ARK *APPLIED RANDOM KNOWLEDGE*

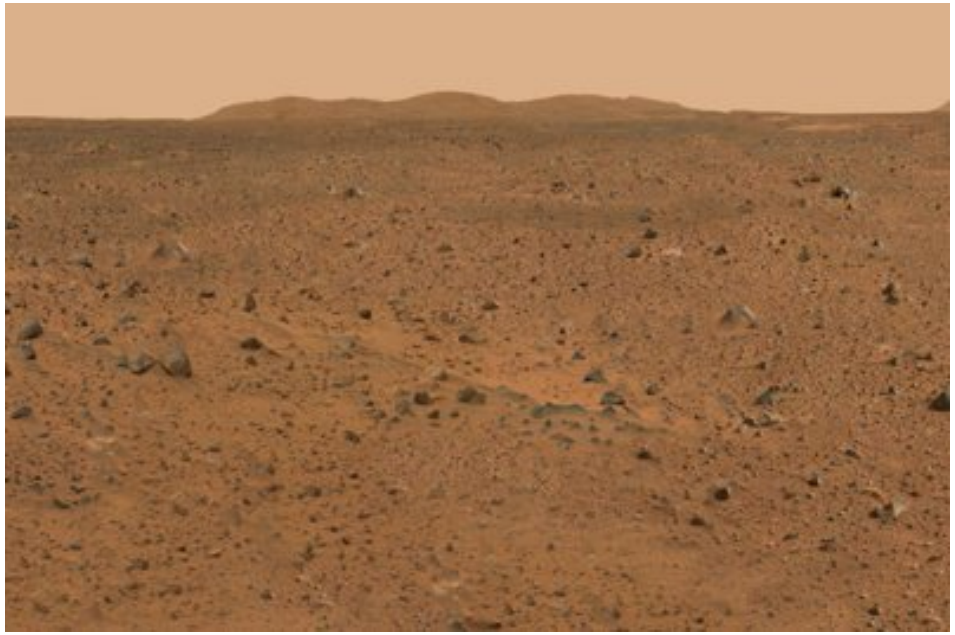
Members: Jeff Gier, Joshua Reddington, Matthew Romero, William Martin, Justin Brown, Ryan Russell

Goals

- Design and build autonomously navigating robot
- Succeed in NSG Robotics Challenge
  - Simulate a Mars-like environment
- Utilize strengths of each individual team member to optimize robot's capabilities

The Challenge

- Mars-like environment
- Rocks
- Ditches/holes
- Large obstacles
- Soft Sand



Brainstorming

- Wheels v. Treads
- Infrared v. Ultrasonic Sensors
- Chassis
- Power
- Suspension?

