



University
of Idaho

RAT PACK – RAT TREADMILL

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INTRODUCTION/BACKGROUND

Project Objective: To redesign and fabricate an improved neonatal rat research treadmill for Idaho State University's psychology department in cooperation with University of Idaho's Biological Engineering department.

Current Design issues

- Does not allow for all size requirements
- Re-belting
- Needs incline and speed adjustment
- Not user friendly

Plan of Action: Create a fully functional treadmill with active speed and angle control processed through an Arduino, with added safety features and fully transparent bumpers for effortless observation of the specimen.

PROJECT SPECIFICATIONS



HIGH PRIORITY

- Belt size: ~12 cm width x 20 cm length, Must fit inside of the rat incubator which is about 2 ft by 3 ft
- 60 db or less machine noise
- Belt material strong enough to be cleaned and will not tear easily from rat claws and would preferably be transparent.
- Needs removable, transparent walls and bumpers
- Must have a variable speed control ranging from 0.5 cm/s to 15 cm/s
- Operate within temperatures ranging from 25 °C to 35 °C.

MEDIUM PRIORITY

- Preferably use fewer custom parts and more standard parts to help with ease of replacement.
- Angle control from 0° to 15°

LOW PRIORITY

- No computer necessary, device runs off a custom UI
- Safety features so that the rats do not fall off back and emergency stop button.
- Automatic timer
- Leave space for a potential camera underneath the treadmill

PROJECT SPECIFICATIONS



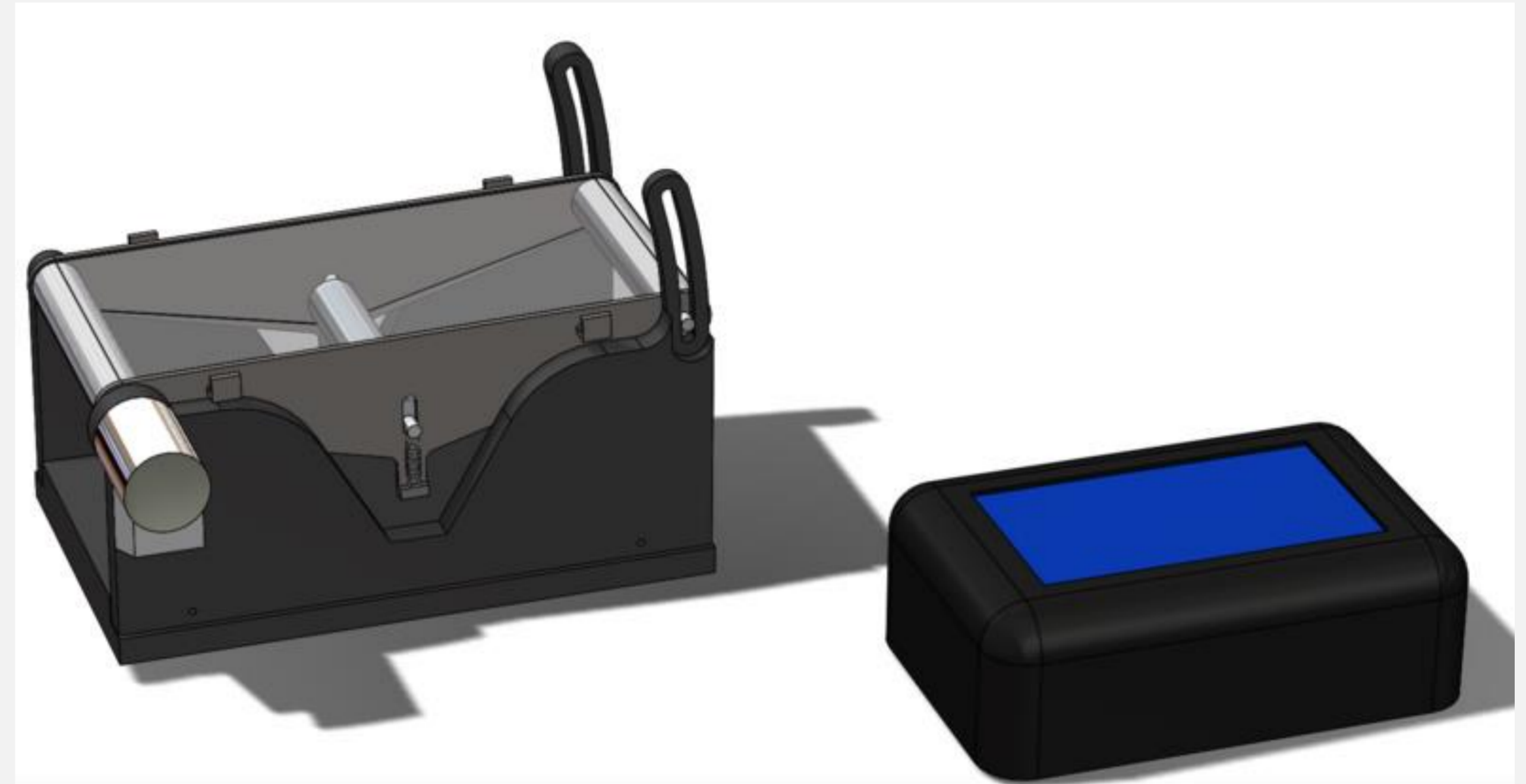
SPECIFICATIONS MATRIX

Project Requirements	12cm x 20cm Belt	Transparent Belt	Belt Is Flexible	Belt is Strong	Easy to Clean	Powered by USB or Outlet	Smaller than 1 x 0.9 x 0.5 m	Operates at < 60 dB	Bumpers ar Clear	Bumpers are Removable	Operates at Speeds Between 0.5 and 15 cm/s	Operates within 25° and 35° C	Inclines between 0° and 15°	<3 Custom Moving Parts	Standalone Operation	Safety Switch Operation	Timer Stops Motor	>512 cm ¹³ of Space Under Belt
	Higher Priority																	
Belt Size	Dark Brown																	
Belt Material		Dark Brown	Dark Brown	Dark Brown														
Cord usage				Dark Brown														
Device Size					Dark Brown													
Noise Level						Dark Brown												
Bumpers							Dark Brown	Dark Brown	Dark Brown									
Variable Speed									Dark Brown									
Operation Temp										Dark Brown								
Medium Priority																		
Angle Control											Dark Brown							
Easily replacable parts												Dark Brown						
Lower Priority																		
No computer required													Dark Green					
Safety stop														Dark Green				
Automatic timer															Dark Green			
Space for Camera																	Dark Green	

