Self-reconfigurable Modular Robots
– MODBOT –

Advisors: Professor Nestinger (ME/RBE), Professor Looft (ECE)
Caleb Swieson (ECE/RBE), Paul Heslinga (RBE),
Stephen Poppa (ME), Kyle Padelford (ME).

Stinger Lab

Eclectic Robotics & Automation

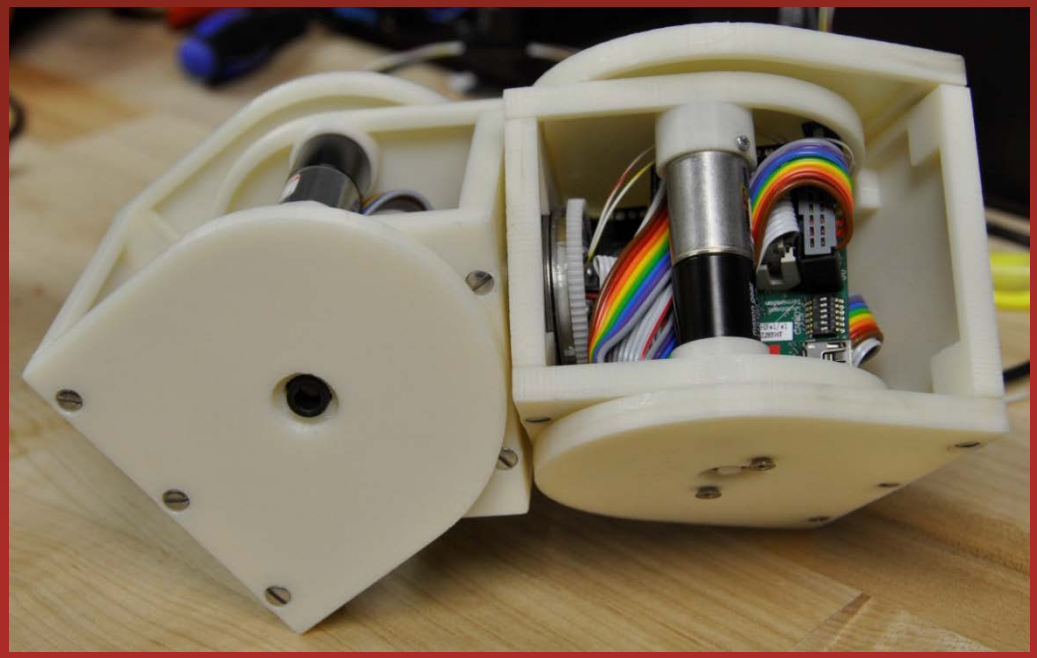
http://stinger.wpi.edu

Outline

- Overview of Project
- Project Goals
- Module Electronics
- Magnetic Connection Mechanism
- Conclusions

Overview of Project

- Design and build a self-reconfigurable modular robot
  - Move individually
  - Connect to other modules
  - Move as a group
  - Change module configuration shape

