



Powering the PUMA

Dec14-08

Dr. Greg Luecke – Client/Advisor

Matt Bogenschultz – Leader

Alex Grieve – Webmaster

Nhat Pham – Communications

Zeyu Zhang – Key Idea Holder



Project Overview

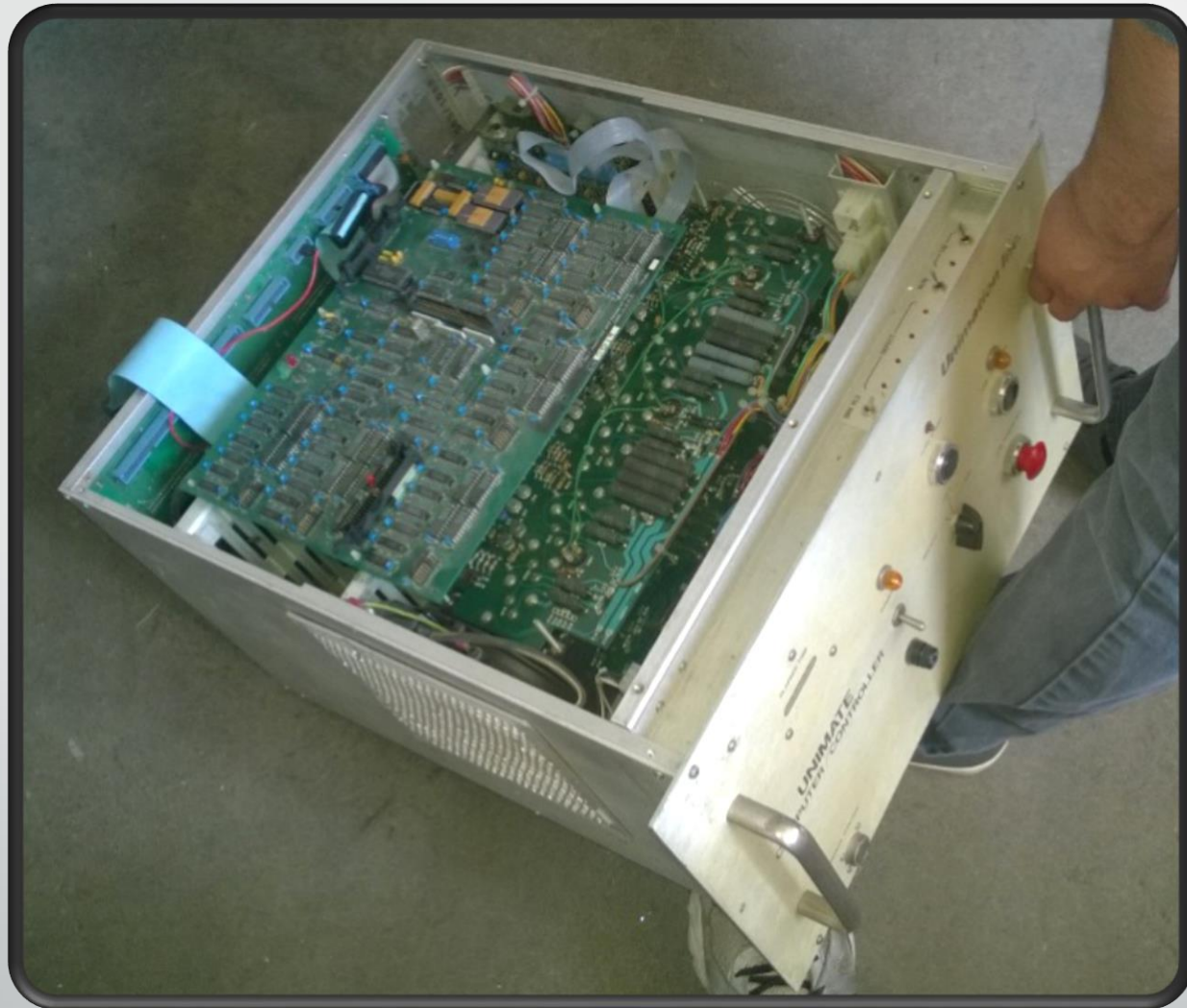
Background



Background