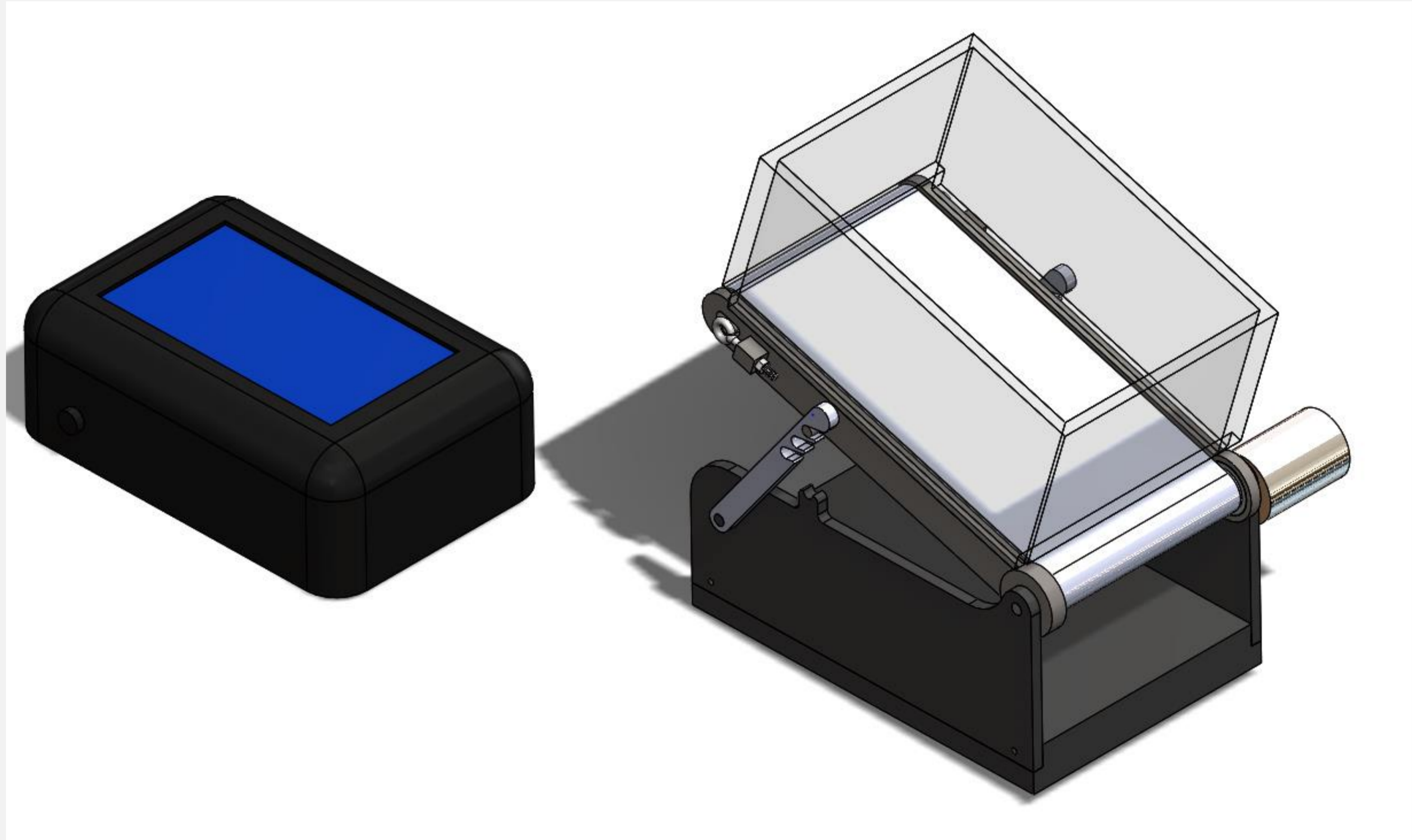
PREVIOUS MEETING

DESIGN DECISIONS

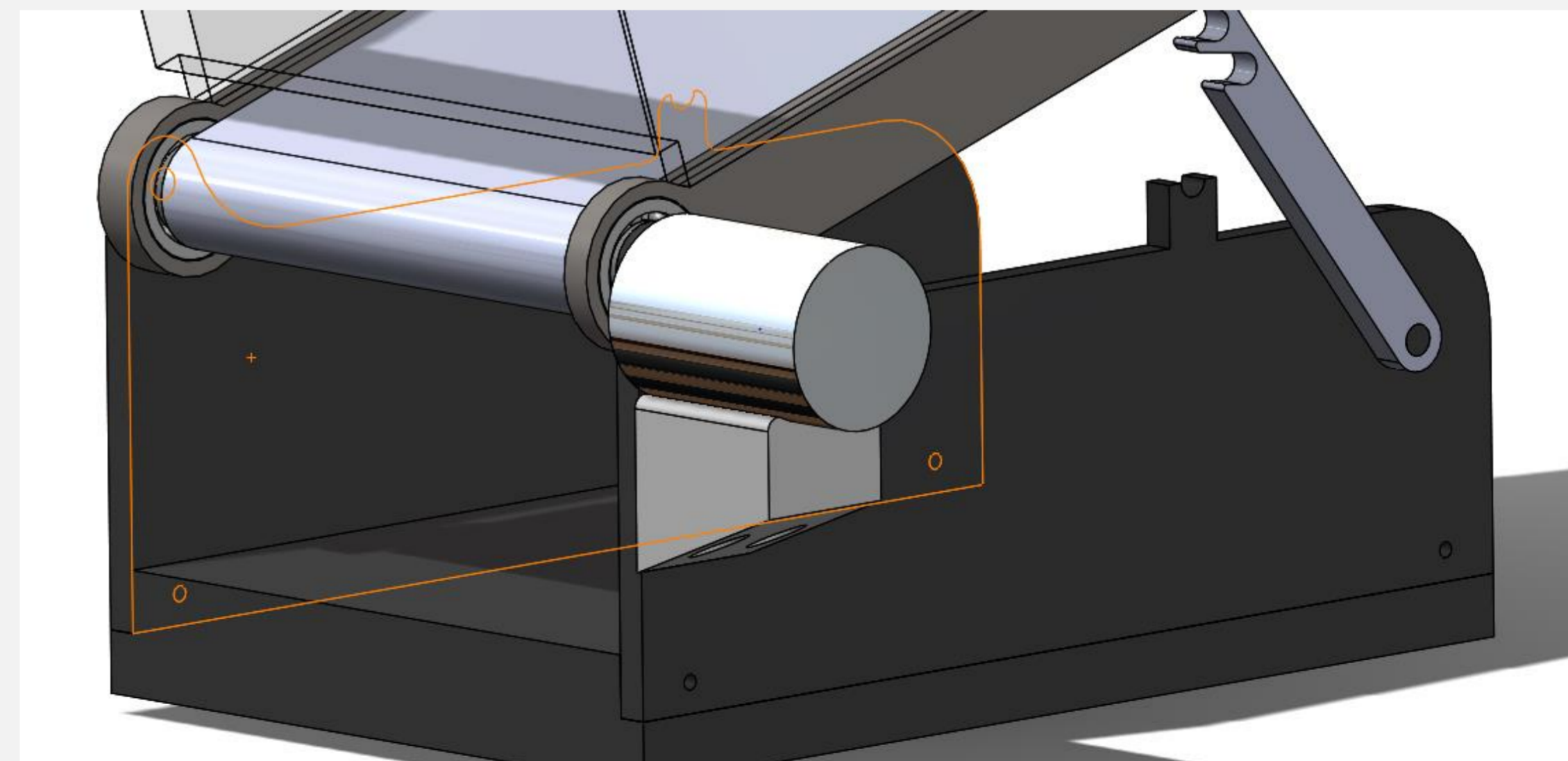
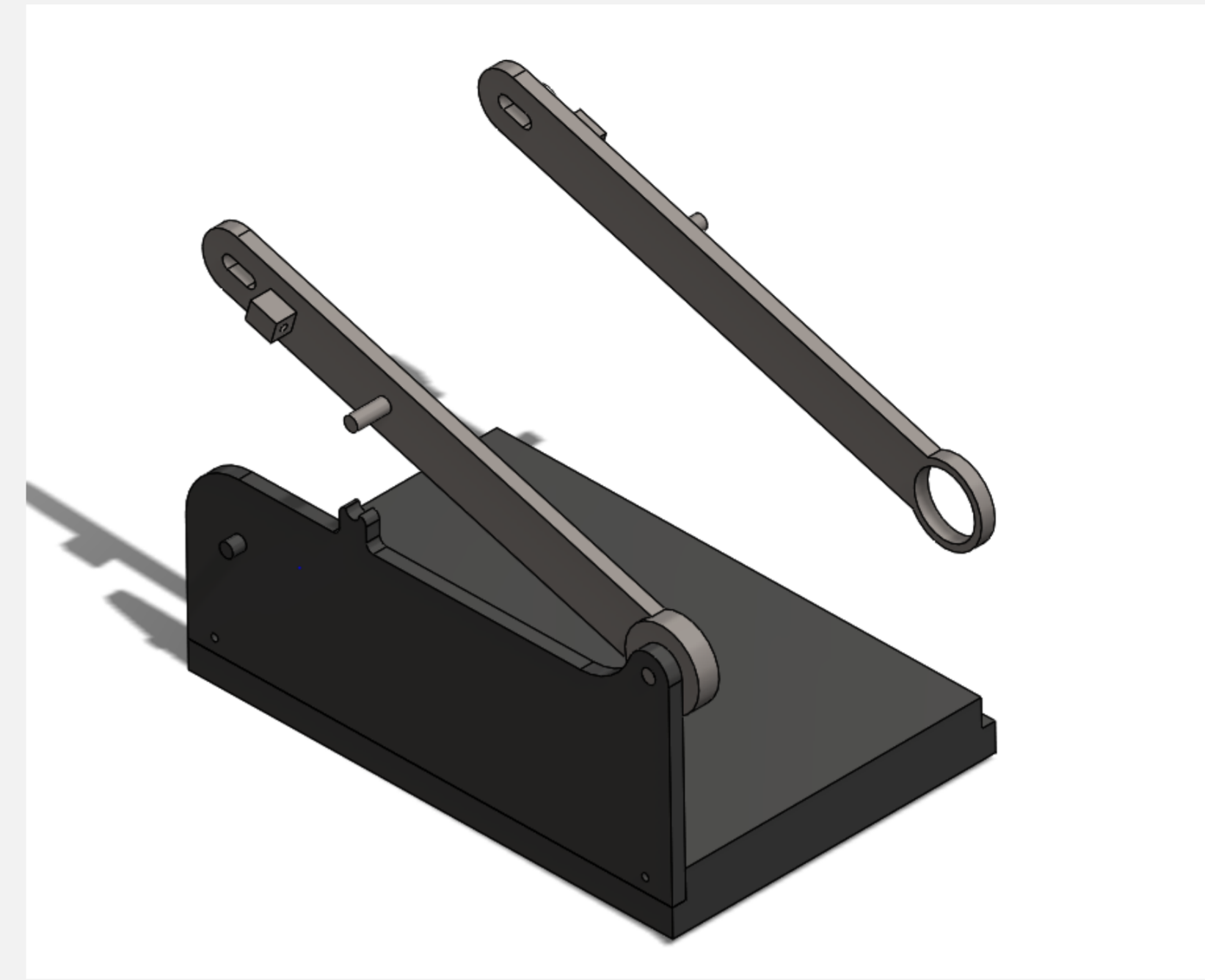
