Robotics Challenge 2011-2012

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Purpose

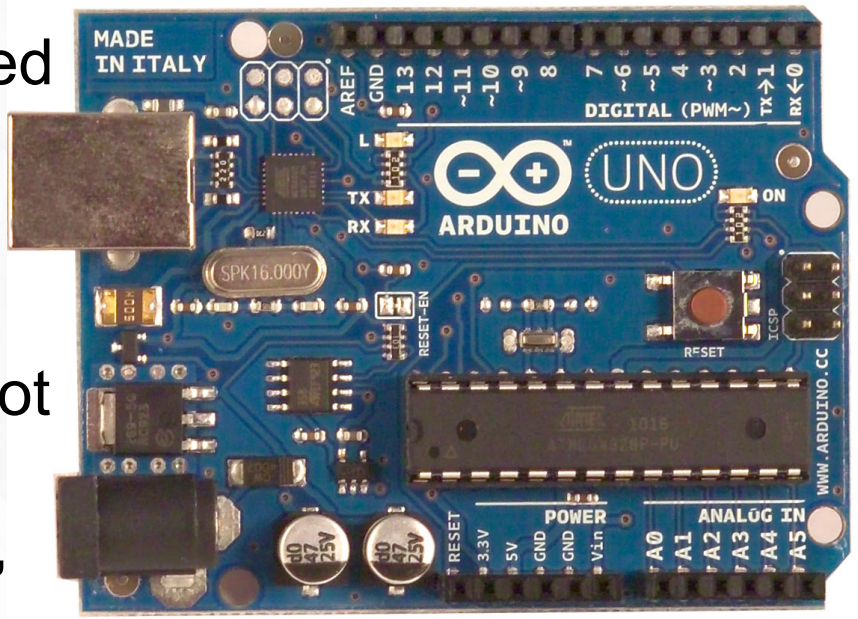
- Fabricate and program an autonomous rover to compete in the 6th Annual Robotics Challenge
- Navigate terrain
- Avoid Obstacles
- Locate a Radio Frequency Beacon
- Budget of $300
- Keep the rover mass under 4kg

Electrical and Mechanical Parts

- Arduino Uno
- Ardumoto - Motor Driver Shield
- Tilt Compensated Compass
- 12v Rechargeable Battery
- Infrared Range Sensor
- Dagu All Terrain wheels
- SPG30 Series - Motors

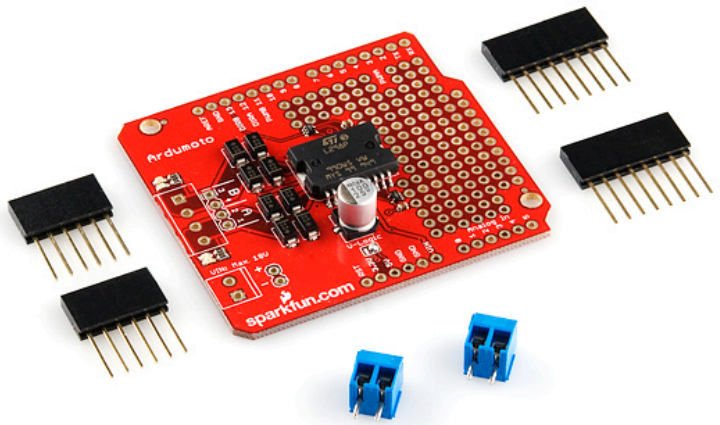
Microcontroller

- Arduino Uno
- Arduino hardware is programmed using a based language similar to C++ with some slight simplifications
- We chose this microcontroller not only because we had prior experience with programming it, but it was also highly recommended for this project
- COST: $35.99