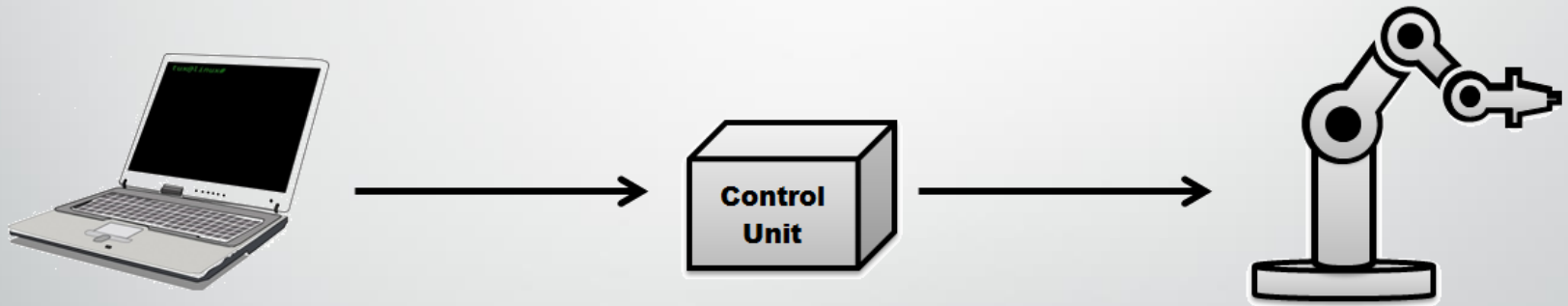


Background



Problem Statement

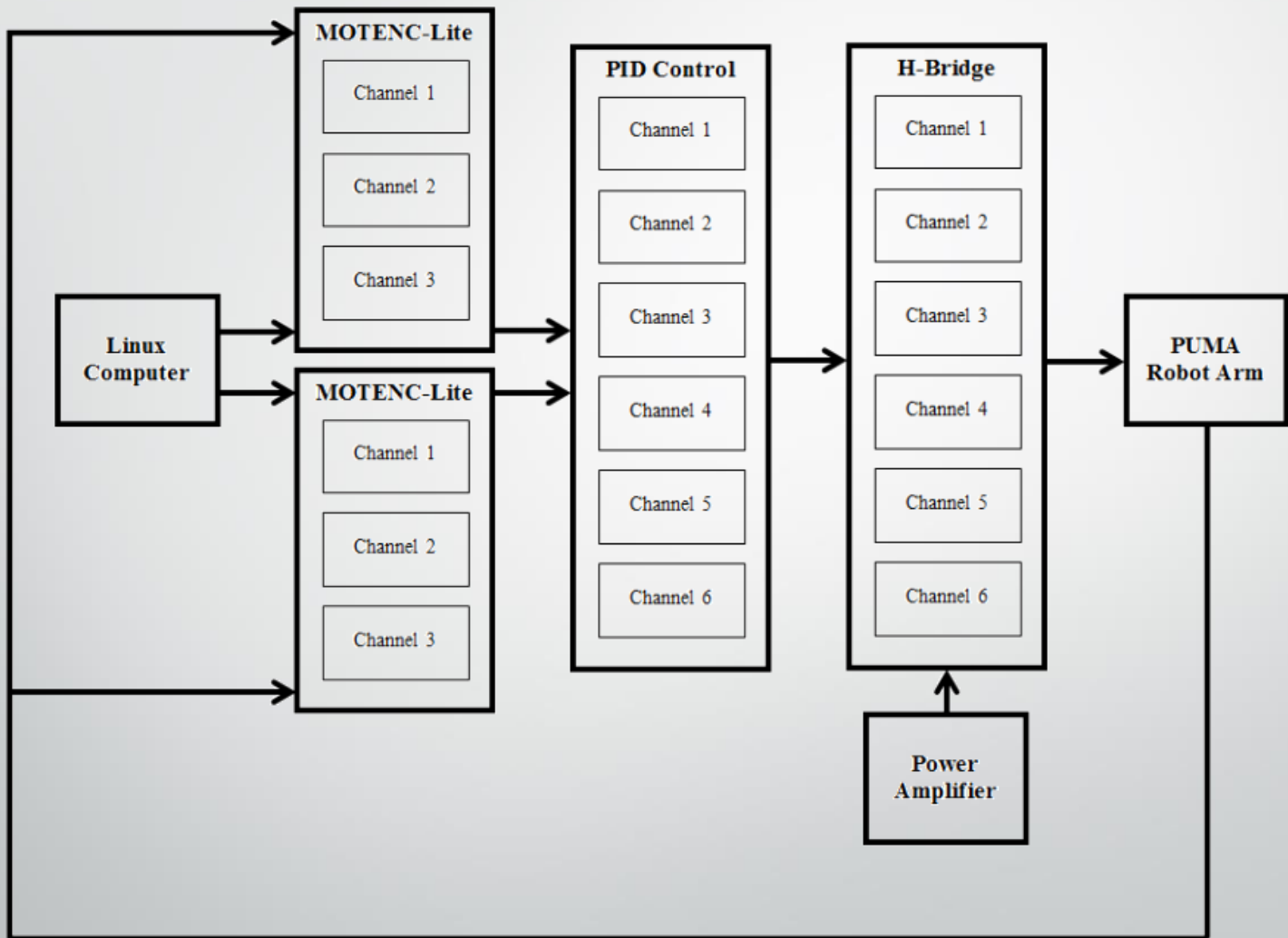
- Our team objective is to develop a control system that will interact with the PUMA robot arm, which will replace the original controllers.