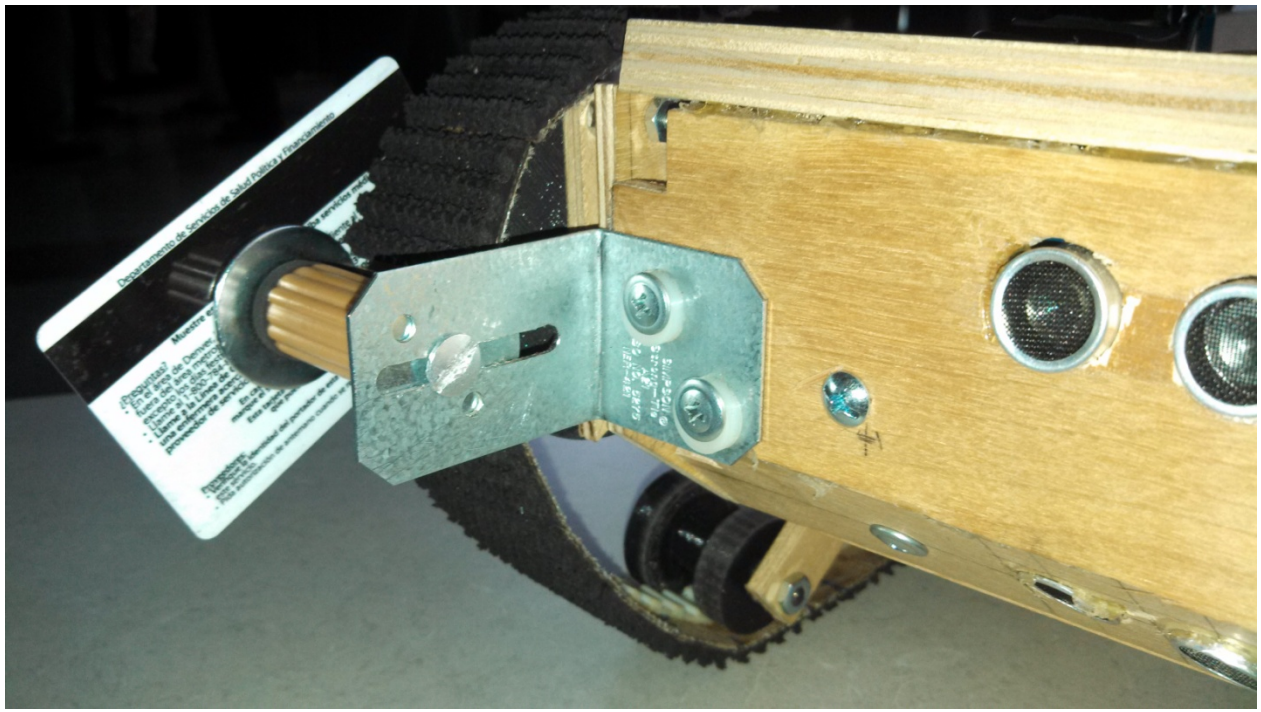
Design

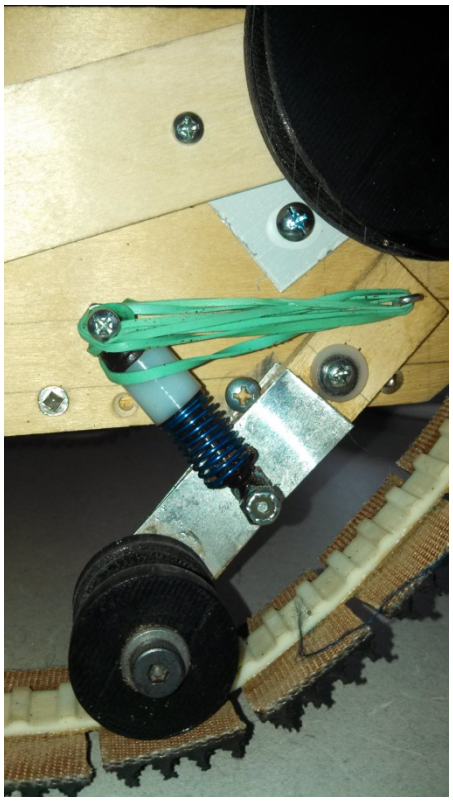
- Mechanically superior
- Adaptability
- Have back-up plan for each aspect in case original idea fails

Initial Concept

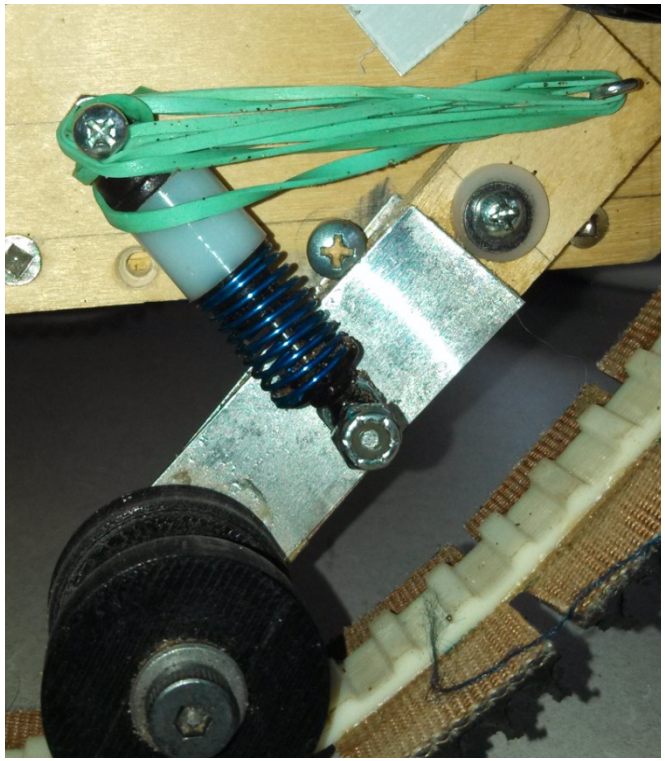
- Treads
  - Modeled after Darpa M3 Suspension system
- Chassis built out of wood
- 3D Print if possible