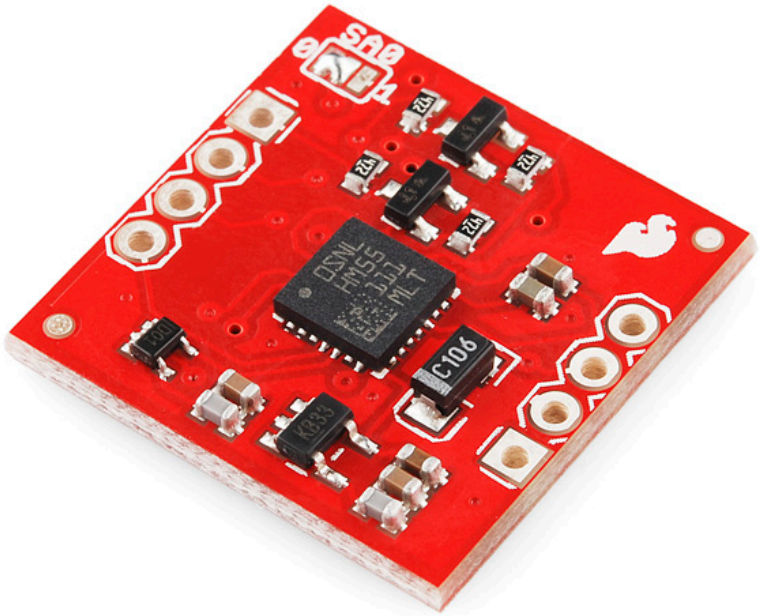
Ardumoto - Motor Driver Shield

- This board takes its power from the same Vin line as the Arduino board and includes blue and yellow LEDs to indicate active direction of the two DC motors it can control
- We chose this board because we have worked with it before and because it is specifically made for compatibility with Arduino
- COST: $24.95



LSM303 Breakout Board - Tilt Compensated Compass

- The LSM303DLH is a triple axis accelerometer combined with a triple axis magnetic sensor
- This component was chosen because there had been prior experience with programming the compass
- It was also chosen in regards to the challenge course, since there were to be dips and hills that needed accounting for
- COST: $29.95



Power Source

- Lynxmotion 12v 1600 mAH NiMH Rechargeable Battery BAT-01
- The power source used is a simple and inexpensive 12V battery pack.
- This pack provides plenty of power to the Arduino which in turn powers the motors.
- COST: $29.95

IR Sensors

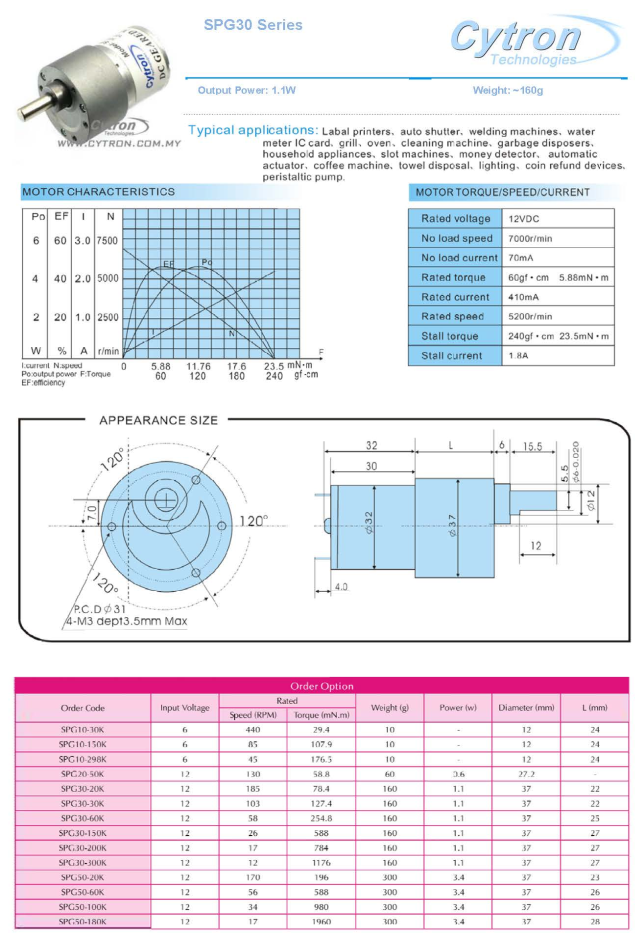
- Infrared Range Sensor
  - Sharp GP2Y0A02YK0F
- Range: 20 cm to 150 cm
- Three sensors were used in order to cover all possibilities of a collision.
- COST: $14.95 (each)