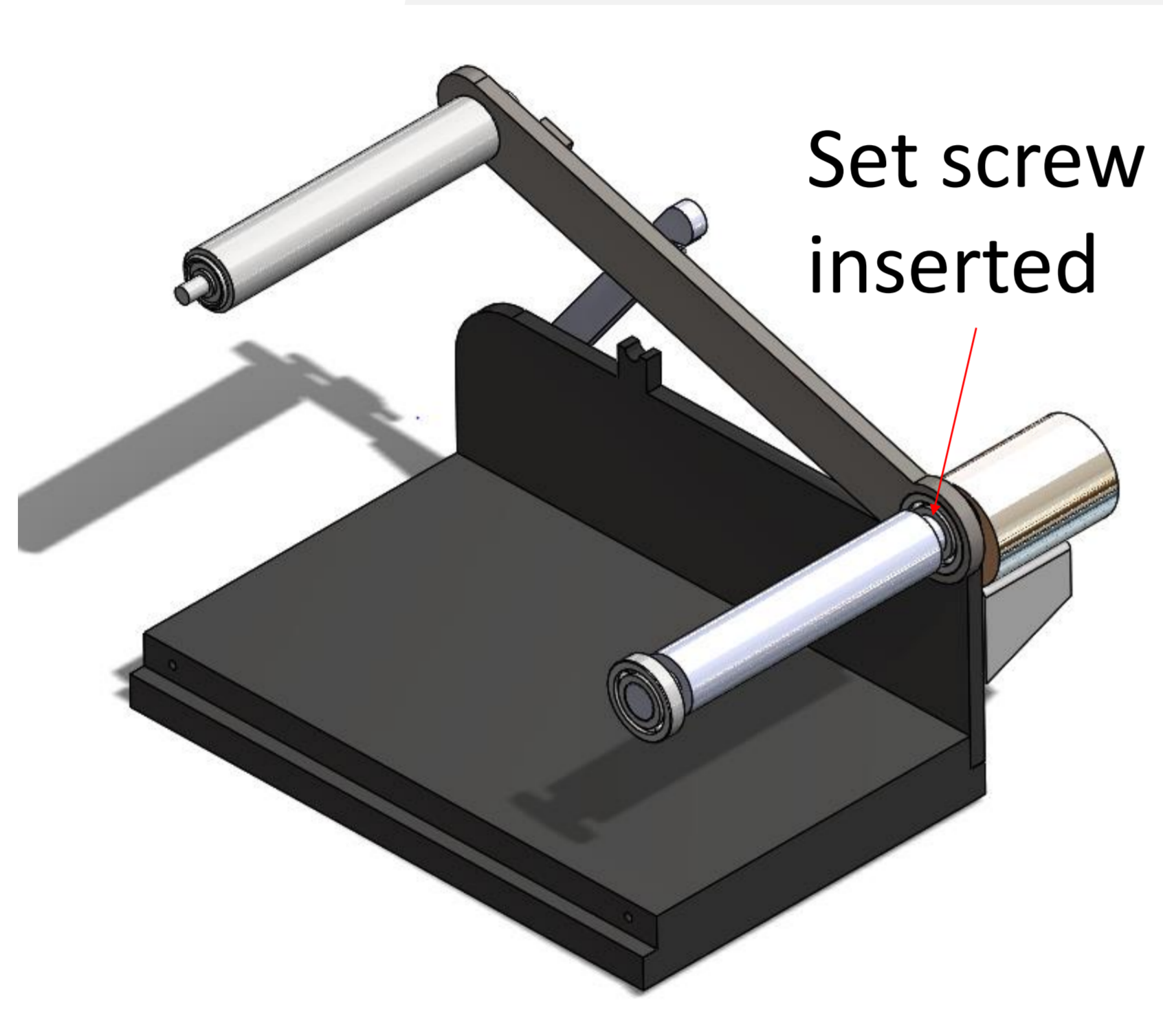
- DC Motor
- Touchscreen interface
- Manual incline mechanism
- Clear Vinyl belt material



