



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 enclosures 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
- Operating temperatures ranging from 25° to 35° C. eed with varying load

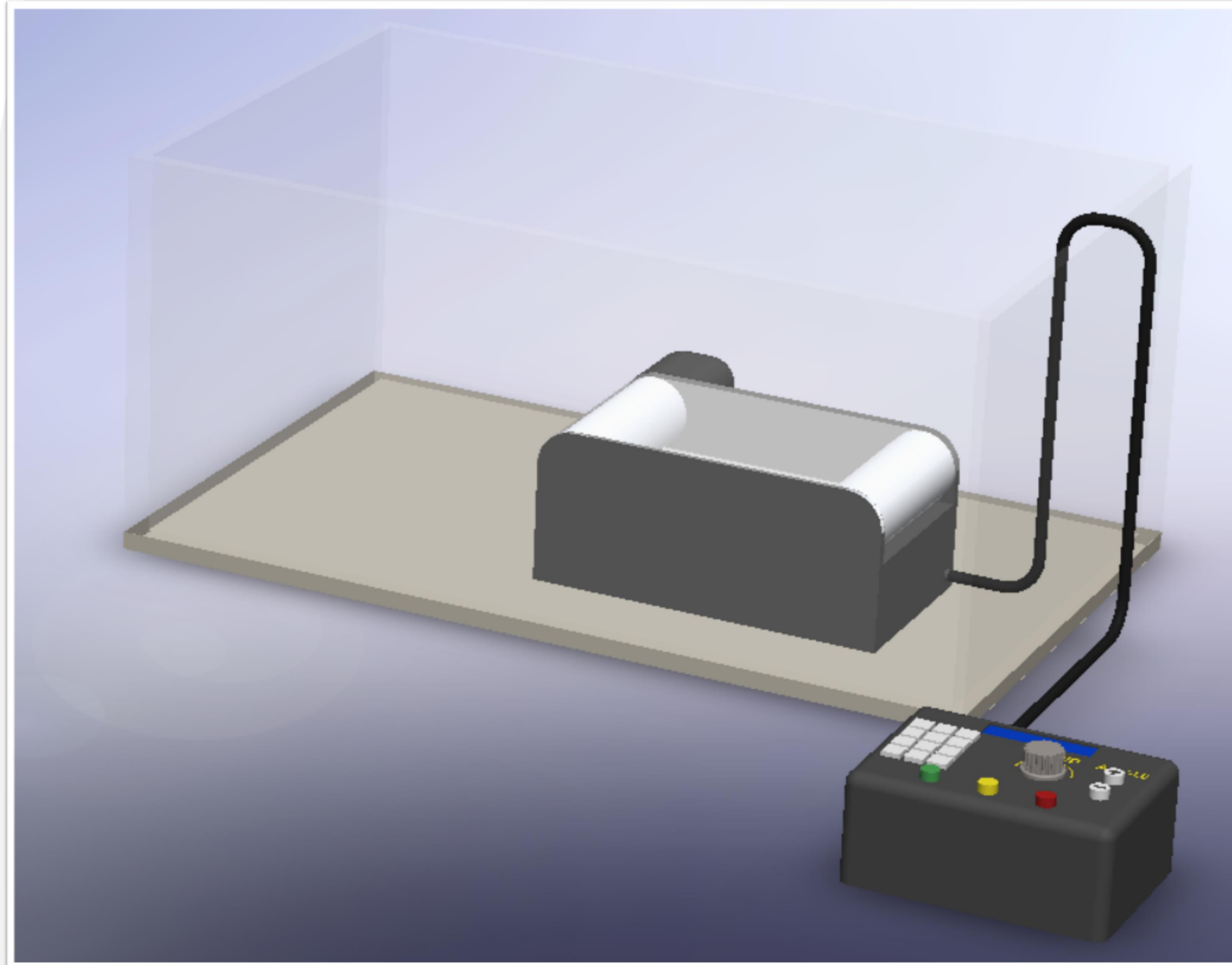
MEDIUM PRIORITY

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

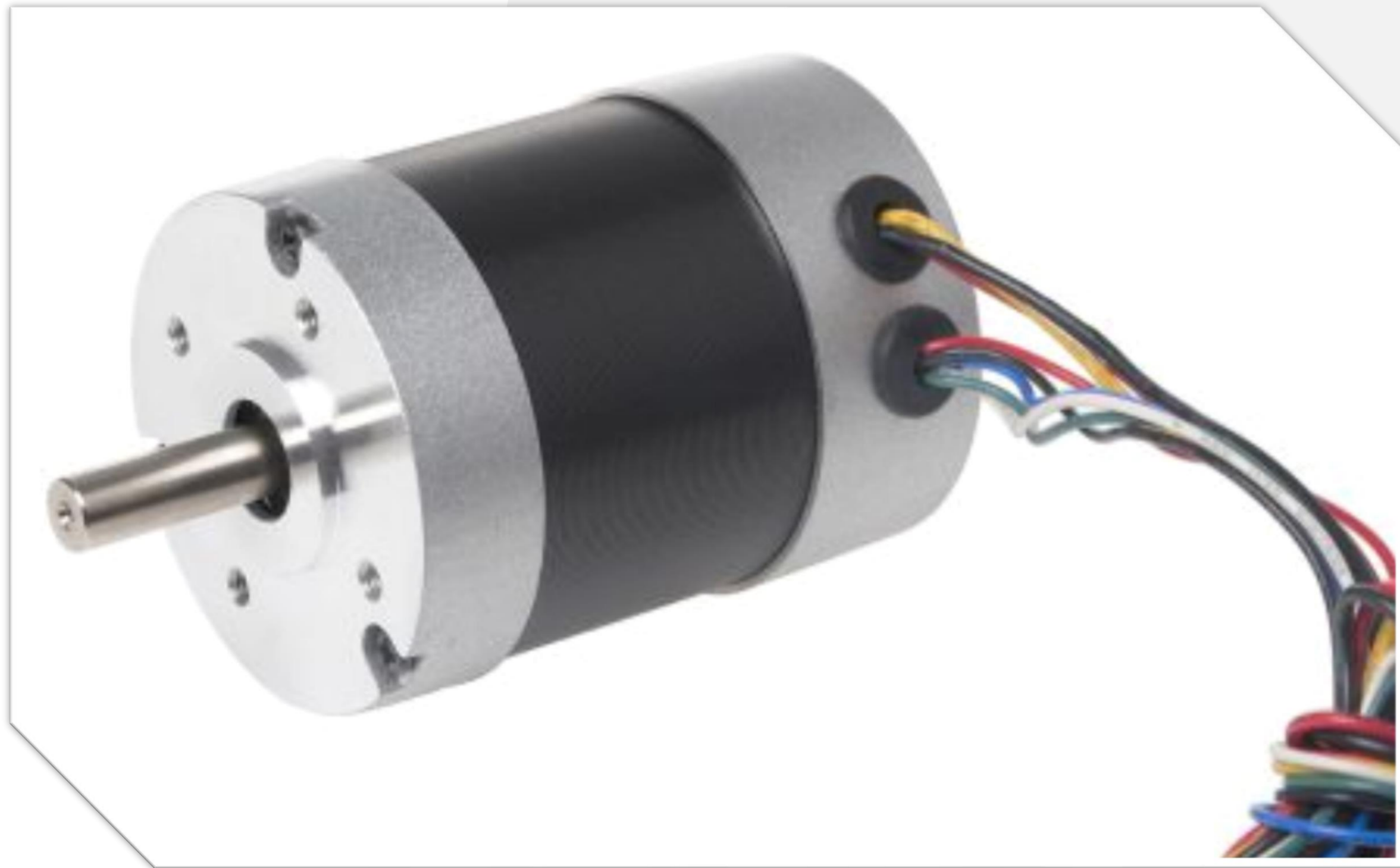
