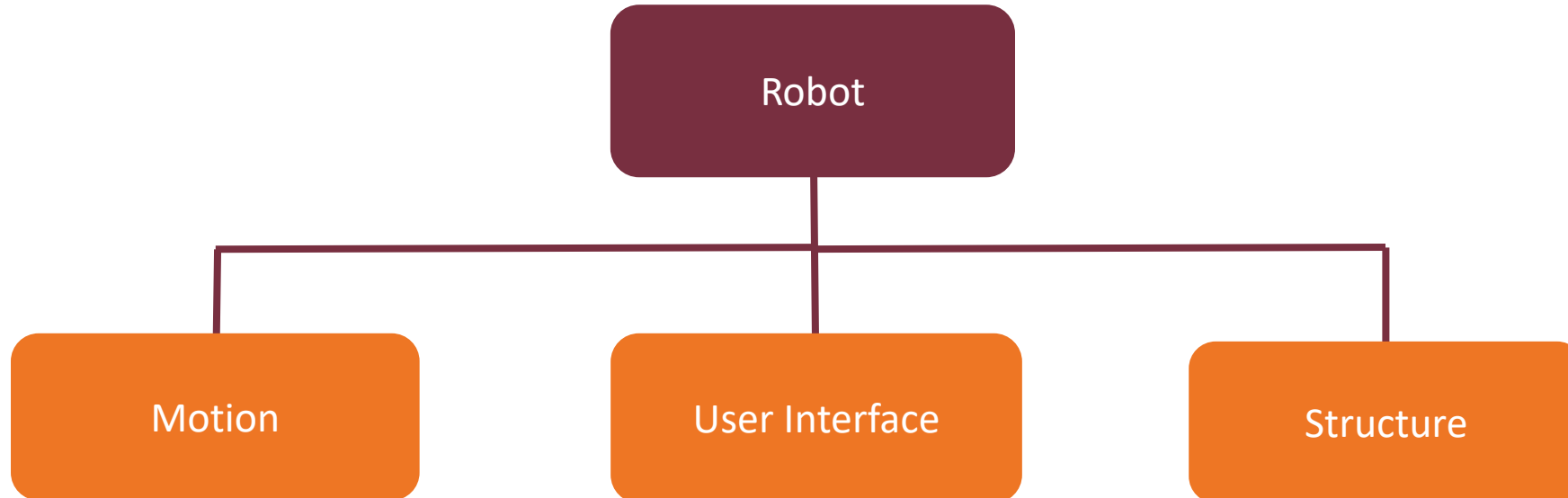
Use in multiple locations



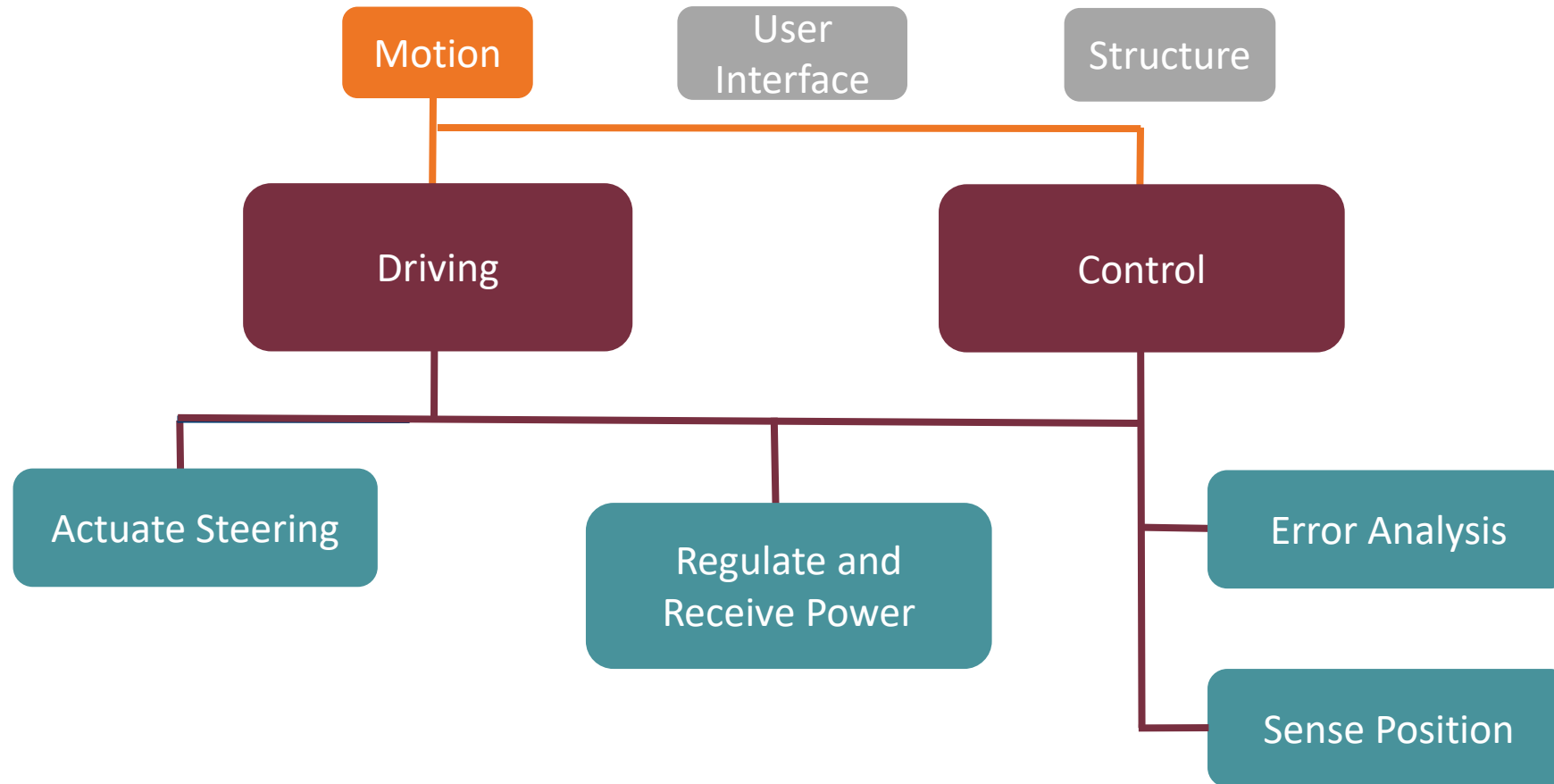
Customizable, well-displayed output that transitions