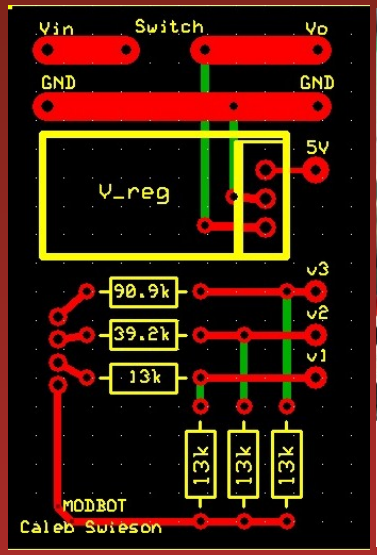


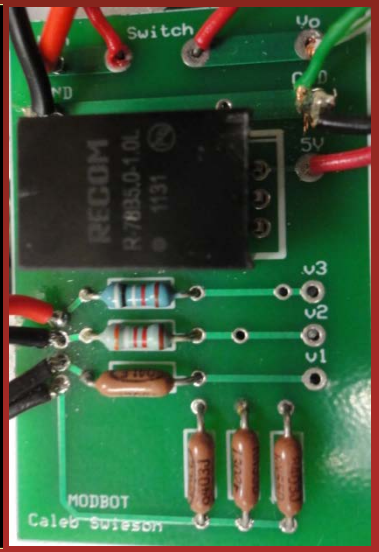
ECE Specific Project Goals

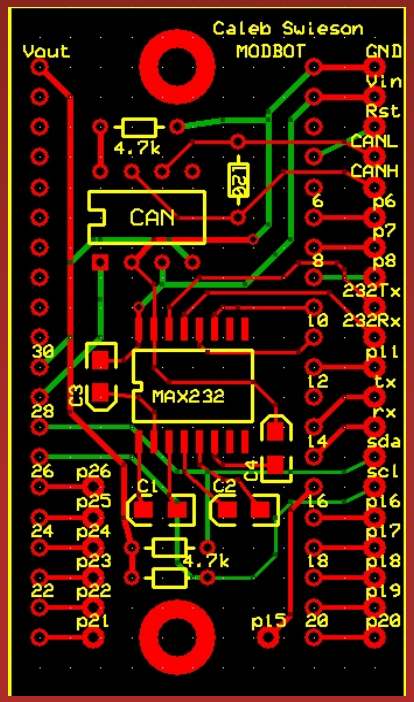
- Develop and implement module electronics
- Research and develop a method for connecting and disconnecting modules using a magnetic mechanism

Module Electronics

- Power & Power Management
- Microcontroller Communication

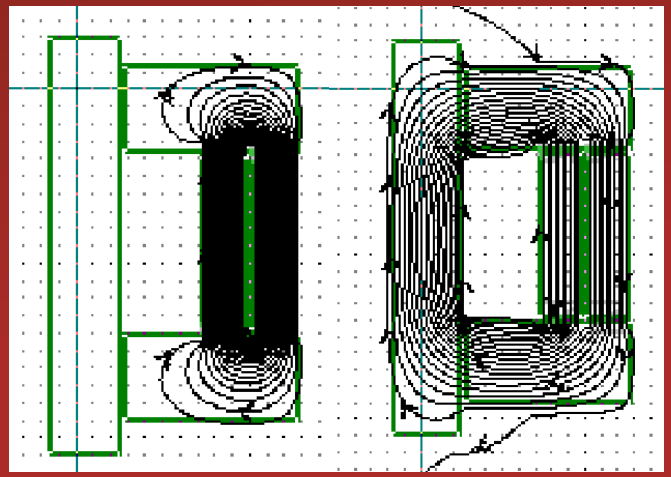


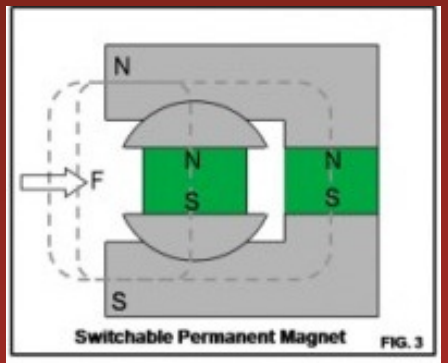


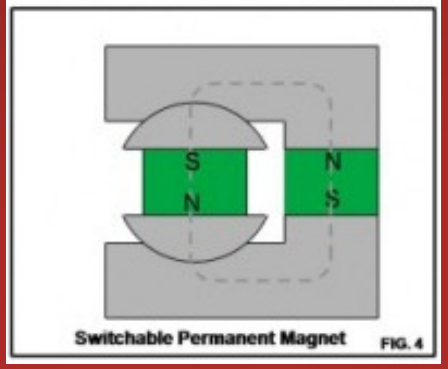


Switchable Magnet Theory

- Two permanent magnets in parallel
- Swap poles of one magnet
  - Mechanically
  - Electrically
- Negates the external magnetic field