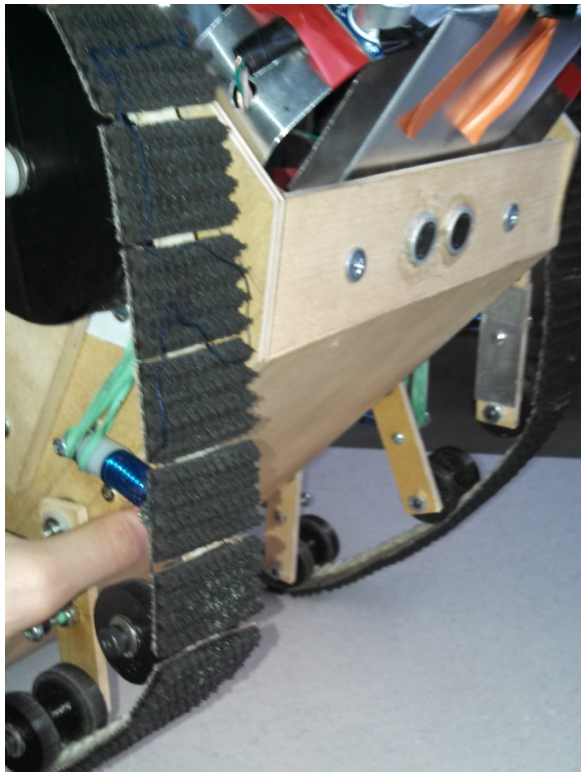
Adjustability





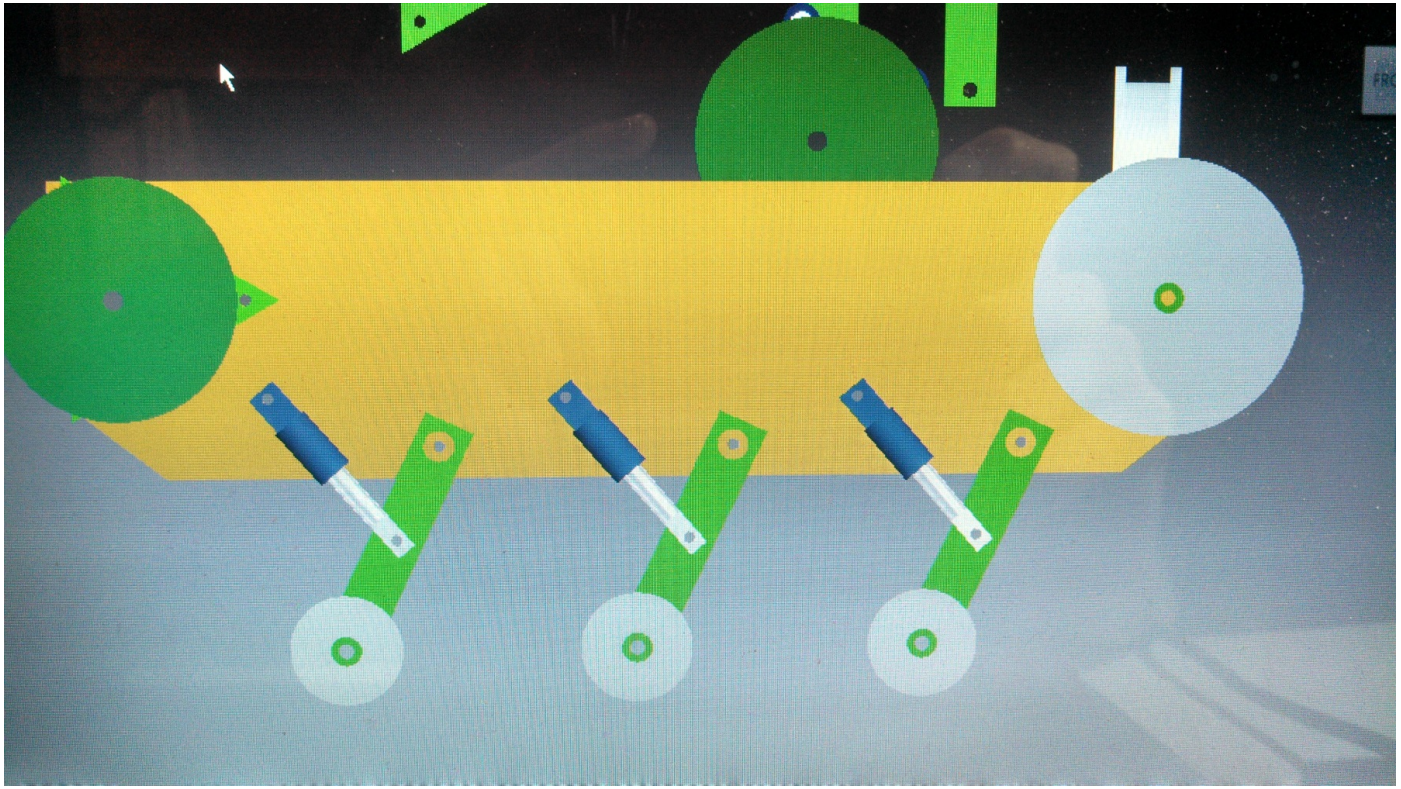
Durability





CAD and drawings

- Autodesk Inventor used for CAD
- Sketches used for majority of creation



Suspension Design Parameters

Parameters (inch, pound, degree)				
Arm length	2.75			
Roller Radius	0.875	Spring Lever	1.27	
Starting angle of arms	15	Spring Preload (lb)	0.75	0.25
robot weight	8.8			
Travel (DeltaT)	1.2			
Sag	0.2			
Max load				
Spring Constant (K)	3			

	T	X	RT	Angle of Arm(from vertical)	Shock Angle with arm	Force from spring	Displacement of shock	Shock angle in rad
State 1	2.6	0.896	0.946	19.02	62.81	0.75	0	1.10
	2.5	1.146		24.63		#REF!		0.00
State 2	2.4	1.343	1.217	29.24	72.4	1.35	0.2	1.26

