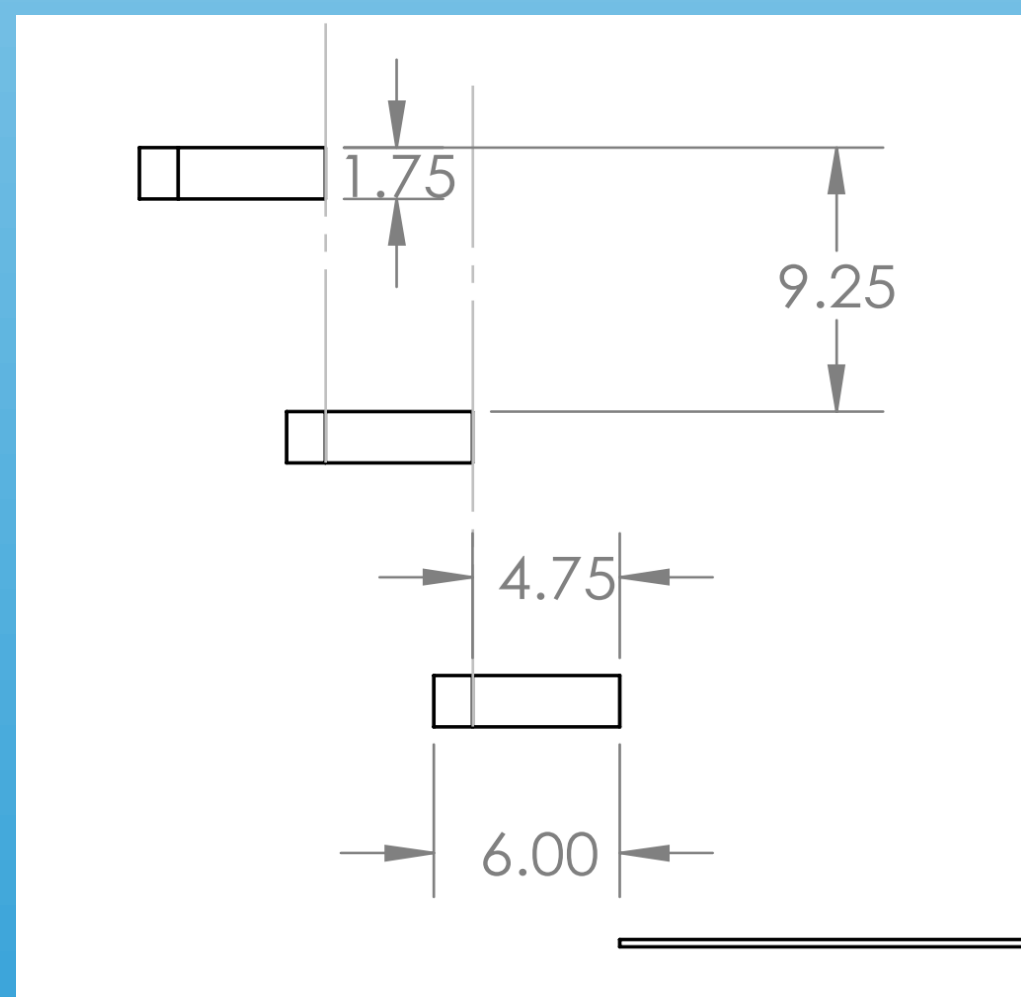


Background

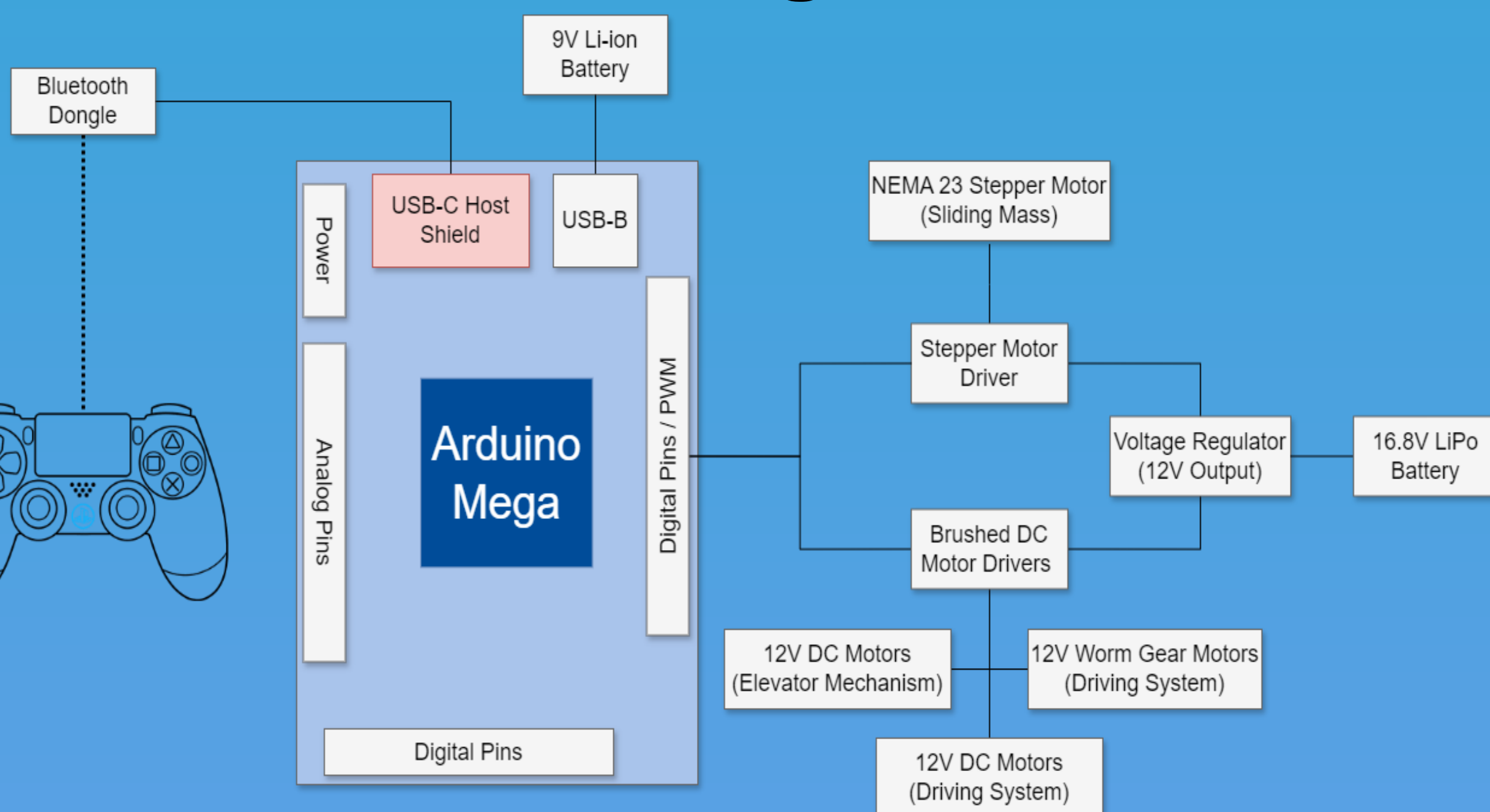
The US Navy has over 450 ships in active service and reserve. With this many ships, the Navy spends over 2 billion dollars per year on ship maintenance. Additionally, the Navy missed its recruitment goal by about 7000 personnel in 2023. The Navy has determined an autonomous robot capable of traversing a Navy ship as a potential solution to these problems. Our team, tasked with creating a robot to climb the steep 60° stairs in Navy ships, has developed the first full-scale prototype to address this challenge.