LOW PRIORITY

- 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

GENERAL DESIGN



DC MOTORS



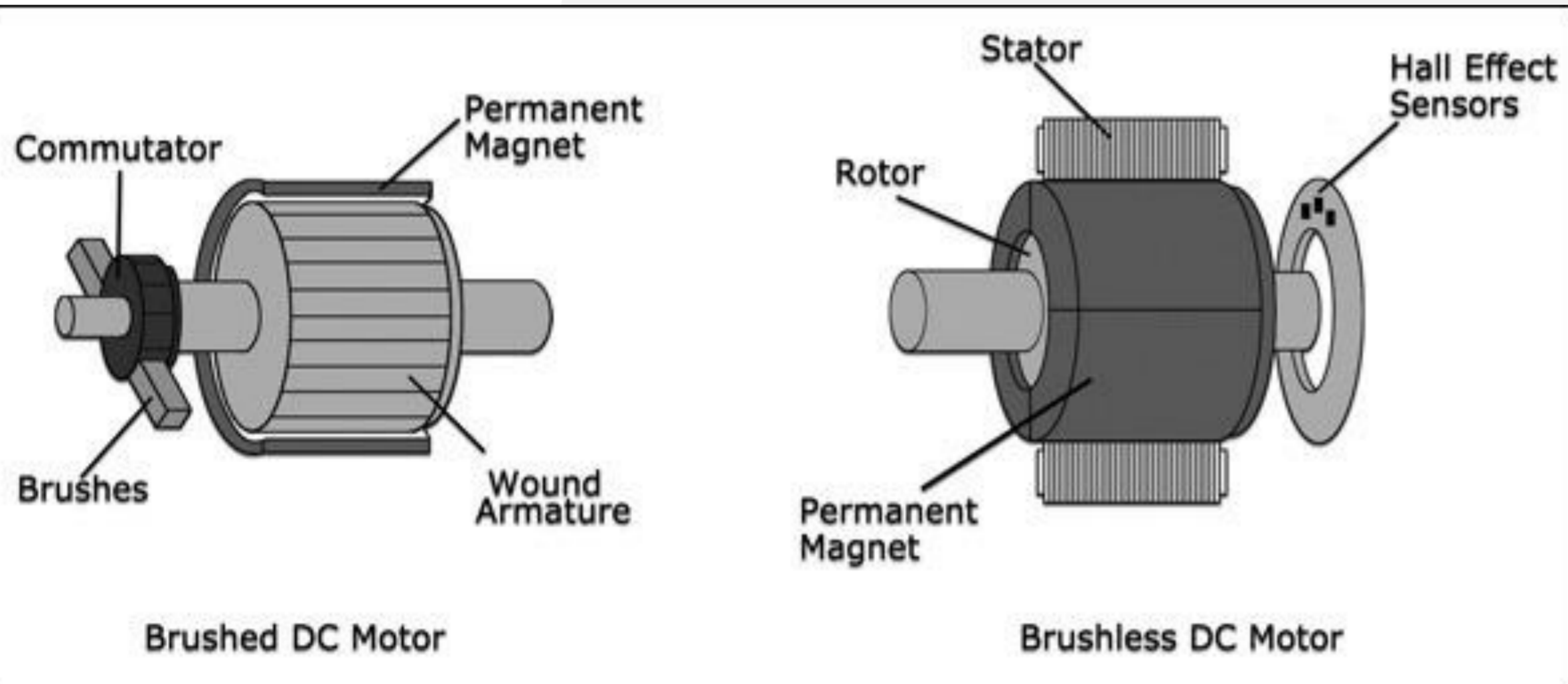
ADVANTAGES

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

DISADVANTAGES

- Lower torque
- May require more coding to maintain steady speed
- Difficult to monitor speed without encoder