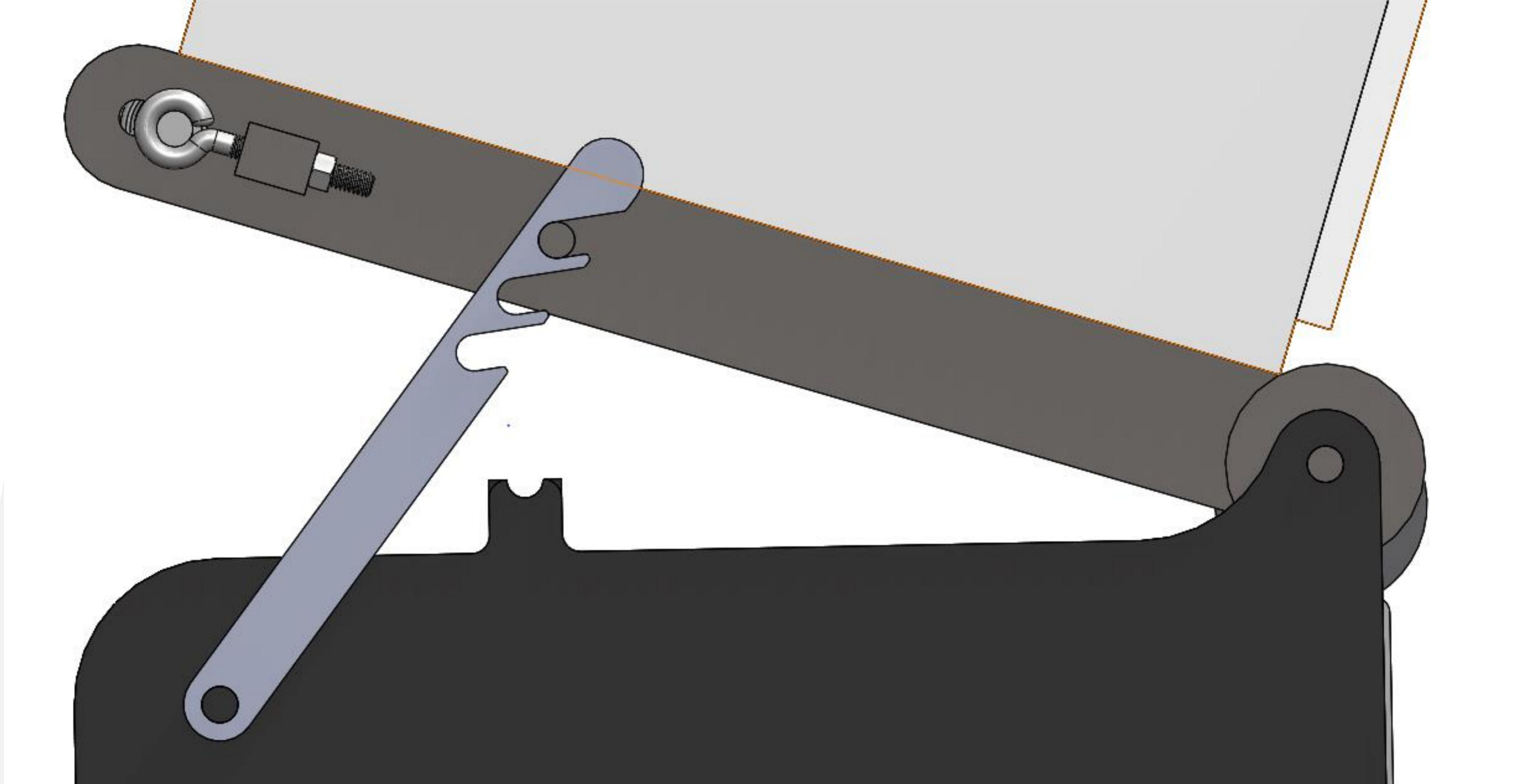
GENERAL DESIGN



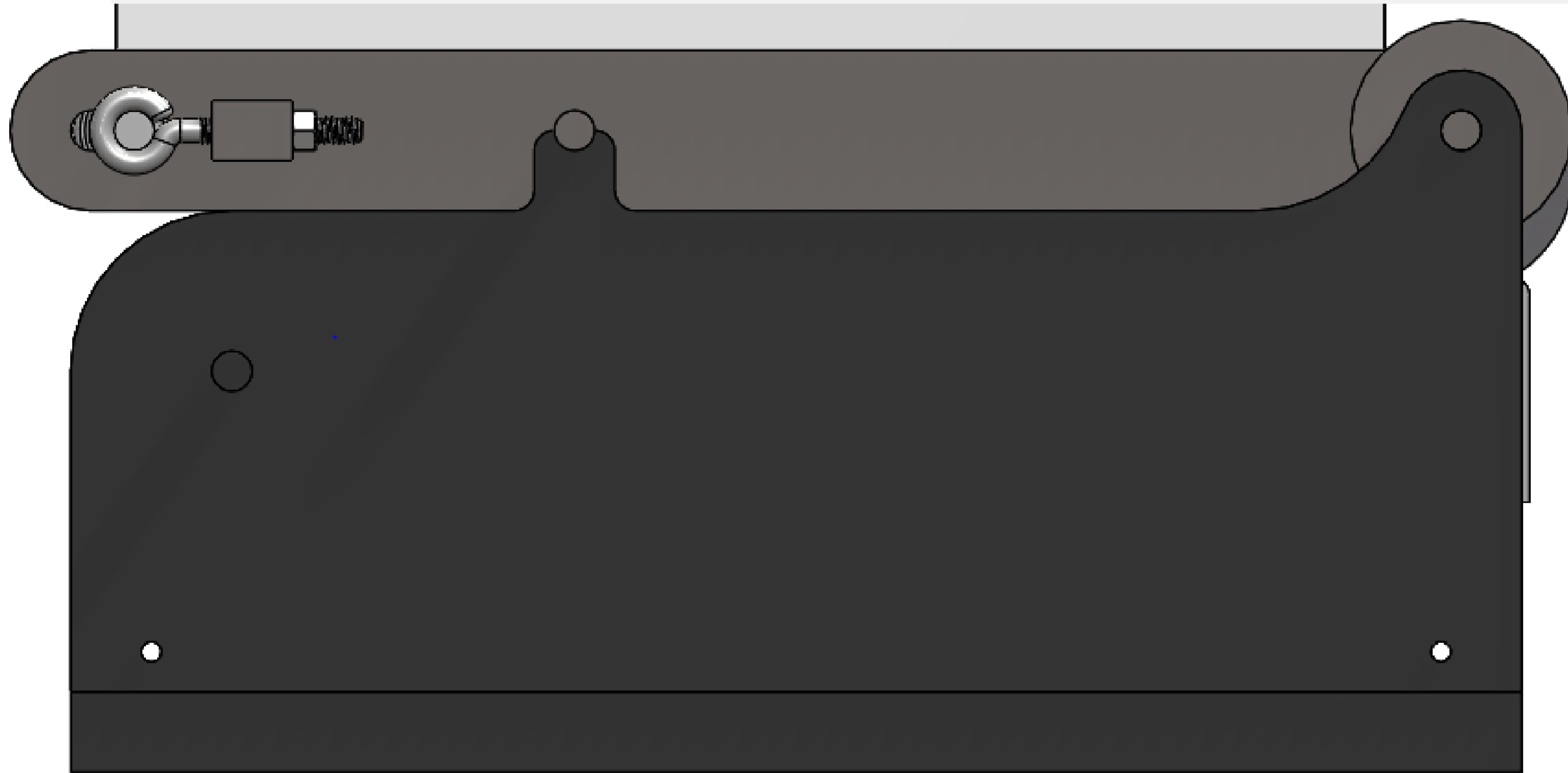
GENERAL DESIGN



