2014 NASA/RASC-AL Robo-Ops Competition

Spring Midterm 2 Presentation

Team 11 Members:

Boris Barreto	-	Electrical and Computer Engineering
Jason Brown	-	Mechanical Engineering
Justin Houdeshell	-	Mechanical Engineering
Linus Nandati	-	Electrical Engineering
Tsung Lun Yang	-	Mechanical Engineering

Team 11 Advisors:

Dr. Jonathan Clark – Mechanical Engineering
Dr. Uwe H. Meyer-Baese – Electrical Engineering

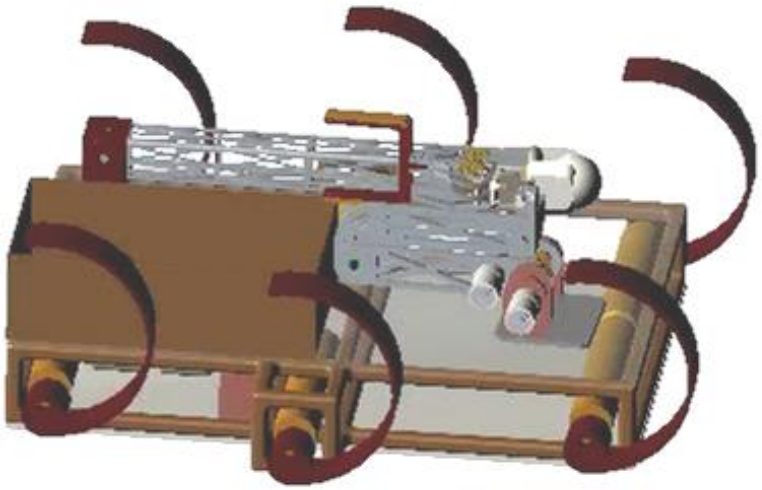
Project Scope

- Build a rover to compete in the 2014 Robo-Ops Competition
- Areas for development
  - Sample Extraction Module
    - Manipulator arm
    - End effector
  - Controls
    - Dynamic control
  - Communications
    - Network

