BOX MOVER PROJECT

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ENGR-3414

FALL 2024

AGENDA

PROBLEM STATEMENT

CONSTRAINTS

DESIGN SPACE

MATERIALS LIST

ASSEMBLY

DISCUSSION

CONCLUSION

PROBLEM STATEMENT

The members of ENGR 3414 were tasked with designing a machine to reduce employee injuries in their product-sorting business using the Engineering Design Process. This device will sort packages by weight, placing heavier items at the bottom and lighter ones at the top, using color codes for weight identification. The team plans to build a prototype for a feasibility study to evaluate the machine's effectiveness.

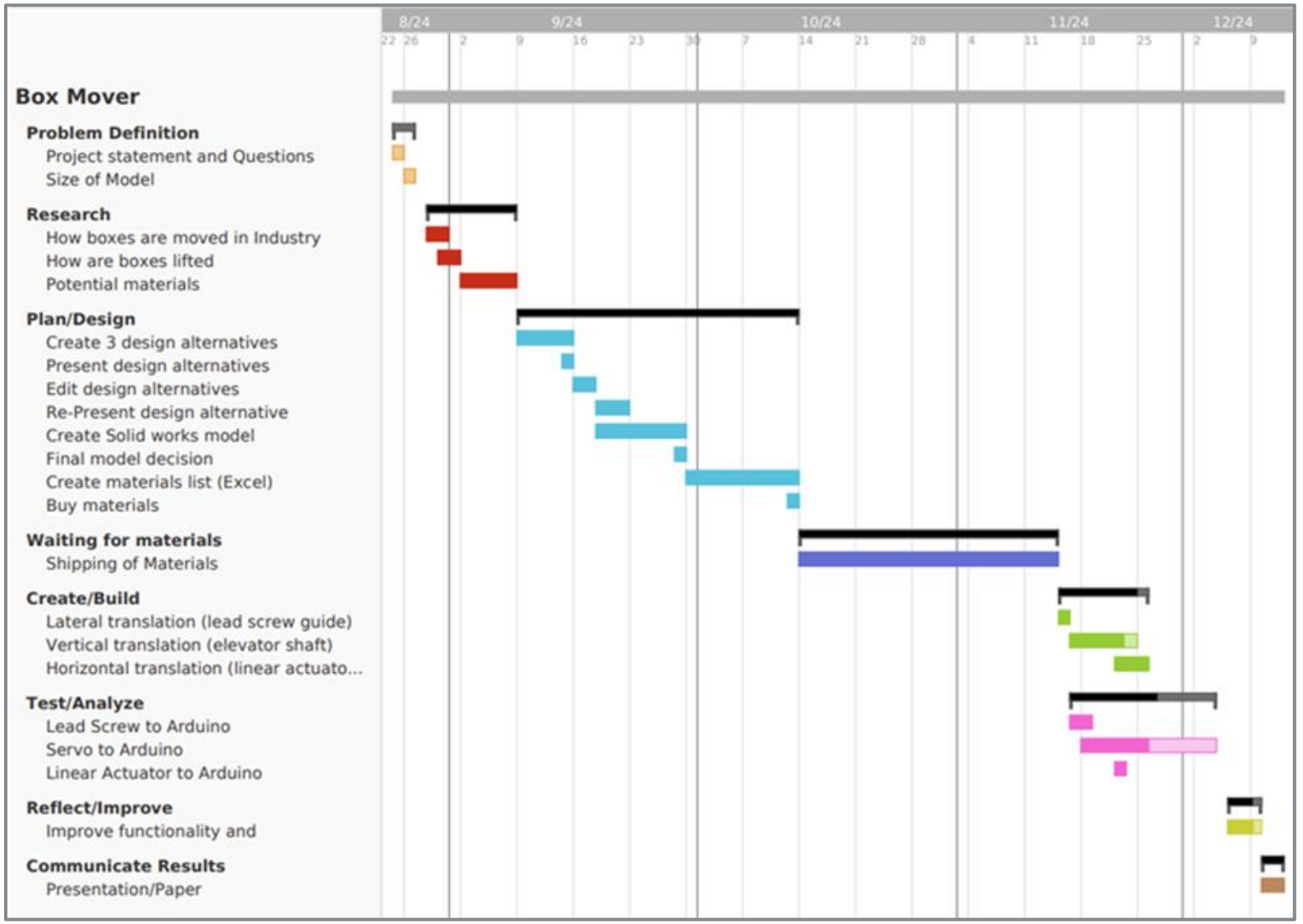
CONSTRAINTS

Time

Budget

Resources

GANTT CHART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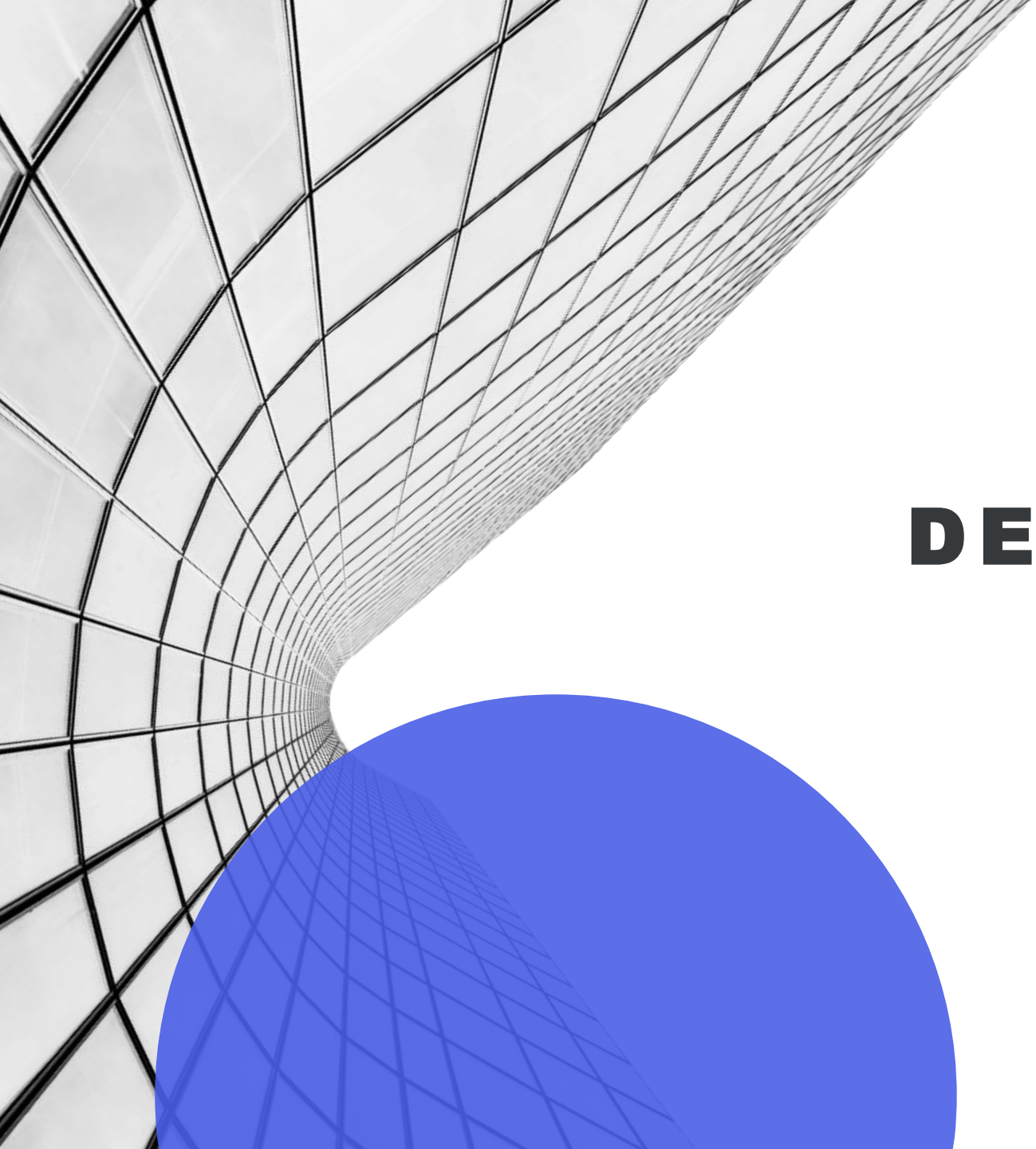
