IOWA STATE UNIVERSITY

sdmay19 - 15

Capacitor Gun

Members: Max Balzer, Bret Tomoson, Grant Larson, Brett Nelson, Mark Fowler, Zachee Saleng

Advisor: Mani Mina

Client: Max Balzer

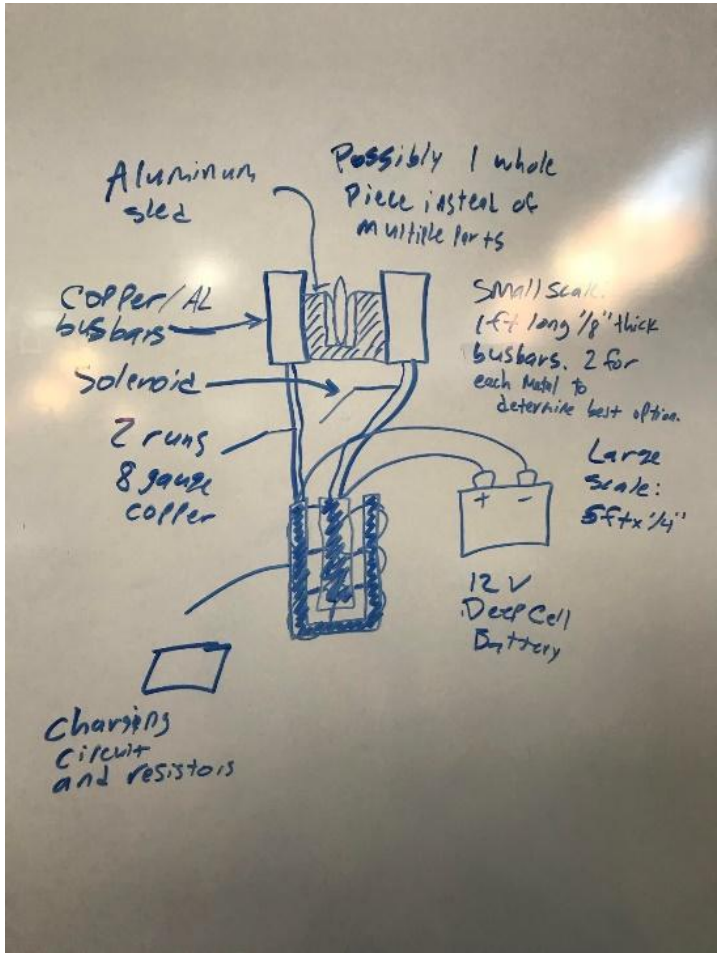
Team Website: sdmay19-15.sd.ece.iastate.edu