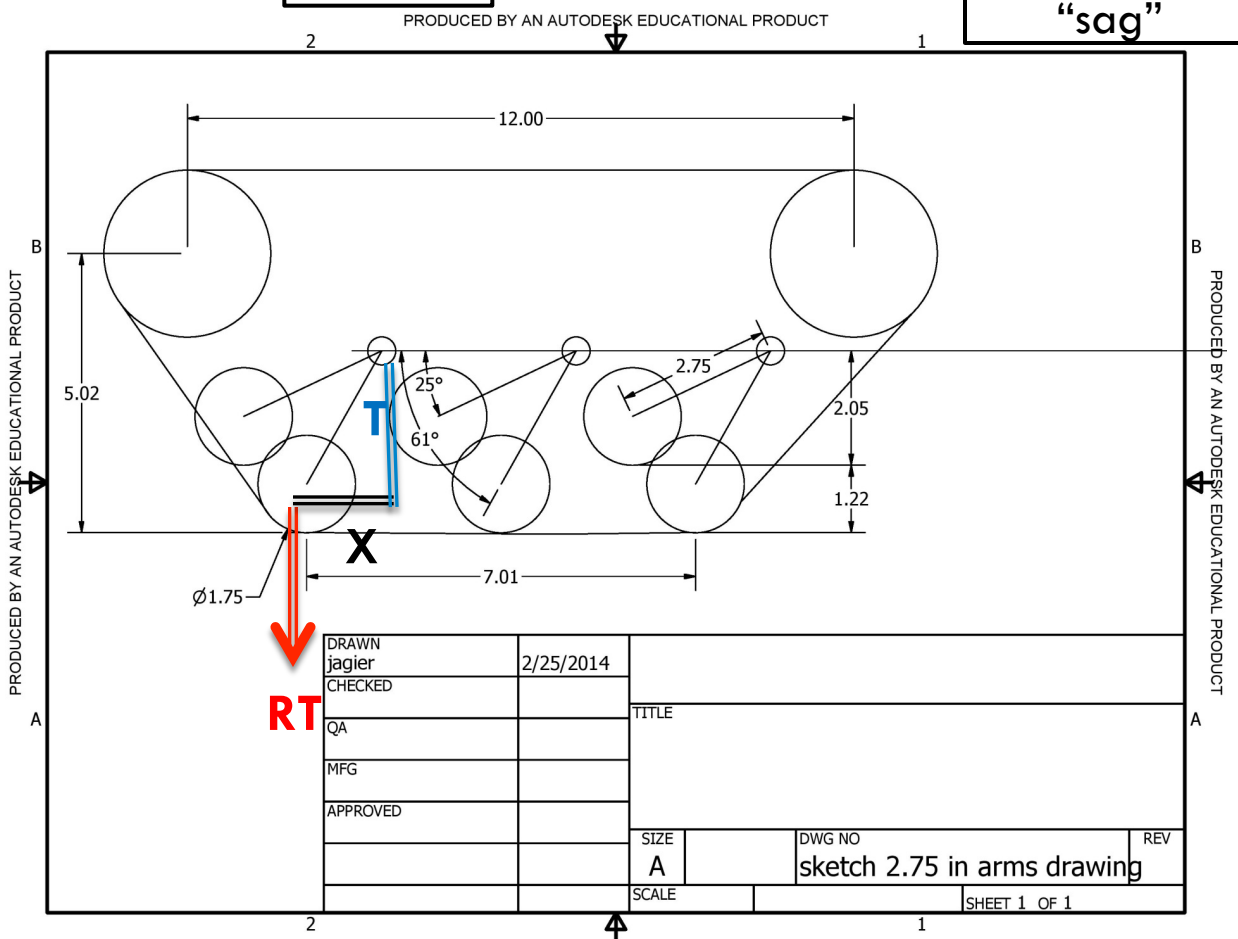
Preload

Suspension "sag"

T= Height

X = Gravity Lever Arm

RT= Reaction Force



Treads

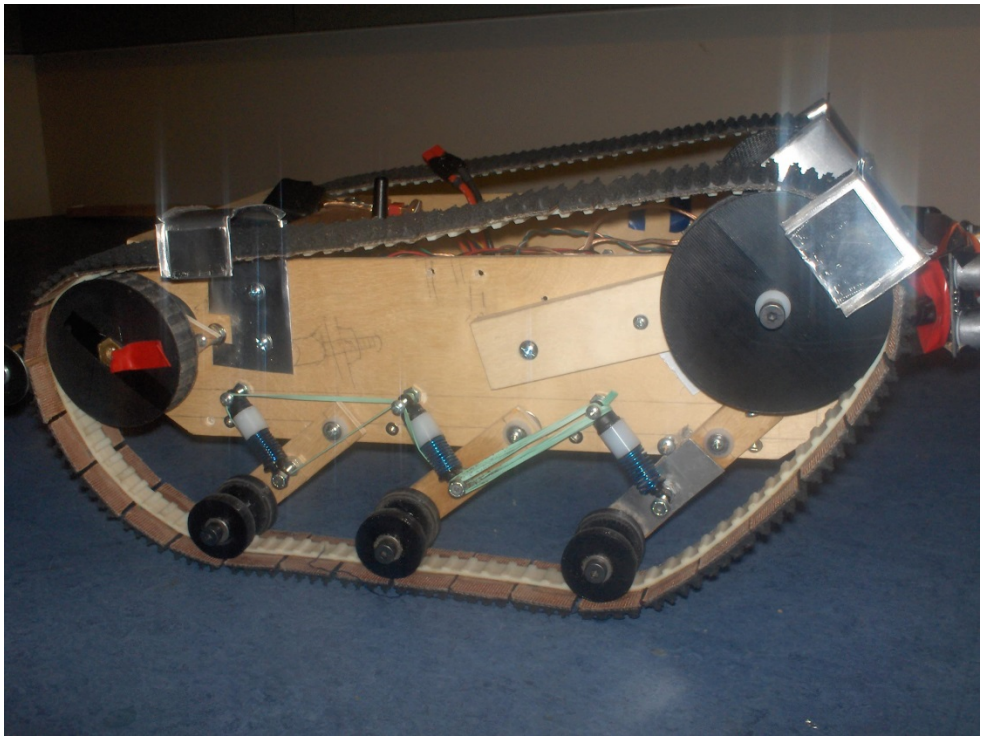
- Flexible: Timing Belt and segmented conveyor belting
- High Traction: SBR cleated conveyor

Roller Design

- Three different varieties, 4 iterations
- Interface and constrain tread
- Interact with obstacles