Requirements

- Functional
 - 6 operational joints
 - Interface through C code
 - H-bridge design
- Non-Functional
 - Professional quality
 - Ease of use
 - Performance

System Block Diagram



Cost Estimate

- Budget: \$5000 (flexible)
- MOTENC-Lite – $\$550 \times 2 = \1100
- H-bridge – TBD
- Power amplifiers – TBD

Project Schedule – Spring

Milestone	Due
Project Plan	February 19 th
Design Document	March 11 th
Map PUMA pins	April 1 st
H-bridge redesign	May 1 st
Linux Computer setup	April 1 st
Test MOTENC-Lite program	April 14 th

Project Schedule – Fall

Milestone	Due
Spec power amplifier	September 22 nd
C library complete	September 22 nd
H-bridge PCBs	October 20 th
System Integration	October 20 th
Testing/debugging	November 21 st

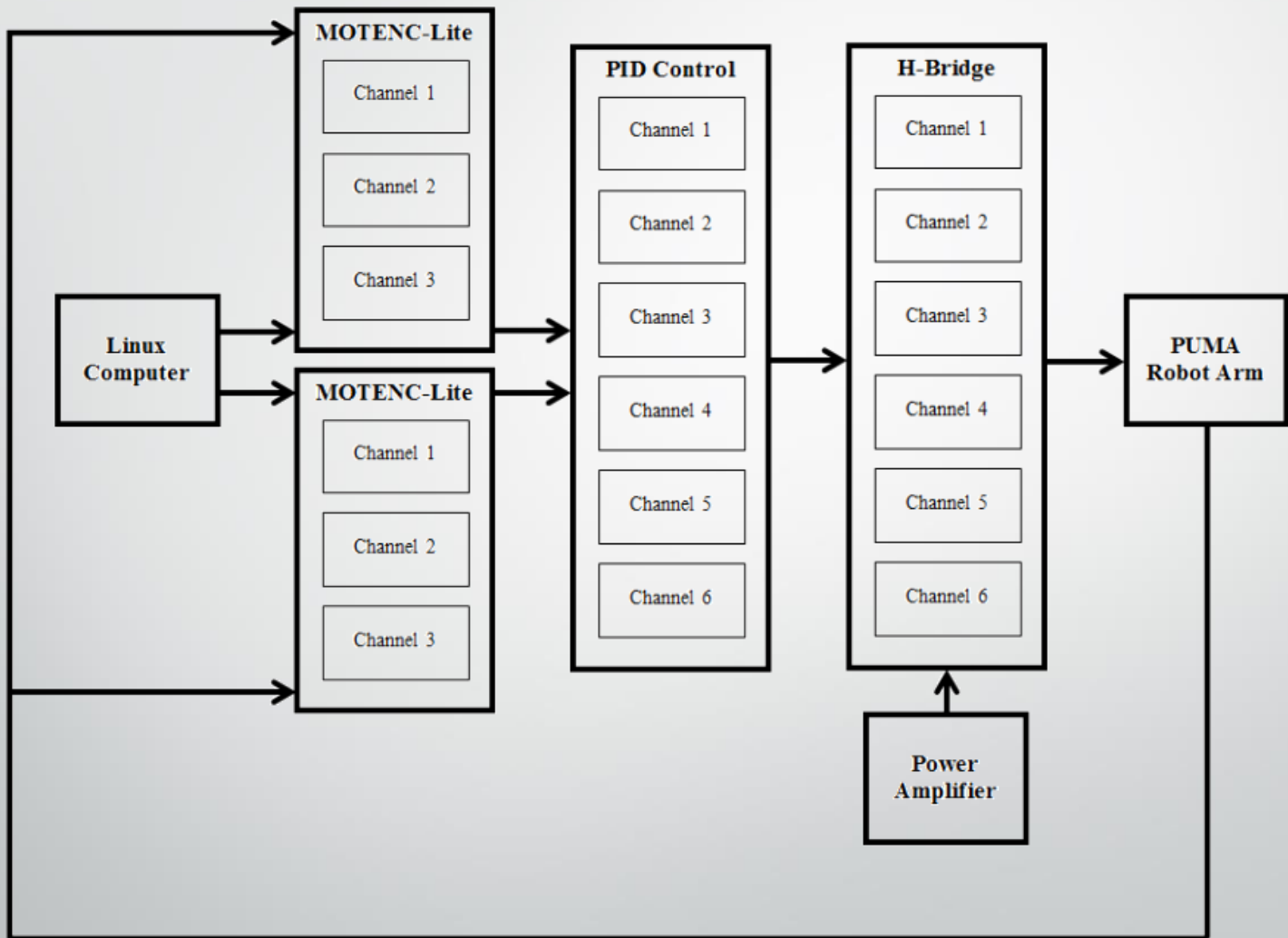
