

Design of a Multi-Functional Mobile Robot

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Competition Overview

▶ Five Events

▶ The Sprint

- ▶ Timed event
- ▶ Must touch a wall 10 meters away
- ▶ Must cross starting and finish line

▶ The Climb

- ▶ Timed event
- ▶ Three stairs
 - ▶ Between 8cm and 15cm in height per step
 - ▶ 50 cm x 50 cm landing per step



Competition Overview

▶ Five Events - Continued

▶ The Tennis Ball Throw

- ▶ Scored by distance thrown along an axis
- ▶ Ball can be placed on the device
- ▶ Scored from where the ball stops

▶ The Golf Hit

- ▶ Scored by distance, and proximity to target axis
 - ▶ *Score = Distance Along Target Axis – Distance From Axis*
- ▶ Ball may be elevated 0.2 cm from the ground
- ▶ Scored from the first bounce

Competition Overview

▶ Five Events - Continued

▶ The Lift

- ▶ Lift a weight as high as possible and hold it for three seconds
- ▶ Scoring formula:
 - ▶ $Score = Mass\ of\ Weight(kg) * Distance\ Lifted\ (cm)$
- ▶ Heavy weight lifted a small height
- ▶ Light weight lifted very high

▶ Overall Score

- ▶ Sum of ranks from all events
- ▶ Lowest score wins

Competition Constraints

- ▶ 50 cm x 50 cm x 50 cm box
 - ▶ Must contain:
 - ▶ Robot
 - ▶ Weight to be lifted
 - ▶ Batteries
 - ▶ Controller
 - ▶ Batteries must be rechargeable
 - ▶ All other energy must be returned to its original form
 - ▶ This includes:
 - ▶ Compressed Air
 - ▶ Springs

Project Overview

- ▶ Background Research
 - ▶ Brainstorming
 - ▶ Design Generation
 - ▶ Component Selection
 - ▶ **Assembly**
 - ▶ Preliminary Testing
 - ▶ Optimization
 - ▶ Compete
 - ▶ Win
-
- Where we have been
- Where we are
- Where we are going

Event 1: The Sprint

- ▶ Two-Pronged Approach
 - ▶ Differential Drive
 - ▶ Two powerful motors
 - ▶ Left- and right-side tracks are driven by the same motor
 - ▶ “Tape Measure” Loophole
 - ▶ Smaller DC Motor extends outwards towards the barrier



Figure 1: Tape Measure Example

Event 2: The Lift

- ▶ Air Jacks & Pneumatic System
 - ▶ Lift rectangular weight on a flat, level surface
 - ▶ Stable lifting platform
 - ▶ Scored based on height and weight



Figure 2: Air Jack System

Event 3: The Throw

- ▶ Air Cannon & Pneumatic System
 - ▶ Simple “Spud Gun” design
 - ▶ Quick release valve
 - ▶ Control Launch angle using legs



Figure 3: Controlled Launch Angle

Event 4: The Climb

- ▶ Chaos Frame
 - ▶ Four, individually tracked and rotating legs
 - ▶ Each leg capable of 360 degrees of rotation
 - ▶ Four points of constant ground contact

