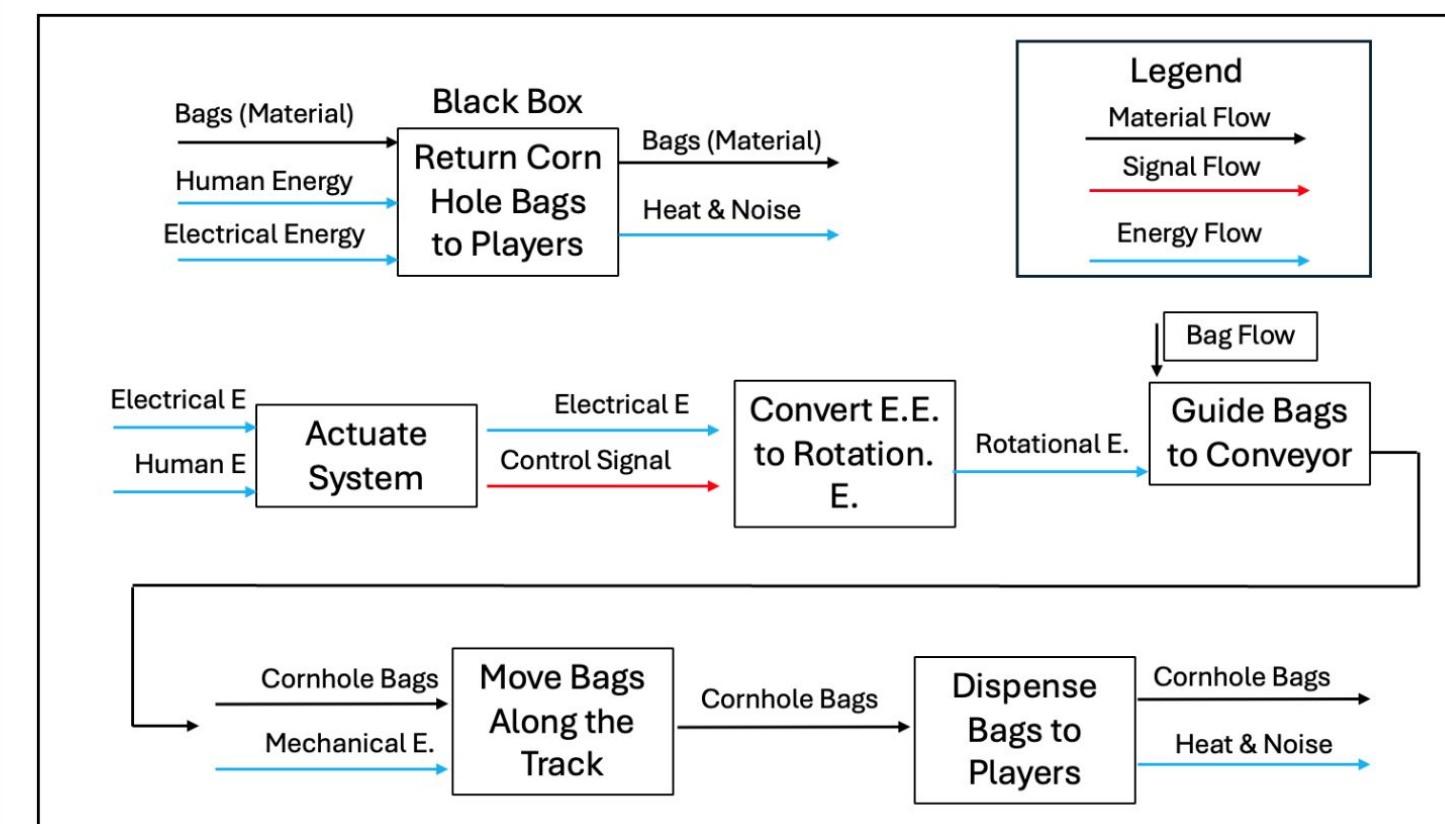


Motivation, Goal, Impact

- Motivation:** Traditional cornhole requires frequent manual bag retrieval, disrupting game flow and increasing cumulative spinal stress.
- Goal:**
 - Minimize jamming and maximize reliability
 - Maintain a lightweight and portable structure
 - Operate efficiently with sufficient battery life
 - Deliver consistent and fast bag return
 - Remain cost-effective for practical use
- Impact:** ACBS maximizes user experience through a semi-automated retrieval system that integrates mechanical and electrical components to reduce jamming and minimize inefficiencies associated with manual bag collection.

