FAMU-FSU College of Engineering

Virtual Design Review 6
Team 510 – Danfoss IGV

03/19/2024

Team Overview

Joseph Bechara
Controls Engineer

Hunter Dabbs
Systems Engineer

Tye Fountain
Mechanical Design Engineer

Thiago Todesco
Manufacturing Engineer

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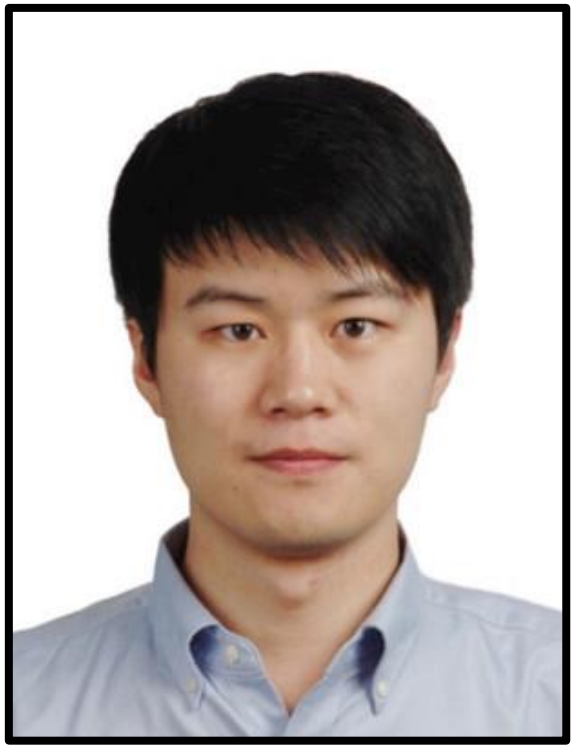
Sponsor and Advisor



Engineering Mentor
Yiwei Liu
Manufacturing Engineer

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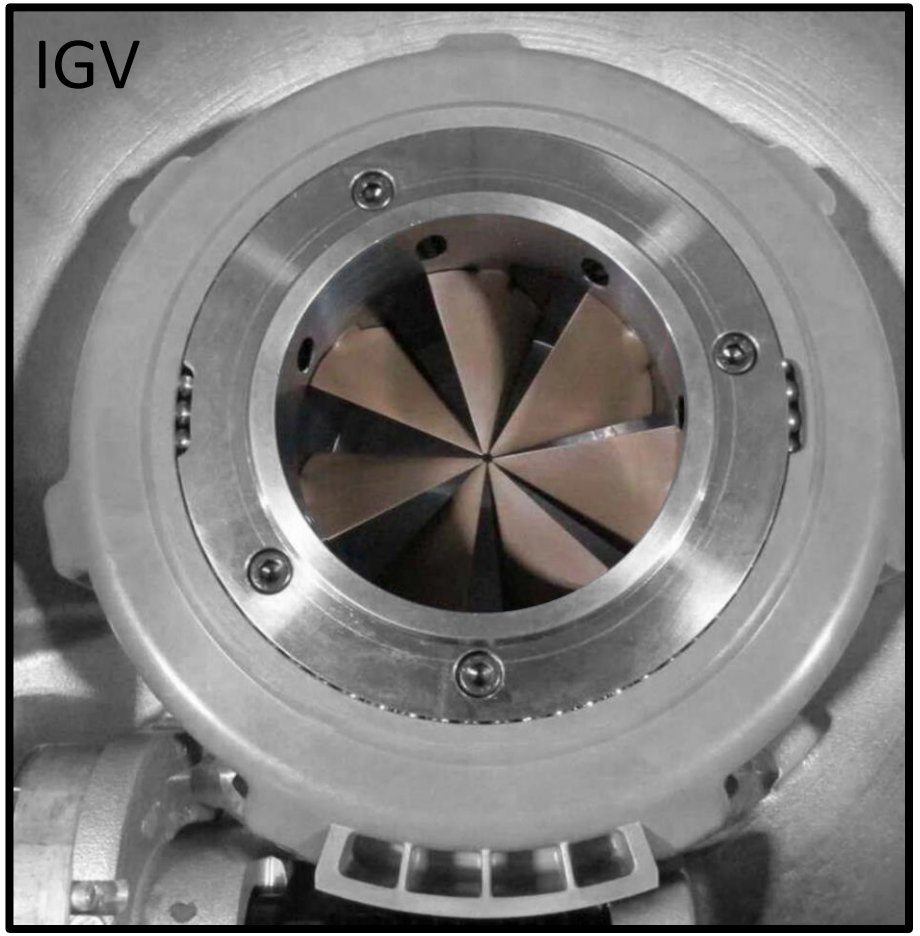
Objective

Develop an apparatus that tests the functionality of four different Danfoss Inlet Guide Vanes (IGVs), giving relevant data and prompting the operator with a pass or fail message.



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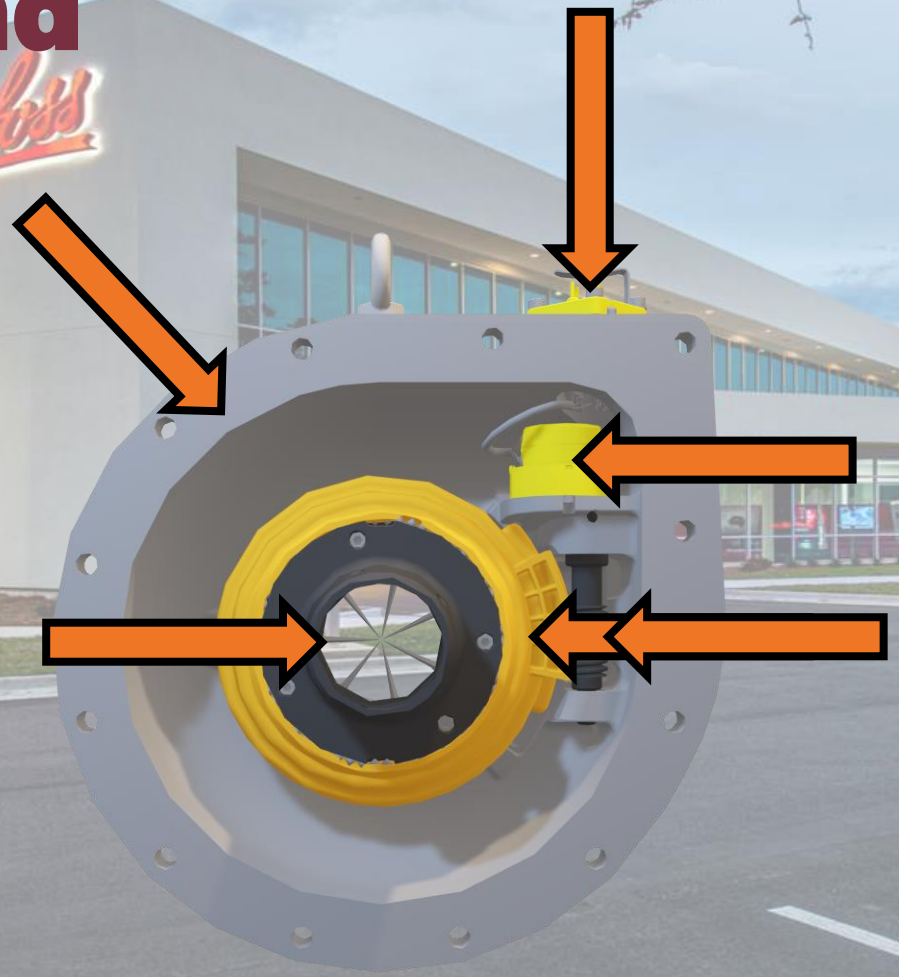
Background



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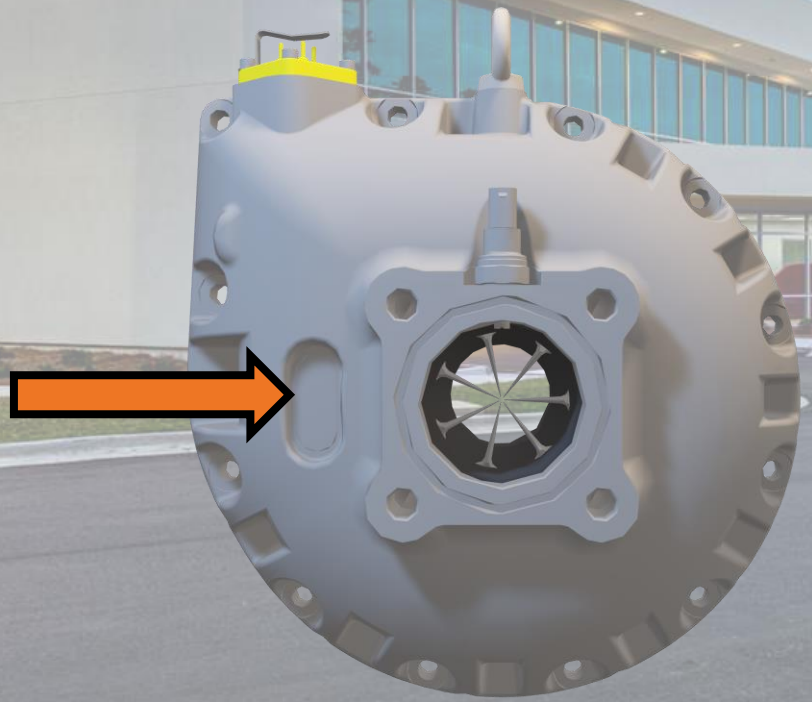
Background