DC MOTORS



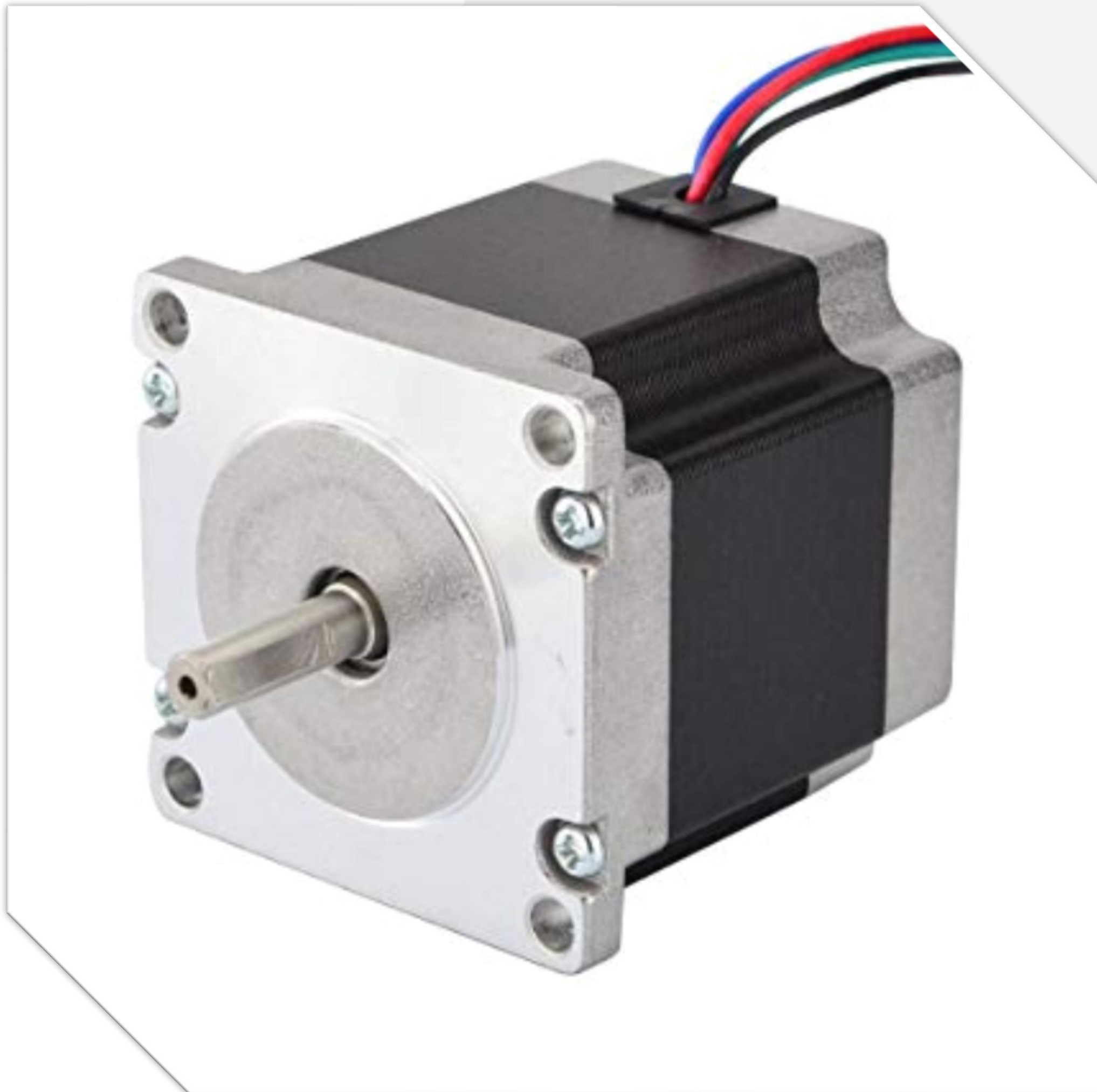
Brushed

- Lifetime of 1000-3000hrs
- Readily available on the market and cheaper
- Noisier due to brush wear

Brushless

- Lower noise
- Longer lifetime
- Requires controller and is more expensive

STEPPER MOTORS



ADVANTAGES

- Precise speed/position control
- Relatively simple to program
- Maintains constant speed with varying load

DISADVANTAGES

- Noisy
- 'Choppy' motion at lower speeds
- High vibrations at low speeds

SAFETY CONCERNS

EMERGENCY STOP AND WALLS



- Animals could fall off treadmill
- Large concerns of pinching points
 - Eliminate cracks that animal limbs could be caught in
- Sensor to stop treadmill if animal hits back wall
- Minimize noise levels



WALLS/BUMPERS

ACRYLIC



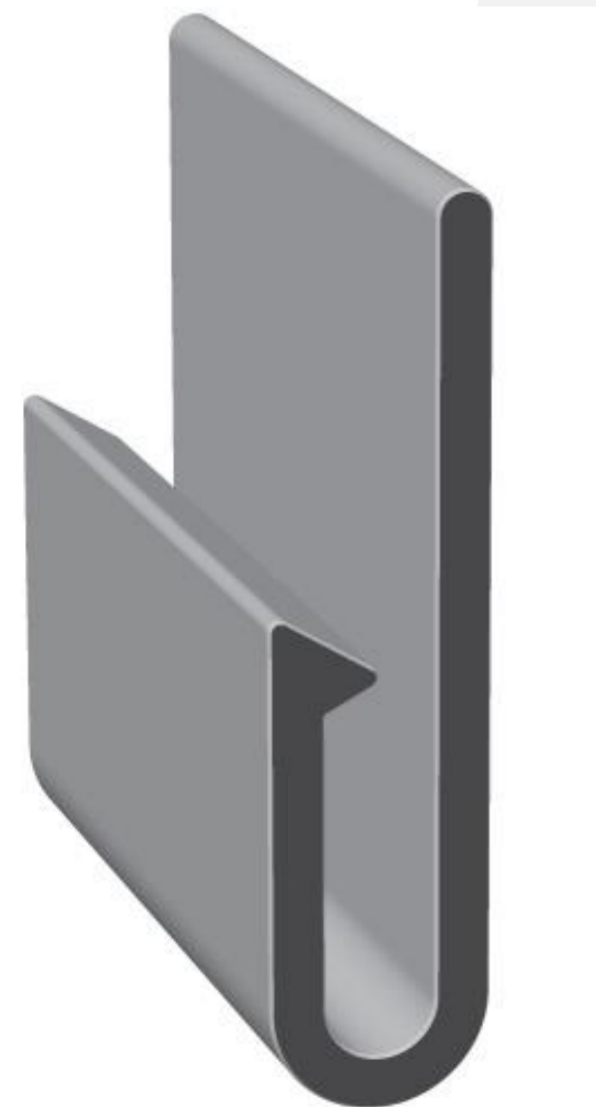
- Transparent
- Easily cleaned and maintained
- Resistant to scratches
- Easy material to work with and machine