Work Breakdown

- Alex
 - MOTENC-Lite and C code
- Nhat
 - H-bridge design
- Matt & Zeyu
 - PID Controller, PUMA wiring, power amplifier



System Design

System Block Diagram



Linux Computer

- Old VRAC computer
 - Core Duo
 - Hopefully no performance issues
- Ubuntu 12.04 LTS OS
- gcc / vim development
- Github repository

MOTENC-Lite

- PCI Data acquisition card
- Specifications
 - 8 channel DAC, $\pm 10V$
 - 8 channel ADC, $\pm 5V$
 - Four quadrature encoder inputs
 - 48 digital I/O
 - Programmable timer interrupts



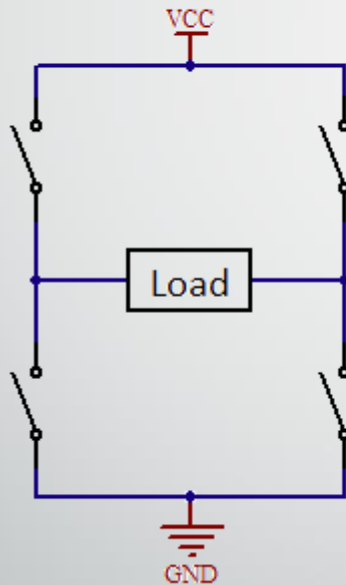
PID Controller

- Software implementation
- Error
 - Sample encoder counts from MOTENC-Lite cards
 - Compare with desired joint position
- Proportional & derivative gains only