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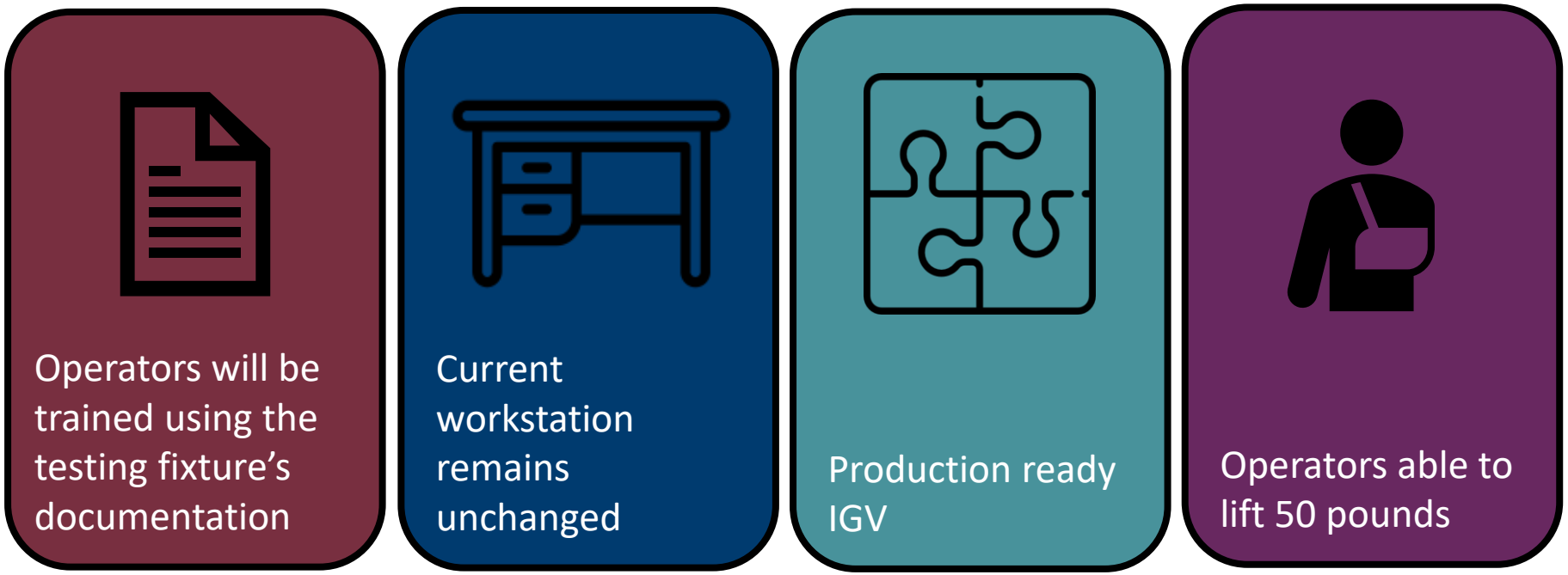
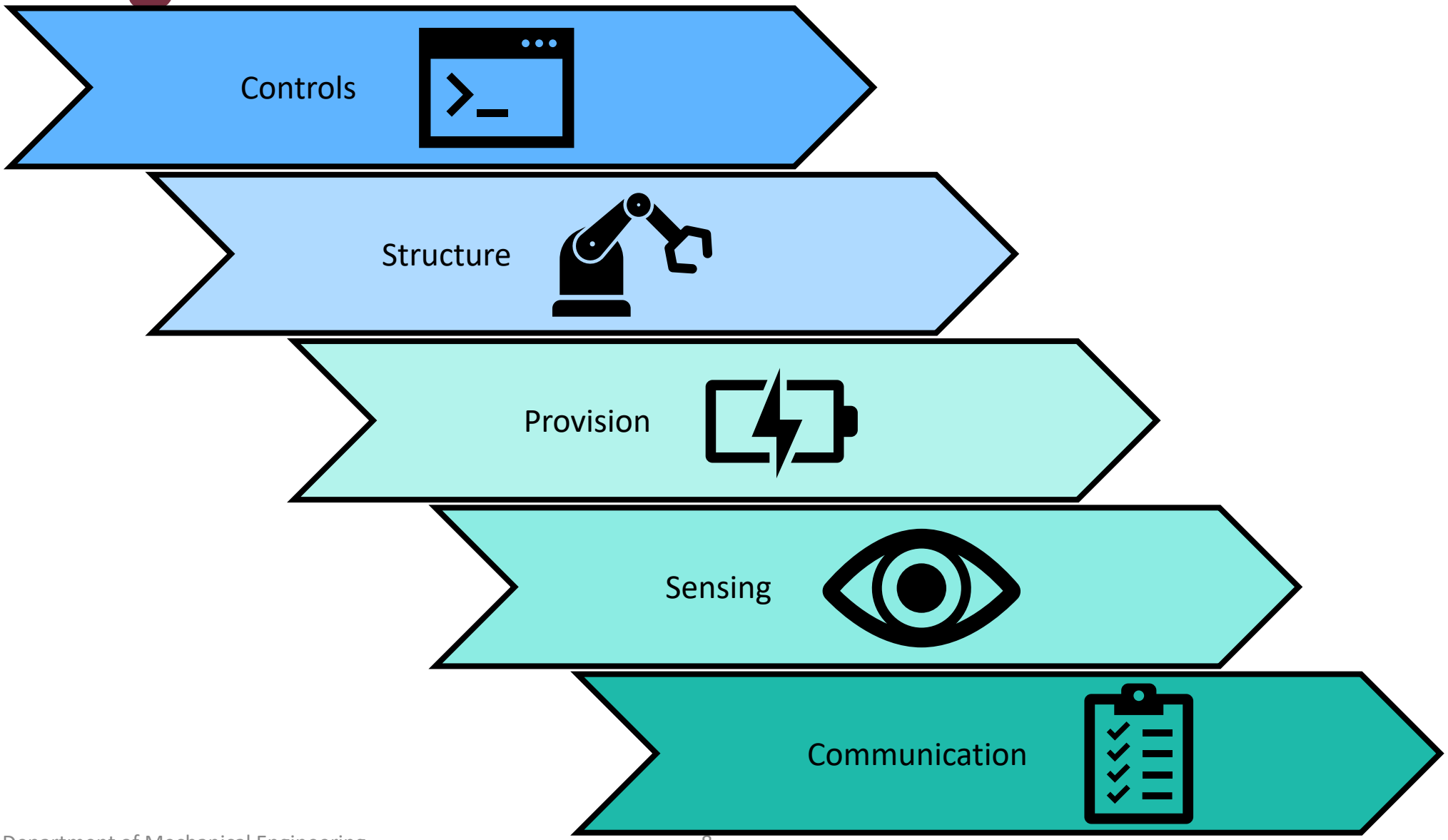
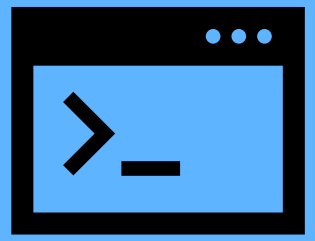
Assumptions



Targets and Metrics

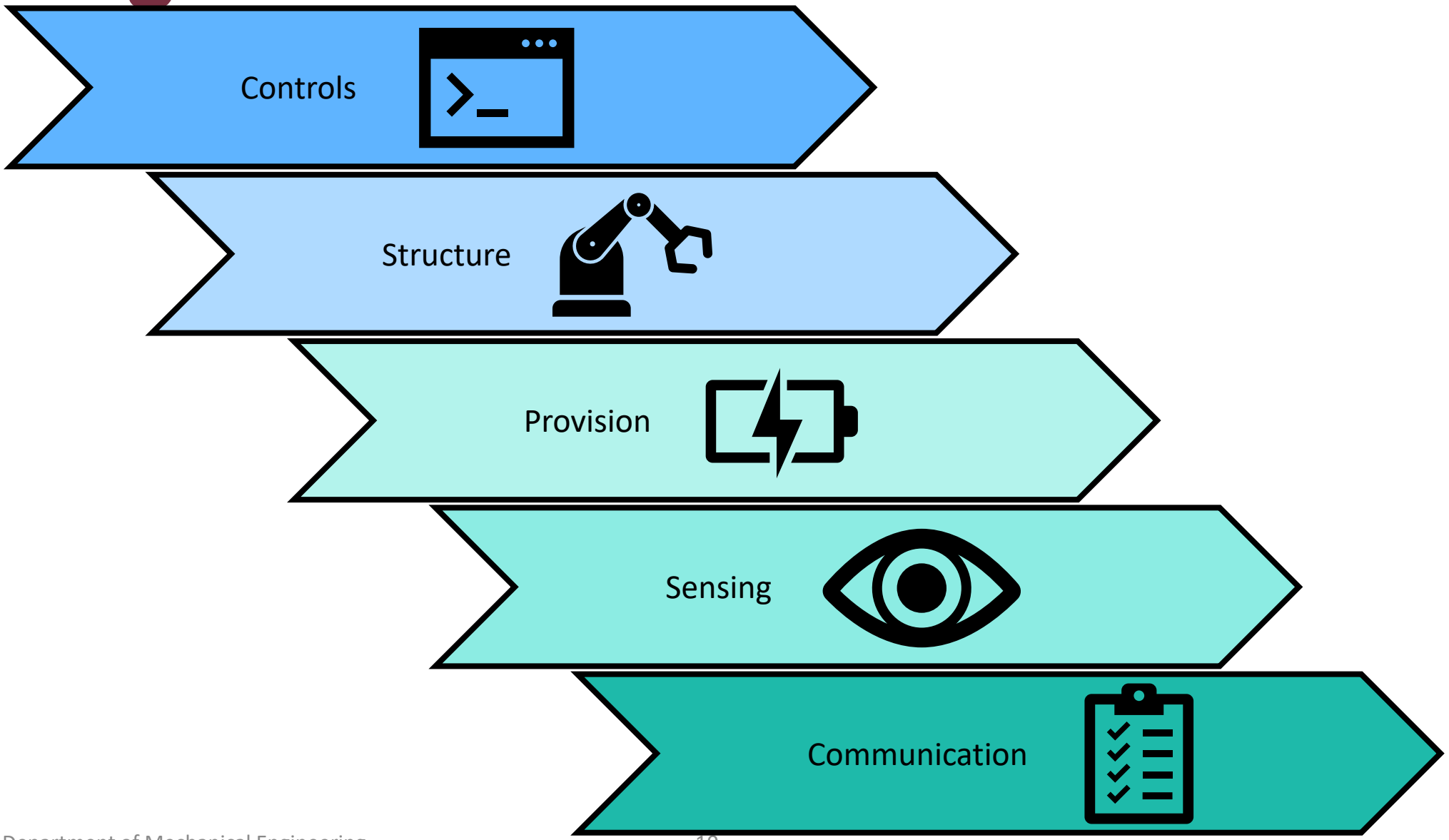


Controls

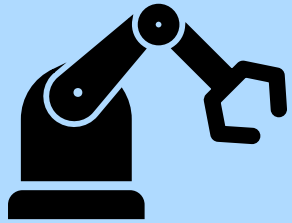


Test Status	Binary: 0/1
Blade movement restriction	Time: 15 seconds
Test Resolution	Binary: 0/1