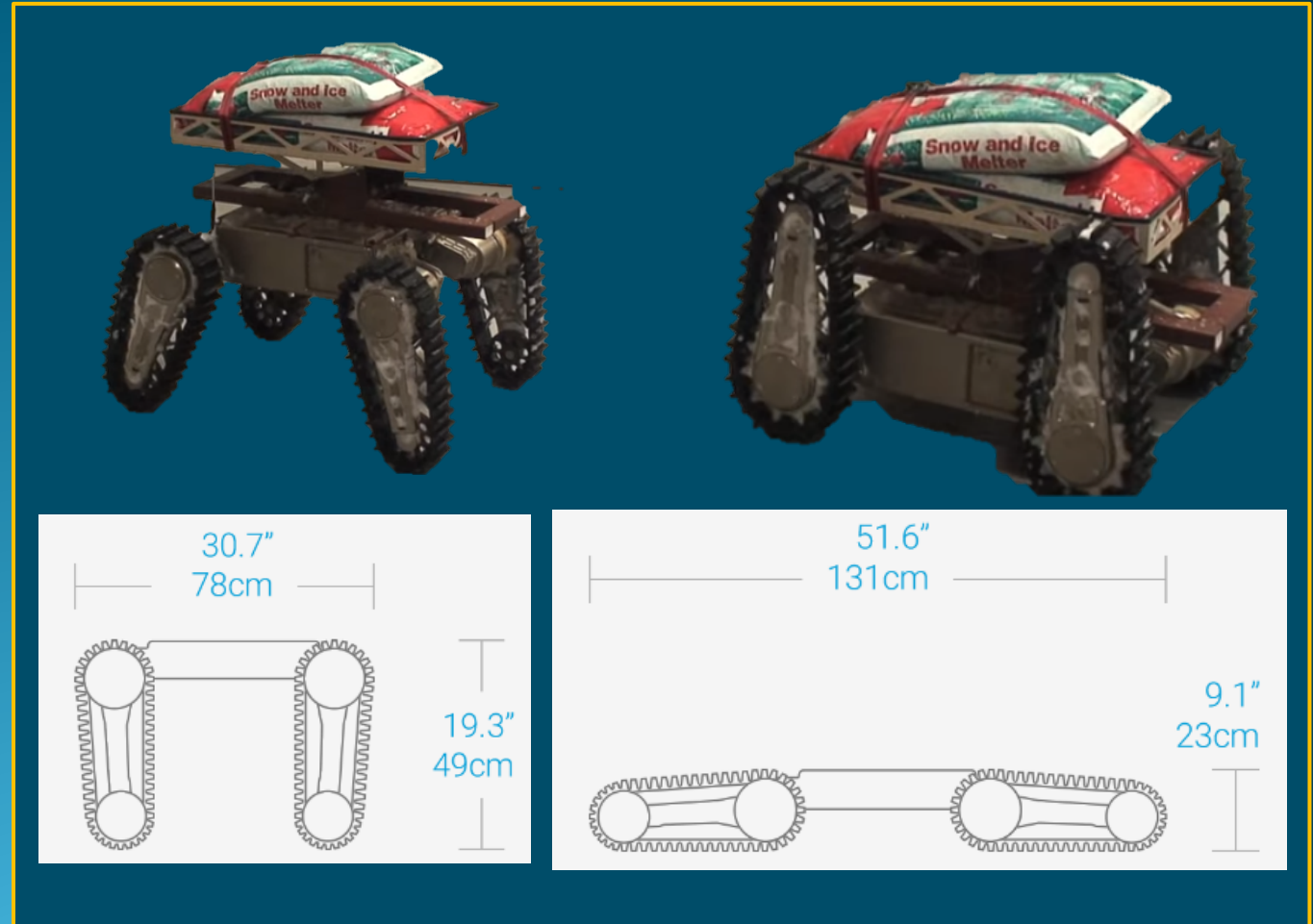


Figure 4: Leg Articulation

Event 5: The Hit

- ▶ Pitching Wheel System
 - ▶ Powerful DC motor spins a single wheel upwards of 5000 rpm
 - ▶ Ball is forced through a curved track such that it exits forwards
 - ▶ Exit velocities calculated to be upwards of 15 m/s