Requirements

Figure 1: Function Structure Diagram



Physical Requirements:

- Product must fit below a standard cornhole board
- Frame pieces cut 2 ft in length to match standard board dimension
- 3D printed legs must provide clearance for system, bags, and board
- Product must align with the scoring hole to transport bags back to the conveyor area
- Product must not be too heavy to remain portable

Weight and Impact Targets:

- Frame must support a maximum of 12 lbs.
- Motor must be able to move 8 lbs. of cornhole bags without stalling; generating about 0.5 ft-lbs. of torque

Final Design

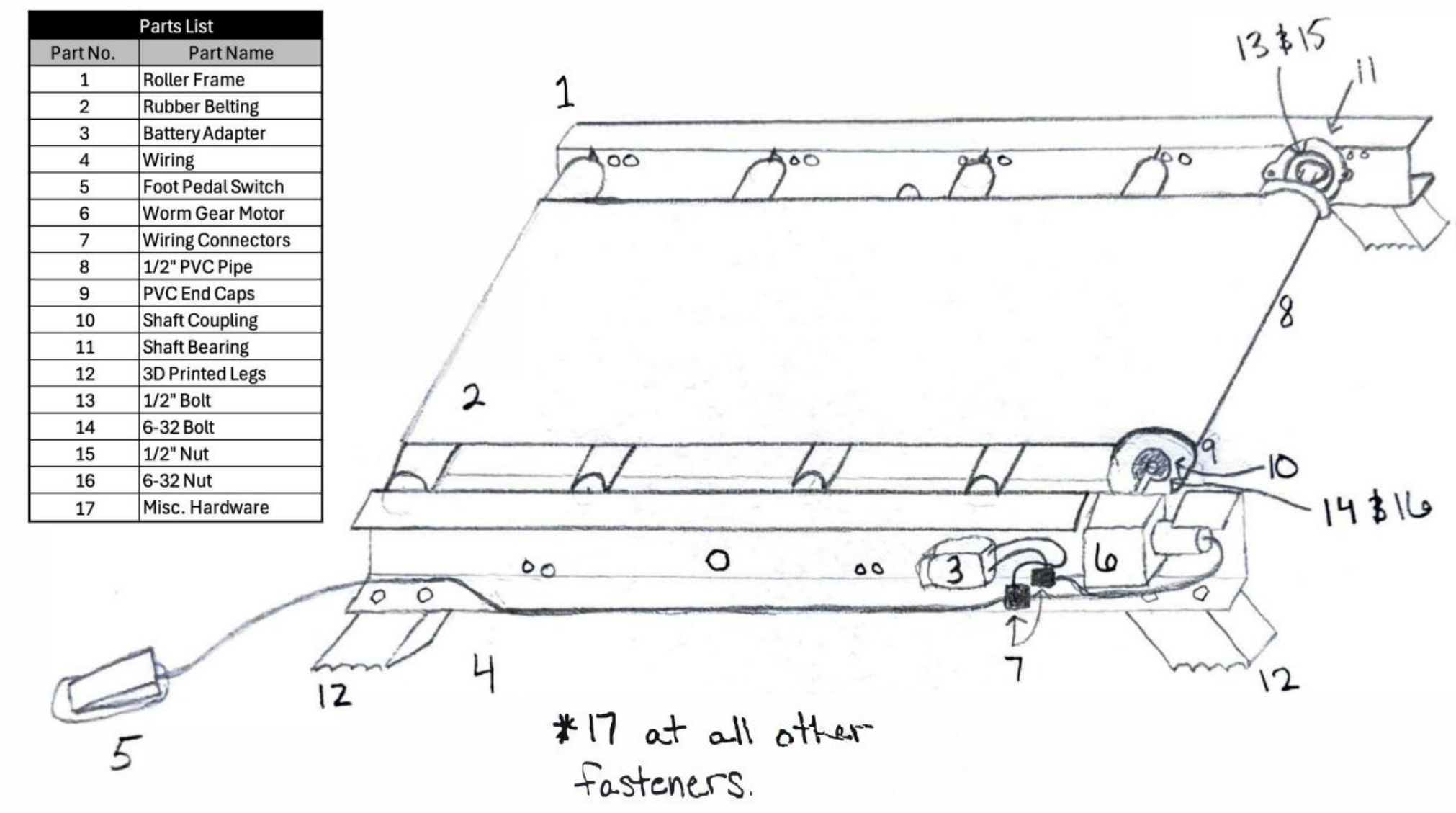


Figure 2: Final Sketch and Parts List

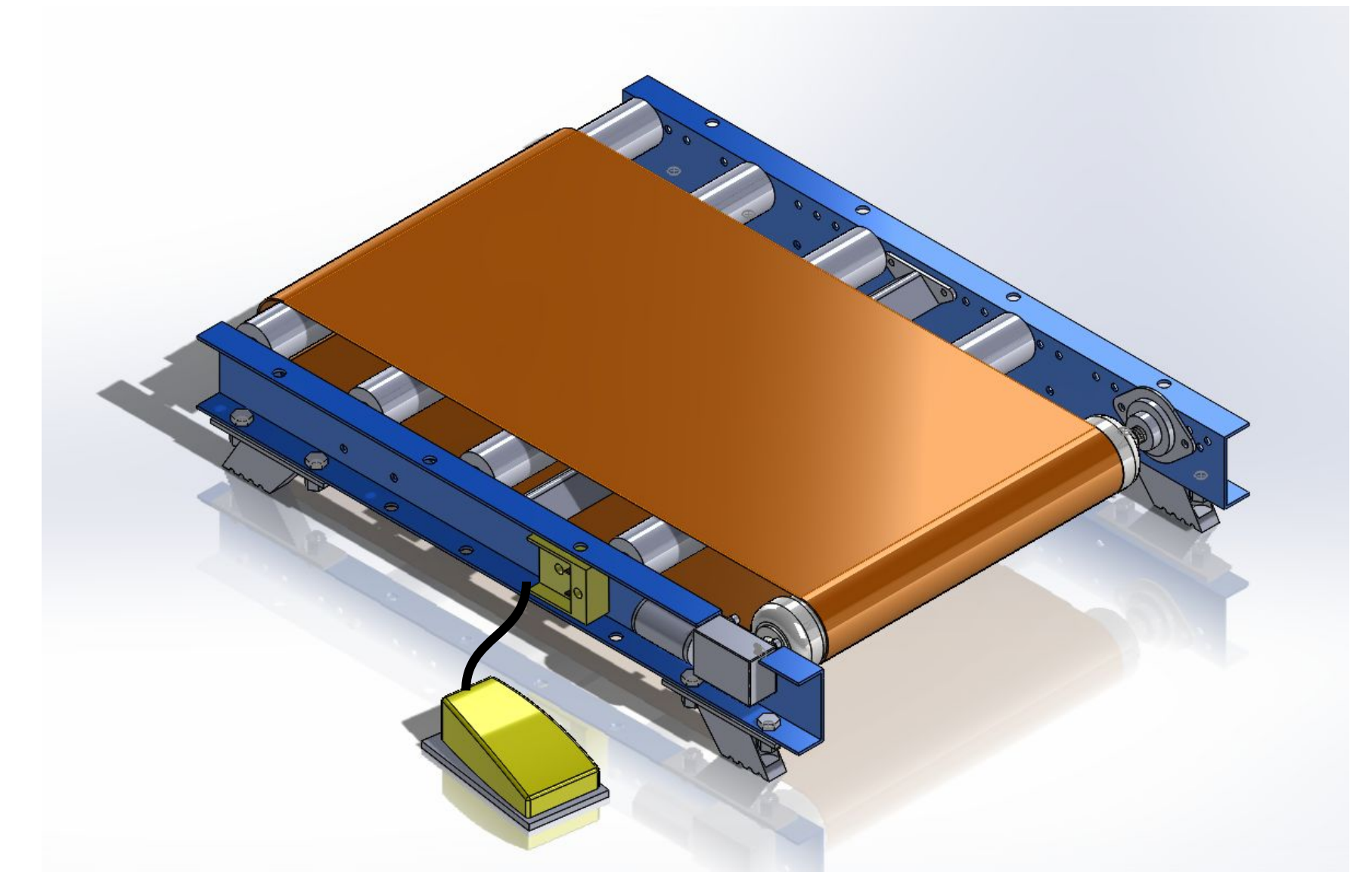


Figure 3: Complete Assembly

Design Calculations & Decisions

Return Time Analysis:

$$t_{avg} = \frac{\sum_{i=1}^n t_i}{n} \quad s = \sqrt{\frac{\sum_{i=1}^n (t_i - t_{avg})^2}{n - 1}}$$

Table 1: Return Time Results

n	t_avg	s
Bags	Sec.	Sec.
1	3.81	0.63
2	3.86	0.42
3	4.52	0.83
4	4.70	0.72
Linear Regression Eq.		
y = 0.33x + 3.39		
R-Squared Value = 0.9		