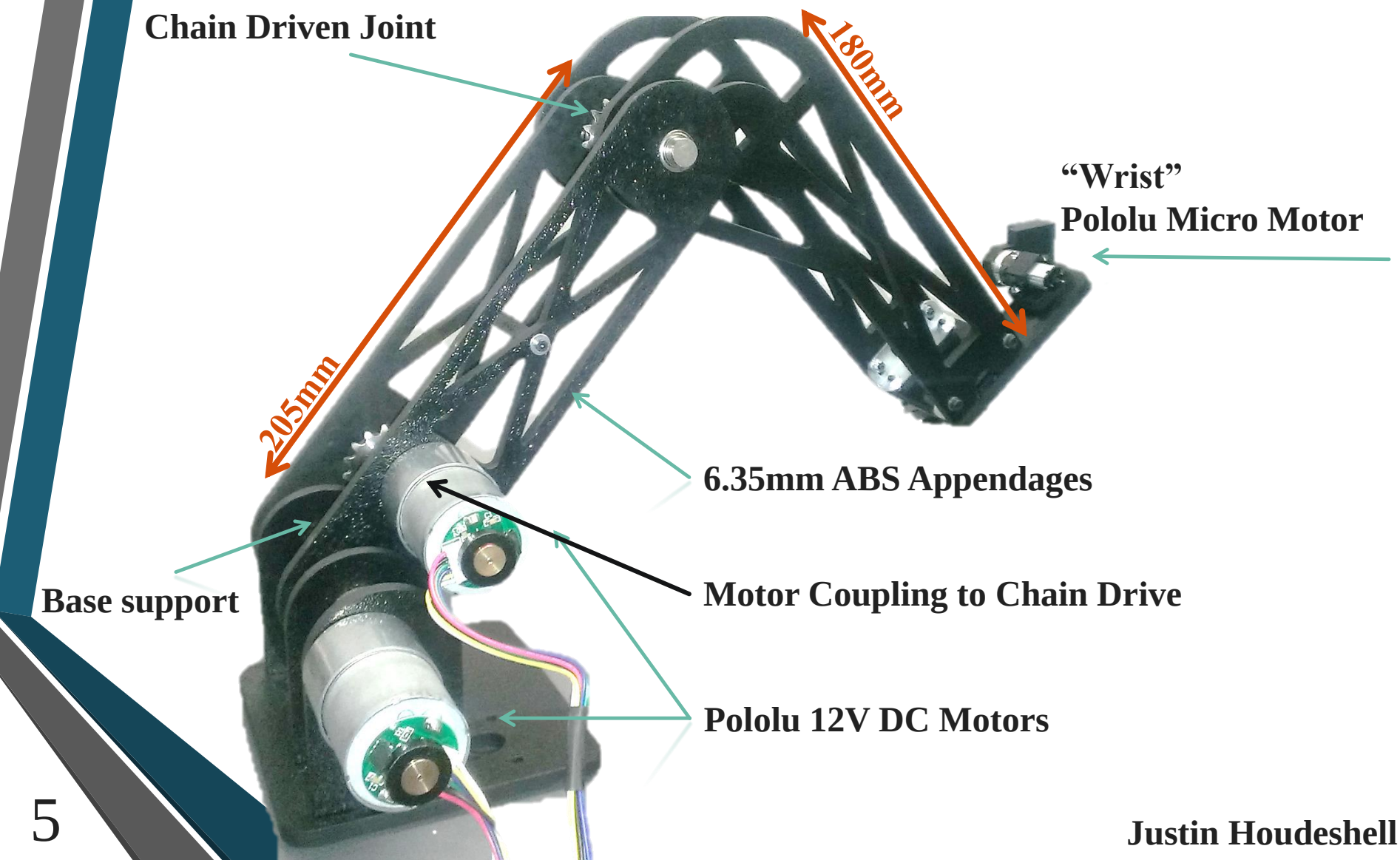
Project Constraints

- Rover Physical Constraints
  - No larger than 1m x 1m x 0.5m
  - Less than or equal to 45kg.
  - Traverse over obstacles up to 10cm in height.
  - Pick up rocks ranging from 2 to 8 cm in diameter and masses ranging from 20 to 150 g.
  - The rover(s) will be controlled remotely based from the home campus of the university