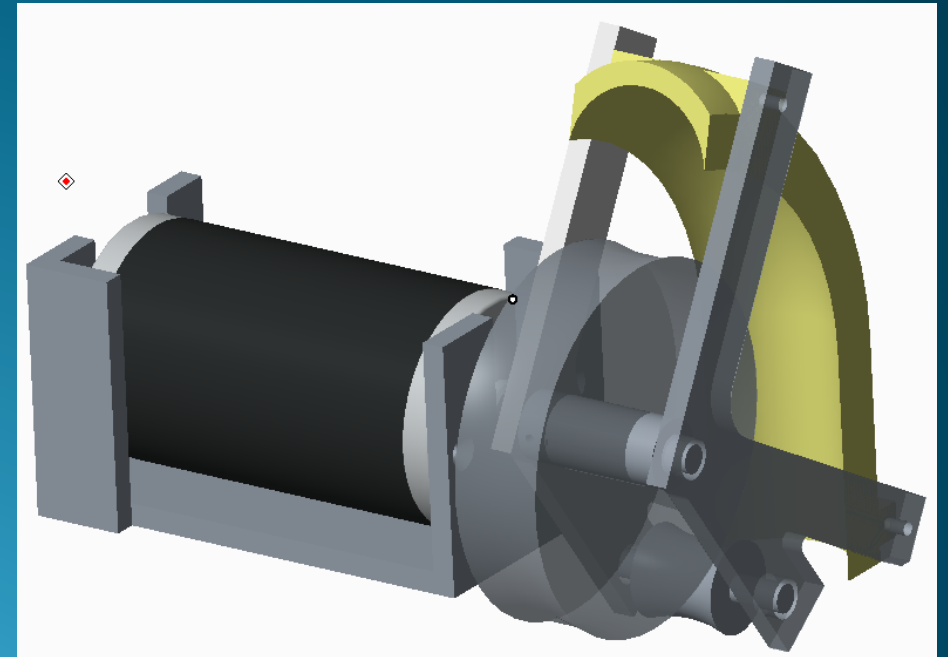
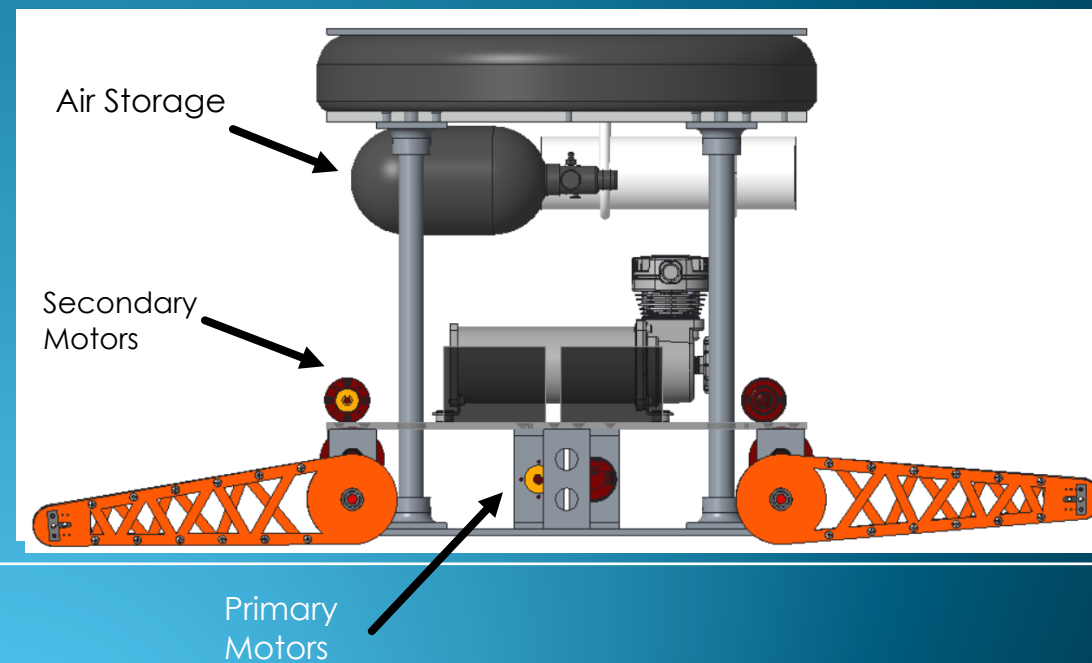