Wheels

- Dagu All Terrain wheels were used because of their perfect grip for all outdoor terrain.
- These tires were also suitable because of their large size and light weight.
- COST: $24.99
  - Set of 4

Motors

- SPG30 –150k
- Cytron 12V
- 26RPM max speed
- Max torque 588mN.m
- 83oz-in Spur Gear motor
- 150:1 gear ratio
- COST: $15.48 (each)



SPG30 Series

Output Power: 1.1W

Weight: ~160g

Typical applications: Labal printers、auto shutter、welding machines、water meter IC card、grill、oven、cleaning machine、garbage disposers、household appliances、slot machines、money detector、automatic actuator、coffee machine、towel disposal、lighting、coin refund devices、peristaltic pump.

MOTOR CHARACTERISTICS

MOTOR TORQUE/SPEED/CURRENT

Rated voltage	12VDC
No load speed	7000r/min
No load current	70mA
Rated torque	60gf • cm 5.88mN • m
Rated current	410mA
Rated speed	5200r/min
Stall torque	240gf • cm 23.5mN • m
Stall current	1.8A

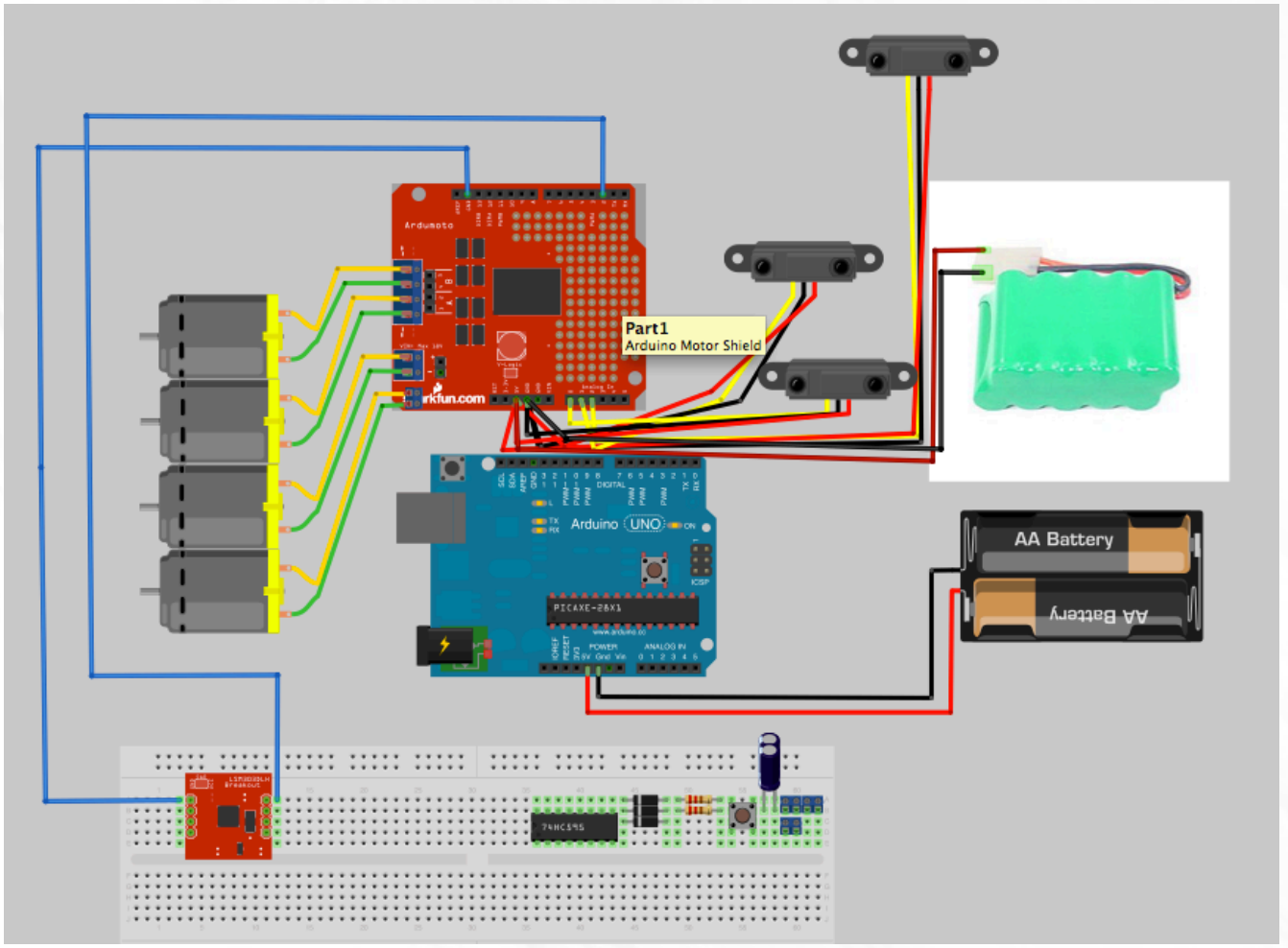
APPEARANCE SIZE

P.C.D ϕ31
4-M3 dept3.5mm Max

Order Option

Order Code	Input Voltage	Rated		Weight (g)	Power (w)	Diameter (mm)	L (mm)