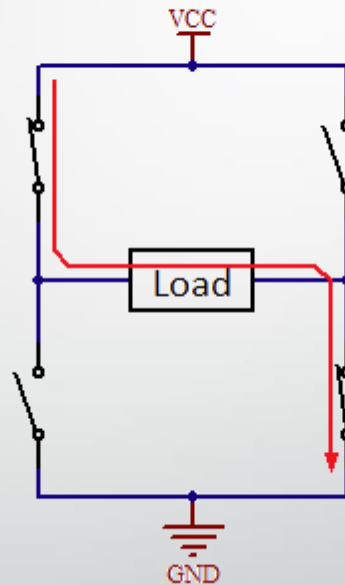
H-Bridge

- Used when current to the load needs to be controlled

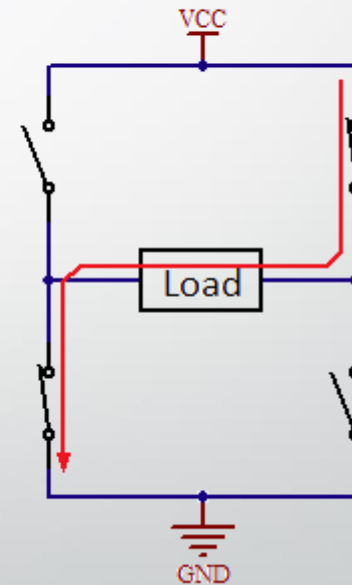
H bridge topology