continuously from an input to an output



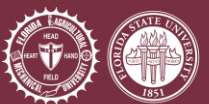
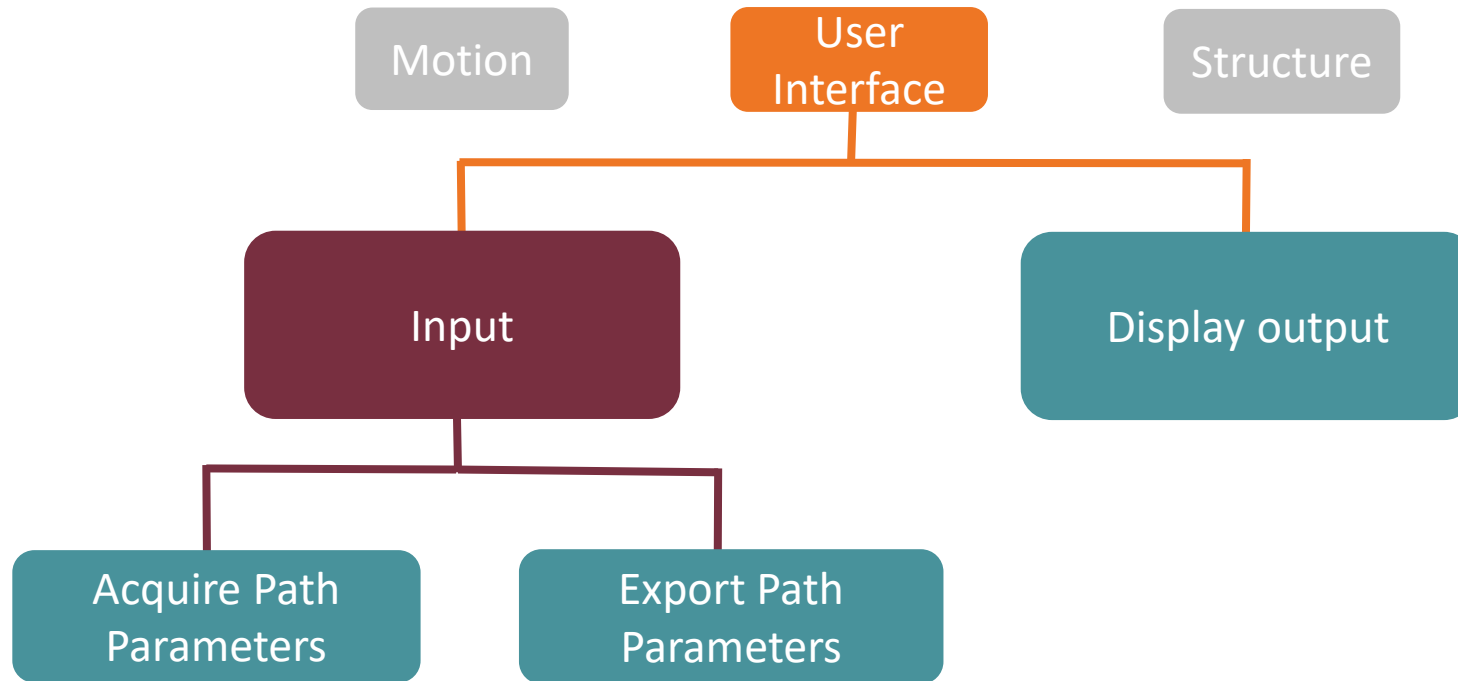
Functional Decomposition