WALLS/BUMPERS

DETACHABLE MOUNTING



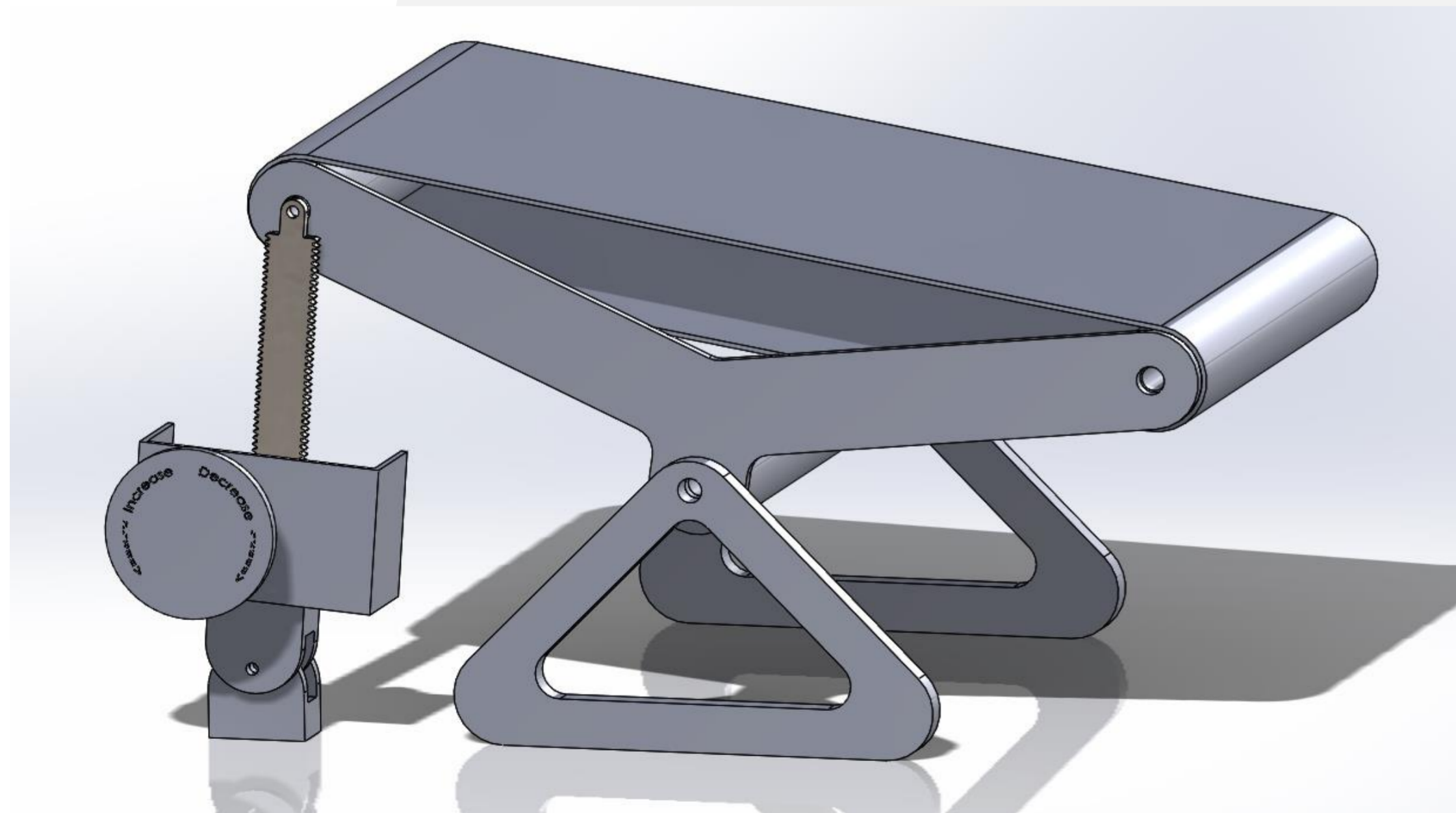
- 4-wall system that can be removed all at once, or if needed, one at a time.
- Large variety of both plastic and metal to choose from
 - Plastic may break more easily
 - Some materials are more permanent than others
- Slots to slide walls together