Overall Design

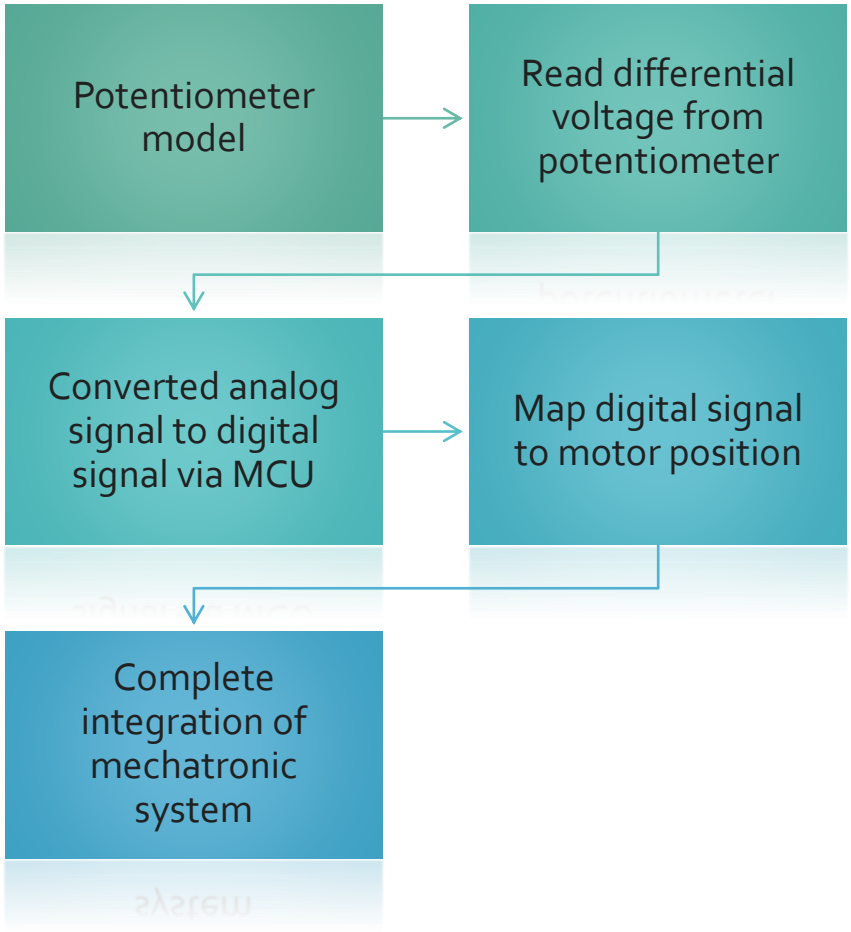


Extraction Arm



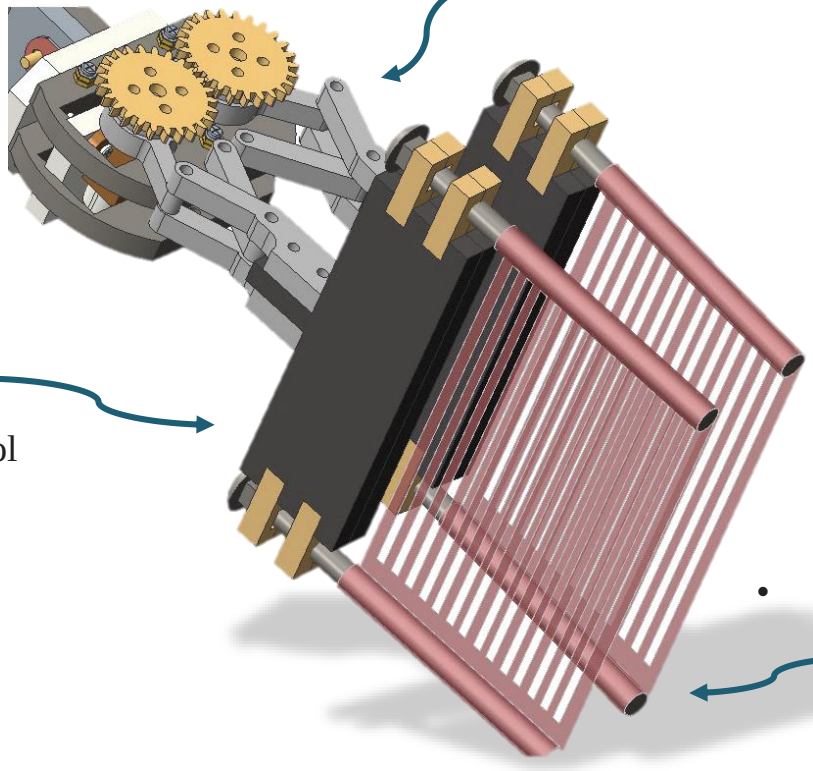
Justin Houdeshell

Extraction Arm

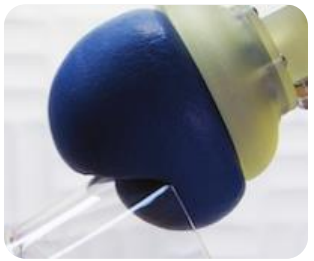


Extraction End Effector

- **2 Prong Pincher Design**
  - Precision

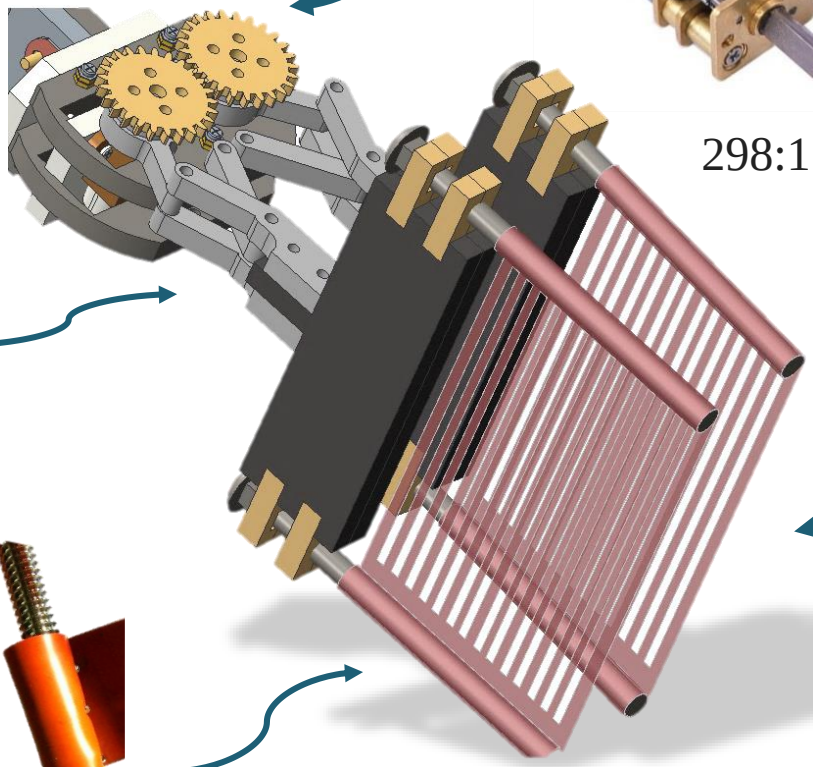


- **Large contact area**
  - Simplified control



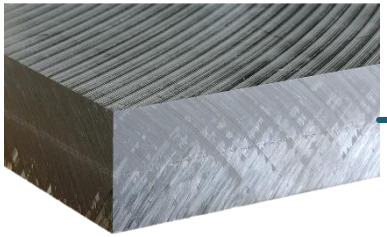
- **Elastic webbing**
  - Strong shape/orientation tolerance