Critical Functions



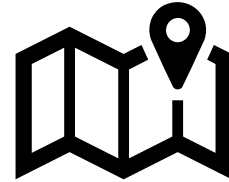
Critical Functions



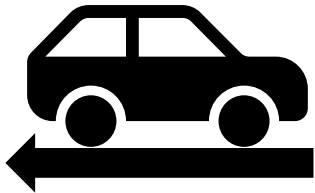
Target and Metrics



Voltage:120V



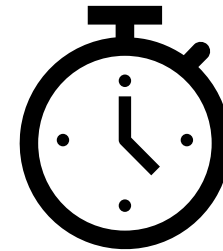
Translation Measurement: $\pm 0.05\text{in}$
Output error: $\pm 0.1\text{in}$



Friction Coefficient: 0.215

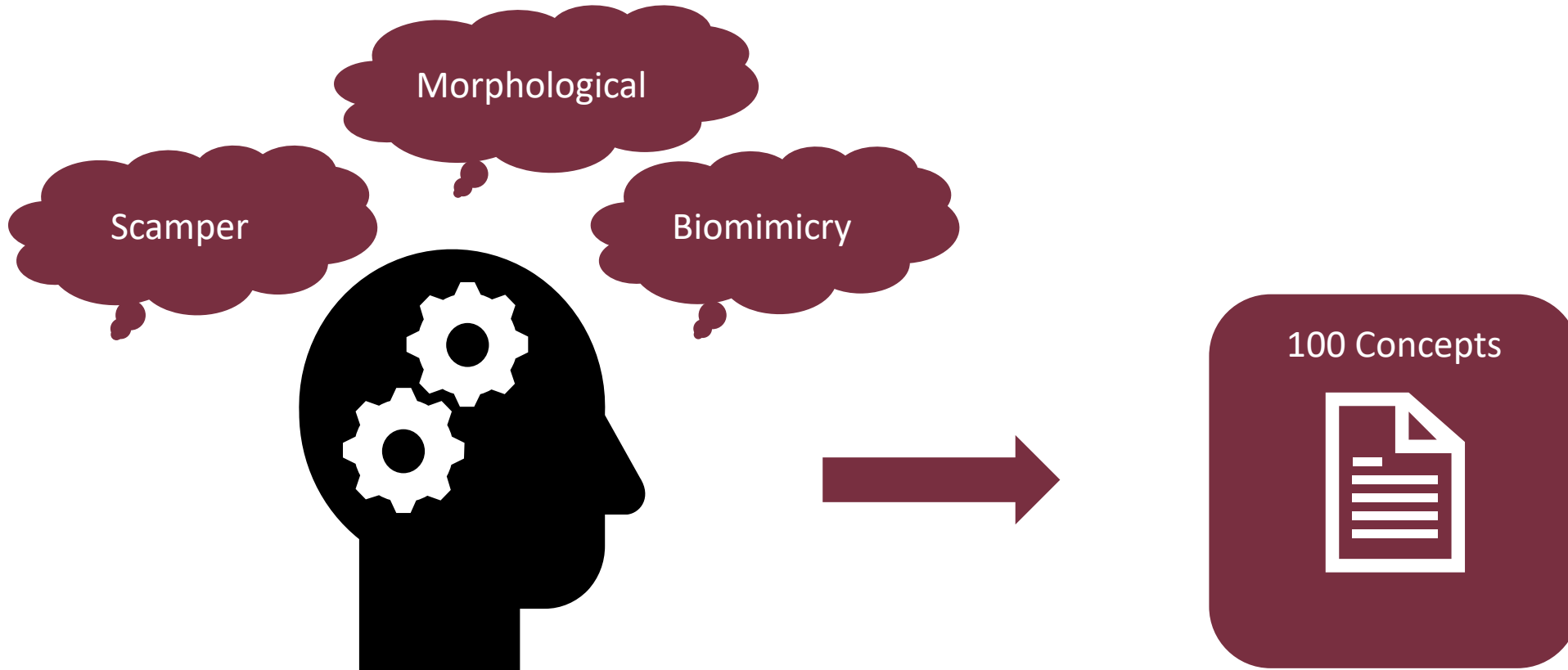


Display area: 8.5in x 11in



Desired completion time: 60sec
Time Delay: 0.5-1 sec

Concept Generation



Medium Fidelity

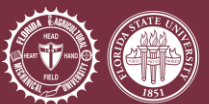
Projectile Trajectory Game(Button-Controlled)

Racecar Game(Potentiometer)

Projectile Trajectory Game PID Control

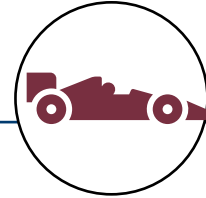
Roller Coaster Potential Energy Study

Gridded Paper Curve Plotting

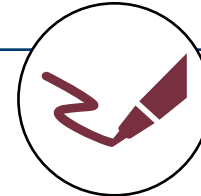


High Fidelity

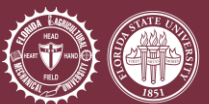
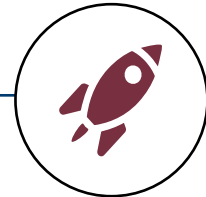
Optimal Path Simulation for Racecar Game