INCLINATION MECHANISM



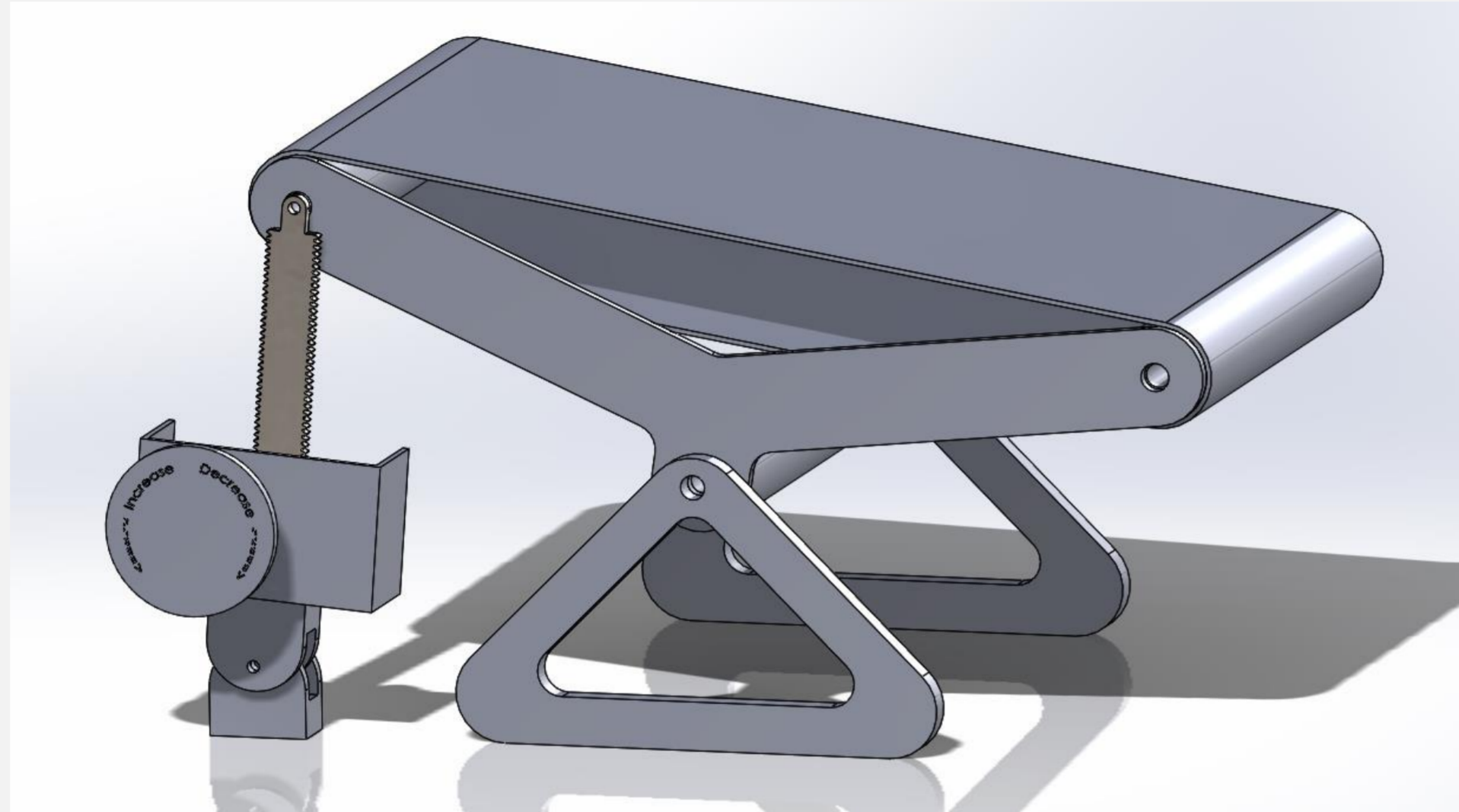
MANUAL



AUTOMATED

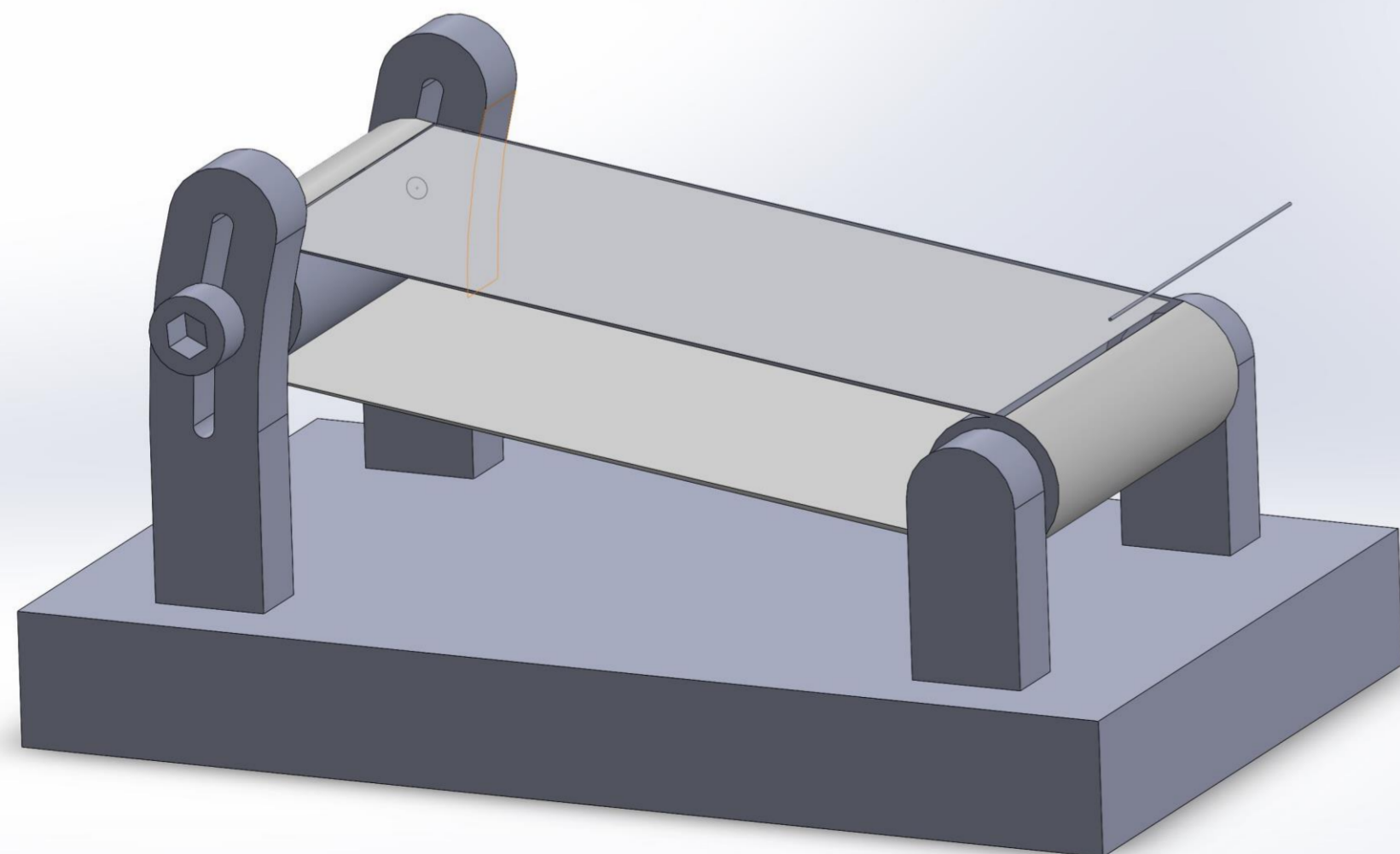


MANUAL OPERATION



ADVANTAGES

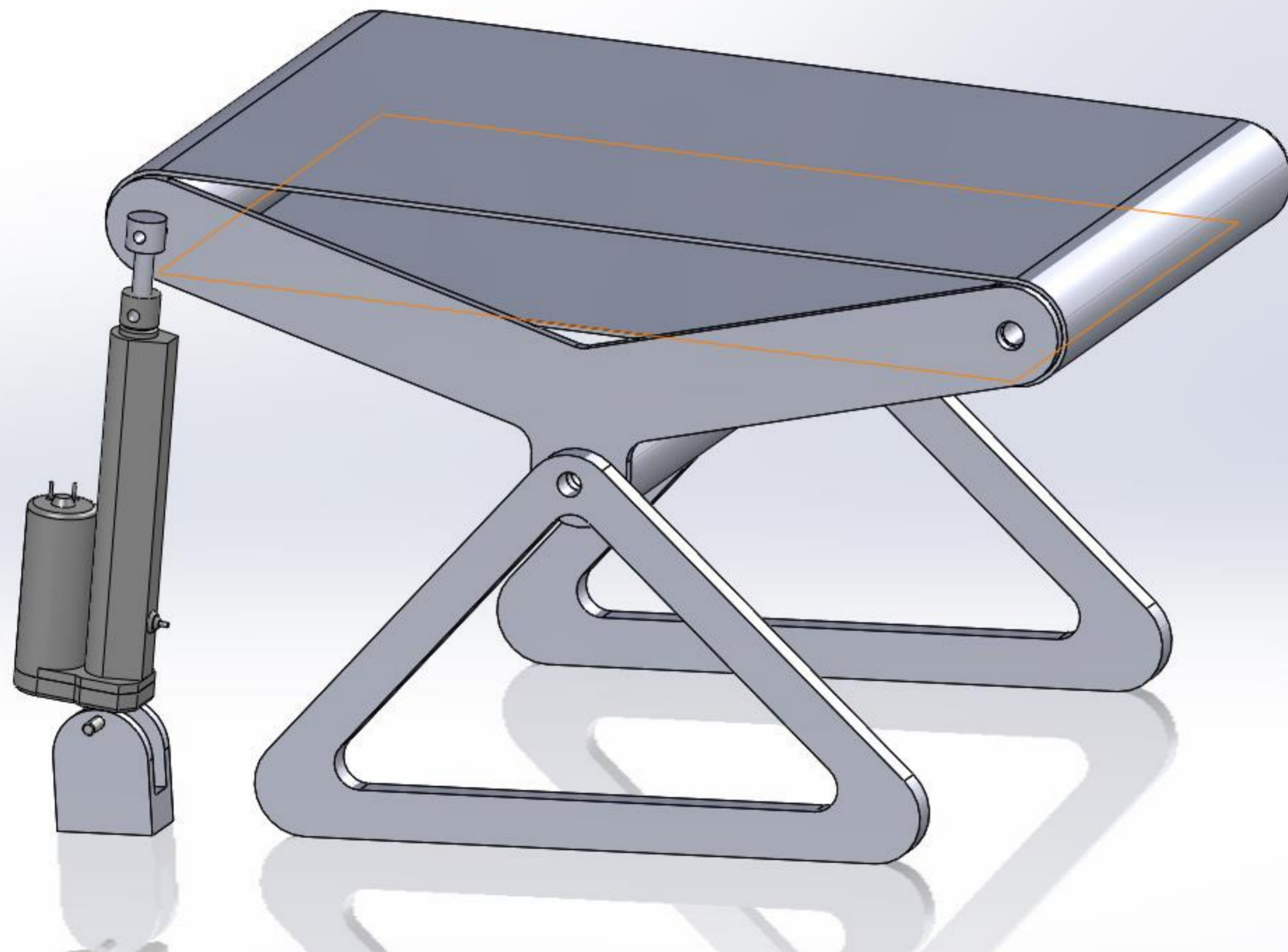
- Requires no user electronic interaction
- Quicker response time
- Simpler



DISADVANTAGES

- Difficult to adjust in incubator
- Less precise
- May require tools to operate

AUTOMATED OPERATION



ADVANTAGES

- Precise angle adjustment
- Can be adjusted remotely
- Provides active feedback through software
- Allows surplus in lifting power for future design changes

DISADVANTAGES

- Expensive linear actuator \$140
- Added complexity

BELT

CLEAR PVC VINYL

PROS

- Completely transparent
- Durable, flexible, inexpensive, and easy to clean.
- Can be heat welded, glued, or welded with a mechanical lacing technique to create a continuous loop of custom size
- Can be purchased in bulk to make additional replacement belts
- Comes in multiple gauges to choose from to best fit our needs

CONS

- Requires fabrication
- May be lacking adequate grip



20, 30, and 40 gauge clear vinyl

BELT

PREFABRICATED BELT

PROS

- Very durable, easy to clean
- Higher friction factor
- Prefabricated

CONS

- Slightly opaque at best
- Not available in the exact dimensions needed
- Expensive
- Long turnaround time between placing order and receiving product