		Speed (RPM)	Torque (mN.m)				
SPG10-30K	6	440	29.4	10	-	12	24
SPG10-150K	6	85	107.9	10	-	12	24
SPG10-298K	6	45	176.5	10	-	12	24
SPG20-50K	12	130	58.8	60	0.6	27.2	-
SPG30-20K	12	185	78.4	160	1.1	37	22
SPG30-30K	12	103	127.4	160	1.1	37	22
SPG30-60K	12	58	254.8	160	1.1	37	25
SPG30-150K	12	26	588	160	1.1	37	27
SPG30-200K	12	17	784	160	1.1	37	27
SPG30-300K	12	12	1176	160	1.1	37	27
SPG50-20K	12	170	196	300	3.4	37	23
SPG50-60K	12	56	588	300	3.4	37	26
SPG50-100K	12	34	980	300	3.4	37	26
SPG50-180K	12	17	1960	300	3.4	37	28

Fritzing


Part1
Arduino Motor Shield
Arduino UNO
AA Battery
AA Battery

Programming

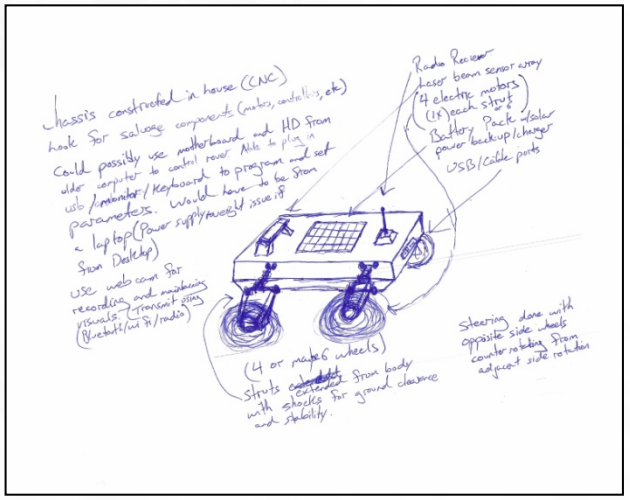
- All programming was done using the Arduino software.
- The majority of the Rover programming is complete except for being able to follow a radio signal at this time. This will be added once we have a practice beacon to test with.
- The current code is based on the mag_chas2 code received at the Robotics Challenge Workshop.
- This code has been modified to work with our rover configuration. The code is continually evaluated for improvement.