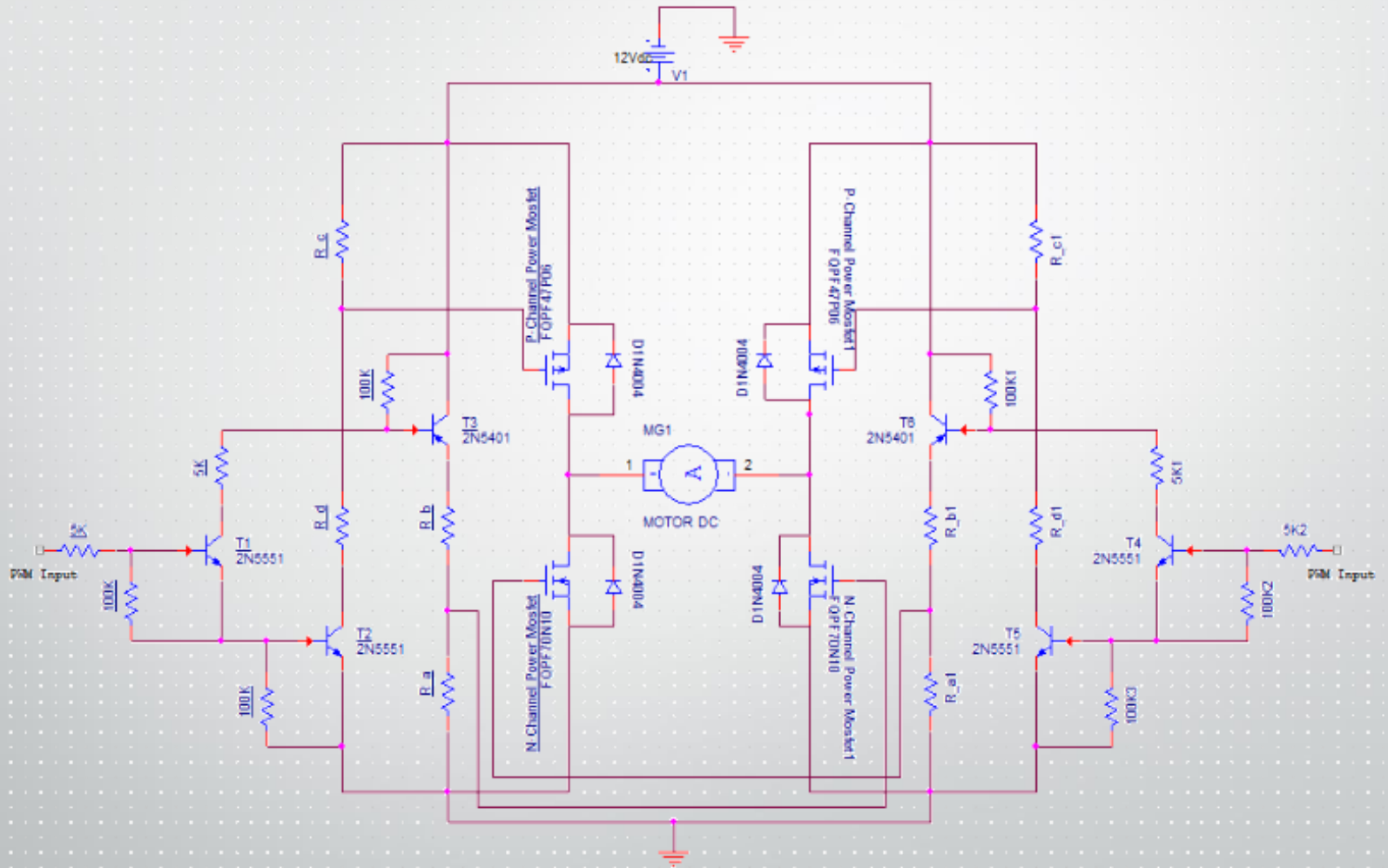
Connecting the load in one direction



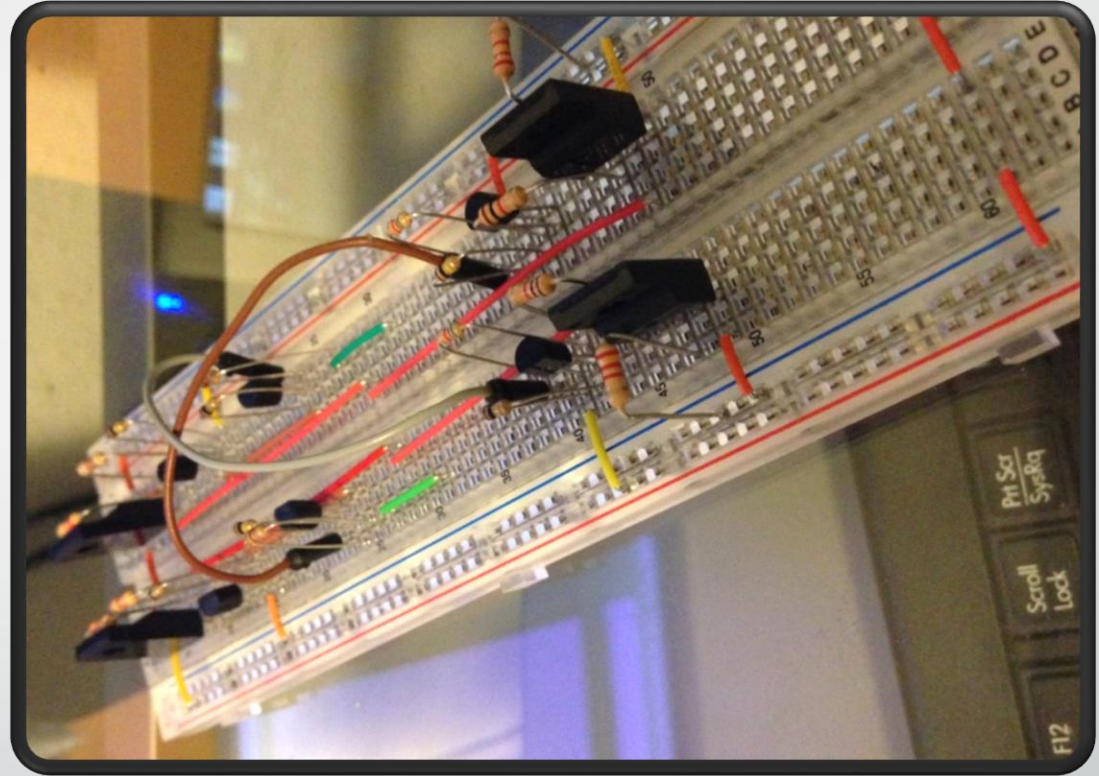
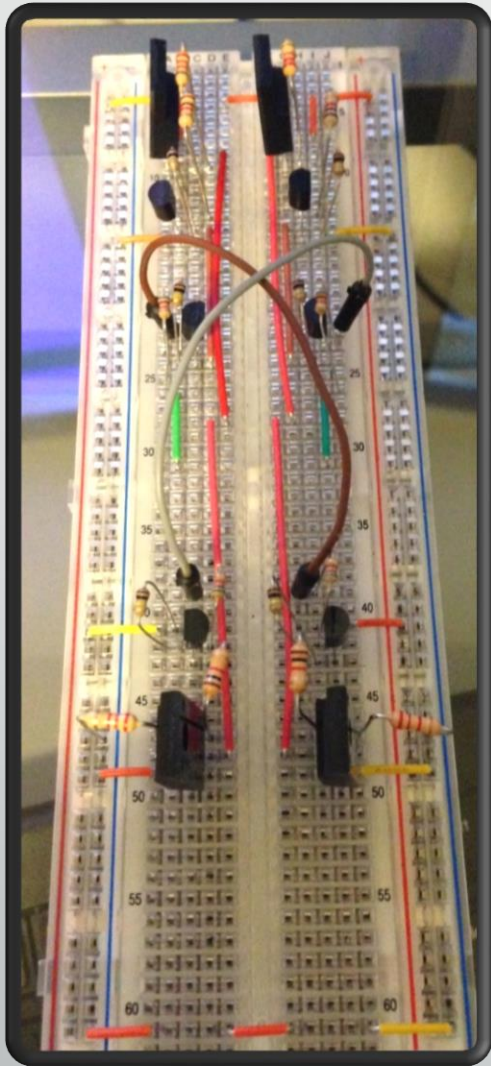
Connecting the load in the other direction