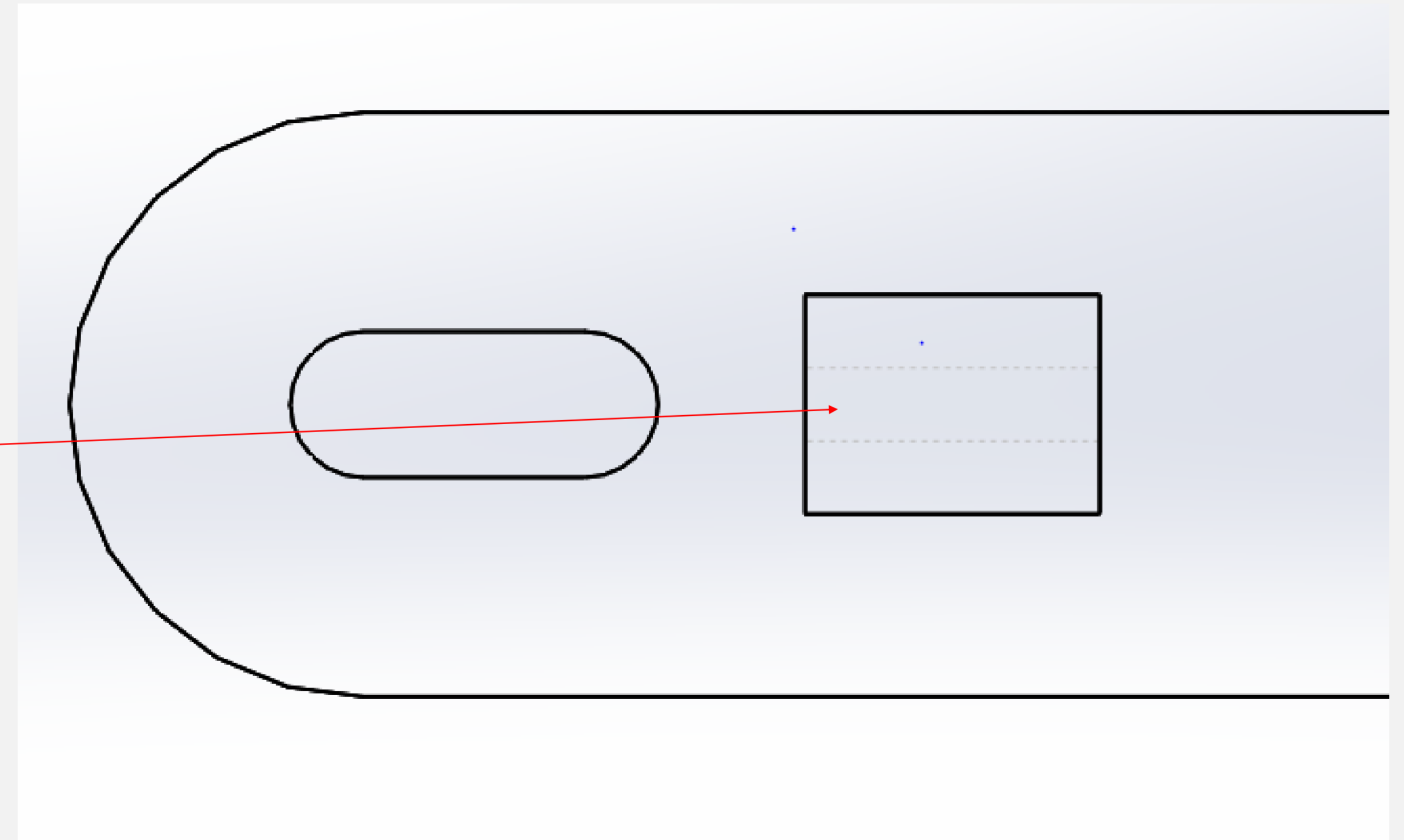
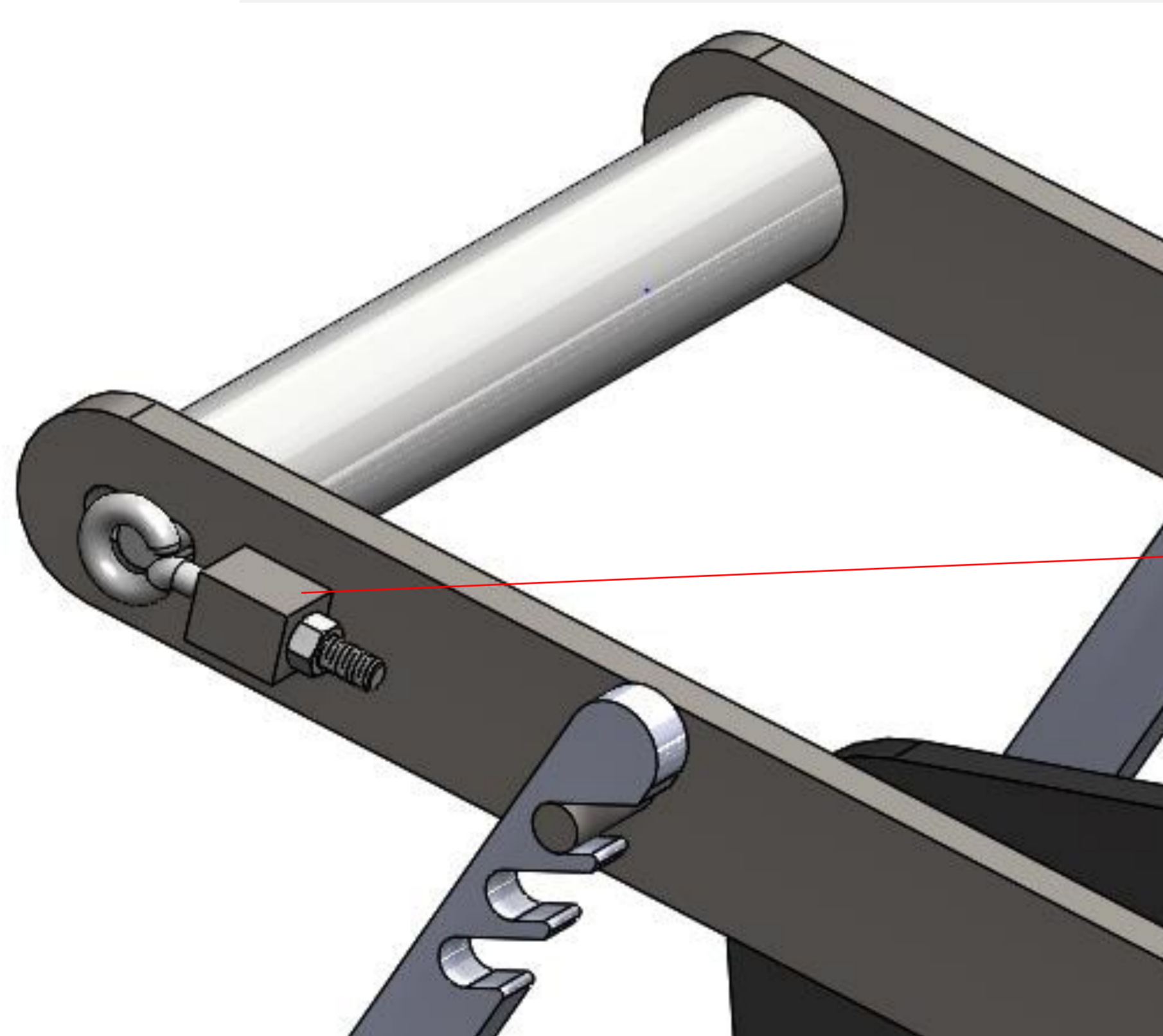
INCLINATION MECHANISM