Programming

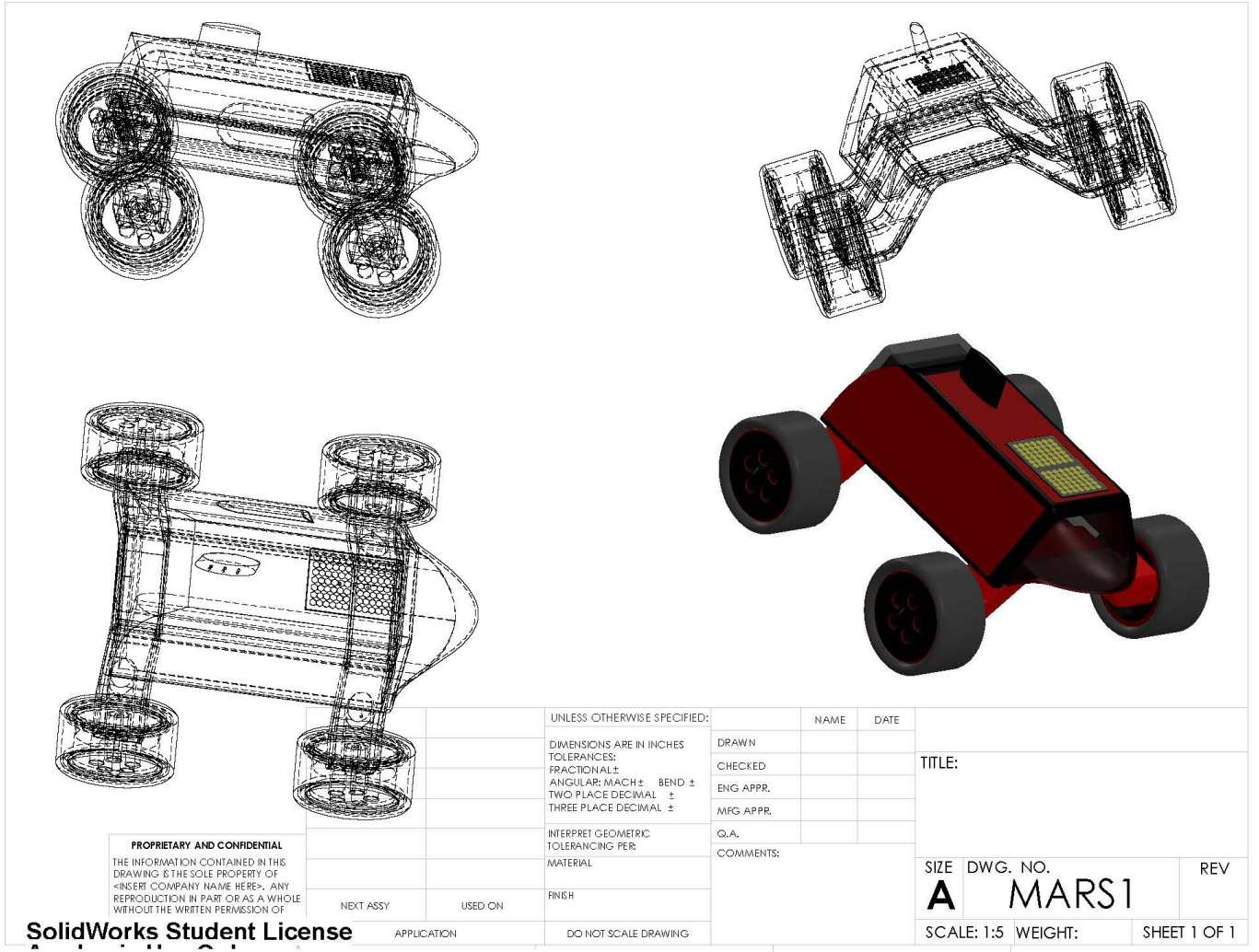
- Outline of code (go West)
  - Get compass heading and IR sensor values
  - Check IR sensors
    - If left sensor detects object, back up and turn right to avoid
    - If right sensor detects object, back up and turn left to avoid
    - If middle sensor detects object, back up and turn
  - Otherwise:
    - If heading indicates facing left of West, right wheels slow down causing right turn
    - If heading indicates facing right of West, left wheels slow down causing left turn
    - Otherwise go straight
  - Rinse, lather, and repeat