H-Bridge

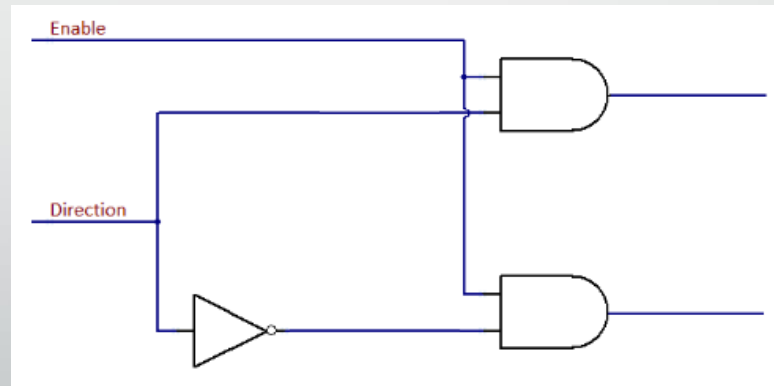
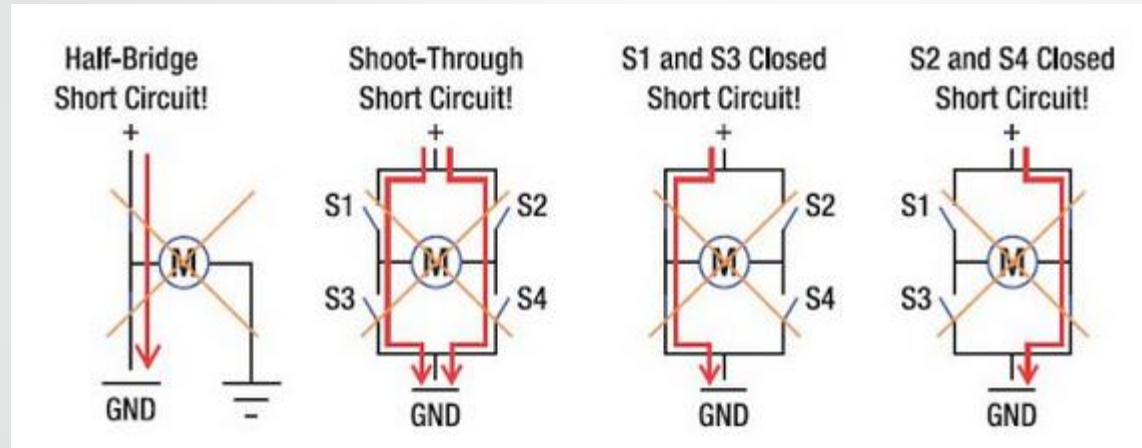


H-Bridge Prototype



Safety Logic Circuit

- Need to prevent shoot through



Testing Plan

- Test components individually
 - Catch “easy” bugs
- Iteratively combine & test system components
 - MOTENC-Lite cards & C library
 - Add PID controller
 - Add H-bridge
 - Add PUMA robot