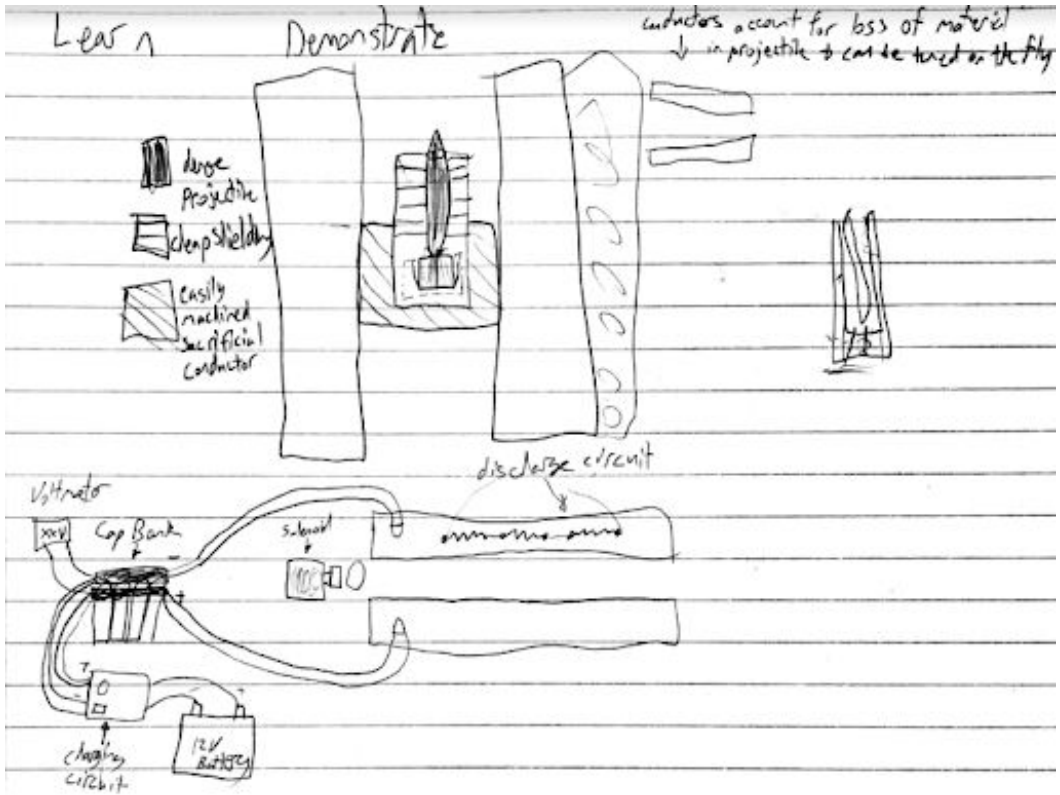
Problem Statement

- Currently, the only option for how firearms (projectile launchers) shoot objects is combustion
- Show the effects of electromagnetics in a practical use by creating and design a functional railgun
- Want to show that EM propulsion is equal to or better than traditional combustion

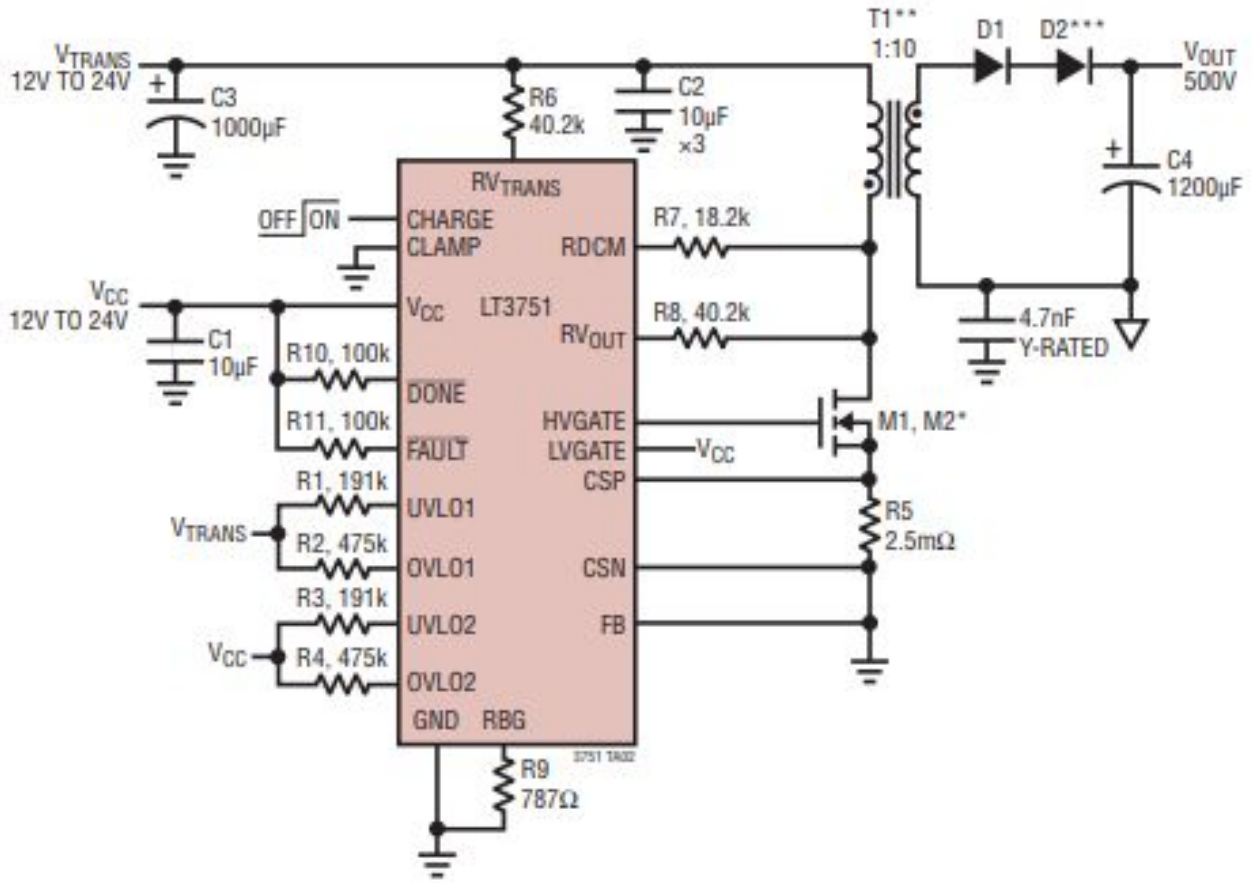
Conceptual Sketches

Overall Design





Conceptual Sketches cont.