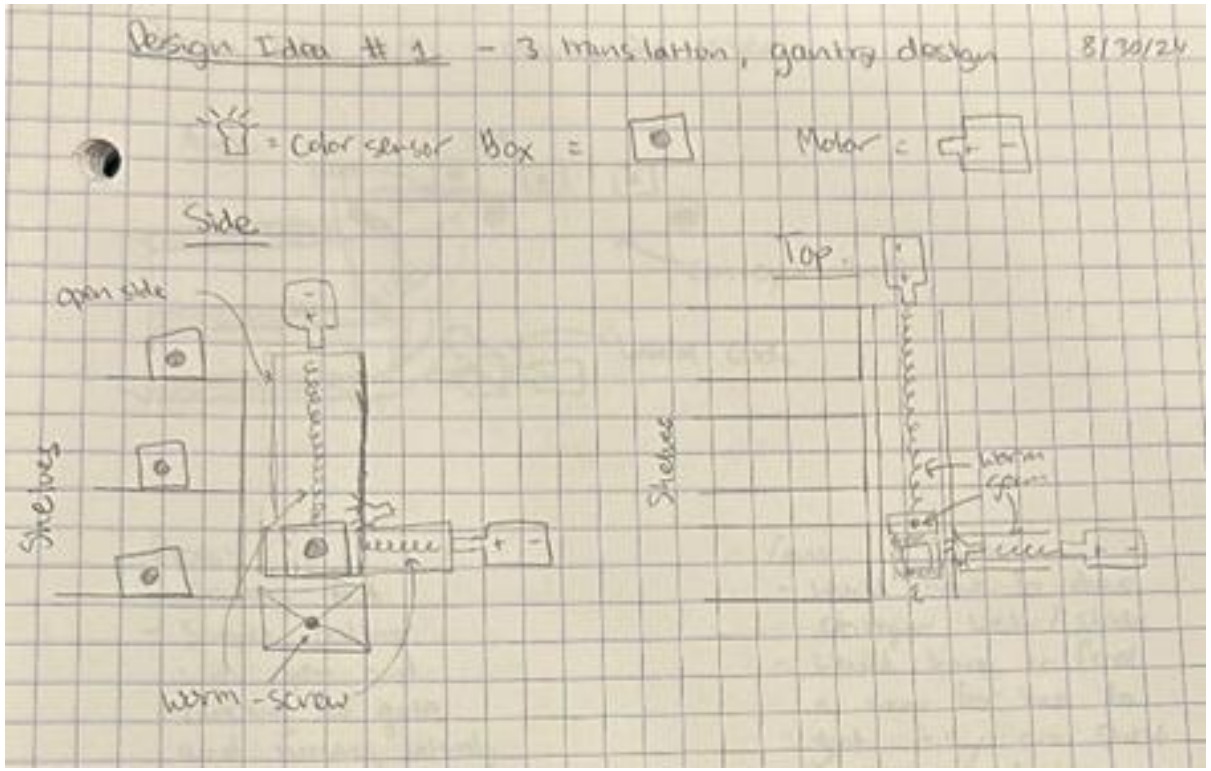
9/24
10/24
11/24
12/24
22 26 2 9 16 23 30 7 14 21 28 4 11 18 25 2 9
Box Mover
Problem Definition
Project statement and Questions
Size of Model
Research
How boxes are moved in Industry
How are boxes lifted
Potential materials
Plan/Design
Create 3 design alternatives
Present design alternatives
Edit design alternatives
Re-Present design alternative
Create Solid works model
Final model decision
Create materials list (Excel)
Buy materials
Waiting for materials
Shipping of Materials
Create/Build
Lateral translation (lead screw guide)
Vertical translation (elevator shaft)
Horizontal translation (linear actuato...
Test/Analyze
Lead Screw to Arduino
Servo to Arduino
Linear Actuator to Arduino
Reflect/Improve
Improve functionality and
Communicate Results
Presentation/Paper