Targets and Metrics



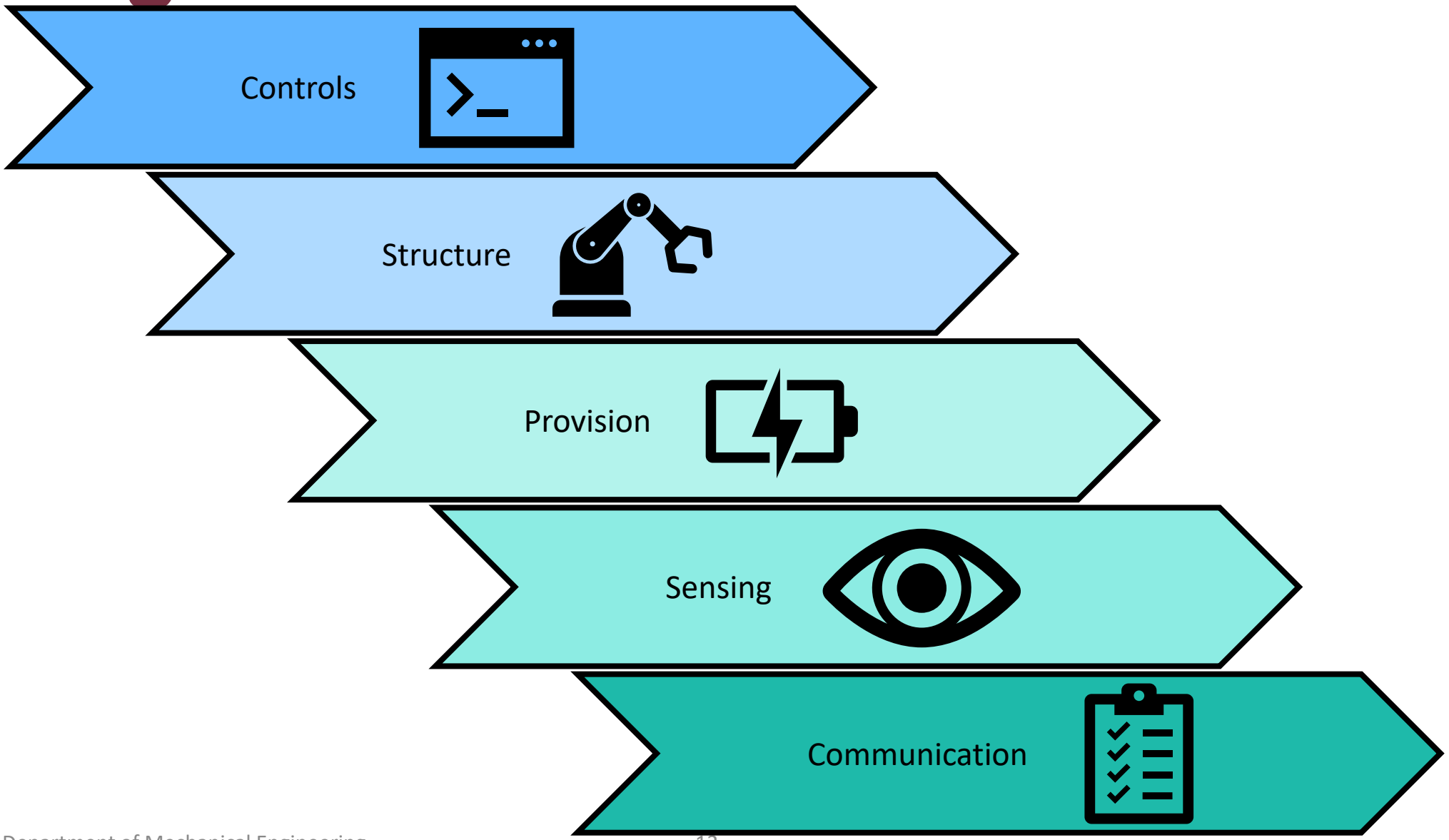
Structure



Structure Resistance → 15 Newtons Impact

Structure Stability → 15 Newtons Impact

Targets and Metrics

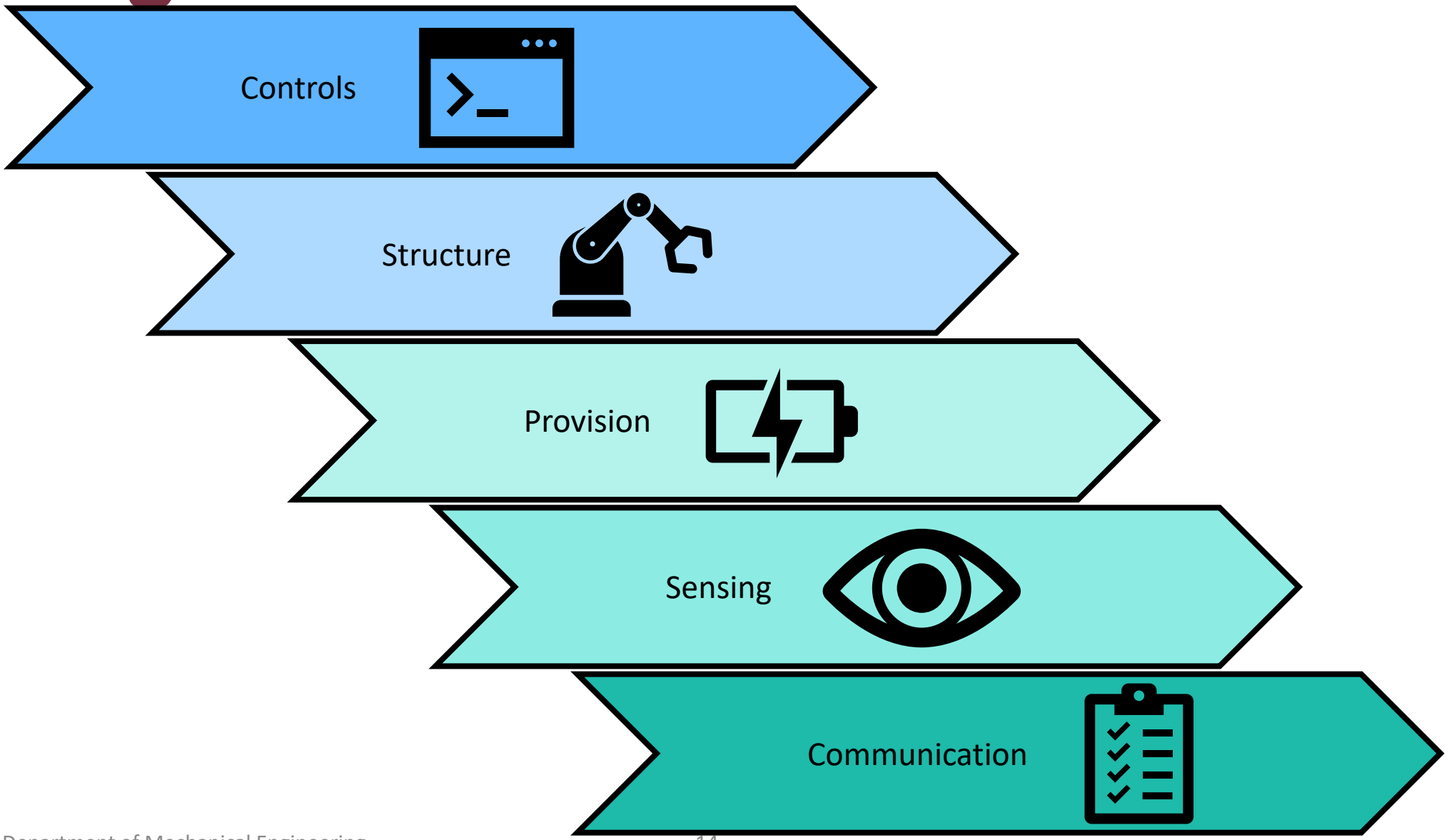


Provision

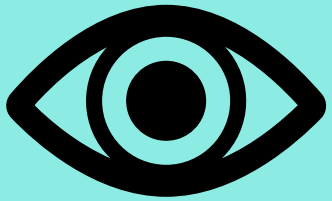
Supply Power to IGV Motor/Lasers → 24 Volts

Supply Power to Arduino → 5 Volts

Targets and Metrics

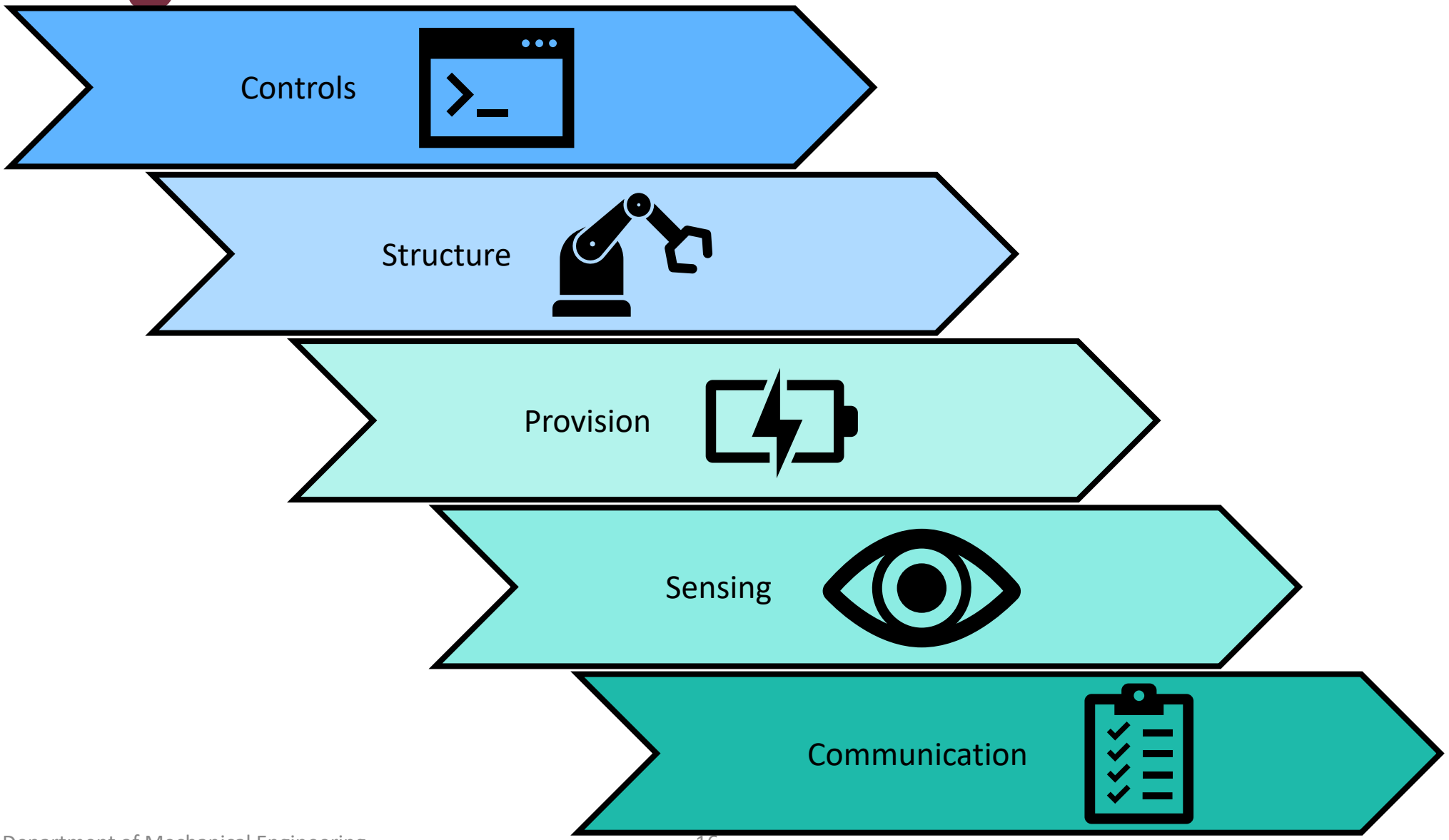


Sensing



Ball Indicator Location Movement	Binary: 0/1
Blade Open/Close	Binary: 0/1
IGV Model	Color