Extraction End Effector

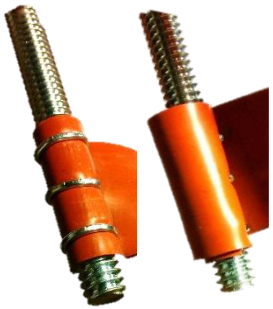


298:1 Pololu Motor

Acrylonitrile Butadiene Styrene (ABS) Plastic



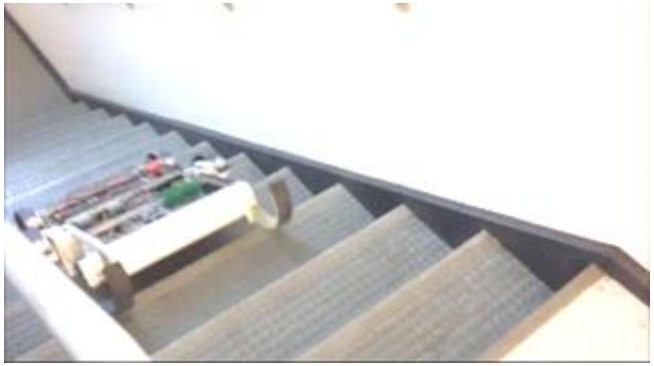
Silicon Rubber



- **Adjustable tension control**

Extraction End Effector

Control Development



Locomotion Types	Status
Buehler Clock Locomotion	Complete
Turn While Walking	Complete
Turn While Climbing	In development
Nudge Function	Not Started
Stair Climbing	Prototype Complete