DESIGN SPACE

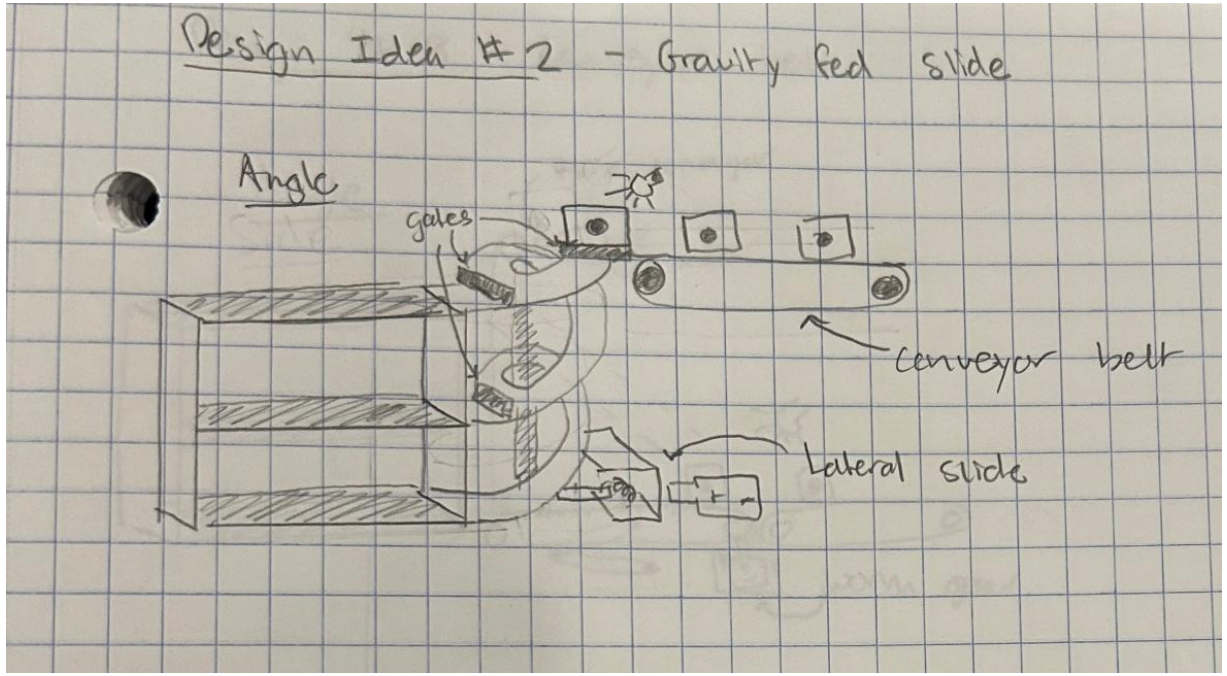
DESIGN 1 – GANTRY



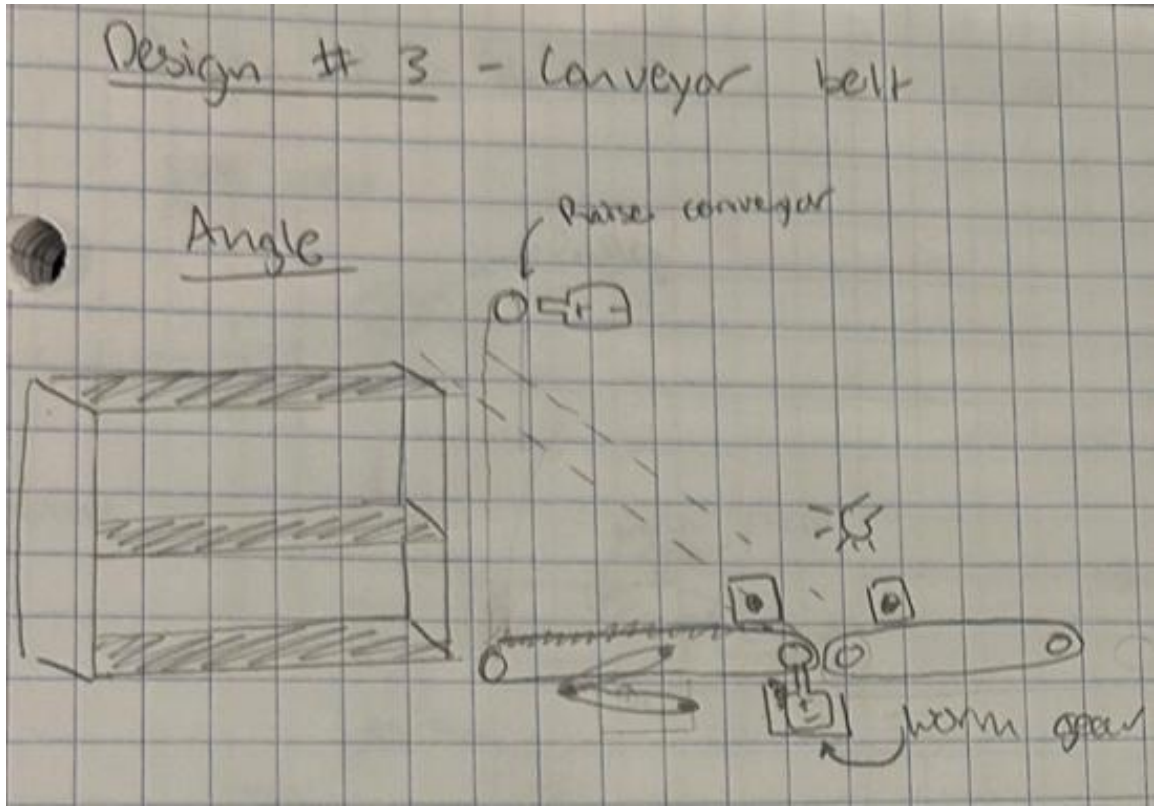
- EACH DEGREE OF MOTION HAS A WORM GEAR
- MODULAR
- PRECISE
- EASY TO SCALE
- EXTRA MATERIALS
- BOTTOM SHELF RECTIFICATION

DESIGN 2 – SLIDE

- ELEVATED CONVEYOR BELT
- SERIES OF GATES
- CODING SIMPLE
- DIFFICULT LATERAL TRANSLATION
- SPEED CONTROL
- SLIDE MATERIAL