Long Exposure Drawing



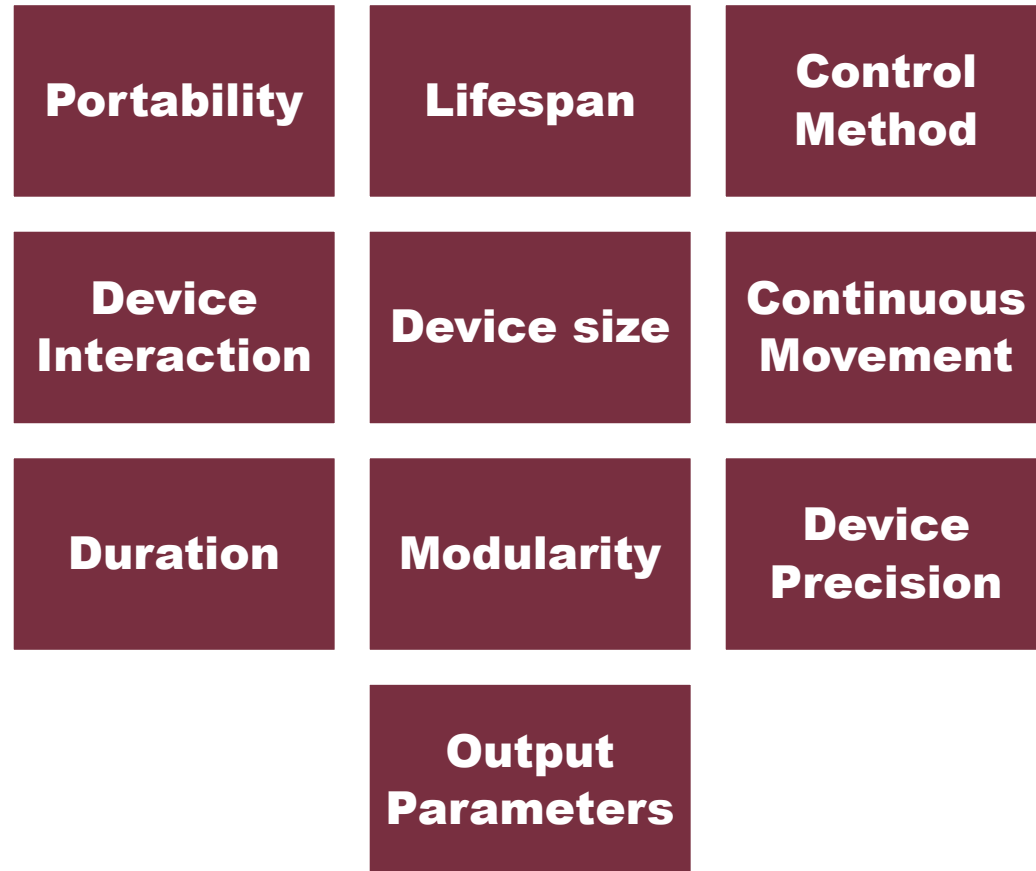
Projectile Trajectory



Concept Selection

Binary Pairwise Comparison

Customer Requirements



Concept Selection

House of Quality

Customer Requirements