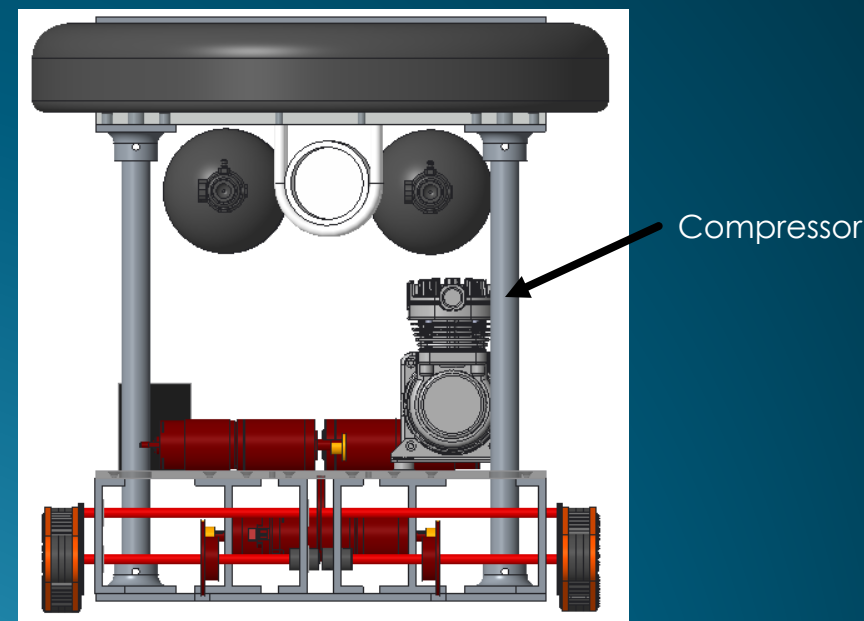
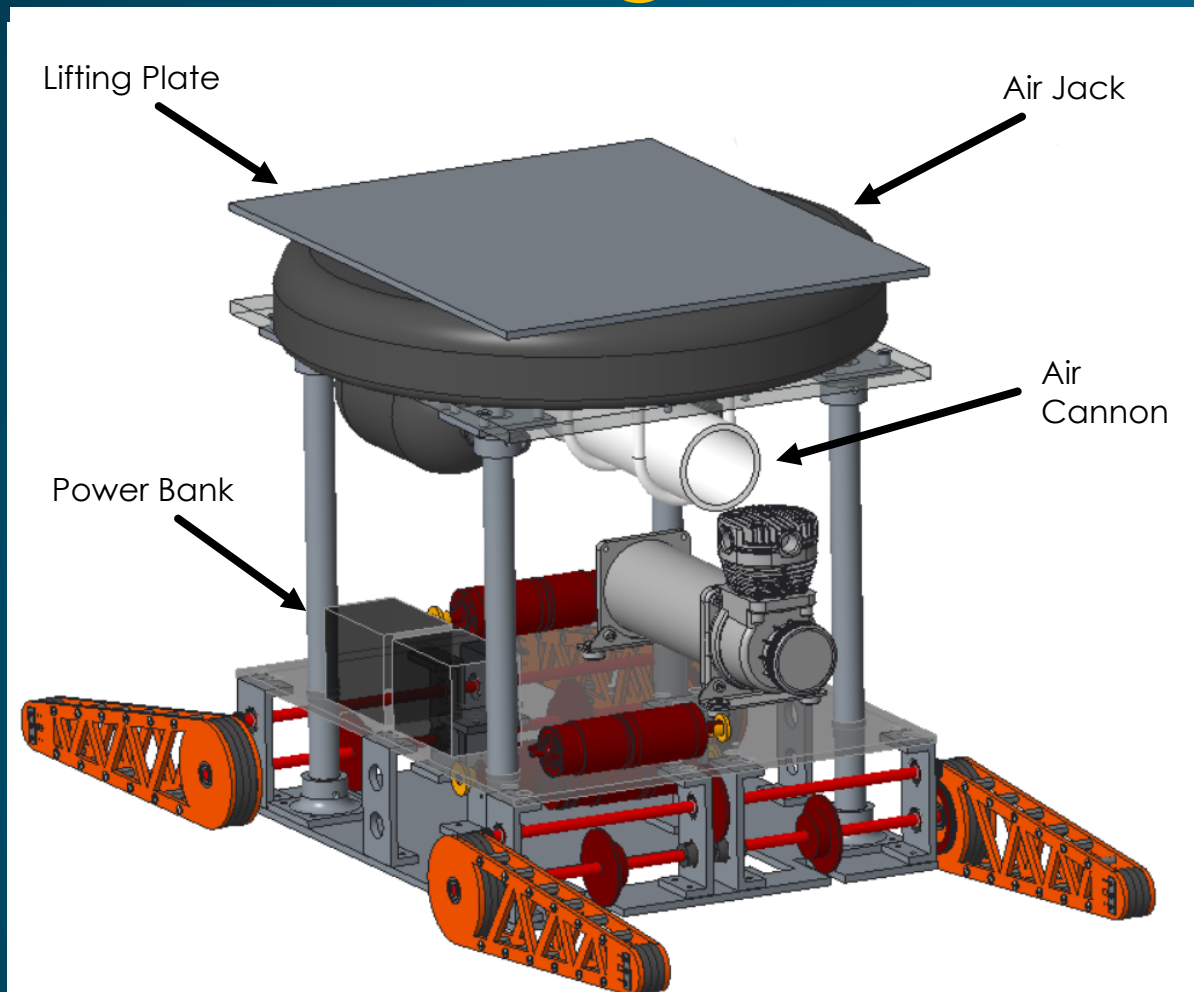