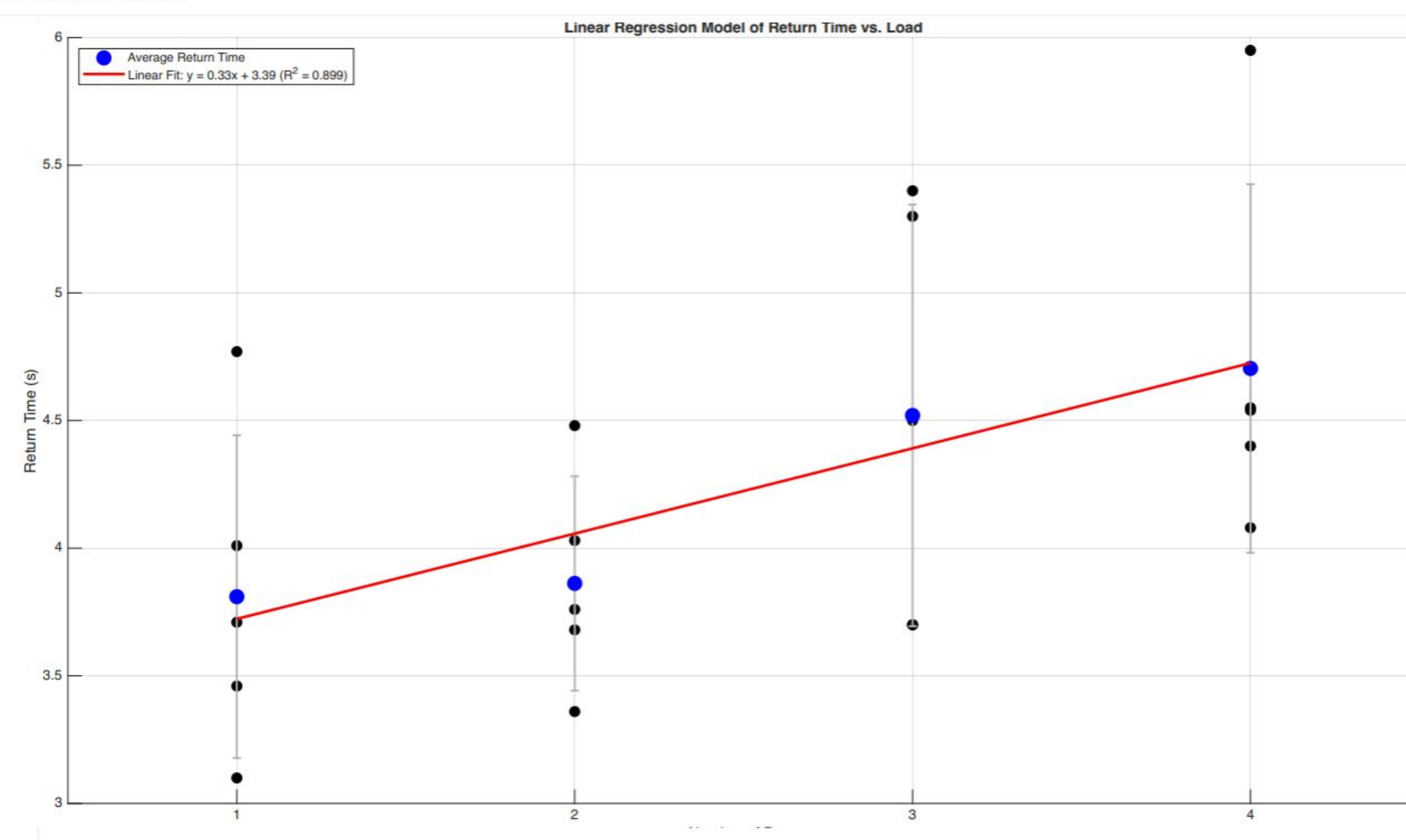


Figure 4: Return time trials (black), average return times (blue), and linear regression fit (red) showing increased return time with increasing bag load.