Targets and Metrics

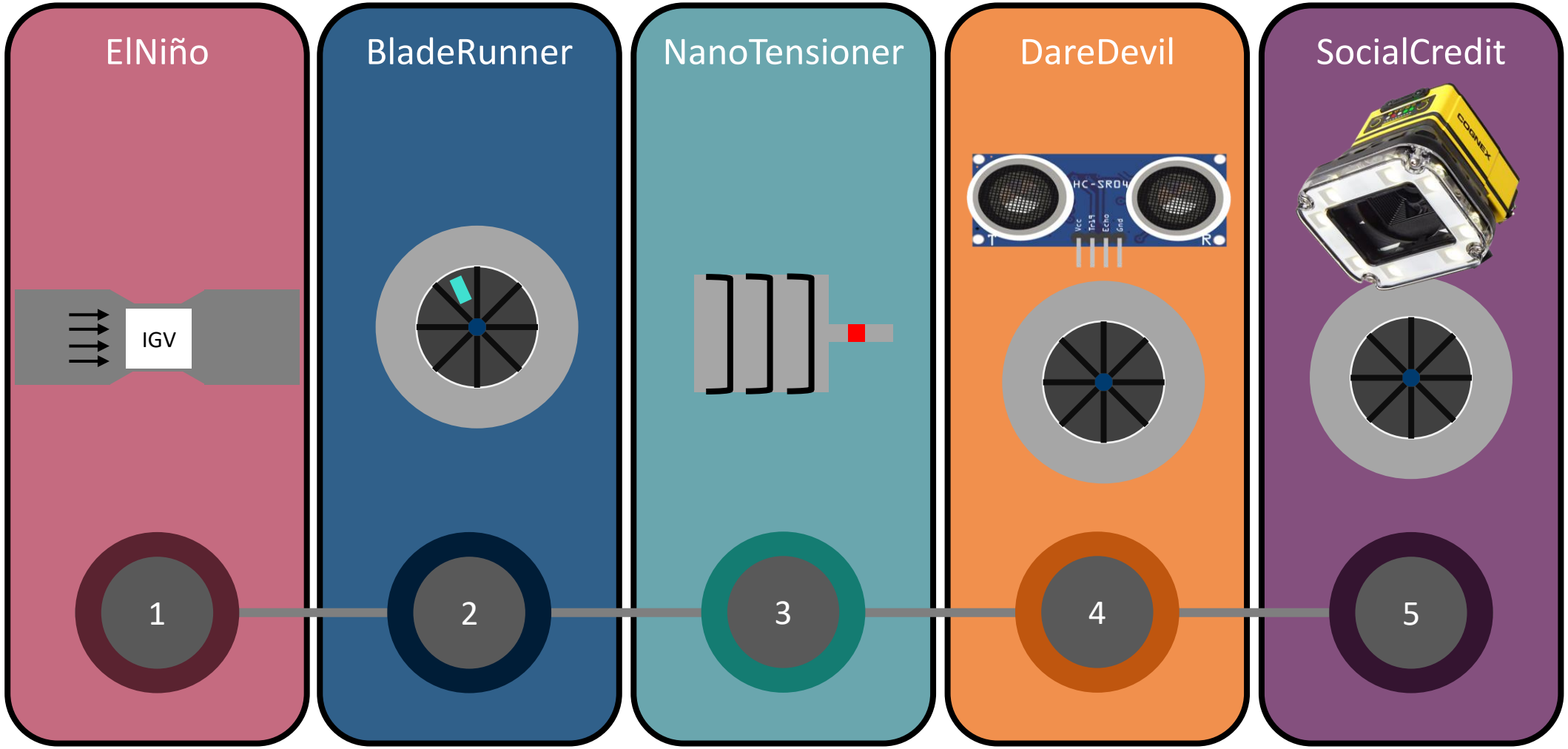


Communication

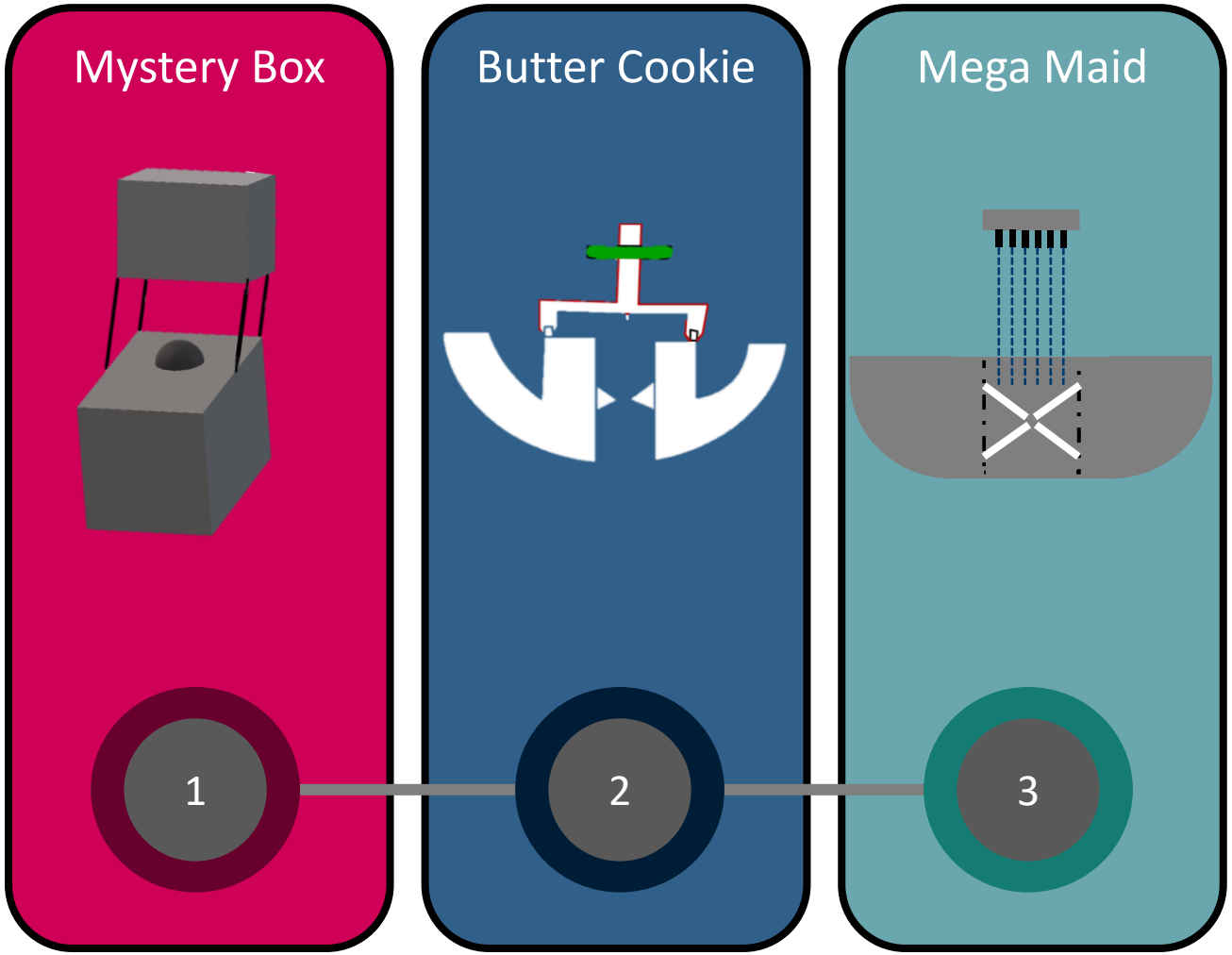
Receive Inputs From the User → Binary: 0/1