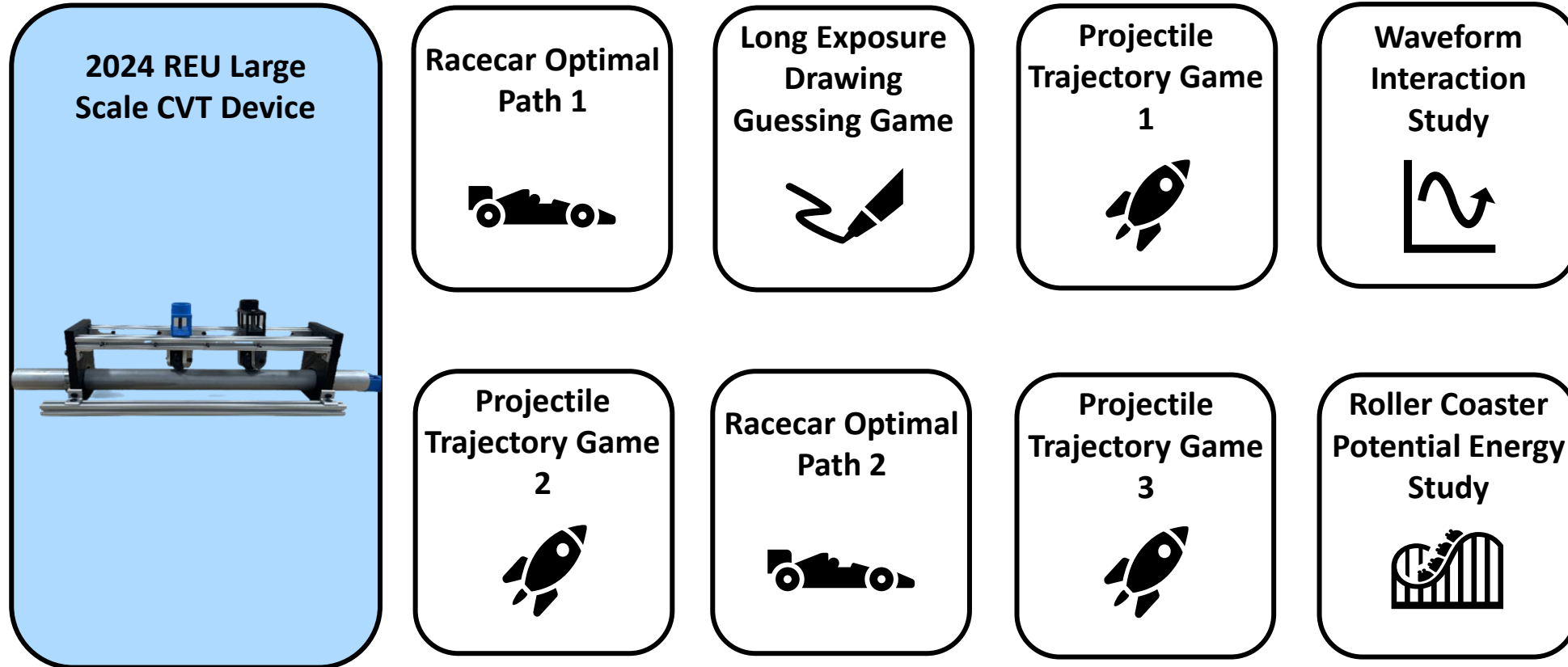


- Engineering Characteristics
- Position Accuracy
 - Actuation Capability
 - Structure Integrity
 - Display Size
 - Device Size
 - User Response Time
 - Power
 - Weight