Prefabricated polyurethane belt

CONTROL INTERFACES

TOUCHSCREEN VS BUTTONS

FUNCTIONS

- Start/Stop
- Speed adjustment
- Angle adjustment
- Set timer



VS



CONTROL INTERFACES



TOUCHSCREEN

Rat Track Touchscreen UI

Angle Control

< 13° >

Timer

0:27:30

7 8 9
4 5 6
1 2 3
ENTER 0

Speed Control

<< < 6.1 cm/s > >>

Status: PAUSED

GO || RESET

ALL IN ONE

CONTROL INTERFACES



TOUCHSCREEN

Rat Track Touchscreen UI

6.3 cm/s	12°	0:37:00
SPEED	ANGLE	TIME

Status: PAUSED

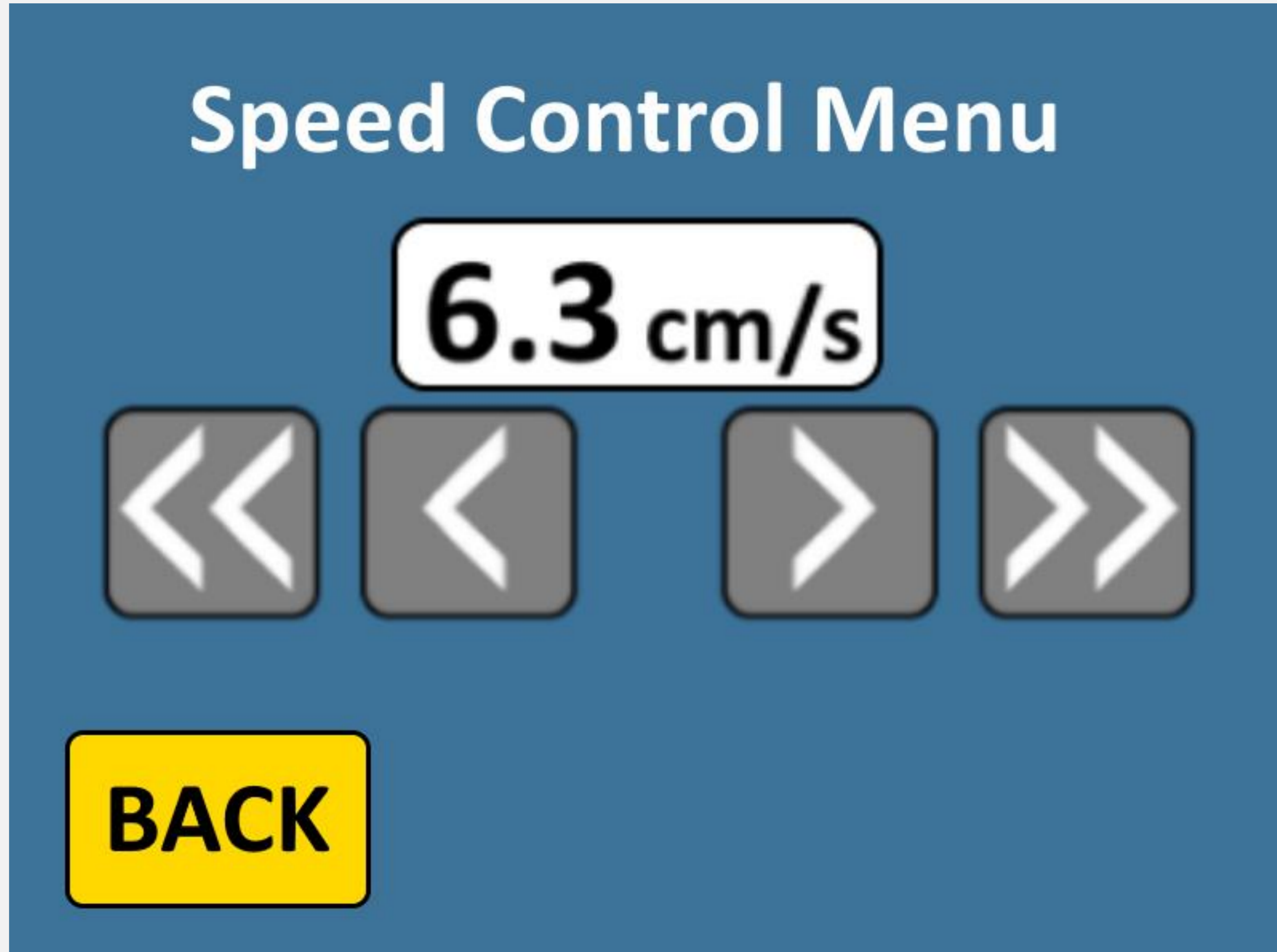
GO		RESET
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SUB MENUS

CONTROL INTERFACES



TOUCHSCREEN



SUB MENUS

CONTROL INTERFACES



TOUCHSCREEN

Rat Track Touchscreen UI

6.3 cm/s	12°	0:37:00
SPEED	ANGLE	TIME

Status: **PAUSED**

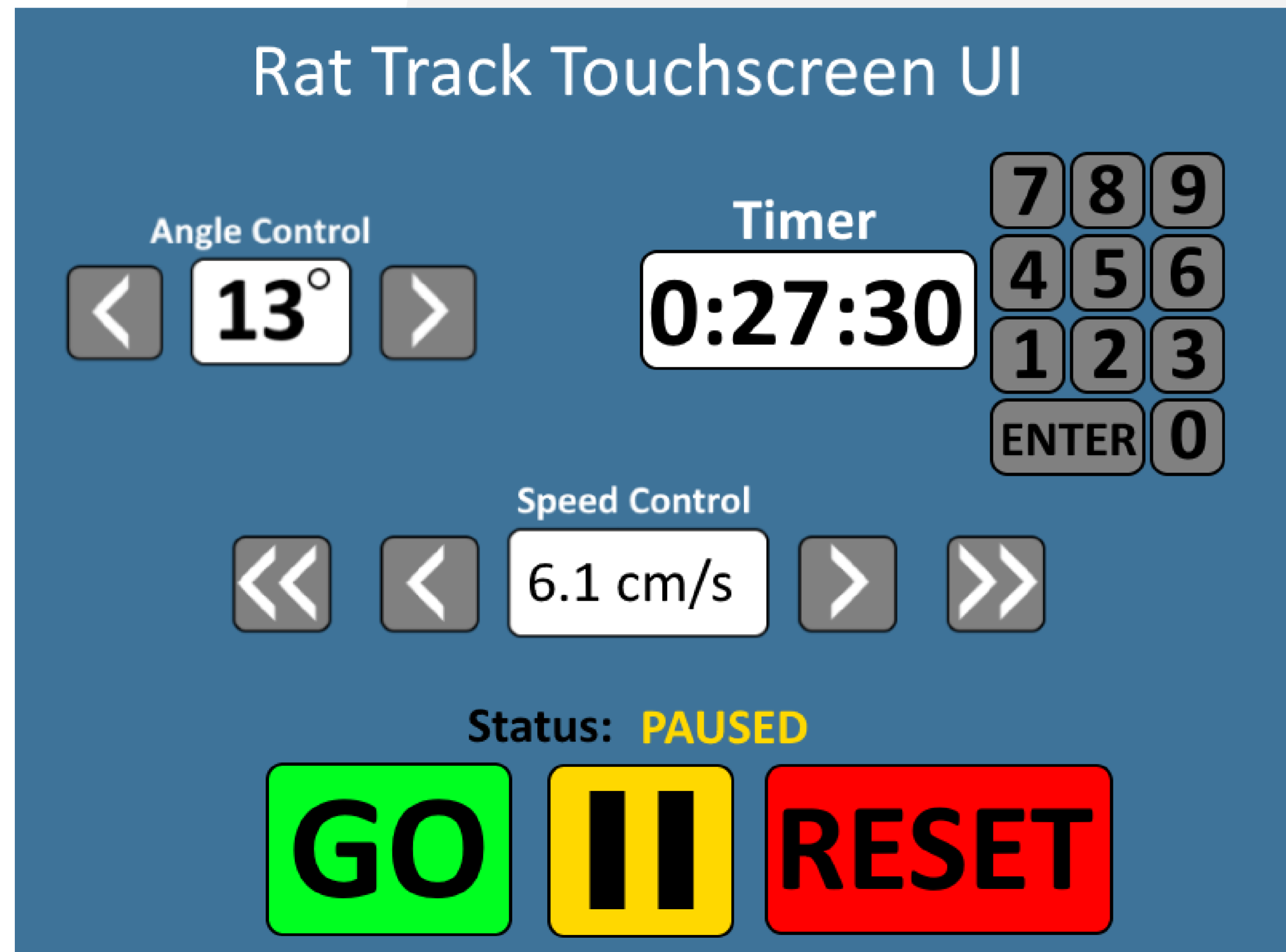
GO	 	RESET
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SUB MENUS