Indicate Results to the User → Binary: 0/1

Medium Fidelity Concepts

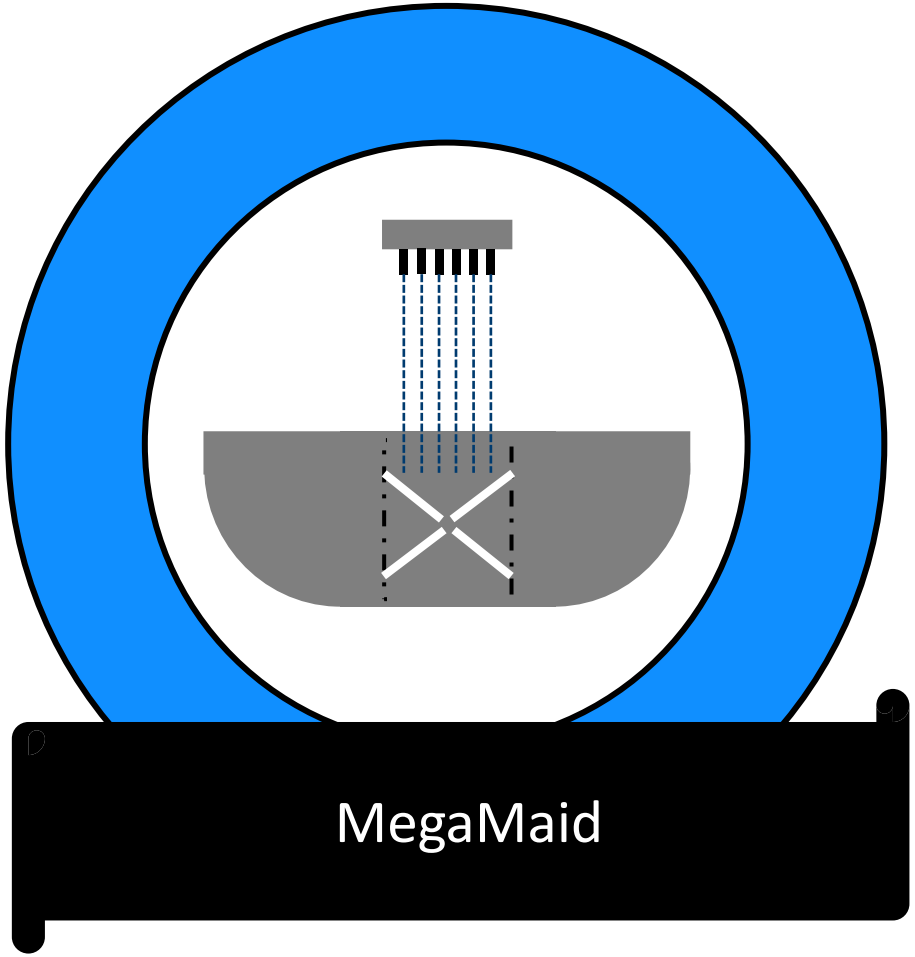


High Fidelity Concepts



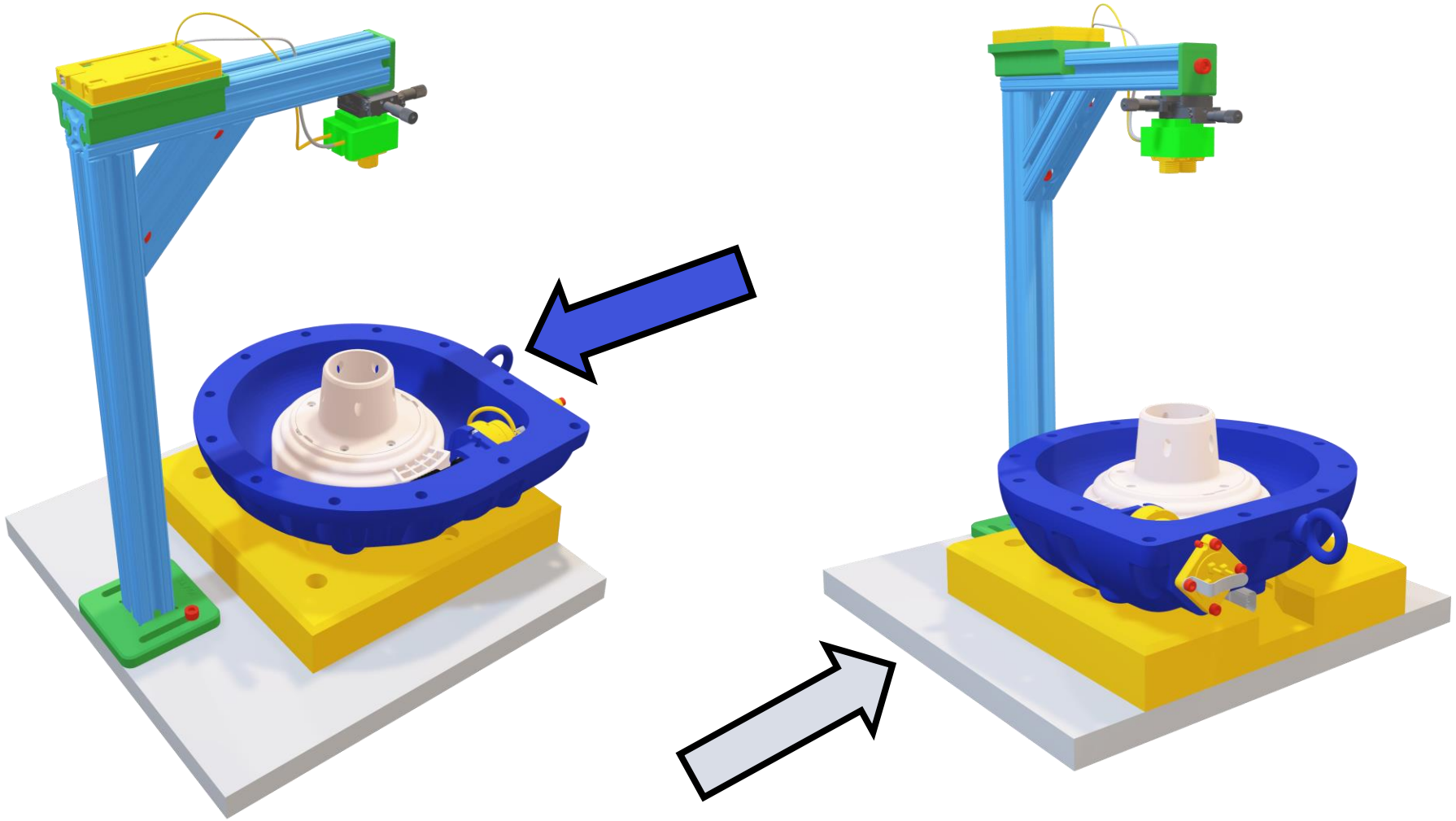
Concept Selection Overview

Final Selection



- Stable design
- Accurate and precise
- Fast
- Durable

Current Design

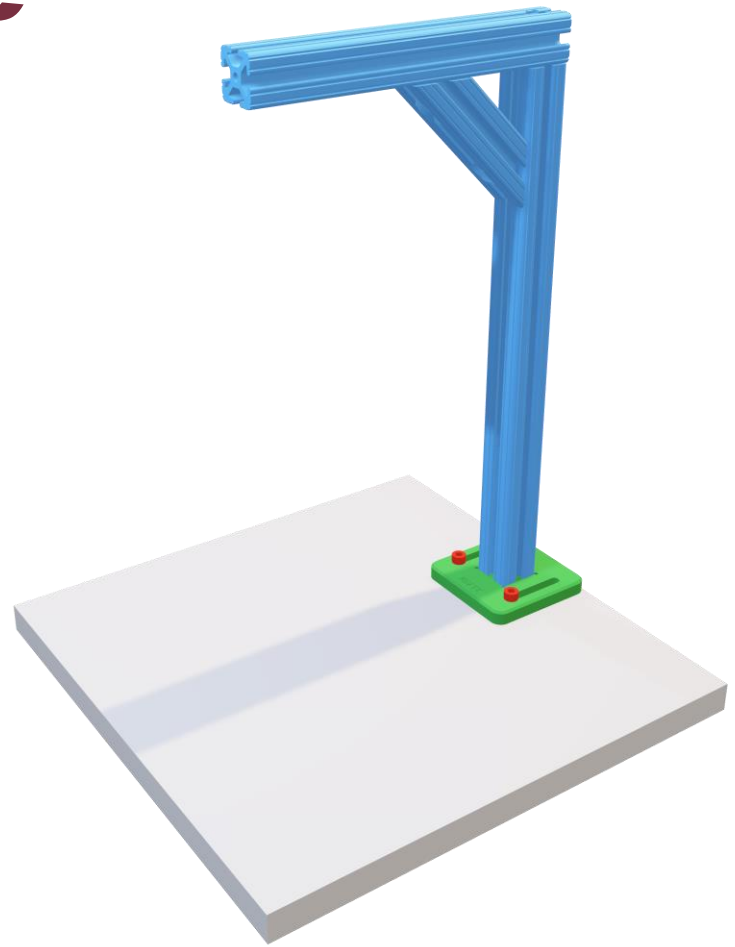


Current Design
Baseplate

- Utilize Existing Baseplate

Current Design
Structural Frame