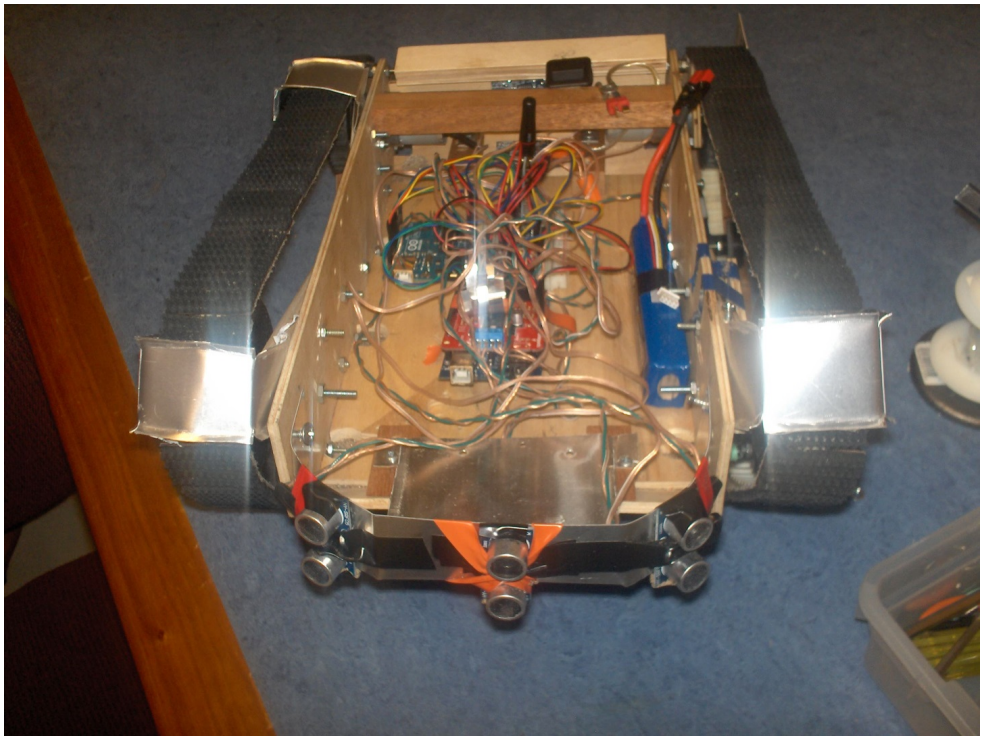
3D Printing

- 1.75 mm ABS Plastic
- Designed using CAD Software
- Printed on Afinia H-Series Printers
- Used for Drive and Tensioner Pulleys and all rollers
- Thermal inserts to keep drive pulley from stripping



Electronics

- Arduino Mega and uno
- Parallax Transciever
- 6 Ultrasonic Sensors
- Sparkfun Motor Driver
- Lithium Polymer Battery 11.1 Volts 2200 Mah
- 25 minute run time

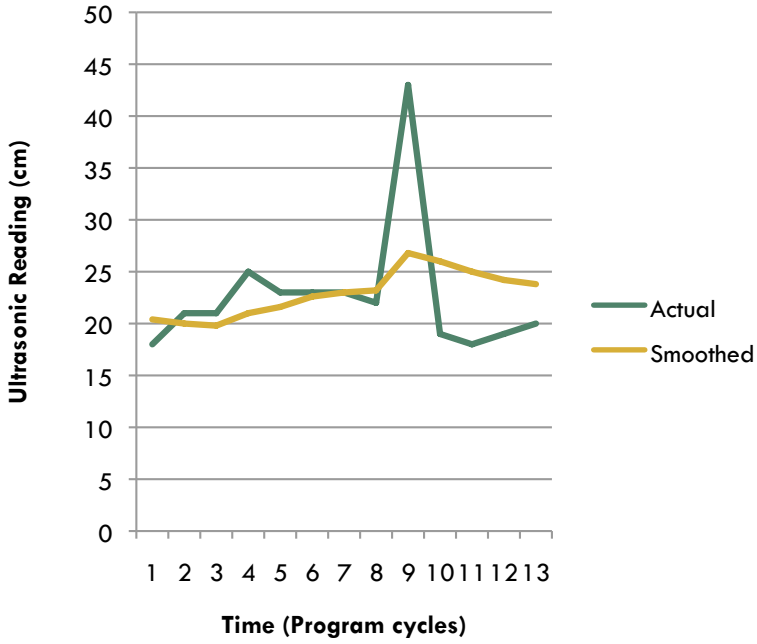


Behavior

- Normal
  - Simple obstacle avoidance
- Cautious
  - Slow and increased attention to sensor readings
- YOLO
  - Head toward beacon no matter what
- Backup
  - Back out of tight spots