Figure 5: Pitching Wheel System

Overall Design



Power System

- ▶ 14.4V, 5000 mAh Power Source
 - ▶ NiMh cells
- ▶ Capable of operating the compressor for 10 minutes before draining
- ▶ Replacement battery

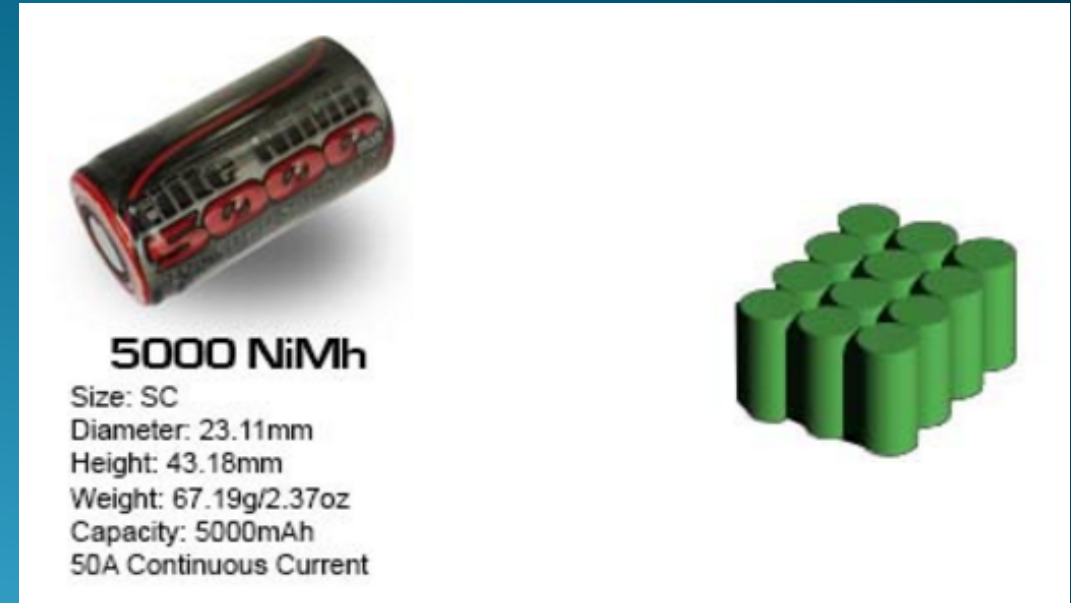


Figure 6: Power Source

Construction

- ▶ Arms are completed
 - ▶ Tracks are currently being cut
 - ▶ Belt tensioner is being added
- ▶ Baseplate and floorplate are being machined

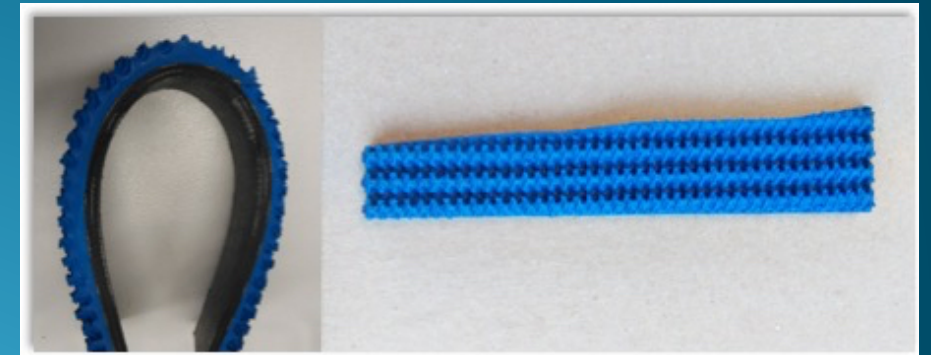


Figure 7: Leg materials

Size Constraints

- ▶ The largest obstacle
 - ▶ Gear ratios
 - ▶ Air storage capacity
 - ▶ Actuators
 - ▶ Lifting mechanism
 - ▶ Compressor
 - ▶ ***Mechanisms for “The Hit”***

Project Summary

- ▶ Competition
 - ▶ 5 events
 - ▶ Project Scope
- ▶ Design
 - ▶ Dual power sources
 - ▶ DC electric and Pneumatic
- ▶ Progress
 - ▶ Construction underway



Figure 8: Actual chaos platform in action

Where We Are Going

- ▶ Physically assemble the robot
- ▶ Configure and troubleshoot electrical system
- ▶ Continue to develop and troubleshoot programming
- ▶ Make Cannon and Lift Operational

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Questions?