- 80/20 Aluminum
- Test Plate
- Workstation Table

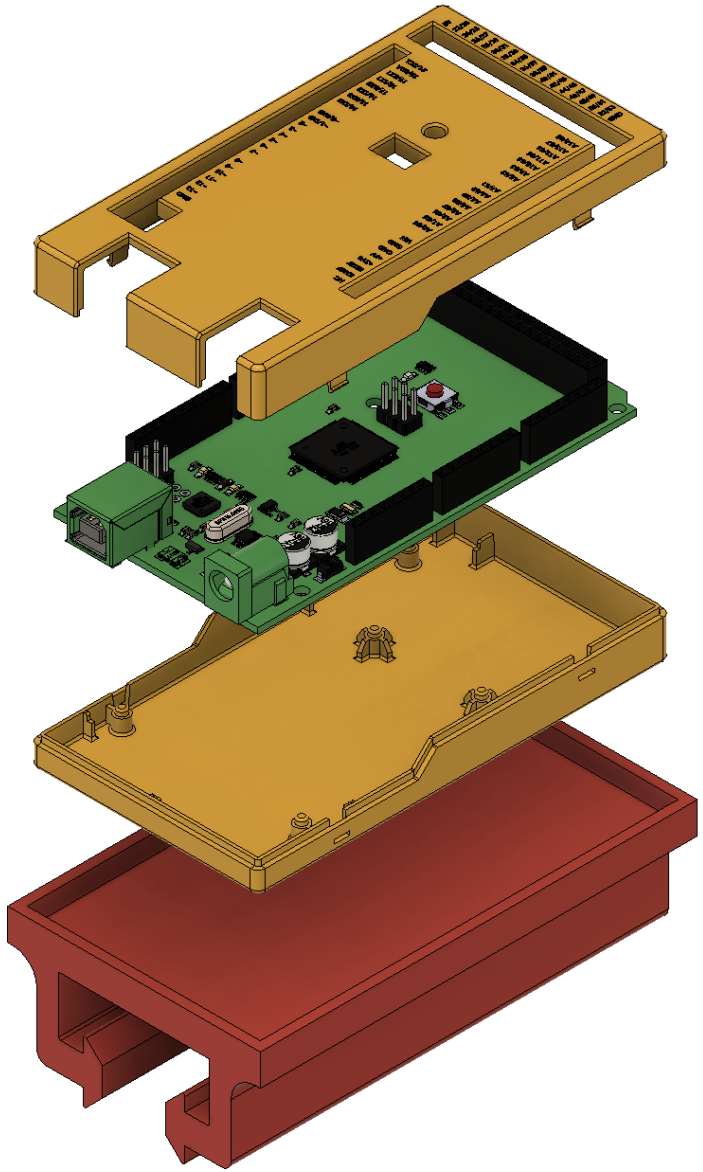


Current Design
Test Plate

- Test Plate
- M8 Screws

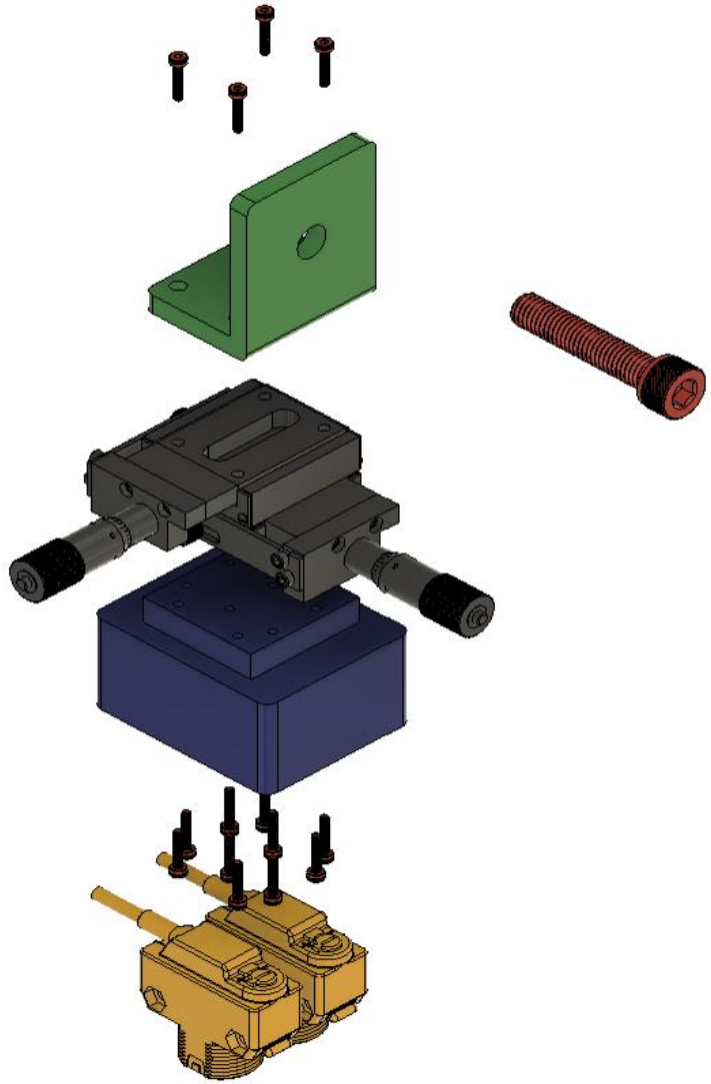
Current Design
Arduino Case

- 80/20 Hardware
- Arduino Protection Case
- Arduino



Current Design
Laser Positioning

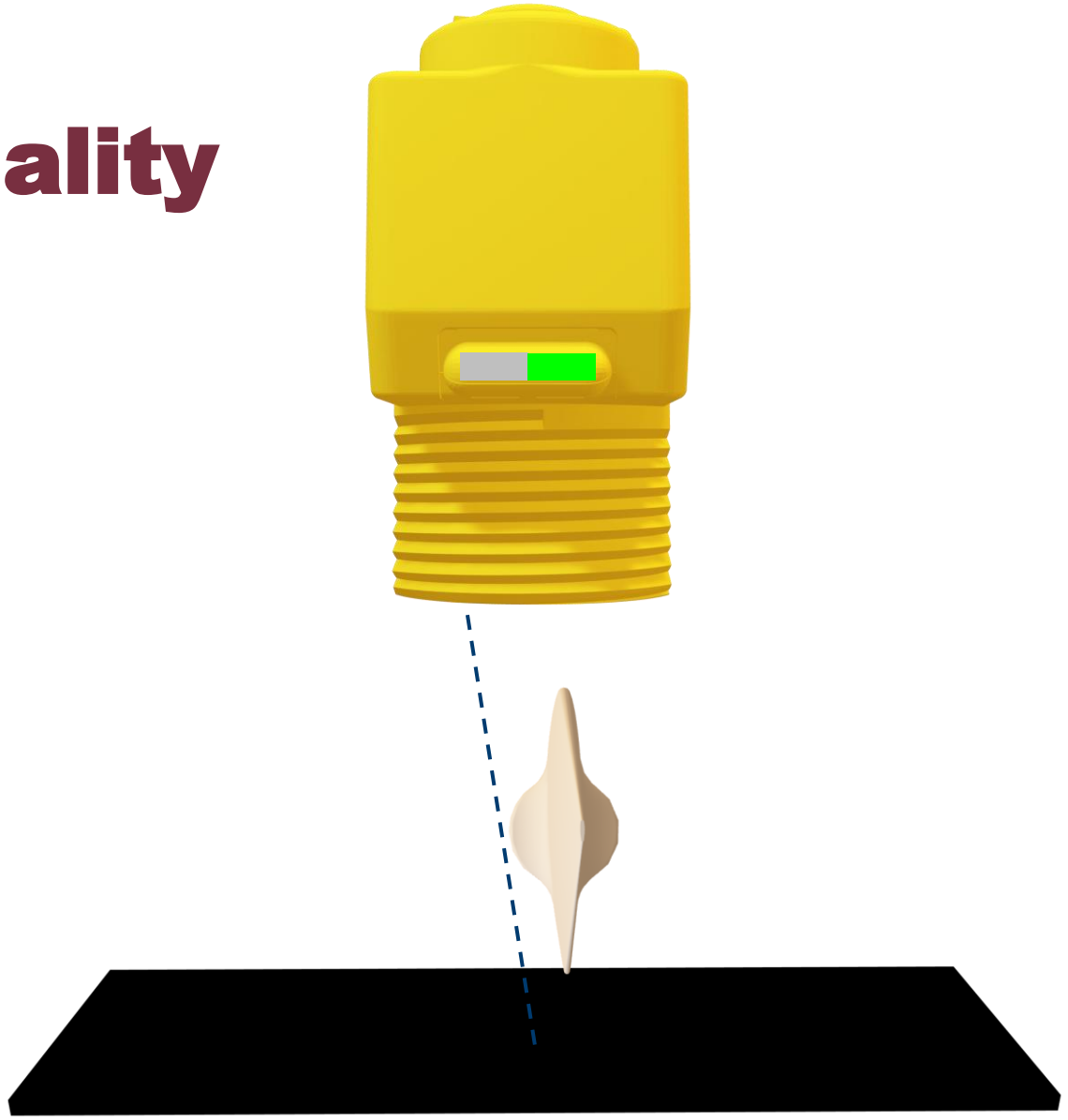
- Screws
- 80/20 Hardware
- X-Y Positioning axis
- Laser Hardware
- Laser