CONTROL INTERFACES



TOUCHSCREEN



ADVANTAGES

- Highly customizable
- Easy to clean
- Easy to understand
- Pretty rad

DISADVANTAGES

- Expensive, \$50-\$70
- Relatively small screen/text
- Potential for mis-selections

CONTROL INTERFACES



BUTTONS



16x2 LCD Screen

```
SPD 13.2   ANG 12'  
TIME 1:23:00
```

OR

```
SPD   ANG   TIME  
13.2  12'  1:23:00
```


CONTROL INTERFACES



BUTTONS



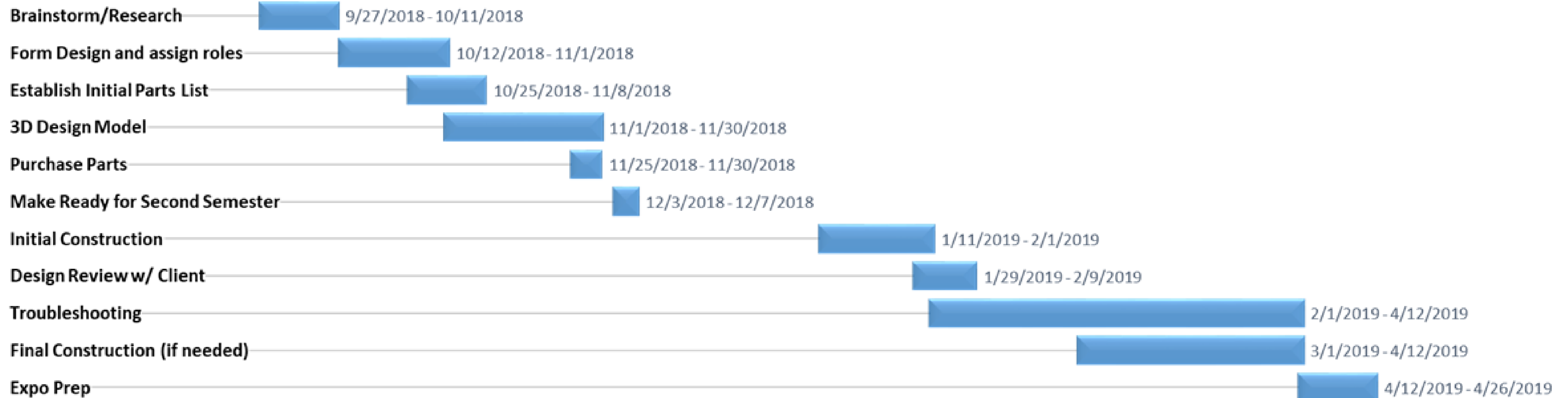
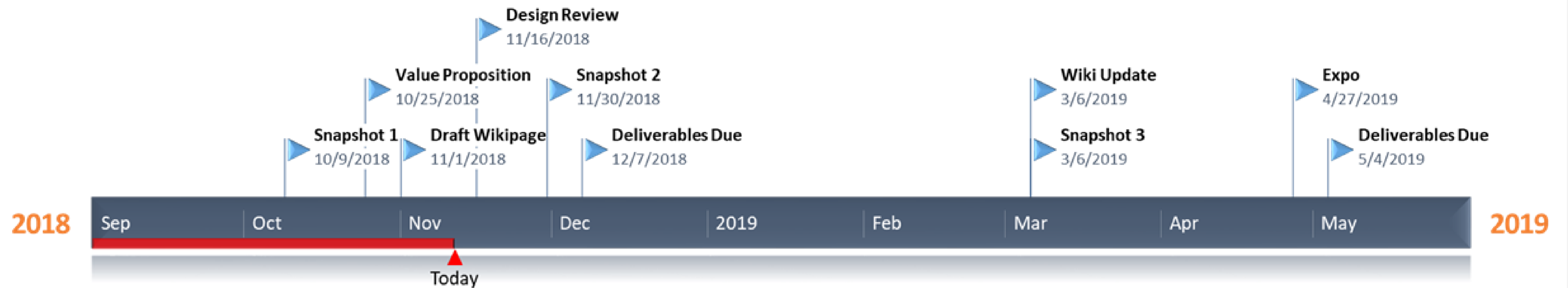
ADVANTAGES

- Simple to operate
- Robust, solid controls
- Low cost, ~\$20 for all components

DISADVANTAGES

- Potential for loose wires
- More difficult to clean
- Not as rad

SCHEDULE



SUMMARY

BUDGET

- Estimated budget is well below available funds

SPECIFICATIONS

- Plan to meet all design specifications, regardless of priority

SCHEDULE

- Feasible timeline with regular goals

DESIGN DECISIONS

- Motor Type
- Control Interface
- Incline mechanism
- Belt material