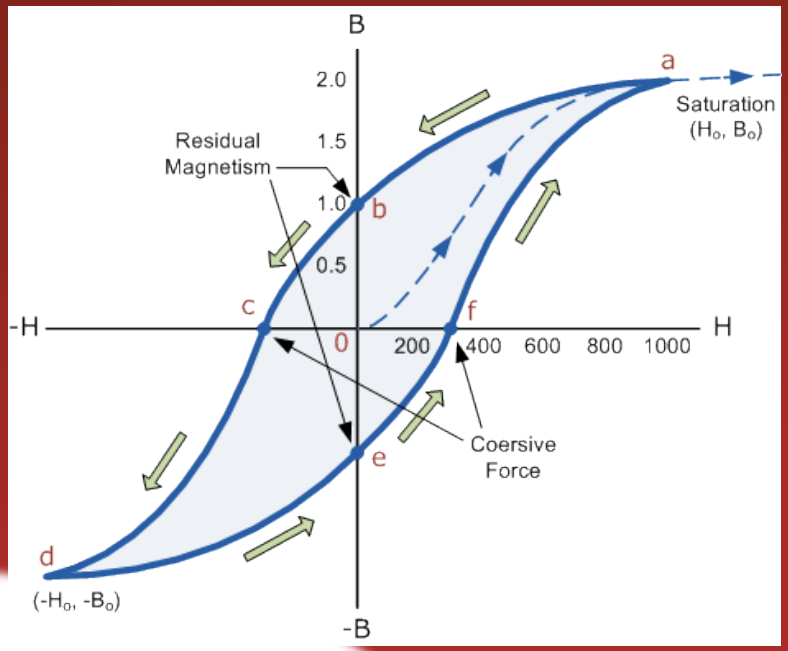


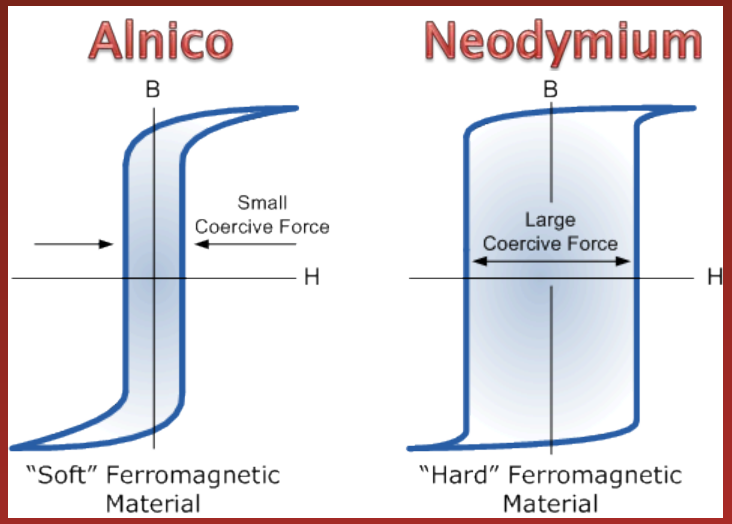


http://www.docmagnet.com/tech_center/tech_papers/switchable_magnets_explained/

Electrically Switchable Magnet

- Generate a magnetic field large enough to swap poles of the “softer” magnet



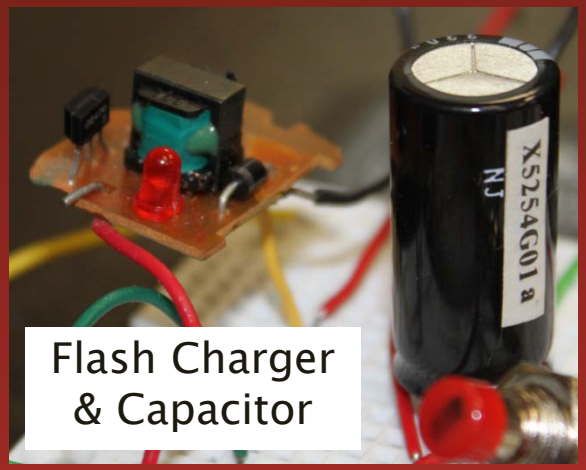


- Wire coiled around the magnet
- High current pulse induces a large magnetic field