Mechanical Design

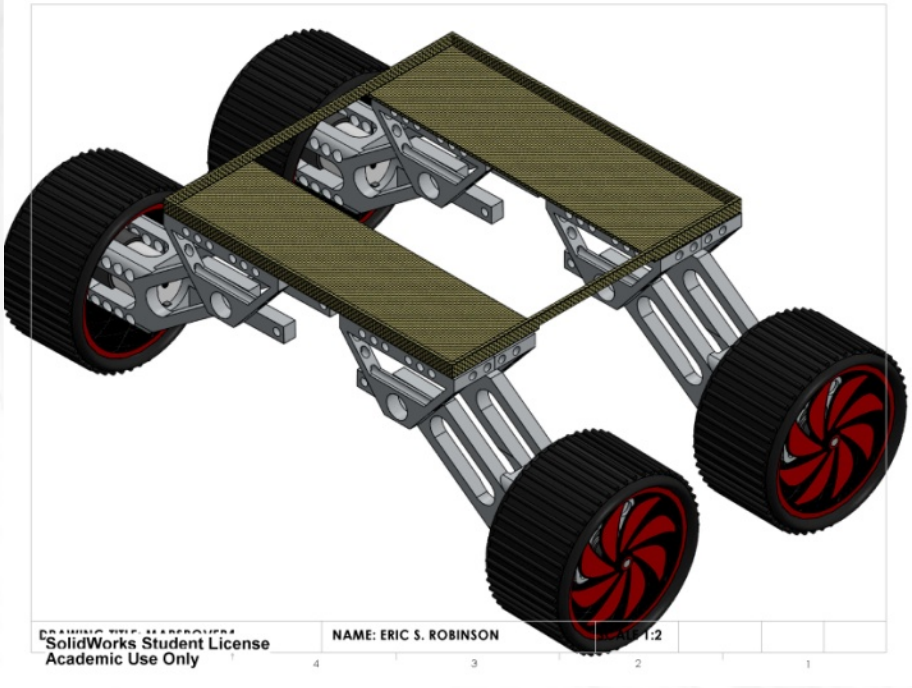
- Long angled struts
- Motors mounted at the end of each strut
  - Wheels directly mounted to motor drive shaft
- “Four motor” design to utilize skid steering
- Design Stages
  - Rough concept
  - Concept in Solid Works
  - Rough prototype