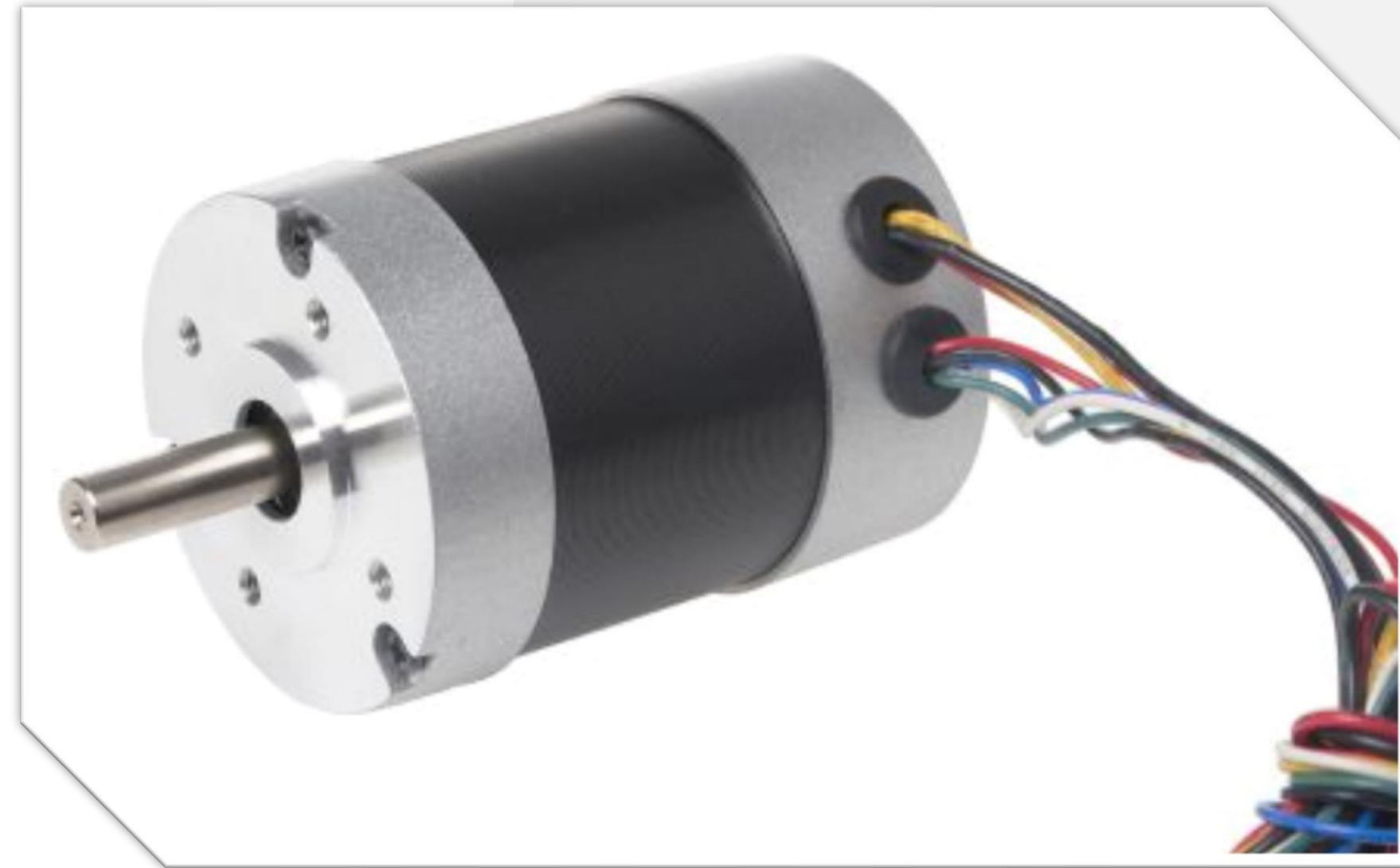
INCLINATION MECHANISM



TENSIONING DEVICE



DC MOTOR

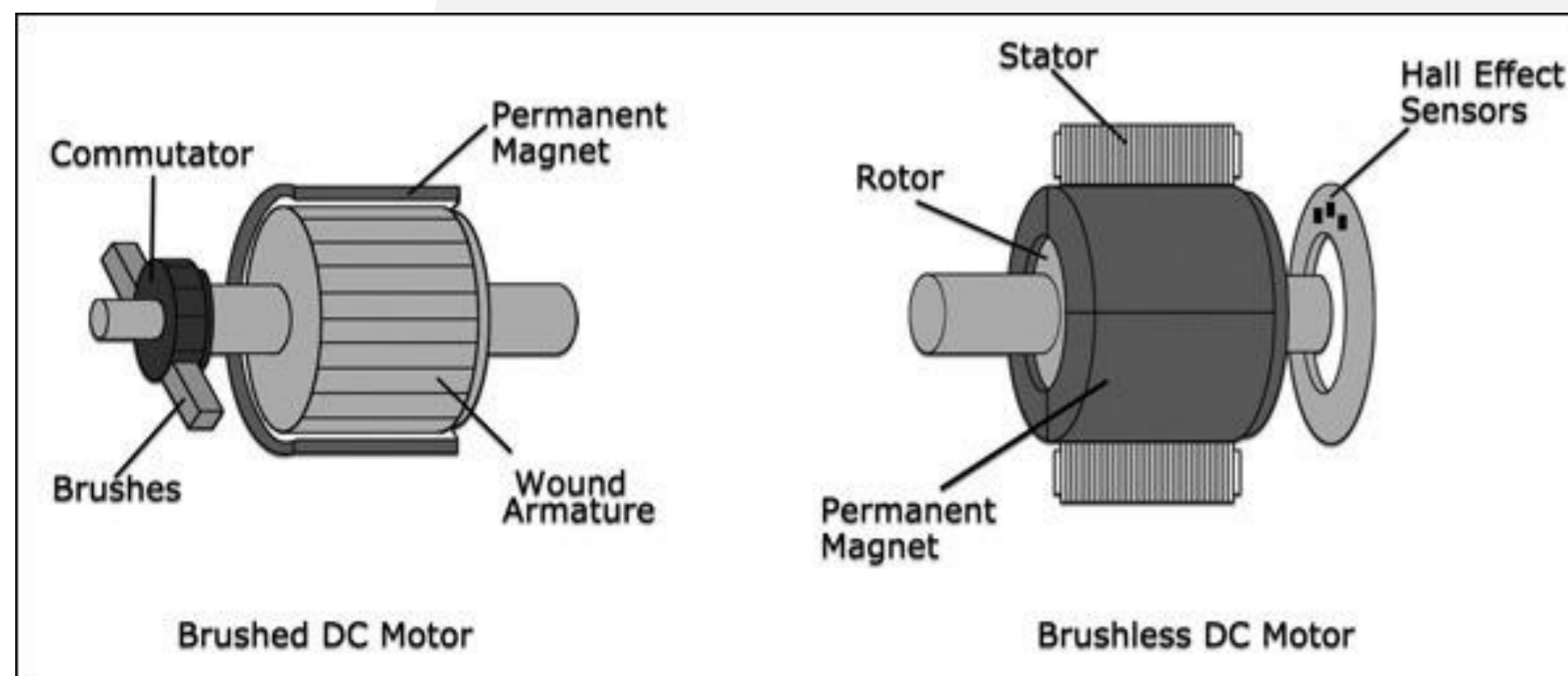


Advantages

- Less noise and shaking
- With encoder it can be easily monitored and controlled
- Smoother, continuous motion

Brushed Motor

- Lifetime of 1000-3000hrs
- Robust and inexpensive
- Slightly noisier due to brush wear and tear

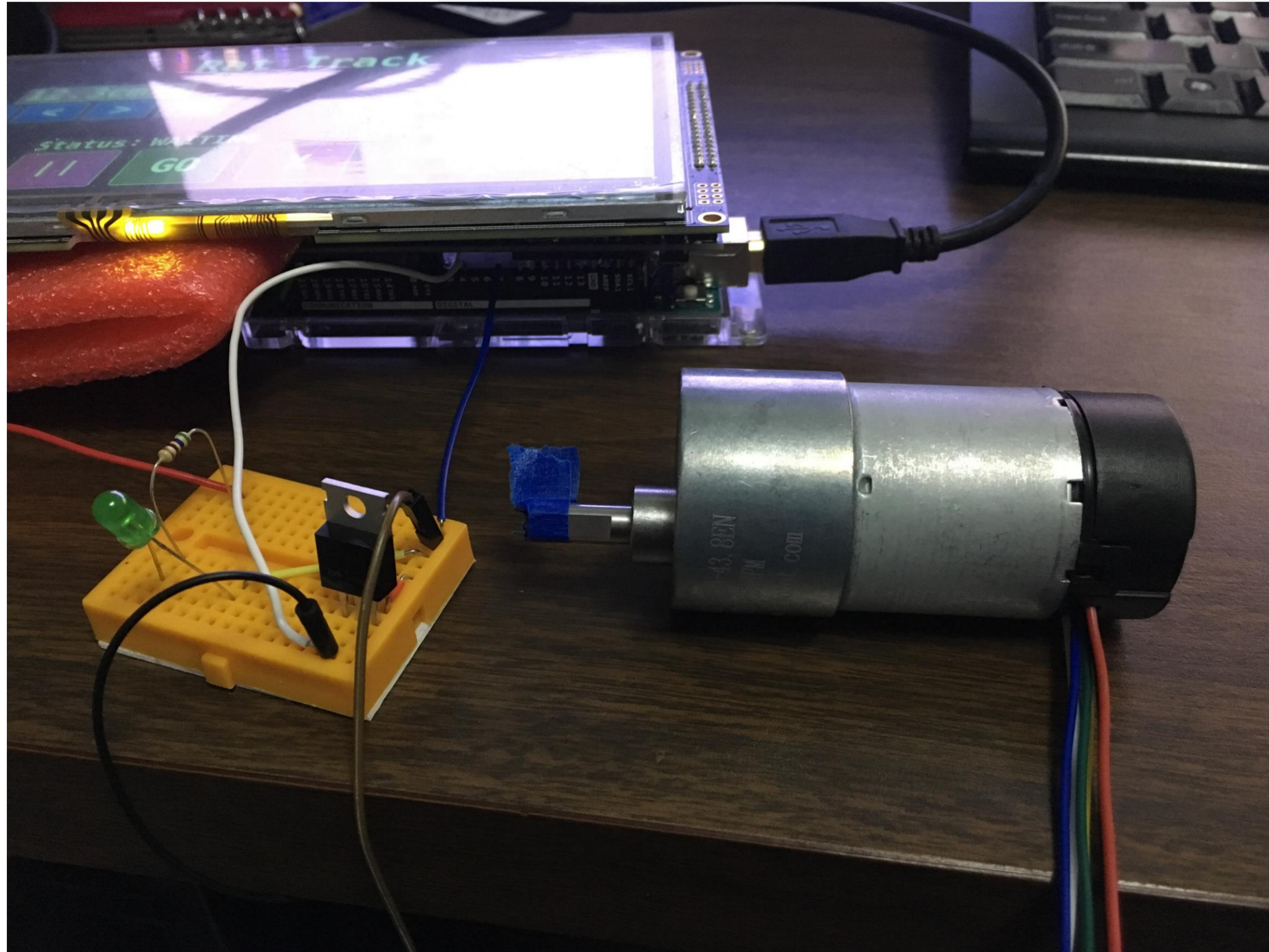


DC MOTOR



Current Setup

- 12V Brushed DC motor controlled through a MOSFET and Arduino Mega
- Encoder is mainly used for positioning, we plan to calibrate the system rather than have an active feedback system
- Smooth and quiet operation from 0.5 cm/s to 15 cm/s