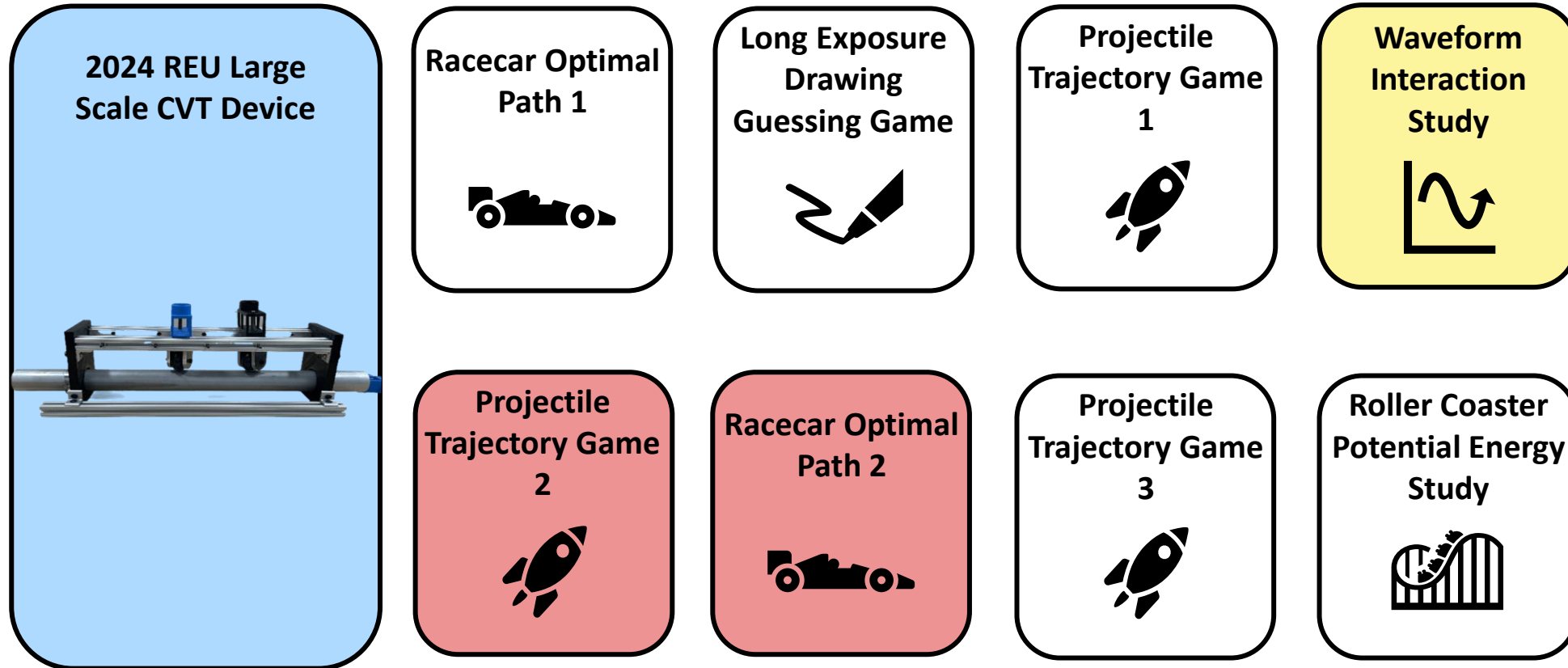
Concept Selection

Pugh Chart: 1st Iteration



Concept Selection

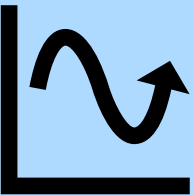
Pugh Chart: 1st Iteration



Concept Selection

Pugh Chart: 2nd Iteration

Waveform Interaction Study




Racecar Optimal Path 1




Long Exposure Drawing Guessing Game




Projectile Trajectory Game 2



Projectile Trajectory Game 3



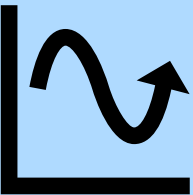
Roller Coaster Potential Energy Study




Concept Selection

Pugh Chart: 2nd Iteration

Waveform Interaction Study




Racecar Optimal Path 1



Long Exposure Drawing Guessing Game




Projectile Trajectory Game 2



Projectile Trajectory Game 3