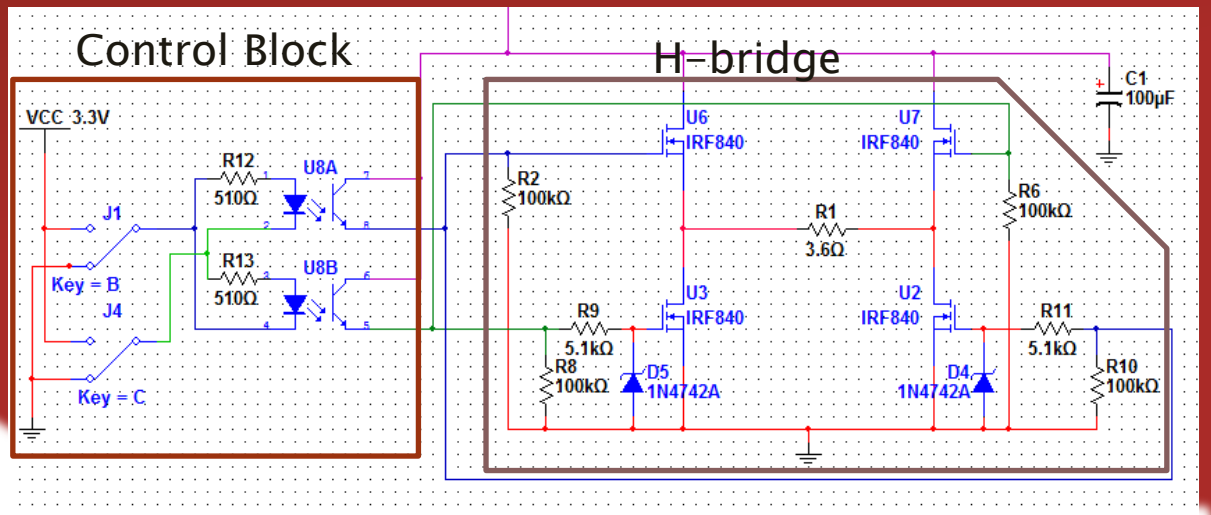
http://www.electronics-tutorials.ws/electromagnetism/magnetic-hysteresis.html

ESM: Circuit Design

- Step up transformer to charge a capacitor
- H-bridge configuration to control current direction
- Optocoupler to isolate control components