Reliability Calculation:

$$Reliability = \frac{Tot. Cycles - Tot. Jams}{Tot. Cycles} \times 100$$

Table 2: Reliability Results

Reliability		
# of Bags	Total Jams	Reliability
1	0	100%
2	2	92%
3	2	92%
4	3	88%

Impact Force Analysis:

$$F_{impact} = \frac{mv^2}{2d} \quad v = \sqrt{2gh}$$

Table 3: Impact Force Results

Impact Force			
m (kg)	0.443	g (m/s ²)	9.810
h (m)	0.140	v (m/s)	1.657
d (m)	0.010	F_impact (N)	60.842

Prototype & Test Results

Initial Prototype and Testing Challenges:

- Misplacement of Rollers
- Height Issues
- Bracket Structure
- Belt Width

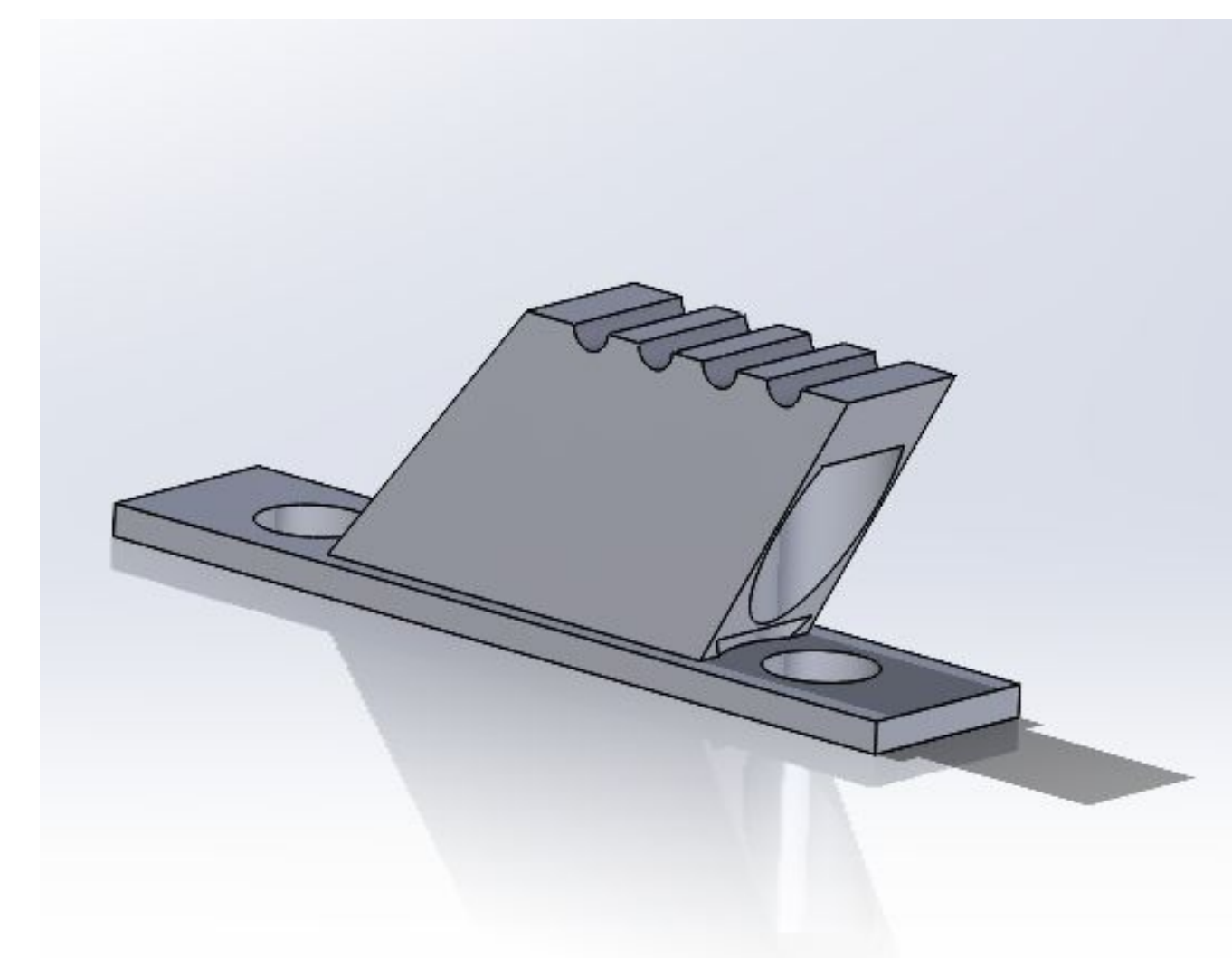


Figure 5: Final CAD Sketch of Legs

Solutions and Refinement:

- Addition of PVC Pipe: PVC pipe was added to improve roller guidance and help maintain proper belt alignment during operation.
- 3D Printed Legs: Legs were added to raise the system to a more effective height and improve overall functionality.
- Placement Refinement by Drilling New Holes: New holes were drilled to reposition the bracket and improve structural alignment and support.
- Cut Belt: The belt was cut to a more suitable width so it would better fit the system and operate more consistently.



Figure 6: Final Prototype