DESIGN 3 – CONVEYOR BELT

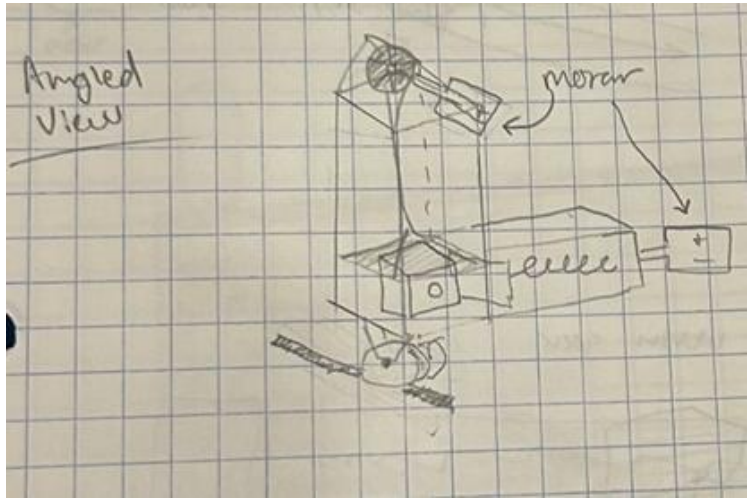


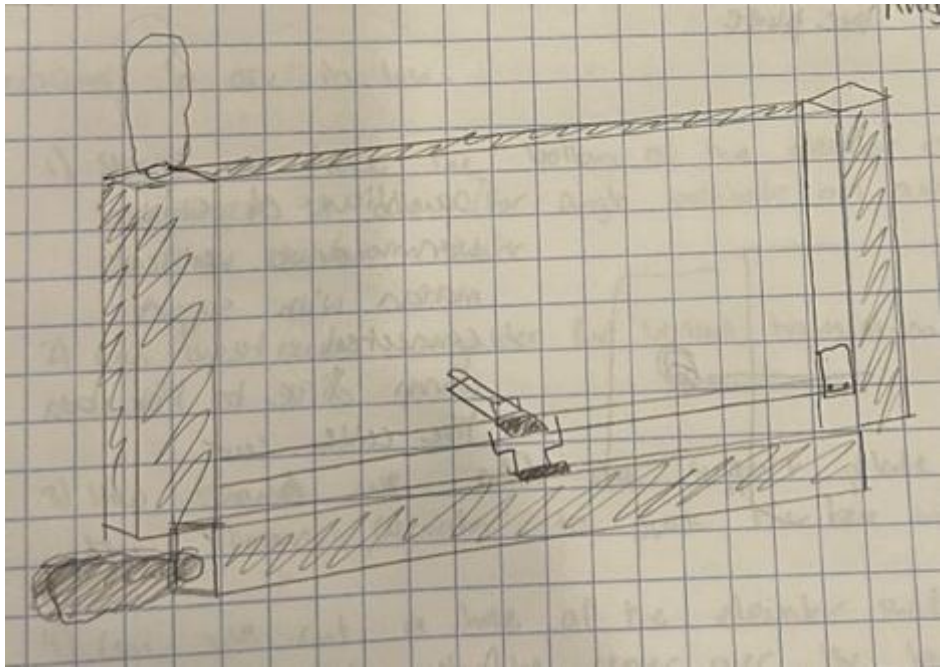
- SERIES OF CONVEYORS
- PULLEY SYSTEM FOR ELEVATION
- CONTROLLED FEEDS
- DIFFICULT LATERAL TRANSLATION
- PIVOT OR WORM GEAR
- MULTIPLE MOTORS

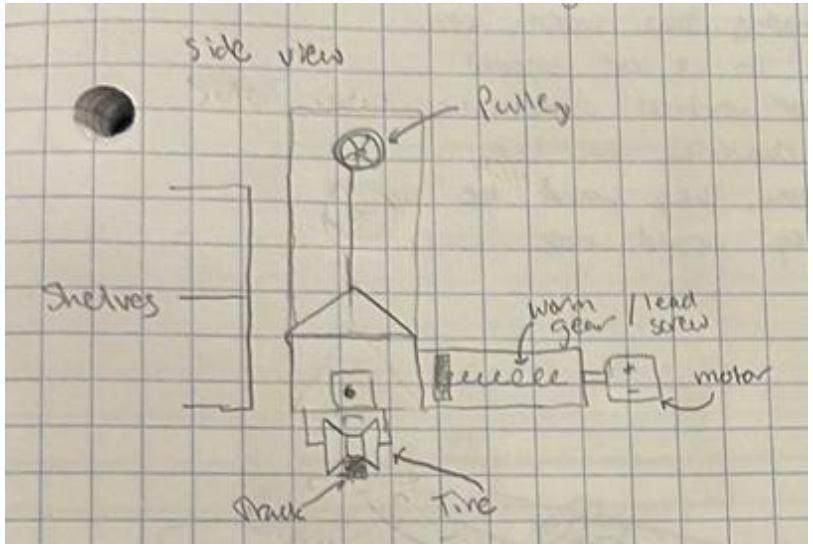
DECISION MATRIX

Criteria	Weight (%)	Gantry	Gravity-Fed Slide	Conveyor Belt
Cost	20%	5	6	5
Complexity	10%	7	8	5
Speed	15%	6	8	7
Scalability	15%	5	3	7
Safety	20%	9	6	7
Energy Efficiency	5%	4	9	6
Durability	15%	8	7	5
Total	**100%**	**6.55**	**6.35**	**6.05**