WALLS/BUMPERS

ACRYLIC



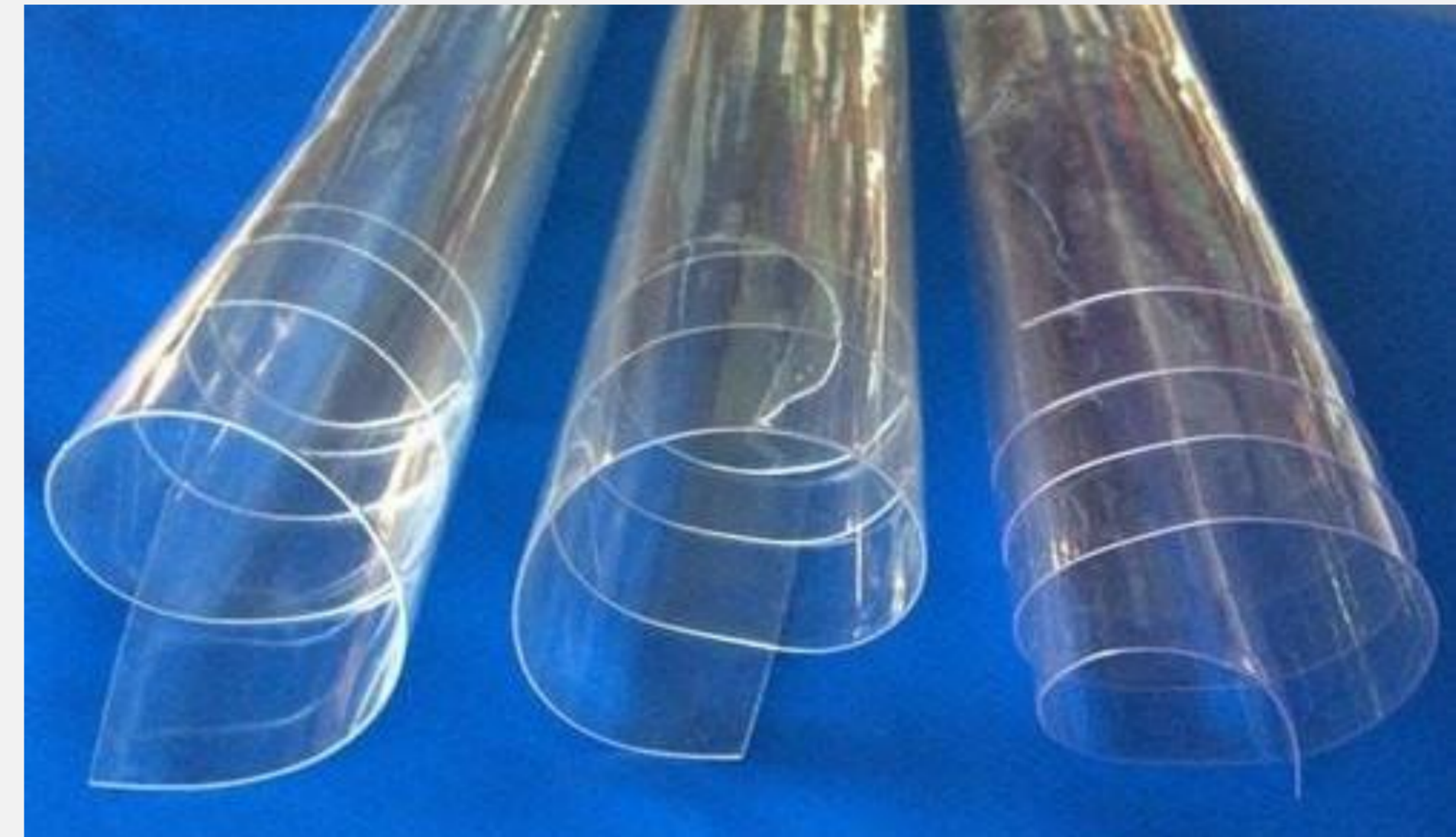
- Transparent
- Easily cleaned and maintained
- Resistant to scratches
- Easy material to work with and machine

BELT

CLEAR PVC VINYL

CONSTRUCTION

- Completely transparent
- Durable, flexible, inexpensive, and easy to clean.
- Formed into continuous loop with transparent tape
- Replacement belts will be fabricated
- Final belt will be laser cut to exact dimensions



CONTROL INTERFACE



TOUCHSCREEN

FUNCTIONS

- Start/Stop
- Speed adjustment
- Set timer

- Data Logging?