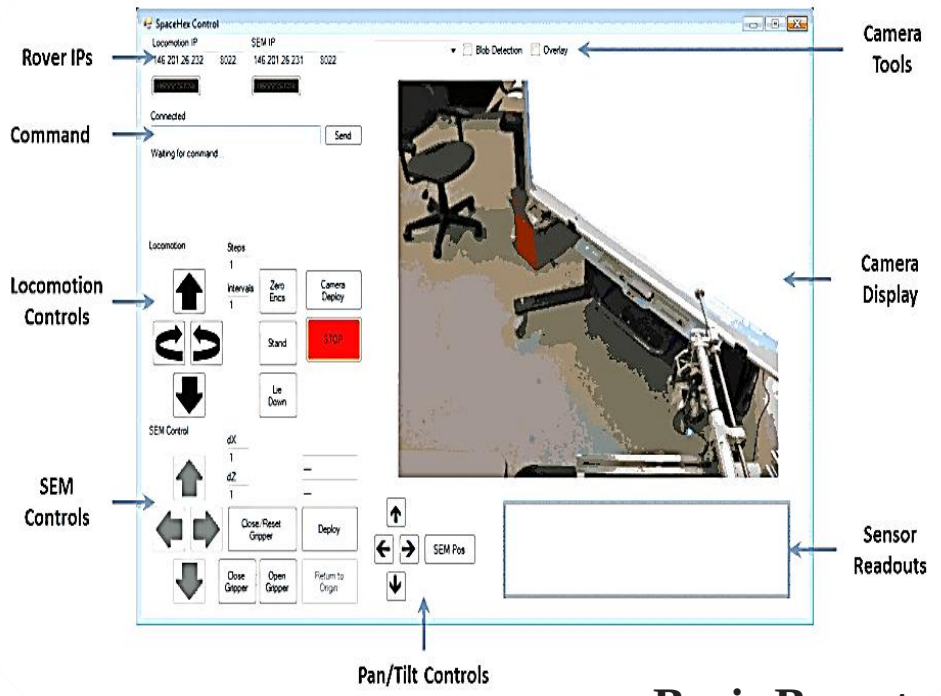
Control Development

Control Development

- The Curses library enables getch() and necessary customizing functions such as halfdelay(int)

- Xpadder maps the buttons on the XBOX controller to the keyboard, allowing it to communicate with the terminal

- Dynamic switching is done through the code. A switch statement is used with default “stand”. Commands will then tell the rover which way to move and can be done without restarting the motion.



Boris Barreto

Communications

Last Year's Issues:

-dropped coverage

-lagging video/ relay of commands

What We've Did:

-update from 3G to 4G Verizon service

-new USB modem

What we plan to do:

-test design and implement into video

-incorporate AT&T (split BW demands) as time permits

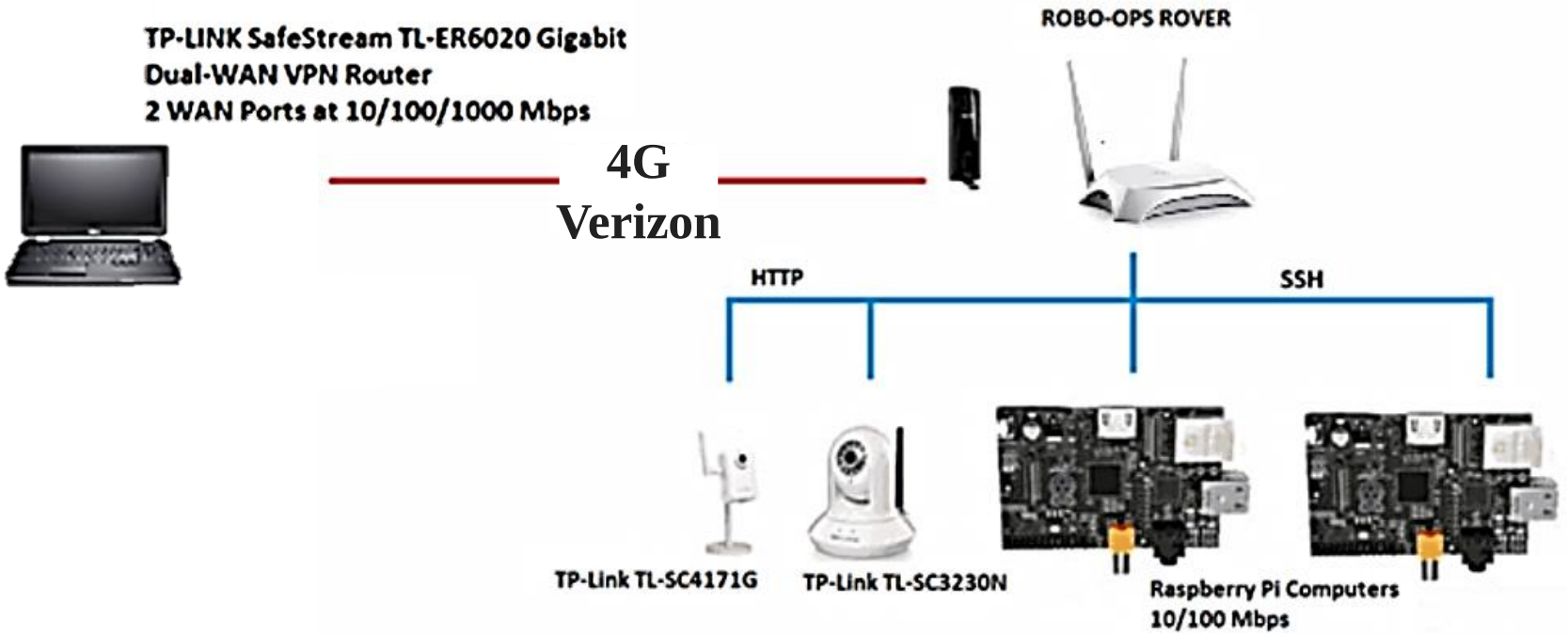
-dynamically be able to switch between networks in GUI