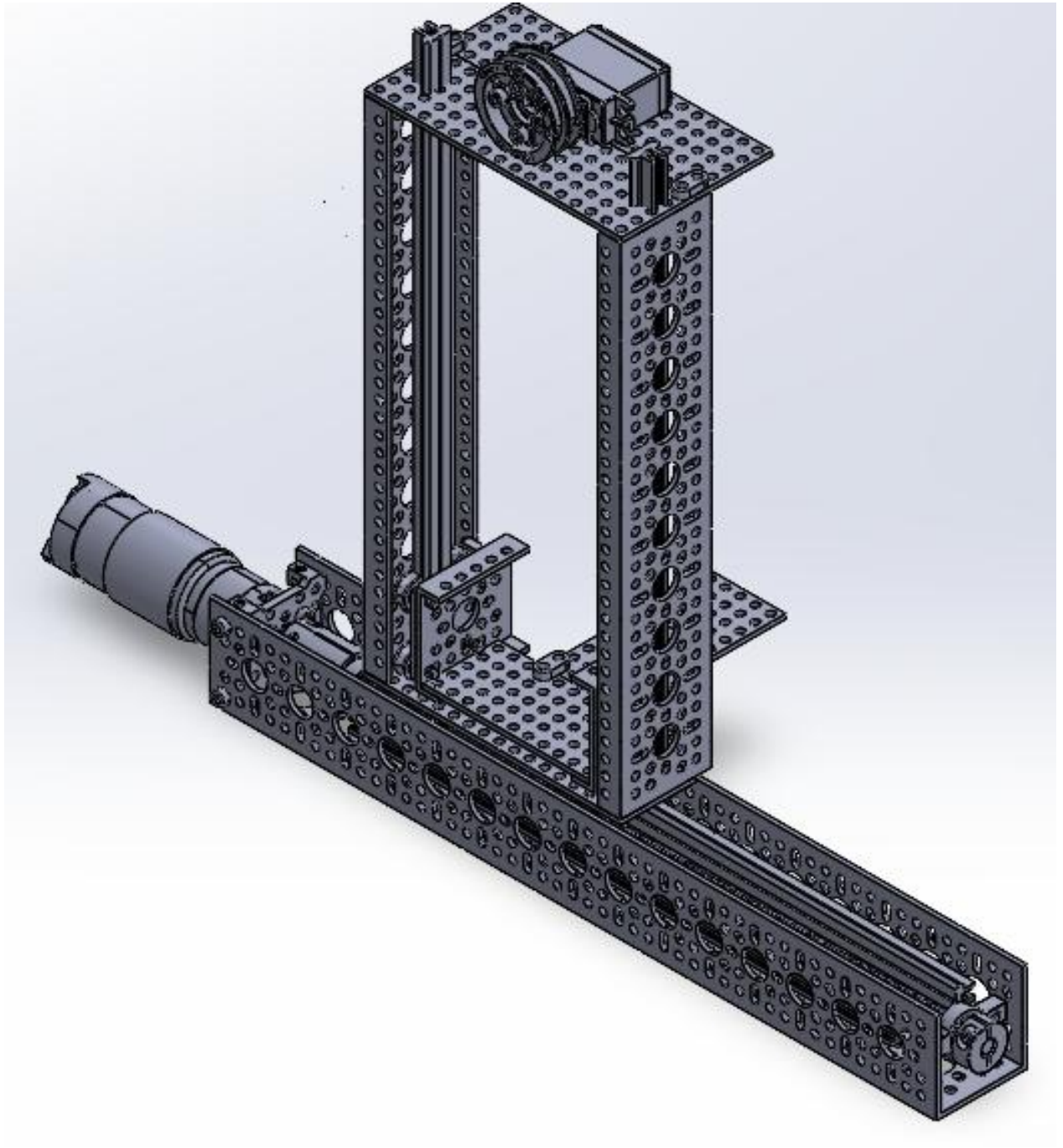
REFACTORED DESIGN







MODEL



MATERIALS

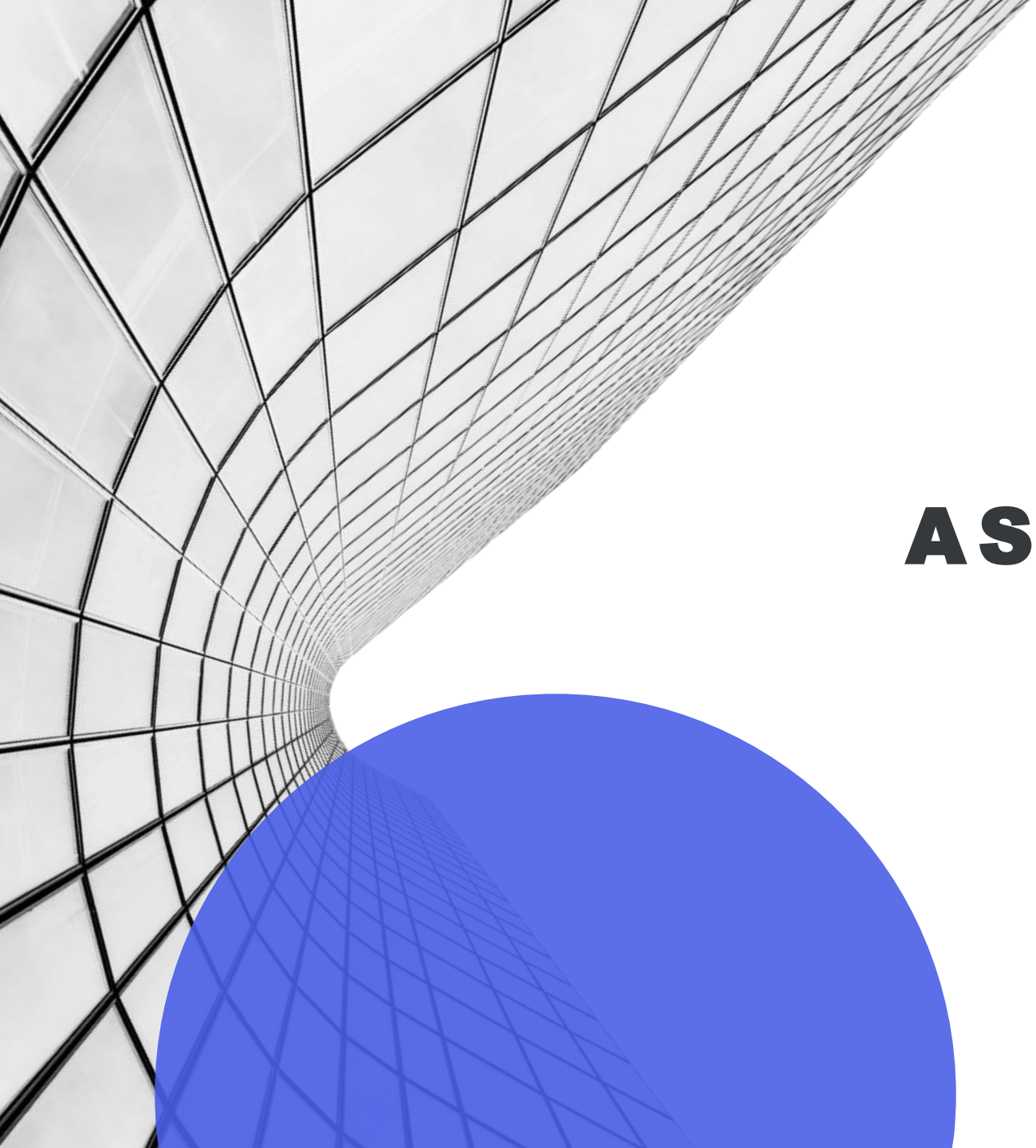
Box Moving Machine Materials List (Servo City)

SKU	Quantity	Description	Image	Price	Total	Notes
V-Guide Lead Screw Dolly Kit (x and y direction)						
3205-0003-0001	2	V-Guide Lead Screw Dolly Kit		$ 34.99	$ 69.98	One for vertical translation and one for horizontal
Structure of Lead Screw Dolly						
1201-0043-0002	1	Quad Block Pattern Mount		$ 6.99	$ 6.99	
2800-0004-0008	2	M4 x 0.7mm Zinc-Plated Socket Head Screw (8mm Length) - pack of 25		$ 3.19	$ 6.38	
2800-0004-0011	2	M4 x 0.7mm Zinc-Plated Socket Head Screw (11mm Length) - pack of 25		$ 3.49	$ 6.98	
2800-0004-0014	1	M4 x 0.7mm Zinc-Plated Socket Head Screw (14mm Length) - pack of 25		$ 3.69	$ 3.69	
4006-0008-1006	1	Hyper Coupler 8mm Round Bore to 6mm D-bore		$ 7.99	$ 7.99	
1613-0516-0008	2	Thrust Ball Bearing 8mm ID		$ 3.99	$ 7.98	
1606-0043-0008	2	2-side, 1 Post Pillow Block 8mm Bore		$ 6.99	$ 13.98	
3504-0804-1808	1	Lead Screw Clamping Collar 8 mm Lead Bore		$ 6.99	$ 6.99	
3501-0804-0350	1	3501 Series Lead Screw (8mm Lead, 4 Start, 350mm Length)		$ 10.99	$ 10.99	
1120-0015-0384	1	1120 Series U-Channel (15 Hole, 384mm Length)		$ 17.99	$ 17.99	
3700-0145-0288	4	3700 Series 14.5mm V-Guide (288mm Length)		$ 3.99	$ 15.96	two for vertical translation two and for horizontal
Motor for horizontal (x) translation						
5202-0002-0001	1	5202 Series Yellow Jacket Planetary Gear Motor		$ 44.99	$ 44.99	
Structure for the vertical translation (y)						
1116-0040-0088	2	1116 Series Grid Plate (5 x 11 Hole, 40 x 88mm)		$ 2.79	$ 5.58	One for bottom of elevator cart and one for support of linear acuator
1116-0040-0136	3	1116 Series Grid Plate (5 x 17 Hole, 40 x 136mm)		$ 3.49	$ 10.47	One for the bottom of elevator and two for top platform
1121-0001-0048	2	1121 Series Low-Side U-Channel (1 Hole, 48mm Length)		$ 2.99	$ 5.98	
1121-0010-0264	2	1121 Series Low-Side U-Channel (10 Hole, 264mm Length)		$ 11.99	$ 23.98	
1216-0001-0001	3	Steel 90 Degree Angle Bracket (1-1) - 4 Pack		$ 3.99	$ 11.97	
Motor for vertial translation (y)						
2000-0025-0002	1	2000 Series Dual Mode Servo (25-2, Torque)		$ 33.99	$ 33.99	
3102-0001-0001	1	3102 Series Dual Mode Servo Programmer (1-1)		$ 9.99	$ 9.99	
Wench Pulley for servo motor (y)						
3410-0025-0112	1	3410 Series Servo-Mount Winch Pulley (25T Spline, Dual Spool, 112mm Circumference)		$ 6.99	$ 6.99	
Support for the linear acutator						
1102-0002-0016	8	1102 Series Flat Beam (2 Hole, 16mm Length) - 4 Packs		$ 1.99	$ 15.92	
				Total Price(Before Tax)	$ 345.76	