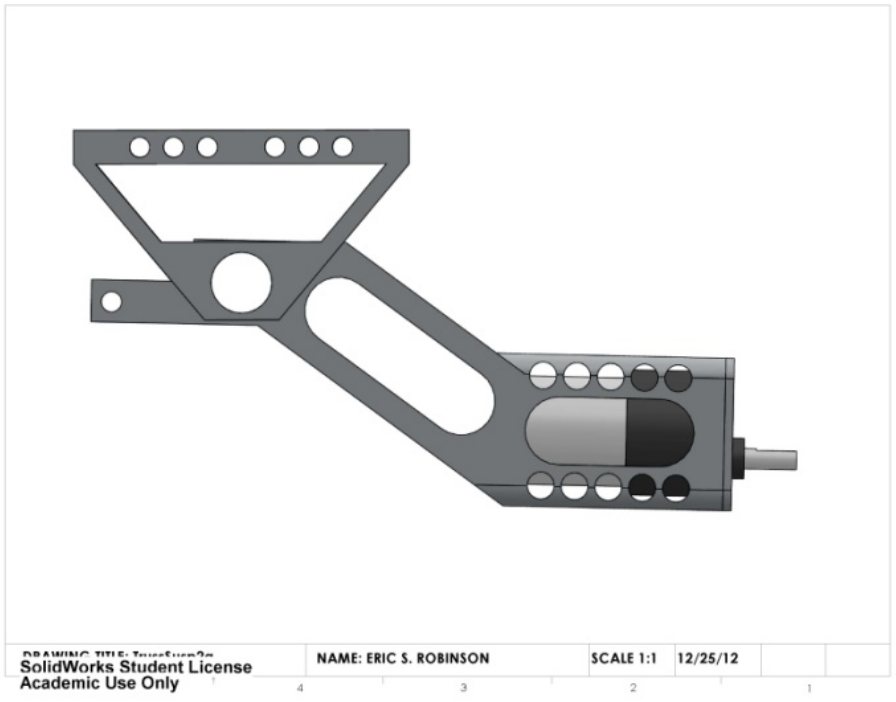


Mechanical Design



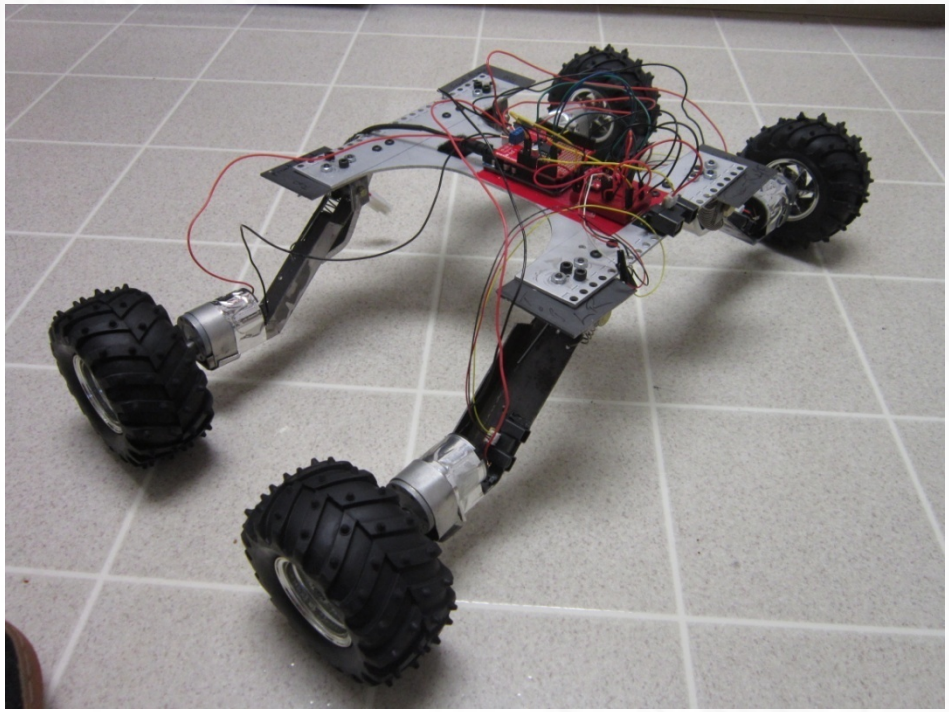
Mechanical Design

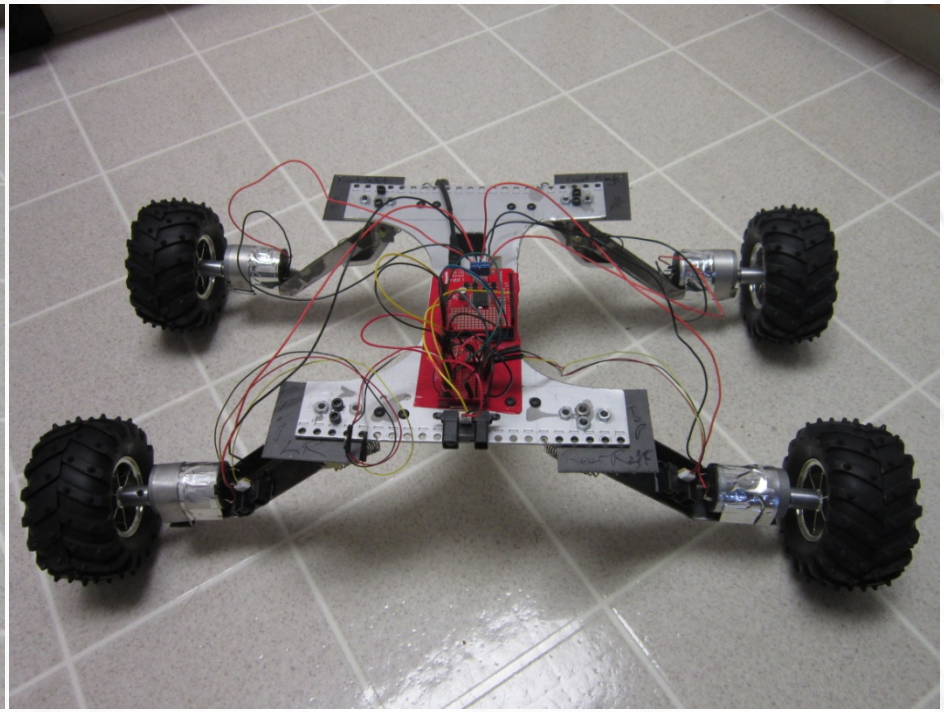




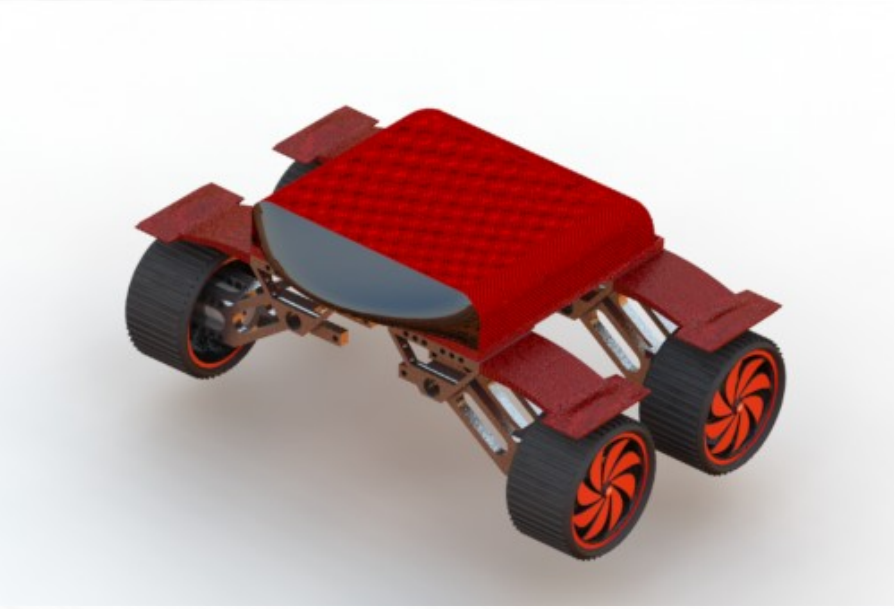
Mechanical Construction

Prototype





Final Concept Design



Bill of Materials

Component	Name	Price	Ammount	Net Price
Microcontroller	Arduino Uno	$35.99	1	$ 35.99
Motor Driver Shield	Ardumoto	$24.95	1	$ 24.95
Tilt Compensated Compass	LSM303 Breakout Board	$29.95	1	$ 29.95
Power Source	Linxmotion 12v	$29.95	1	$ 29.95
IR Sensors	Sharp GP2Y0A21YKOF	$14.95	3	$ 44.85
Wheels	Dagu All Terrain	$24.99	1	$ 24.99
Motors	SPG30 Series	$14.48	2	$ 28.96
				$ 219.64

Lessons Learned

- Basic wiring
- Soldering
- Arduino programming language
- Electronic component integration through programming
- Design to fabrication limitations
- Plenty of trial and error in the project setting

Future Plans

- Create practice beacon for testing
- Have robot travel to Radio Frequency signal
- Add more variety of sensors
- Find more efficient resources
- Design improvement
- Focus on developing the original chassis designed

Questions?