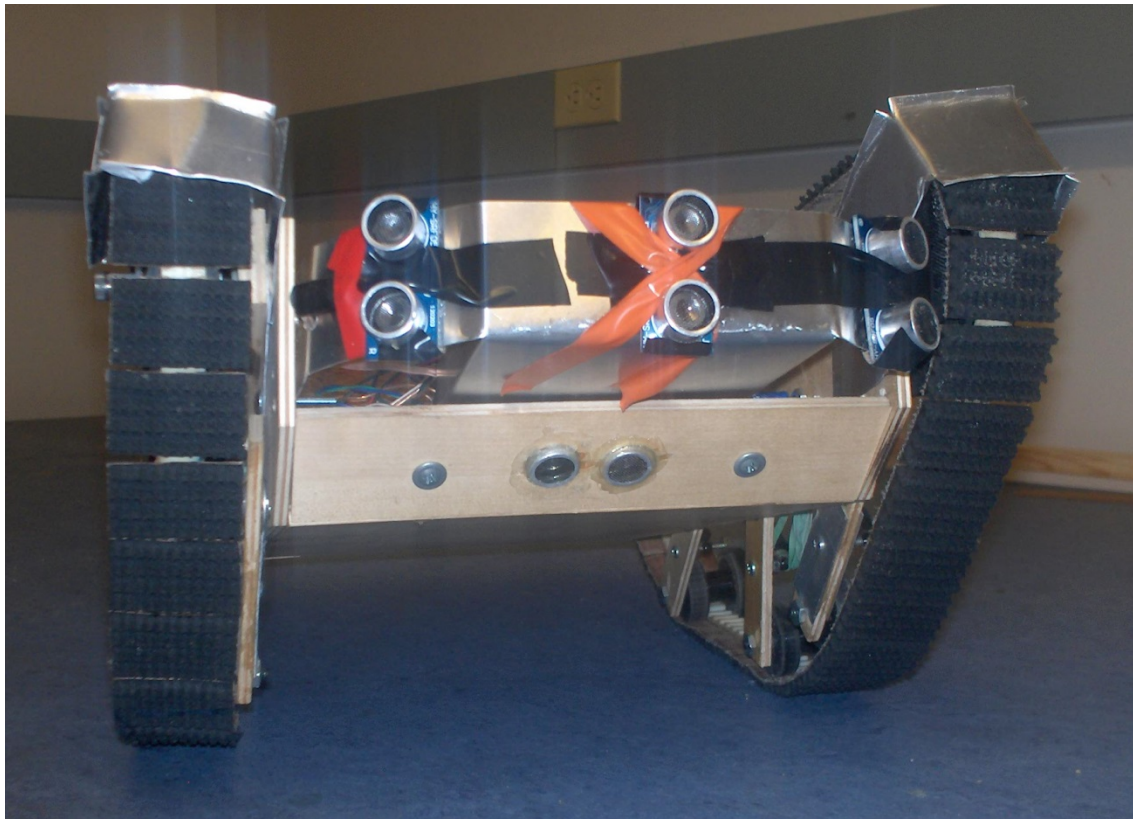
Sensor Libraries

- Allow more standard input
  - Reduce static noise inherent to many sensors
- Allow calibration
  - Would make sure gyroscope and accelerometer did not drift
- Simplistic interface
  - Changed complex data scructures into simple commands



Design Review: The good

- Climbs Well
- Suspension Geometry
- Motors
- Traction
- No Breakdowns at competition
- Compass Navigation
- Utilized each members individual Skills
- Fun



Design Review: The bad

- Treads Inconsistent
- Add tensioner
- Redesign suspension arms to reduce moment
- Programming not needed to dodge obstacles
- Spend 1/3-1/2 time in planning/ problem identification
- Ask better questions and accept unknowns
- Electronics Organization
- Breadboard mounted on chassis

CSU Green Team