Overview/Design Specs

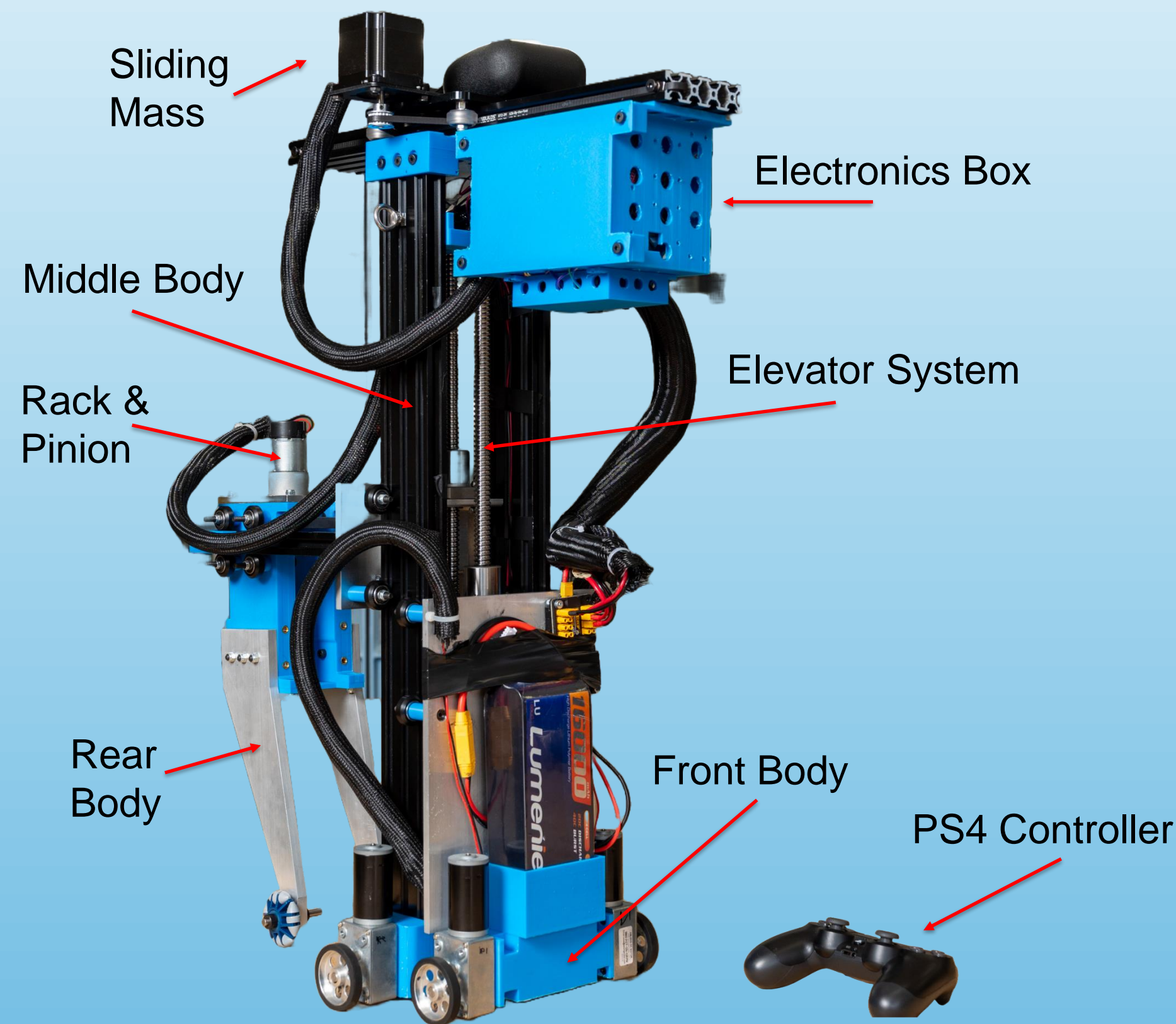
The stairs we were tasked with climbing are 60° with 9.25" vertical spacing and 4.75" of usable tread. The Trident I robot consists of 8 motors and over 20 custom-made parts.