Rat Track Touchscreen UI

Angle Control: < 13° >

Timer: 0:27:30

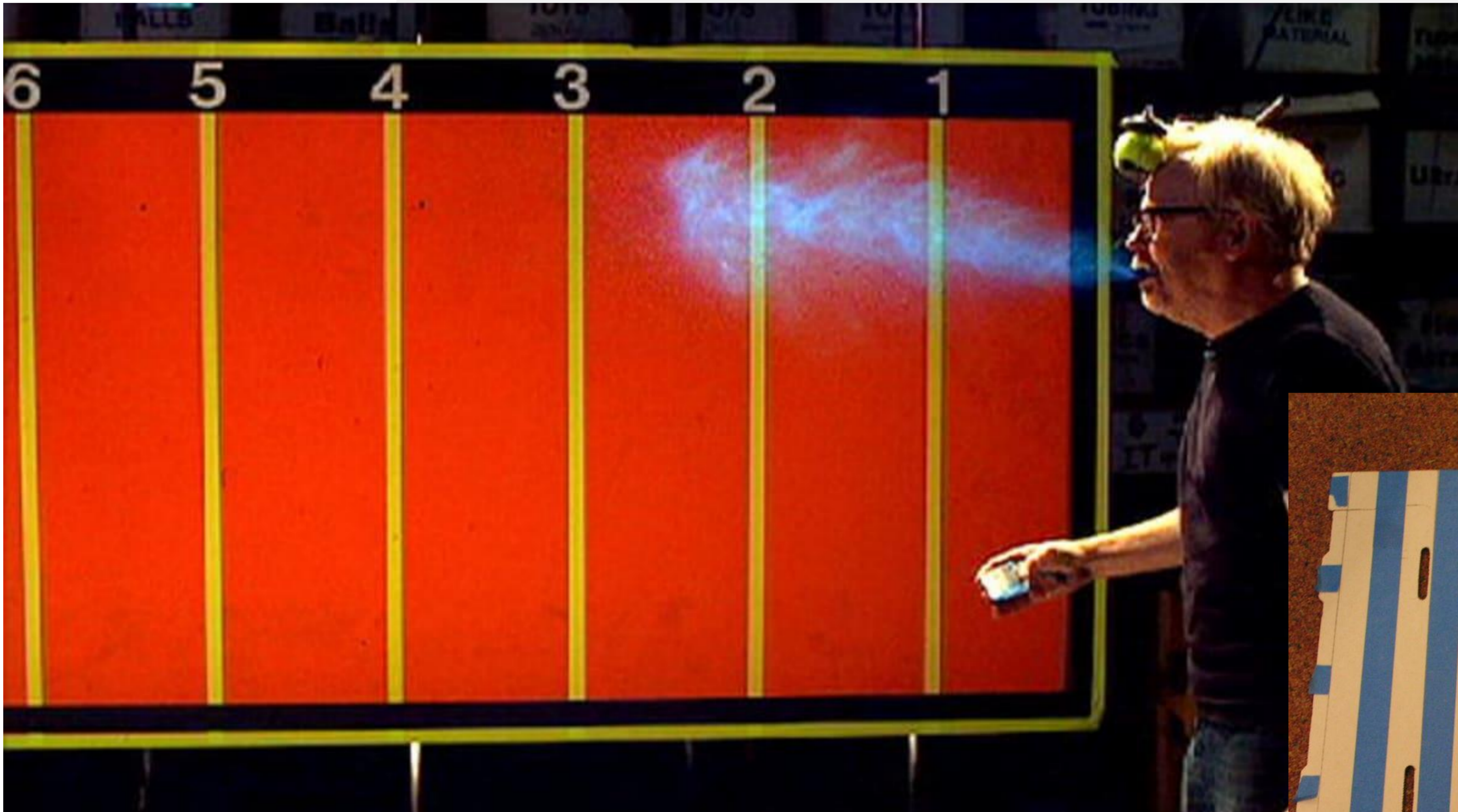
Speed Control: << < 6.1 cm/s > >>

Status: PAUSED

GO || RESET

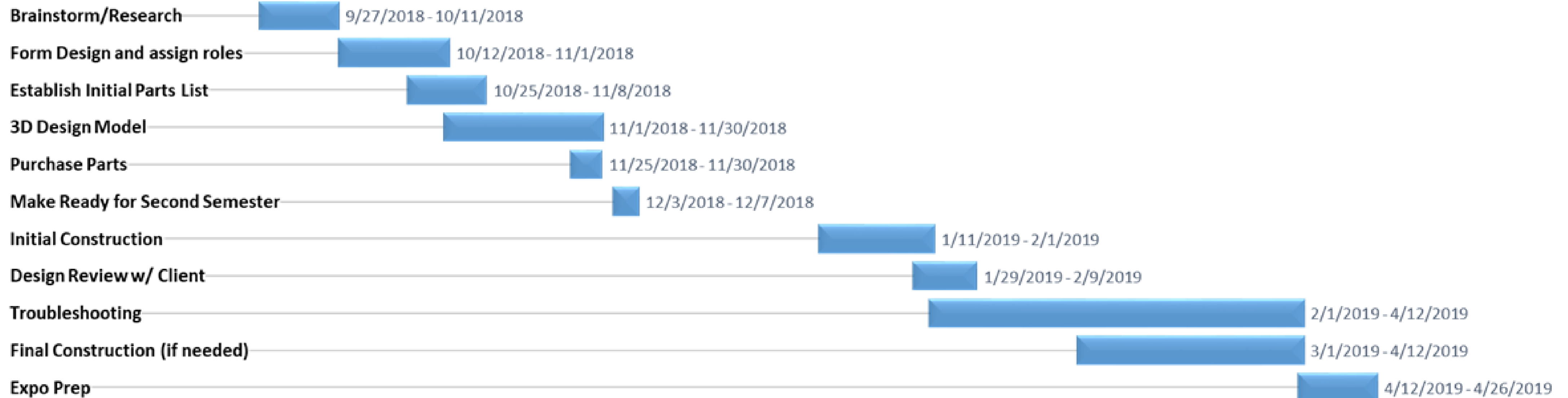
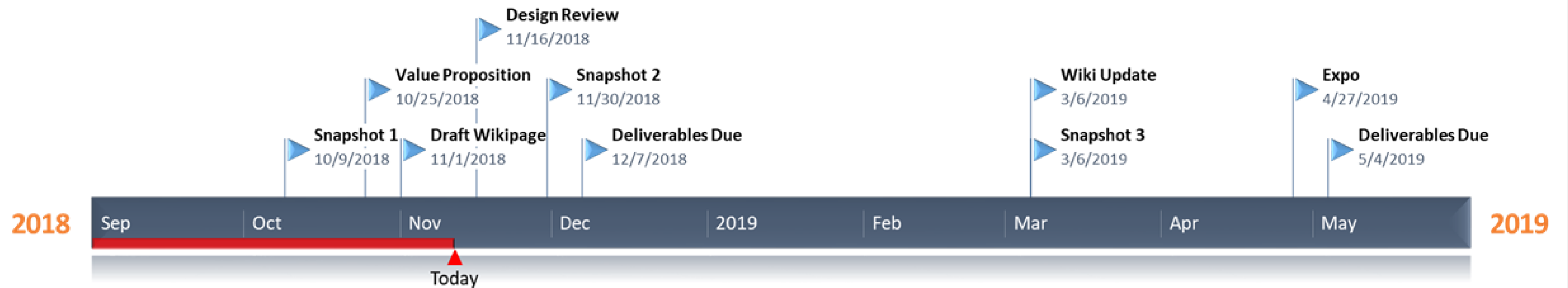
7 8 9
4 5 6
1 2 3
ENTER 0

SPEED VALIDATION



- Measure belt speed with slow motion video footage.

SCHEDULE



WIKIPAGE



Variable Speed Treadmill for Studying Neonatal Rats

The goal of the project is to design, build, and evaluate a variable speed and variable incline treadmill for exploring the impact of locomotor activity on the development of motor control and musculoskeletal tissues.

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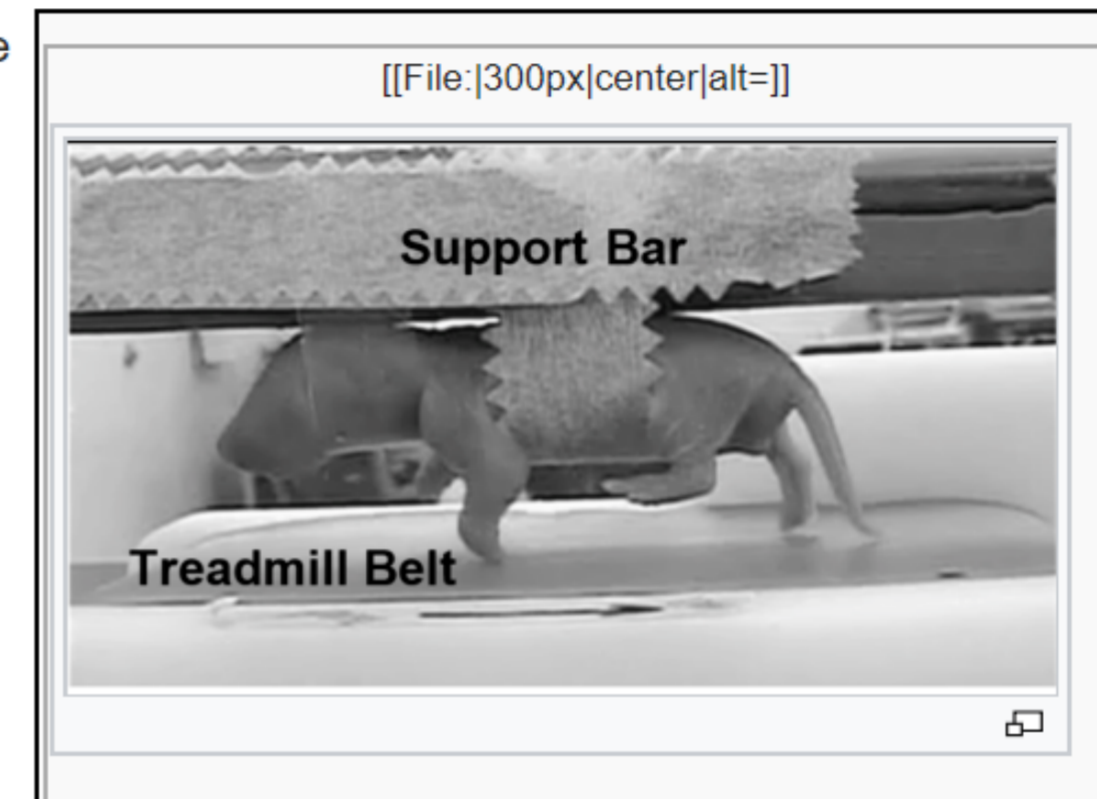
[Problem Definition](#) [\[edit\]](#)

[Background](#) [\[edit\]](#)

Our treadmill will make research much easier for the lab technicians at ISU. Our robust and simple to control design will allow for less downtime and headache when testing the effects that early locomotion have on the animal's tissues. This advancement could help the researchers expand our knowledge of biological tissues and their formation/growth, as well as psychological changes in animal models.

[Specifications](#) [\[edit\]](#)

The client has listed the project requirements in order of priority. It is anticipated that all of the following requirements will be met.



Sponsors	Idaho State University
Team Name	Rat Pack
Duration	Fall 2018 - Spring 2019
Faculty Adviser	Dev Shrestha
Mentor	Jacob Miller
Clients	<ul style="list-style-type: none">• Michele Brumley/ Idaho State University• Nathen Schiele/ University of Idaho
Team Members	<ul style="list-style-type: none">• Colin Burkhalter, ME• Mitchell Williams, ME• Stephen Schoonen, BE• Stuart Sater, BE

SUMMARY

BUDGET

- Both current and projected budgets are well within available funds

SPECIFICATIONS

- Plan to meet all design specifications, regardless of priority

SCHEDULE

- Meeting timeline goals

- DC Motor
- **Touchscreen interface**
- **Manual incline mechanism**
- **Clear Vinyl belt material**
- **Construction is underway**