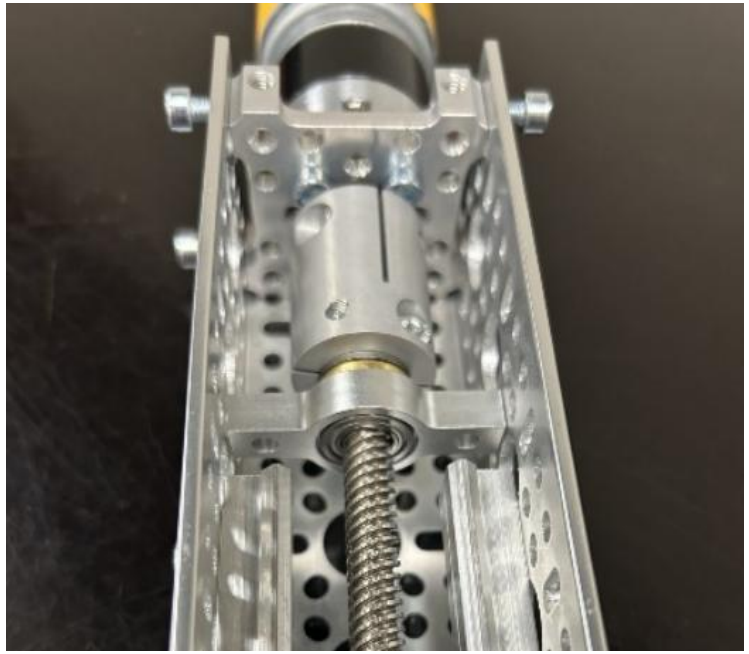
Box Moving Machine Materials List (Amazon)

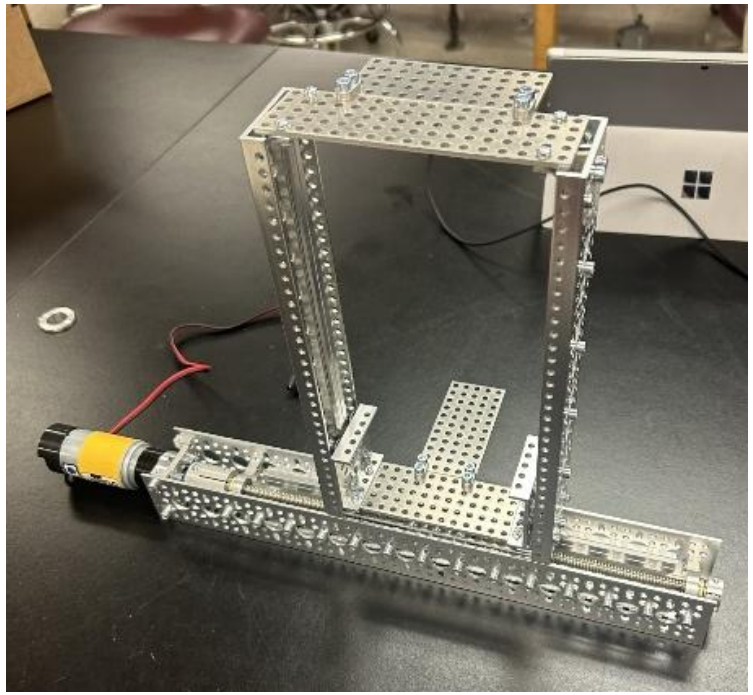
SKU	Quantity	Description	Image	Price	Total
Linear Acuator for push (z)					
Linear Acutator	1	DC HOUSE Mini Electric Linear Actuator Stroke 4"-Force 4.5 lbs-12V | High-Speed		$31.99	$ 31.99
Electronics					
Battery	1	HRB 4S Lipo Battery 3000mAh 14.8V 60C RC Lipo Battery Compatible with RC Car Truck		$33.99	$ 33.99
Ardunio Board	3	Arduino Uno REV3 [A000066]		$27.60	$ 82.80
Motor Controller	1	BOJACK L298N Motor DC Dual H-Bridge Motor Driver Controller Board Module		$ 9.99	$ 9.99
Jumper Wires	1	40 PCS 20 CM (8 inch) Breadboard Jumper Wires Length Optional Dupont wire		$ 3.99	$ 3.99
		Total			$ 162.76
Color Sensor	1	Teyleten Robot GY-31 TCS3200 TCS230 Color Sensor Module Color Recognition Sensor		$ 9.99	$ 9.99