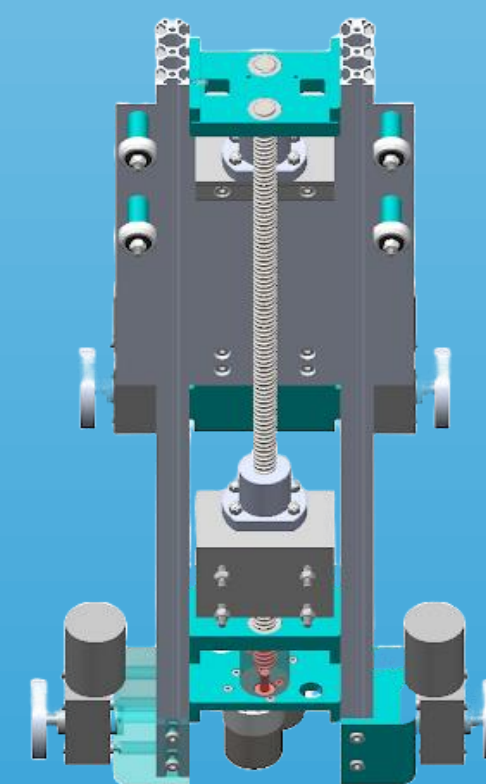
Block diagram



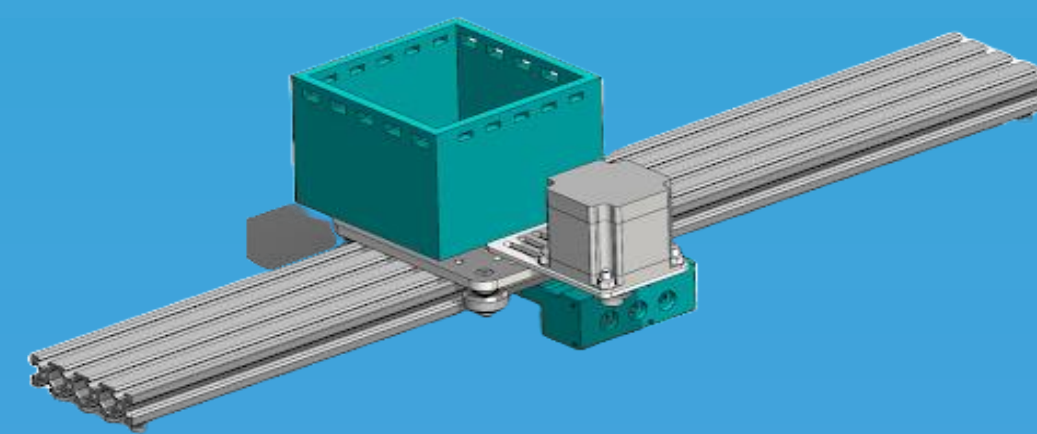
Trident I Final Design



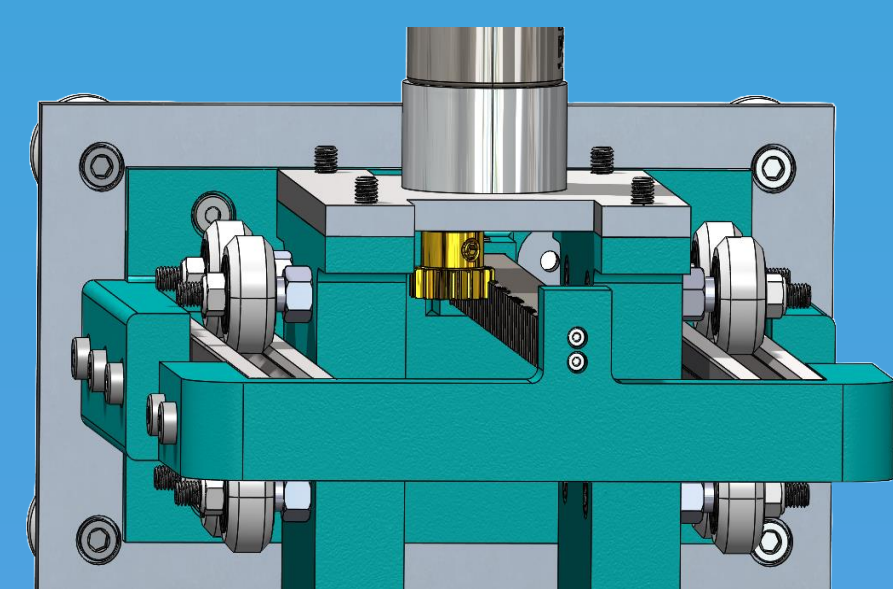
Key Mechanisms



Elevator Mechanism
DC motors and ball screws for stair climbing



Sliding Mass
Belt/stepper motor driven gantry system for center of mass adjustments



Rack and Pinion
DC motor rack and pinion system for horizontal translation relative to other bodies



Driving System
DC worm gear motors and wheels for driving

Stair Climbing



Key Results (Specs chart)

Specification	Target	Actual
Success Rate (%)	90%	80%
Overall Weight (lb)	< 60lb	~ 33lb
Tilt angle pitch (°)	5°	14°-18°
Tilt angle roll (°)	5°	18°
Completion Time (mins)	10 mins	24 mins
Lifting Motor Power (W)	2.1W	5.6W
Driving Motor Power (W)	0.018W	0.9W

Conclusion & Outlook

The Trident Robot successfully demonstrates the ability to climb the stairs withing US Navy ships. While the current robot prototype is capable of navigating through various steep climbing conditions, further iterations are recommended to optimize the robot's functionality. Future iterations should explore opportunities to implement an autonomous control system utilizing various sensors to improve operation speed and precision.

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