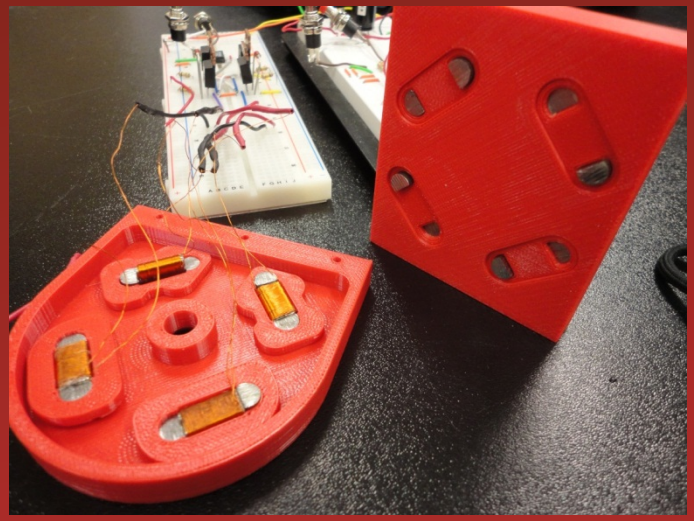


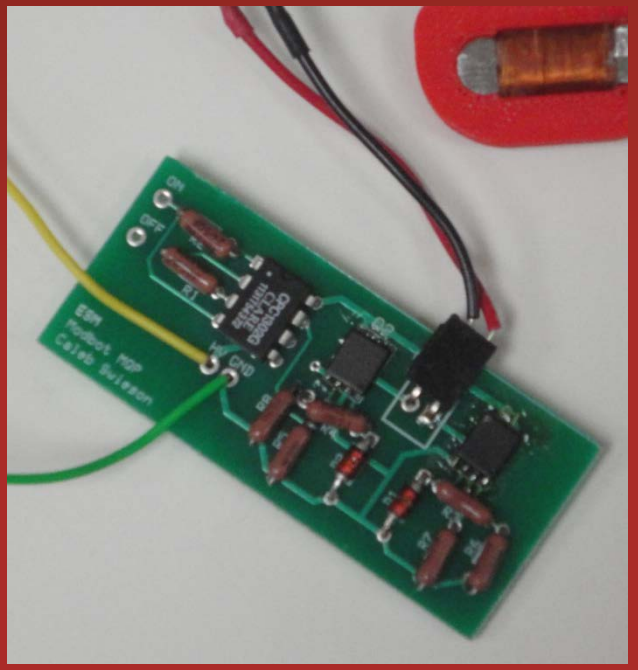
Flash Charger & Capacitor



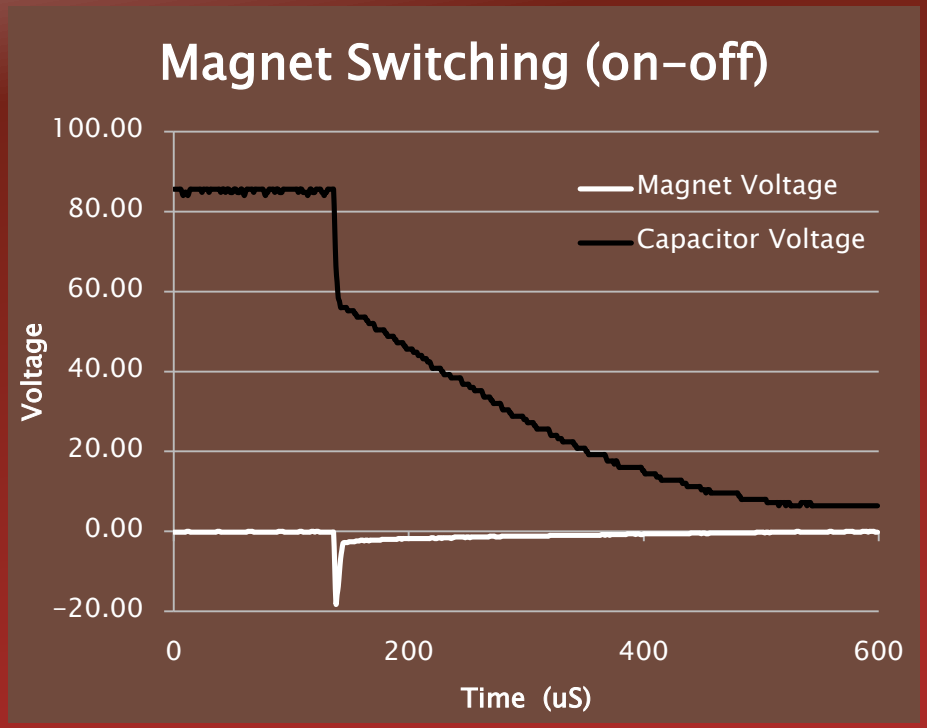
ESM: Prototype

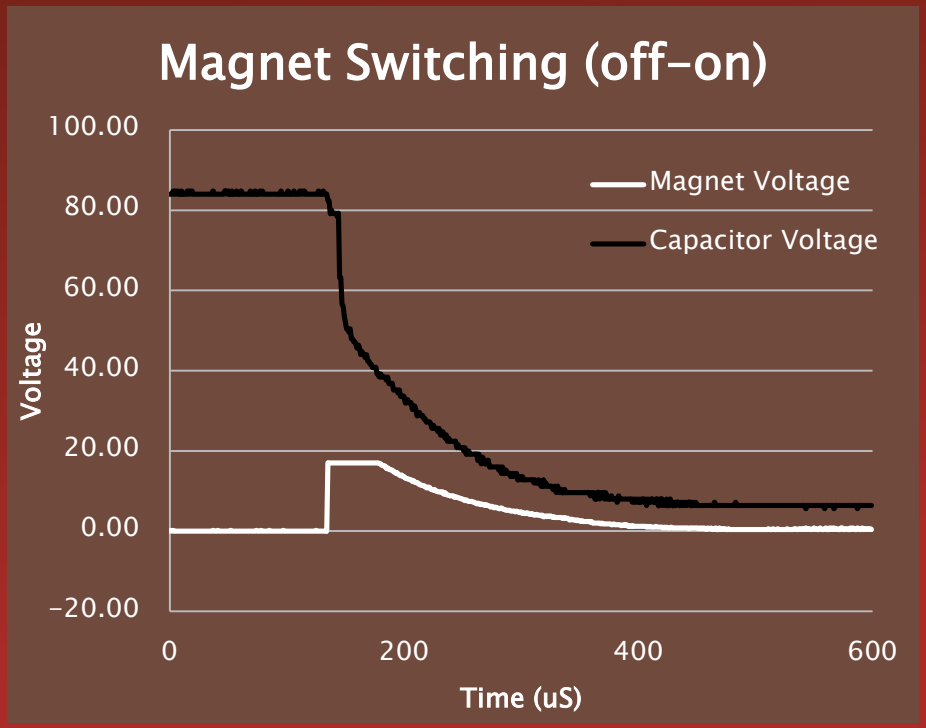
- 3D printed connection mechanism faces
- Printed PCB board for switching circuit