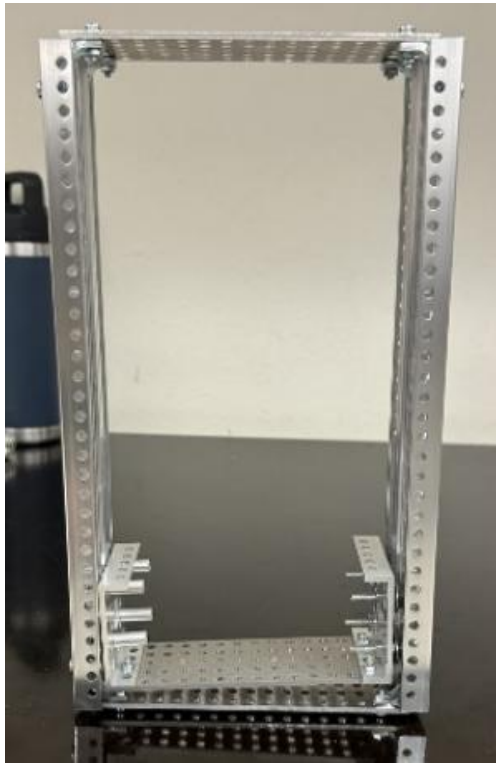
L I S T



ASSEMBLY







DAY 1-2

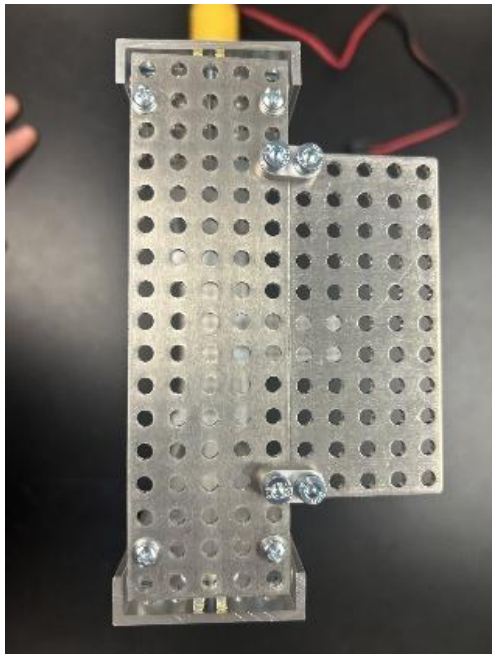
STRUCTURE

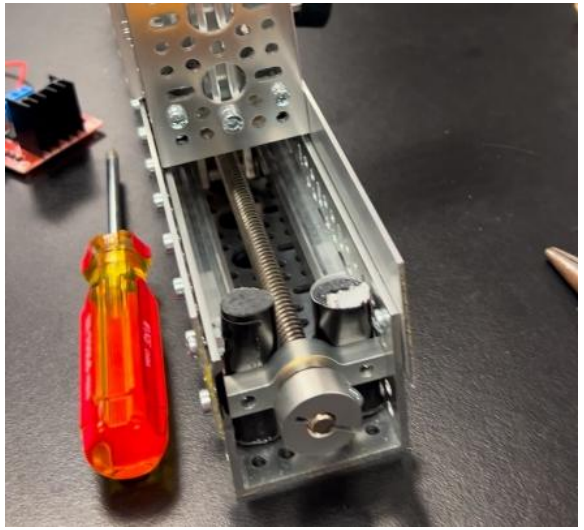
- HORIZONTAL ASSEMBLY
- HYPER COUPLE, PILLOW BLOCK
- M4 BOLTS
- TROUBLESHOOTING ELEVATOR
- HORIZONTAL ROCKING