-this is done through script writing

-open source software is needed, complex idea

-may provide layout for next year's team

Planned Design



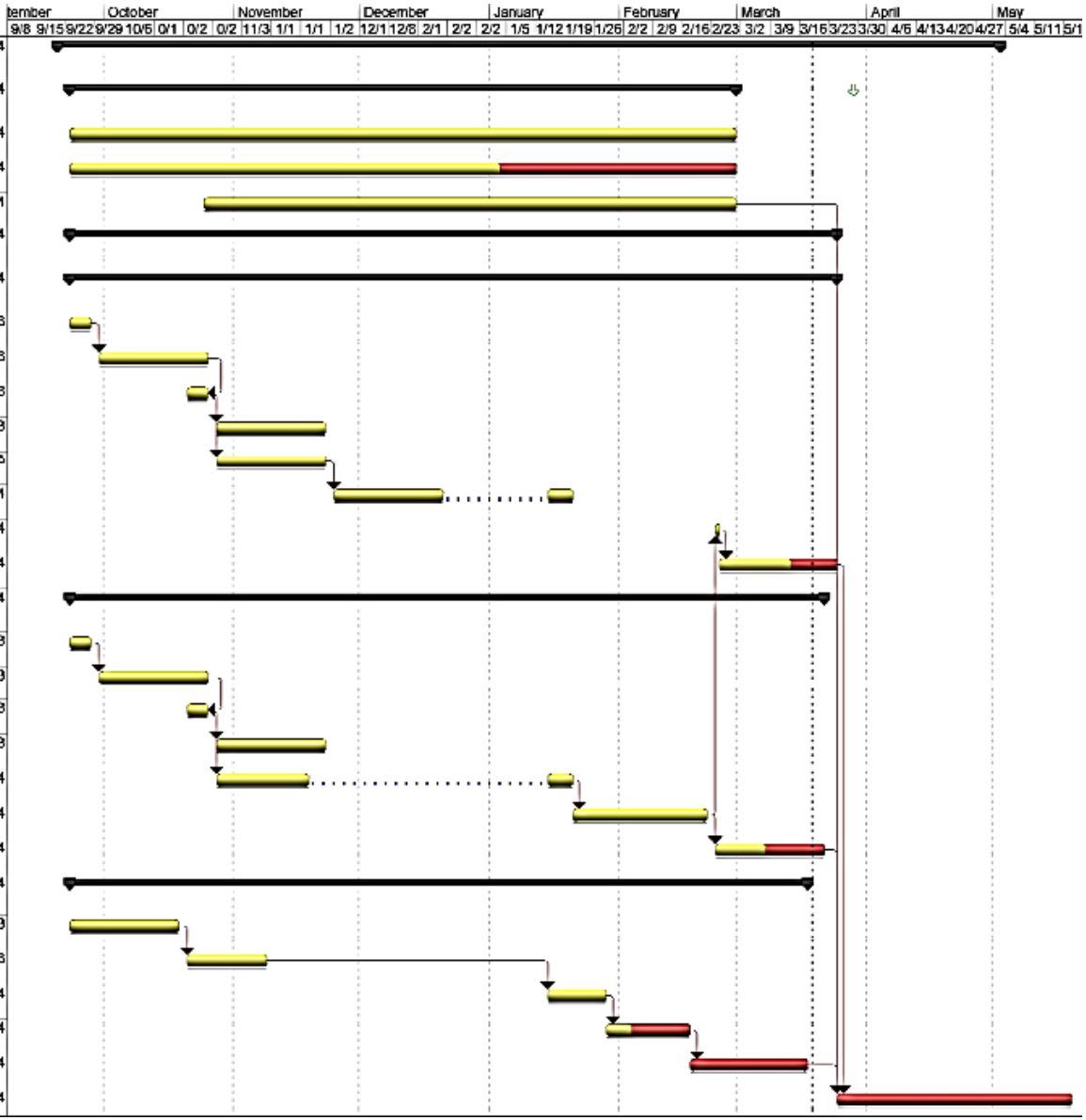
- Communicate with USB modem
  - Verizon supplies a private IP address
- Data packets processed and transferred in WAN different than LAN
  - Think of a smartphone and the rate at which it can access data