Current Design
Blade Functionality

Laser Receiver Status

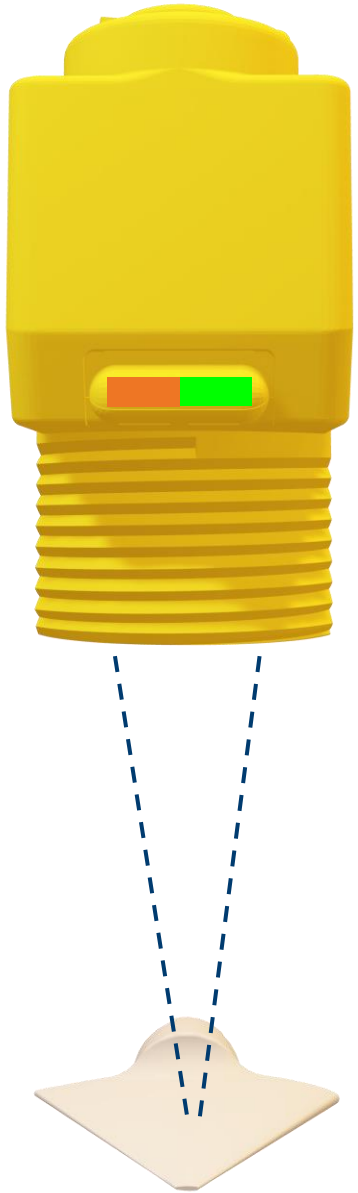
Black Tape



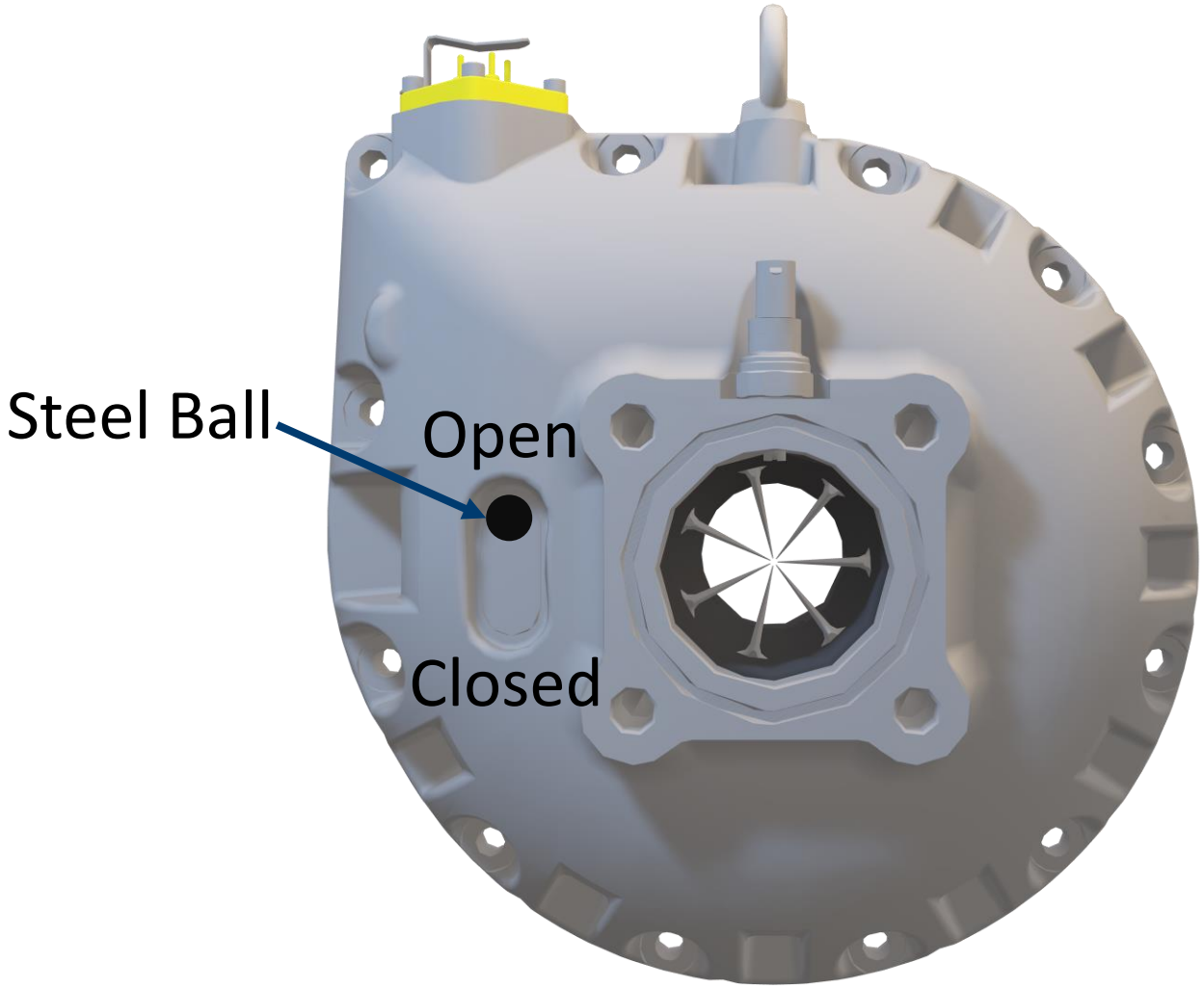
Current Design
Blade Functionality

Laser Receiver Status

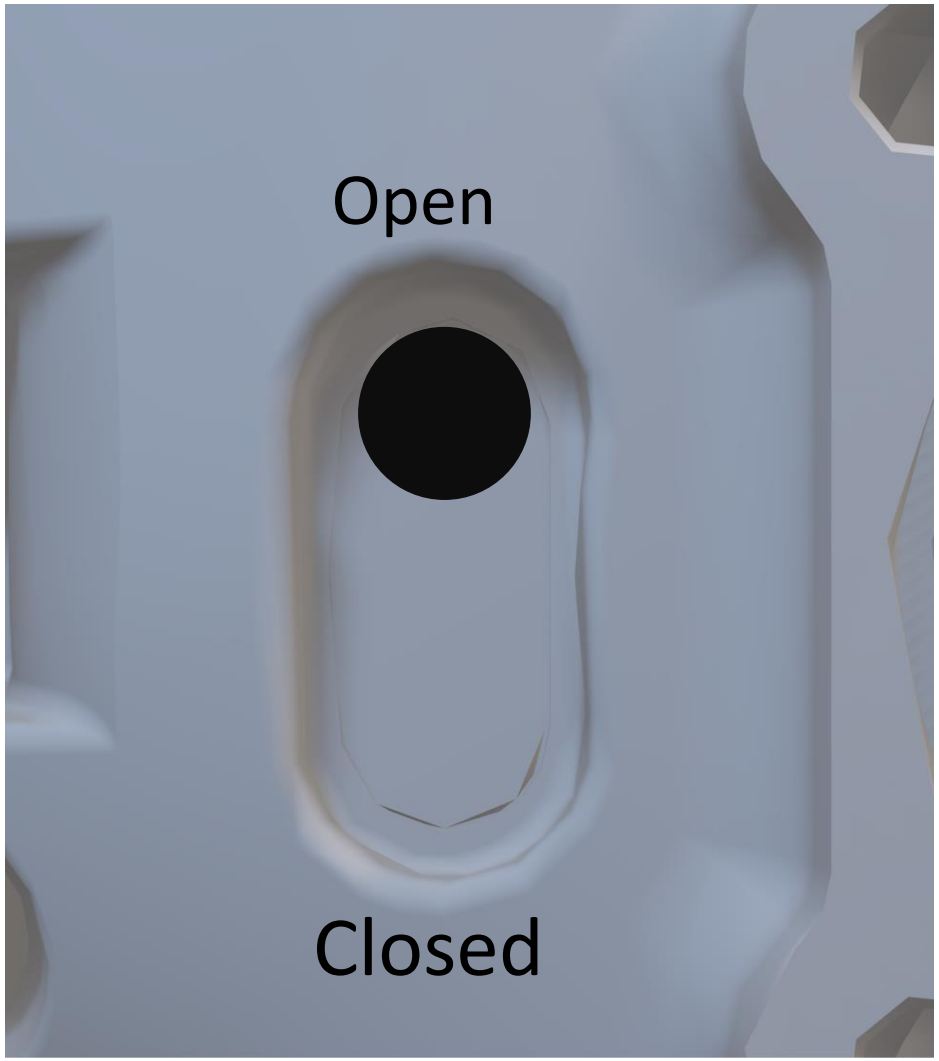
IGV Blade



Current Design
Steel Ball Tracking

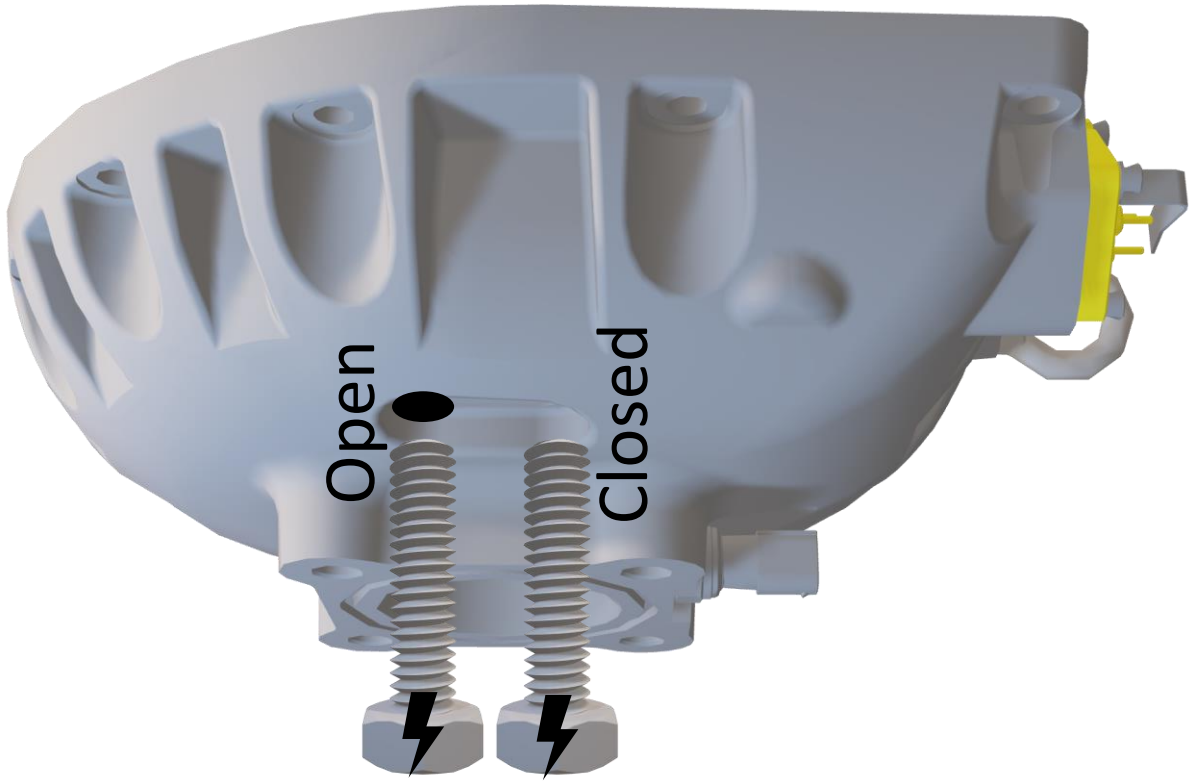


Current Design
Steel Ball Tracking



Current Design
Steel Ball Tracking

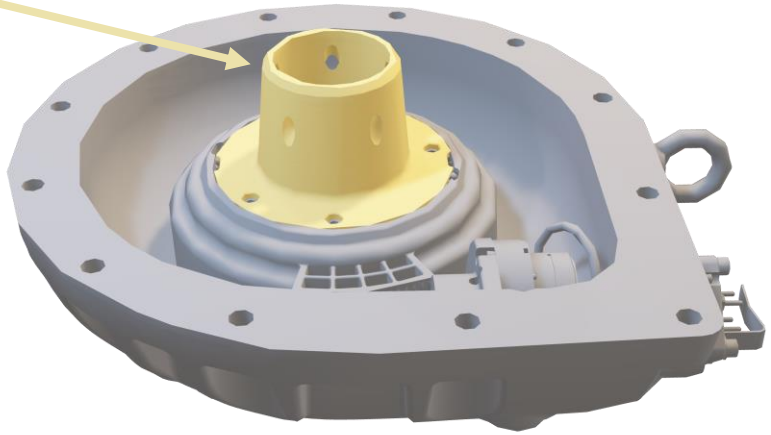
- The ball moves relative to the blades
- Magnetic flux is tracked as the ball moves



Tracking IGV Model

Color Sensor

IGV



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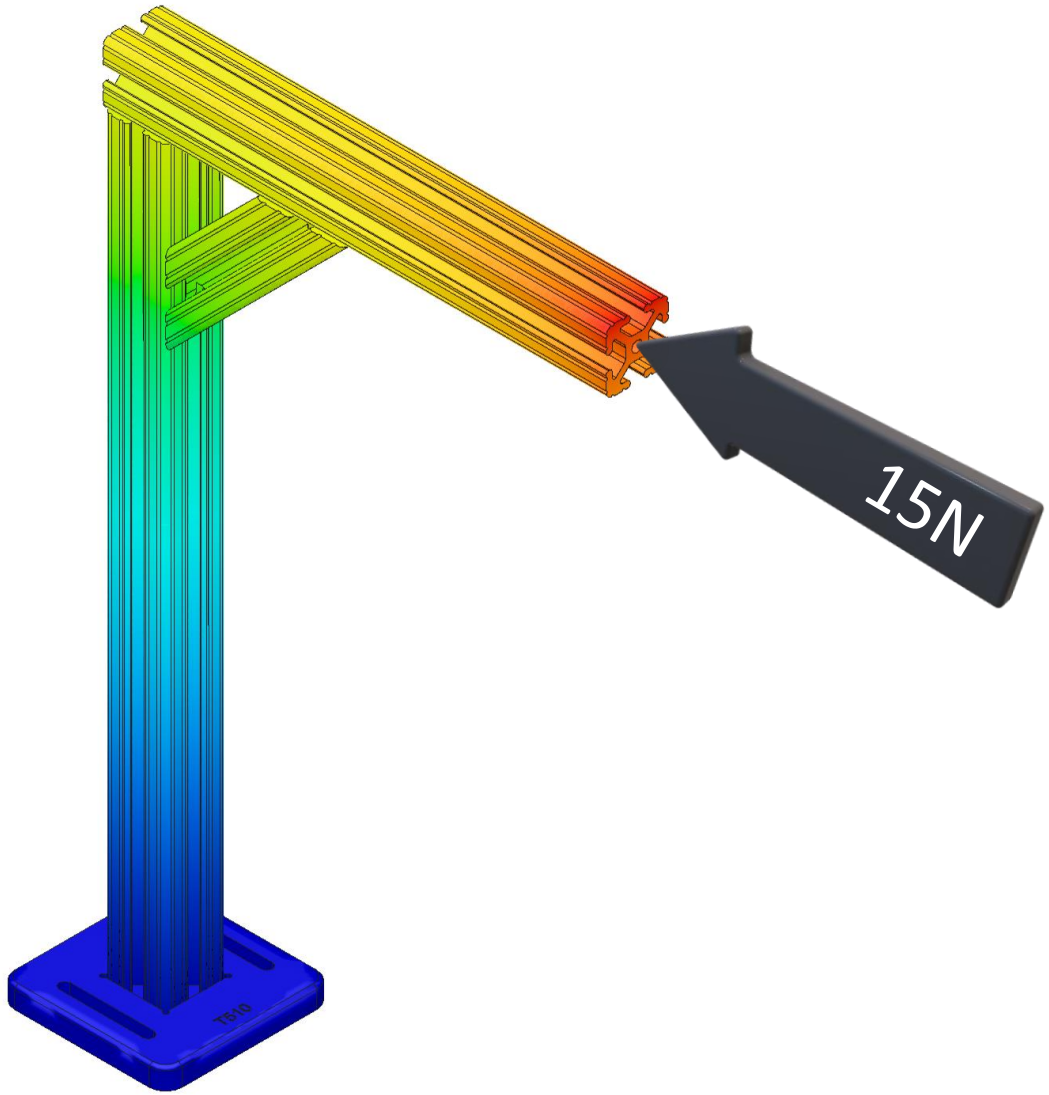
Testing In Progress