Conclusion

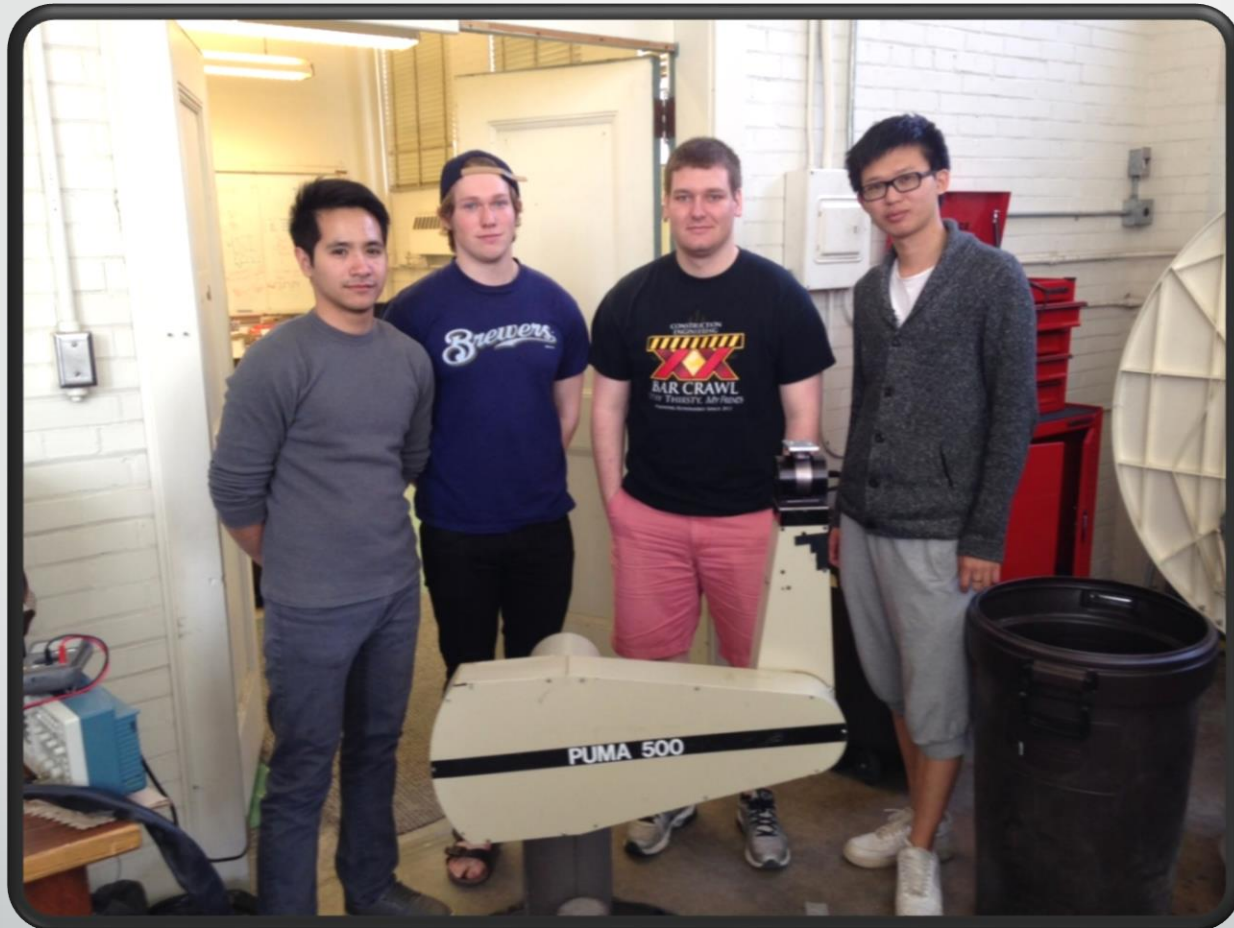
Project Status

- Documentation – complete
- Pin mapping – complete
- Linux computer setup – complete
- H-bridge design – near complete
 - Still need logic circuit
- MOTENC card testing – near complete
 - Still need to connect & verify encoder count functionality

Next Semester

- H-bridge
 - Finish logic circuit, fabricate PCB
- Choose power amplifier
- Write C library
- System Integration
- Testing/Debugging

Questions?





Additional Slides

Website

- <http://dec14o8.ece.iastate.edu/index.html>