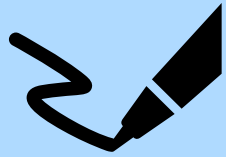
Roller Coaster Potential Energy Study



Concept Selection

Pugh Chart: 3rd Iteration

Long Exposure
Drawing
Guessing Game



Racecar Optimal
Path 1



Projectile
Trajectory Game
2



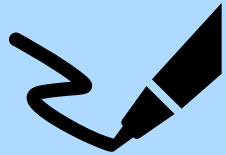
Roller Coaster
Potential Energy
Study



Concept Selection

Pugh Chart: 3rd Iteration

Long Exposure
Drawing
Guessing Game



Racecar Optimal
Path 1



Projectile
Trajectory Game
2



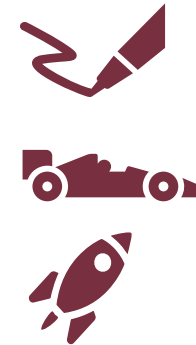
Roller Coaster
Potential Energy
Study



Concept Selection

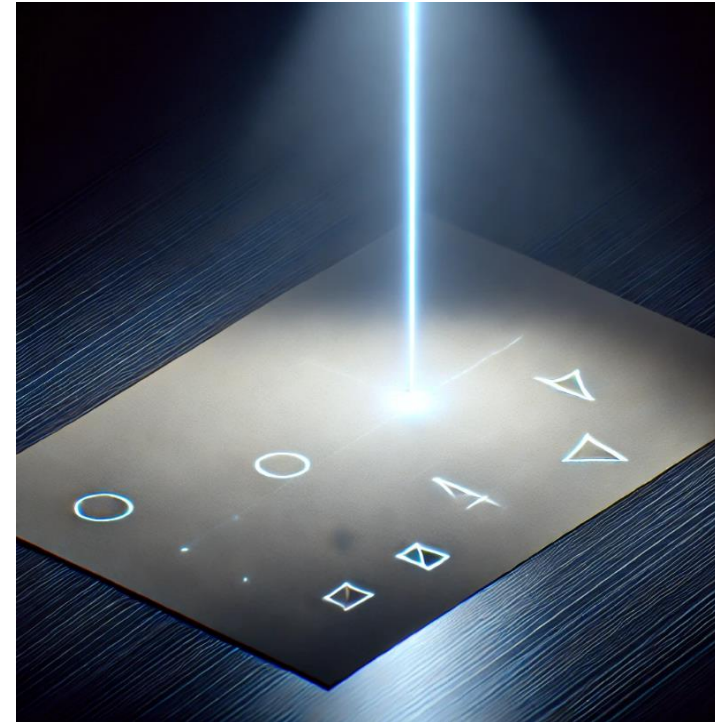
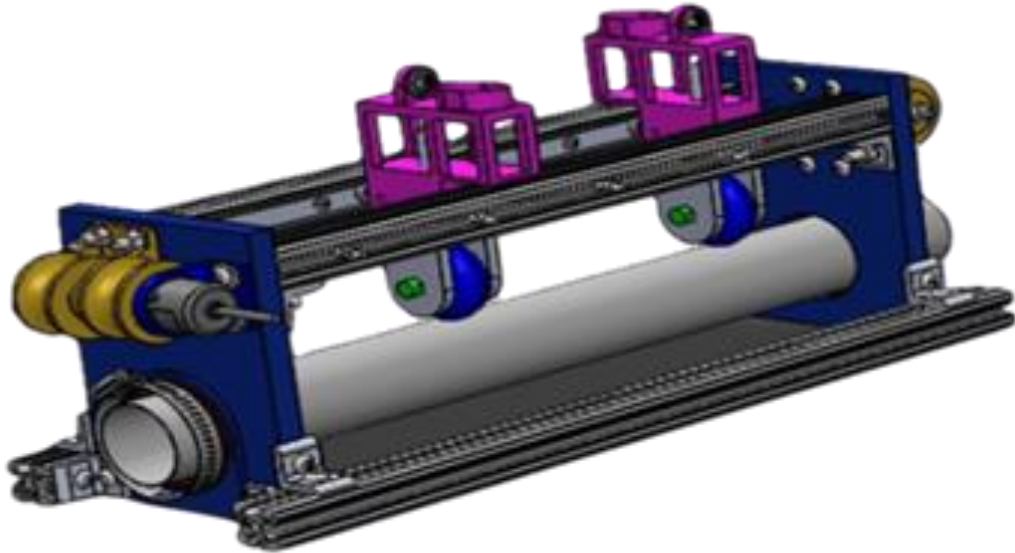
Analytical Hierarchy Process