FEA Analysis

	Displacement (mm)
	0.00
	0.03
	0.06
	0.08
	0.10



Testing and Validation

Tests Conducted

Laser Testing

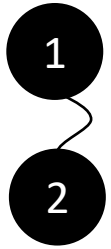
Measure: 0/1

Color Sensor

Measure: Color

Motor Movement

Time: 1 minute



Steel Ball Indicator Location

Measure: 0/1

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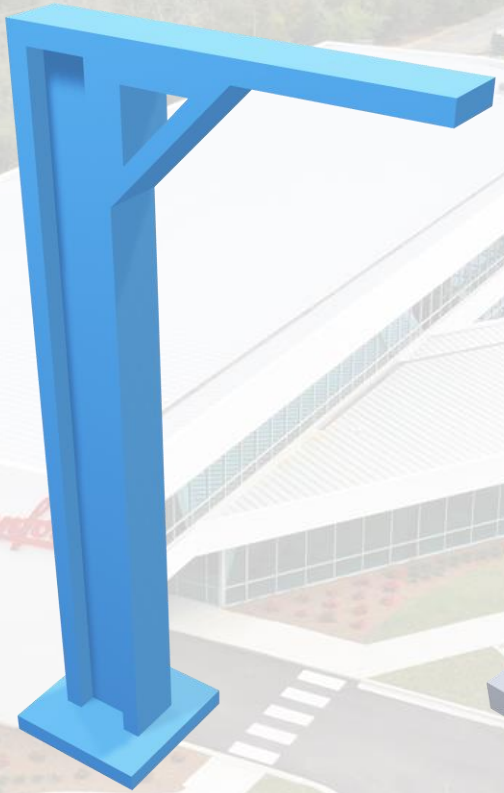
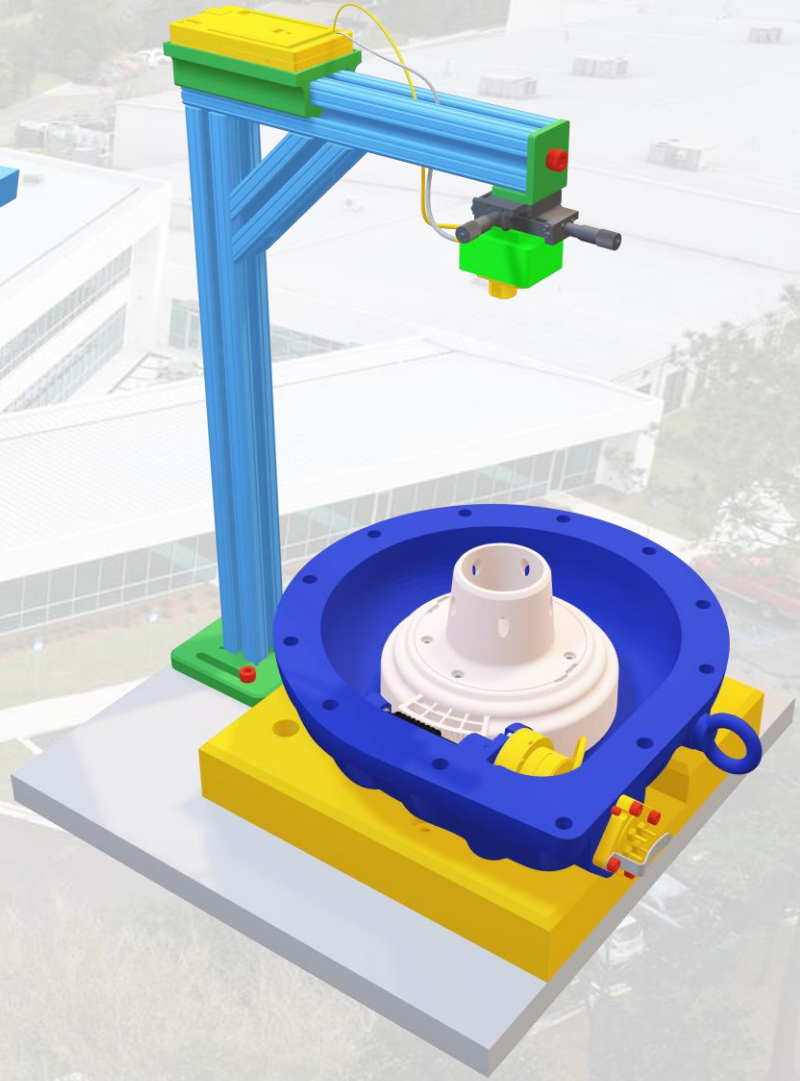
Design Inclusive PFMEA Document

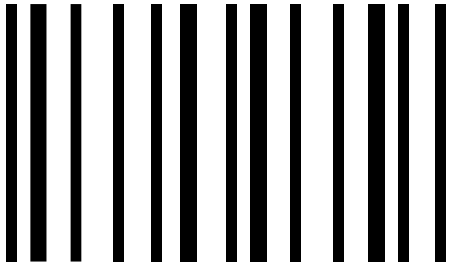
PFMEA													
Process Function / Requirements	Potential Failure Mode	Potential Effects of Failure	SEV	CLA	Potential Cause(s)/ Mechanism(s) of Failure	OCC	Current Process Controls **Prevention**	Current Process Controls **Detection**	DET	RPN	stomer Issue	Recommended Action(s)	Responsibility & Target Completion Date
WIRE & SECURE 4-Pin Feed Thru	Stepper motor mis-wired	Does not operate or reverse operation	4		Wiring reversed	4	SOP, Training	Visual	8	128		No recommened actions	
PERFORM IGV functionality test	Incorrecy IGV assembly	Compressor performance drop	7		Incorrect IGV assembly selected	2		Automated test	3	42		No recommened actions	
PERFORM IGV functionality test	Incorrect thorat assembly	Compressor performance drop	7		Incorrect throat assembly selected	2		Automated test	3	42		No recommened actions	
PERFORM IGV functionality test	Blade(s) won't fully open/close	Compressor malfunction	7		blade mechanism defect	4		Automated test	3	84		No recommened actions	
PERFORM IGV functionality test	Blade(s) won't move	Compressor malfunction	7		blade mechanism defect	3		Automated test	3	63		No recommened actions	
PERFORM IGV functionality test	IGV move reversly	Compressor malfunction	7		IGV blade mechanism installed incorrectly	4		Visual	7	196		Upgrade IGV functionality test system to include automated detection for reversed blades	Senior Design 2025
PERFORM IGV functionality test	Chips on blade edge	Compressor malfunction	7		Improper storage or assembly of blades	2		Visual	7	98		No recommened actions	
PERFORM IGV functionality test	Ball indicator does not function properly	Maintanence and end user dissatisfaction	4		blade magnet not installed or installed incorrectly	3		Automated test	3	36		No recommened actions	
PERFORM IGV functionality test	Blade movement resitriction or resistance	Compressor malfunction	7		blade mechanism defect	3		Automated test	3	63		No recommened actions	

Summary

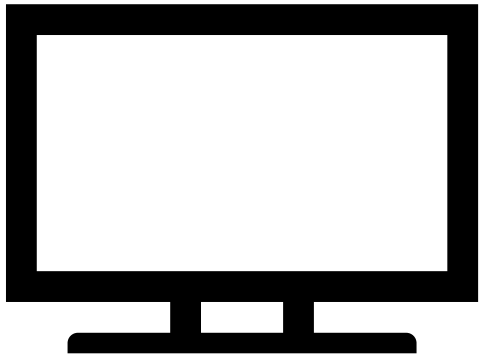




Potential Improvements



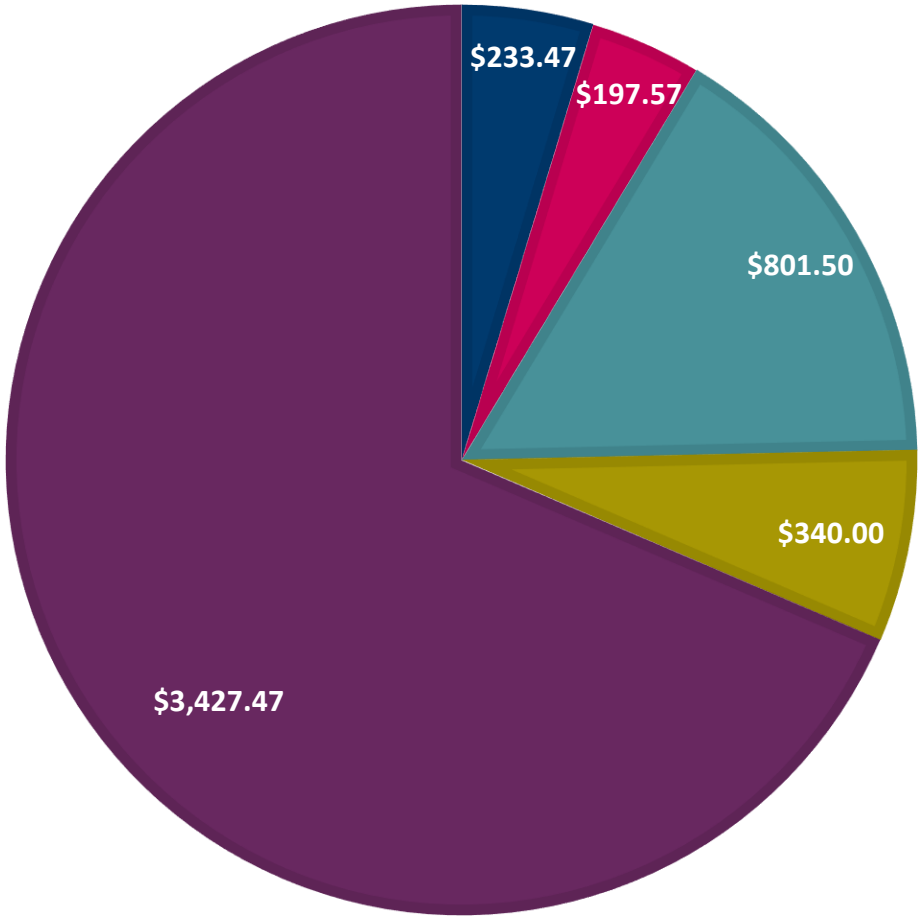
Barcode Scanner



Monitor GUI

Blade Defect

Budget Breakdown



	Remaining Budget $3,427.47
	Micrometer $801.50
	Lasers $340.00
	Miscellaneous $233.47
	Aluminum $197.57

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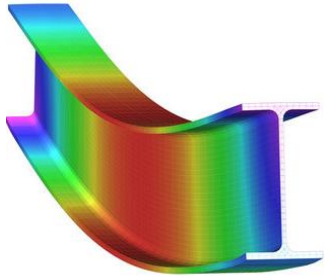
Lessons Learned

Recover From Mistakes

Adapt to Customer Requirements



Finite Element Analysis

Managing Scope Creep