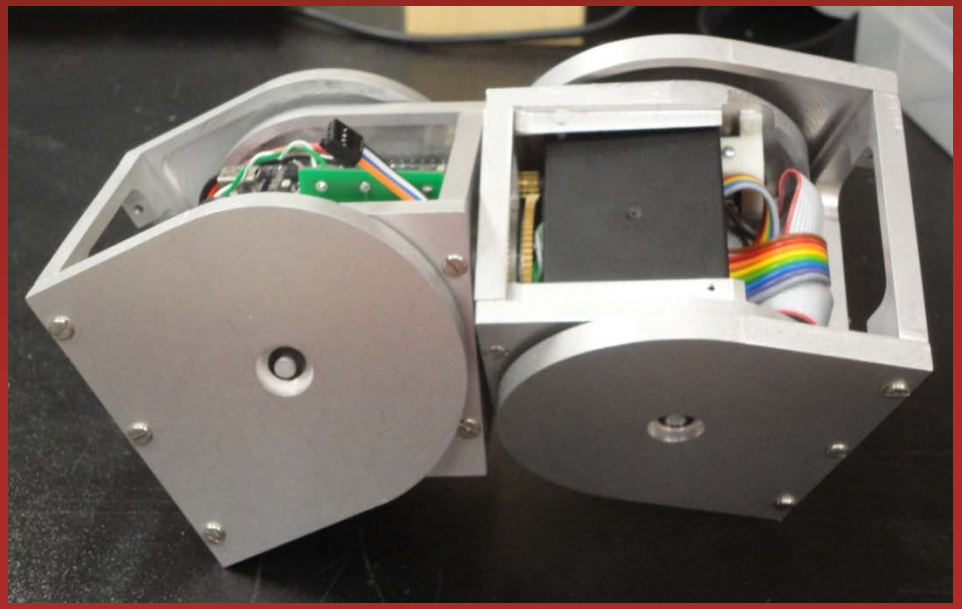
ESM: Switching Tests





Conclusions

- Electronic components integrated into module
- Circuit successfully switched magnet poles
- Viable connection mechanism



Acknowledgements

- Professor Nestinger
- Professor Looft
- Professor Emanuel

Questions?