Project Procurement

	Item	Vendor	Part Number	Cost	Quantity	**Total**
Arm	Pololu 12V Motors with Encoders	Pololu	397172	$39.95	3	**$120**
	Encoders	Pololu	110512	$8.95	4	**$36**
	Pololu 298:1 Micro Metal Gear Motor	Pololu		$16.95	4	**$68**
	Shafts, Bearings, Chain, Sprocket and Misc. Hardward	Misumi	Various	$270	1	**$270**
	¼ “ ABS Plastic	Interstate Plastics		$15.00	4	**$60**
Communications	Verizon Wireless Service	Florida State University IT Services		$60.00 /month	3 months	**$180**
TOTAL						**$734**

Project Schedule

Task Name	Start	Finish
Fundrasing	Fri 9/20/13	Fri 5/2/14
Locomotion Controls	Mon 9/23/13	Fri 2/28/14
Turn While Walking	Mon 9/23/13	Fri 2/28/14
Turning while climbing	Mon 9/23/13	Fri 2/28/14
Control with and Xbox	Fri 10/25/13	Fri 2/28/14
Sample Extraction Module	Mon 9/23/13	Mon 3/24/14
Gripper	Mon 9/23/13	Mon 3/24/14
Brainstorming	Mon 9/23/13	Fri 9/27/13
Prototyping – Cardboard Stage	Mon 9/30/13	Fri 10/25/13
Selection of Final Design	Mon 10/21/13	Fri 10/25/13
Determine Parts Necessary	Mon 10/28/13	Fri 11/22/13
Complete CAD Model	Mon 10/28/13	Fri 11/22/13
Construction	Mon 11/25/13	Mon 1/20/14
Attachment to Arm	Mon 2/24/14	Mon 2/24/14
Testing Gripper	Tue 2/25/14	Mon 3/24/14
SEM Mechanism	Mon 9/23/13	Fri 3/21/14
Brainstorming	Mon 9/23/13	Fri 9/27/13
Prototyping – Cardboard Stage	Mon 9/30/13	Fri 10/25/13
Selection of Final Design	Mon 10/21/13	Fri 10/25/13
Determine Parts Necessary	Mon 10/28/13	Fri 11/22/13
Complete CAD Model	Mon 10/28/13	Mon 1/20/14
Construction	Tue 1/21/14	Fri 2/21/14
Testing SEM System	Mon 2/24/14	Fri 3/21/14
Communication	Mon 9/23/13	Mon 3/17/14
Develop Communications Design	Mon 9/23/13	Fri 10/18/13
Determine Necessary Components	Mon 10/21/13	Fri 11/8/13
Acquire Necessary Components	Wed 1/15/14	Tue 1/28/14
Build Communication System	Wed 1/29/14	Mon 2/17/14
Test and Debug Communications	Tue 2/18/14	Mon 3/17/14
Complete System Integration –	Tue 3/25/14	Mon 5/19/14



PROJECT SUMMARY

Competition Status	Not selected to participate 2014 Robo-Ops competition
	Switch to back up plan
Rover Locomotion	Improved locomotion control (turn while walking/Stair climbing)
	Dynamic control (Xpadder/getch())
Extraction Module	Manipulator with 3 DOF and Elastic pincher Completely Constructed
	Debugging Programming of Arm and Gripper Controllers
Communication	Simplified plans due to issues acquiring network service
	Ensuring Stable Connection Established with single network
Future plans	Compile all parts
	Finishing Debugging Robotic Arm Programming

References

- http://www.maxonmotorusa.com/maxon/view/product/motor/dcmotor/re/re40/148867
- http://www.robotshop.com/en/pololu-298-to-1-micro-gear-motor-hp.html
- http://www.tp-link.us/products/details/?categoryid=1678&model=TL-ER6020
- http://www.britannica.com/EBchecked/topic/182081/elastomer#ref625240
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- http://wpirover.com/category/robo-ops/
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- http://raspberrypi.stackexchange.com/questions/1976/alternatives-to-raspberry-pi
- http://www.tp-link.us/products/?categoryid=202
- http://www.raspberrypi.org/

Question/Comment?