Alternative Value Matrix	
	Alt. Value
Concept 2	0.489
Concept 1	0.181
Concept 3	0.331
Sum	1

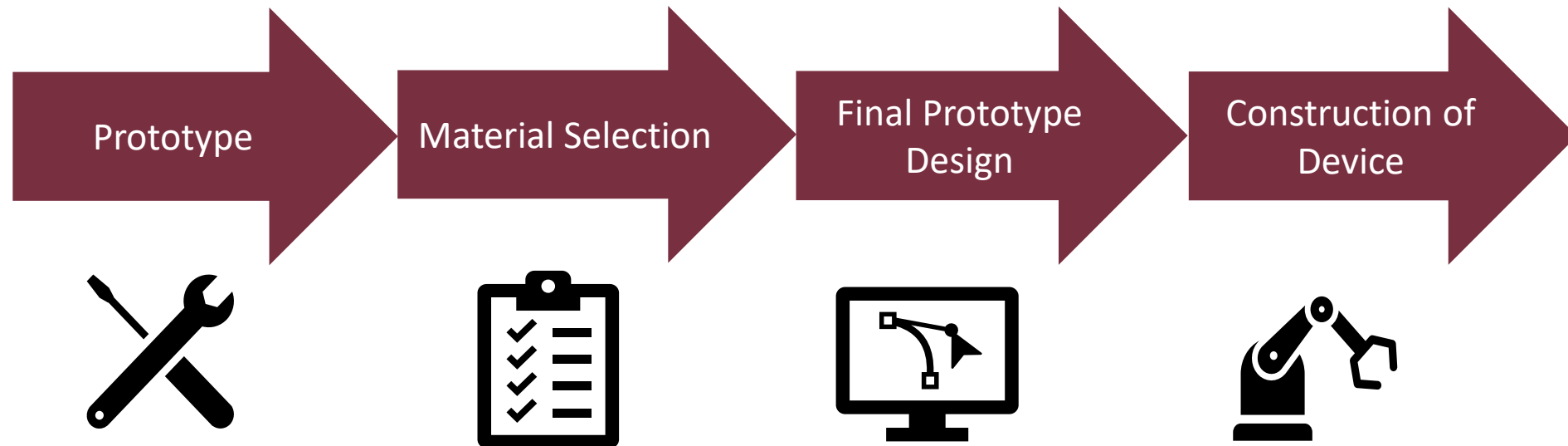


Concept Selection Final Selection

- Long Exposure Drawing Guessing Game



Future and Beyond



Back Up Slides

The Future and Beyond



Concept Selection

Pugh Chart: 1st Iteration

Pugh Chart 1									
Engineering Characteristic	2024 REU Large-scale CVT Device	Concept							
		1	2	3	4	5	6	7	8
User Response Time	Datum	+	+	+	-	+	+	+	+
Device Size		+	+	+	+	+	+	+	+
Display Size		-	+	-	-	-	+	-	+
Position Accuracy		+	+	+	+	+	-	+	-
Actuation Capability		+	-	+	S	S	-	+	-
Structural Integrity		S	+	+	S	-	-	+	S
Weight		-	-	-	S	-	-	-	S
Power		-	-	S	S	-	-	S	S
Total Pluses		4	5	5	2	3	3	5	3
Total Minuses		3	3	2	2	4	5	2	2



Font Check

- This is 10-point
- This is 15–point Times
- This is 20–point
- This is 25–point
- This is 30–point
- This is 35–point
- This is 40–point
- This is 50–point
- This is 60–point