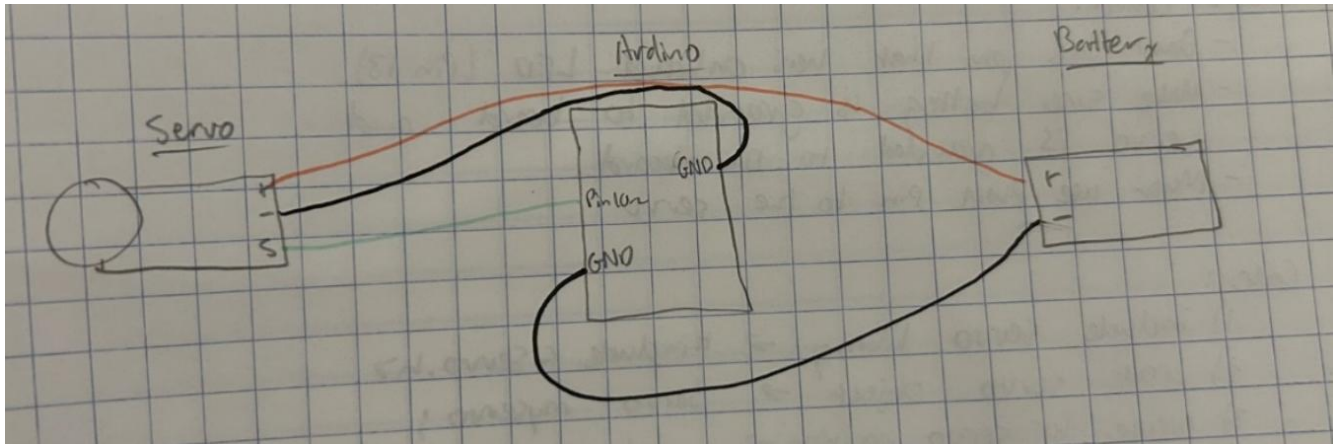
DAY 3-4

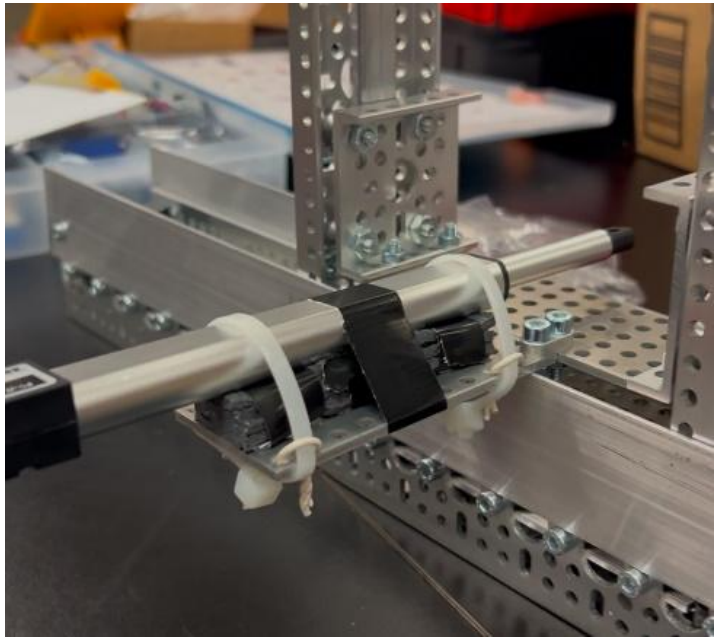
FRICTION/SERVO

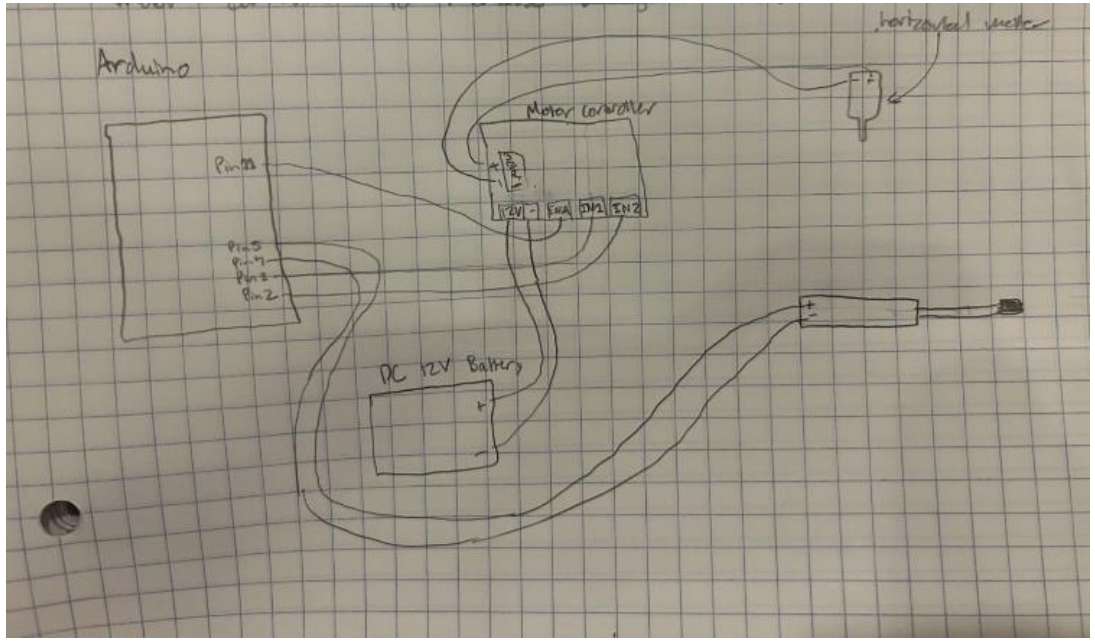
- GUIDE RAILS
- PADDING
- TENSION ON BEARINGS
- PROPER GROUNDING











DAY 5-6

INTEGRATION

- SERVO RESOLUTION
- MOUNTING LINEAR ACTUATOR
- TWO DEGREES OF TRANSLATION

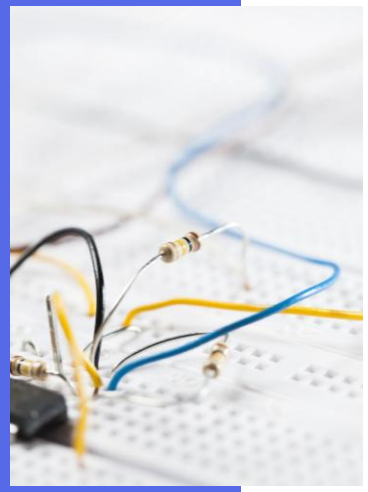
DISCUSSION

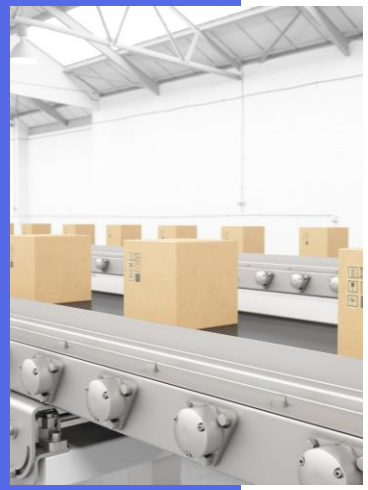
WHY IS IT IMPORTANT?

- 25% of work force missing 10 days due to back pain (“Chronic Back Pain”).
- 40% of adults had back pain in 2019 (Lucas, Jacqueline W., et al)

WHO WILL IT AFFECT?

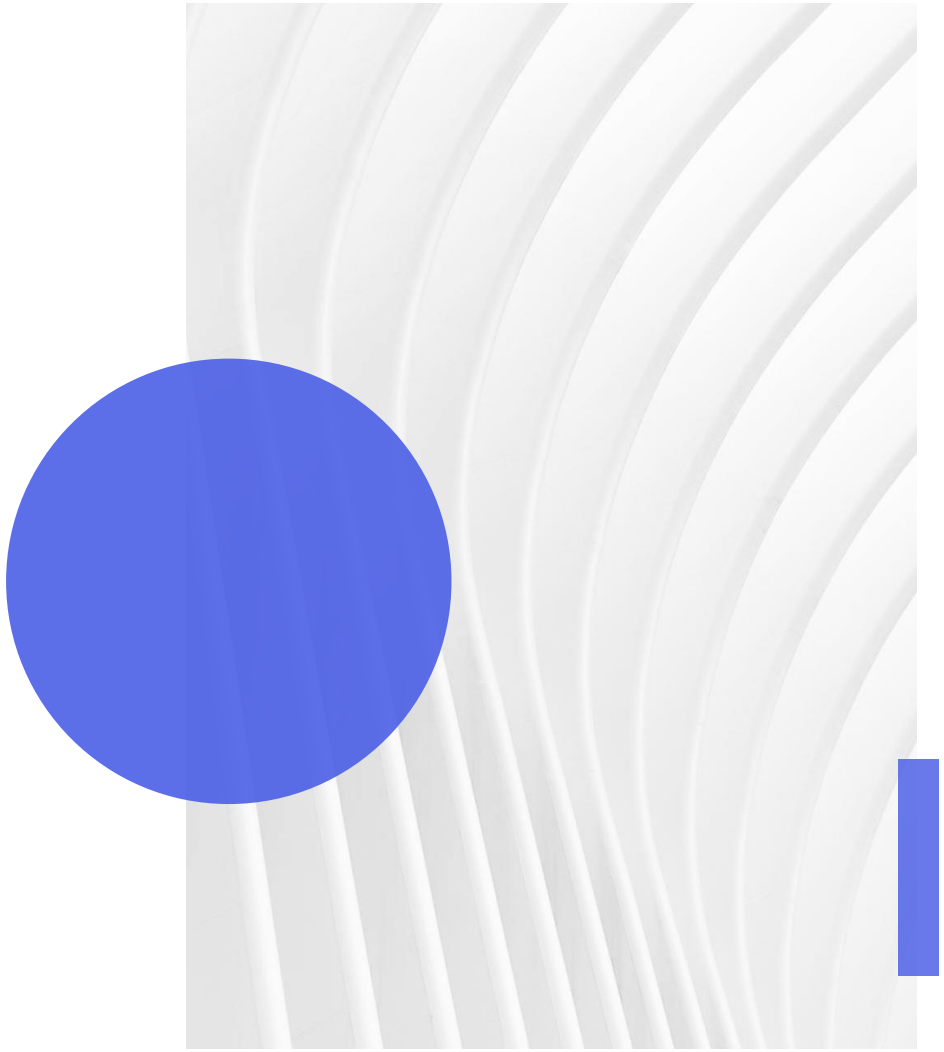
- Our product can aid all workers in the warehouse industry
- More days at work and longer working careers





CONCLUSION

- ENGINEERING DESIGN PROCESS
- USE OF AI
  - SYNTAX NATIGATION
  - PROBLEM SOLVING
- NEXT STEPS



THANK YOU

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REFERENCES

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