Charging circuit, 12V to 450V

Functional Requirements

- Fire the projectile
- Fire multiple projectiles before degradation
- Charge capacitors
- Discharge capacitors & rails

Non-functional Requirements

- Accuracy
- Projectile is aerodynamic
- Stability when firing
- Safety when used

Other considerations / constraints

- Muzzle energy between 3-5 kilojoules
- 4 capacitors due to cost (~$1000)
- Minimization of heat damage
- Charging time of 2 minutes between successive shots

Uniqueness

- More functional than a hobbyist project
- Fully electronic & mechanical
- Hands on project

Potential Risks

- High voltages
- High current
- High heat
- End of the barrel is dangerous

Hardware

- Aluminum
- Polycarbonate
- Capacitors
- Cables
- Drawer slide
- Charging circuit
- Large piece of wood

Cost

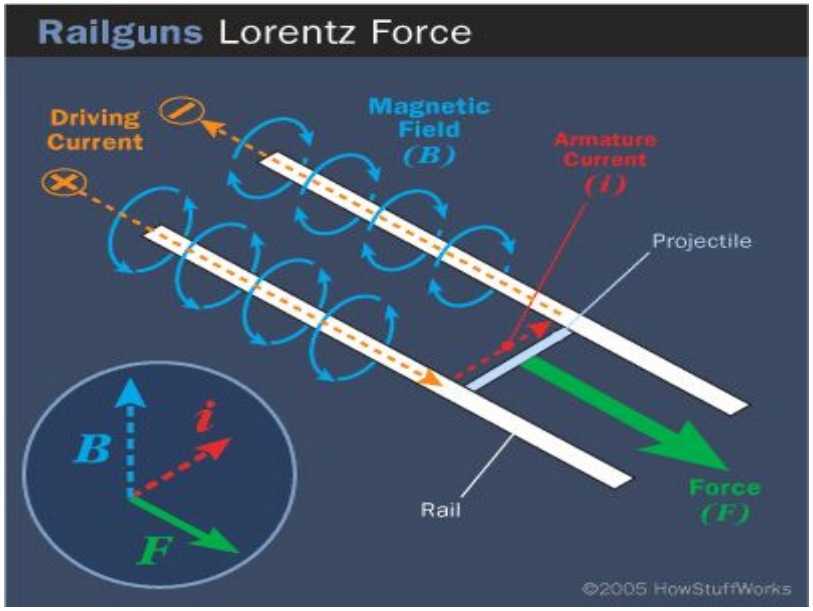
- Capacitors: 2 at $116 = $232
- Charging circuit parts: $55
- Safety gloves: $15
- Connections: $22
- Heat sink: $7
- Discharge circuit: $6
- Overall: $337

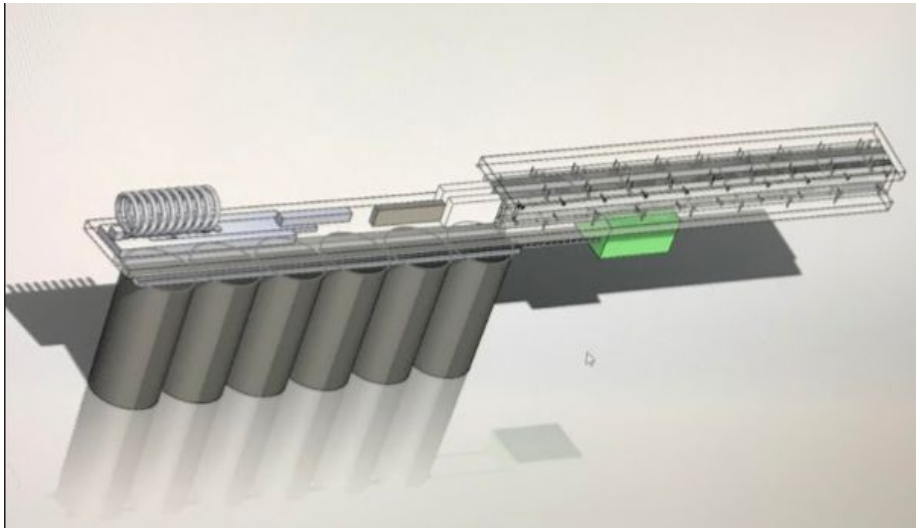
Fall Schedule

- Research: 6 weeks
- Calculations: 2 weeks
- Ordering of materials: 2 weeks
- Finalize virtual design: 2 weeks
- Building: 2 weeks
- Testing: 2 weeks
- Final demo/documentation: 1 week

Design

Our design uses capacitors to charge our rails in order to create a magnetic field. From this point, our drawer slide will then be used to give the projectile a push. The projectile will enter the magnetic field, conduct, and be propelled by the magnetic field.



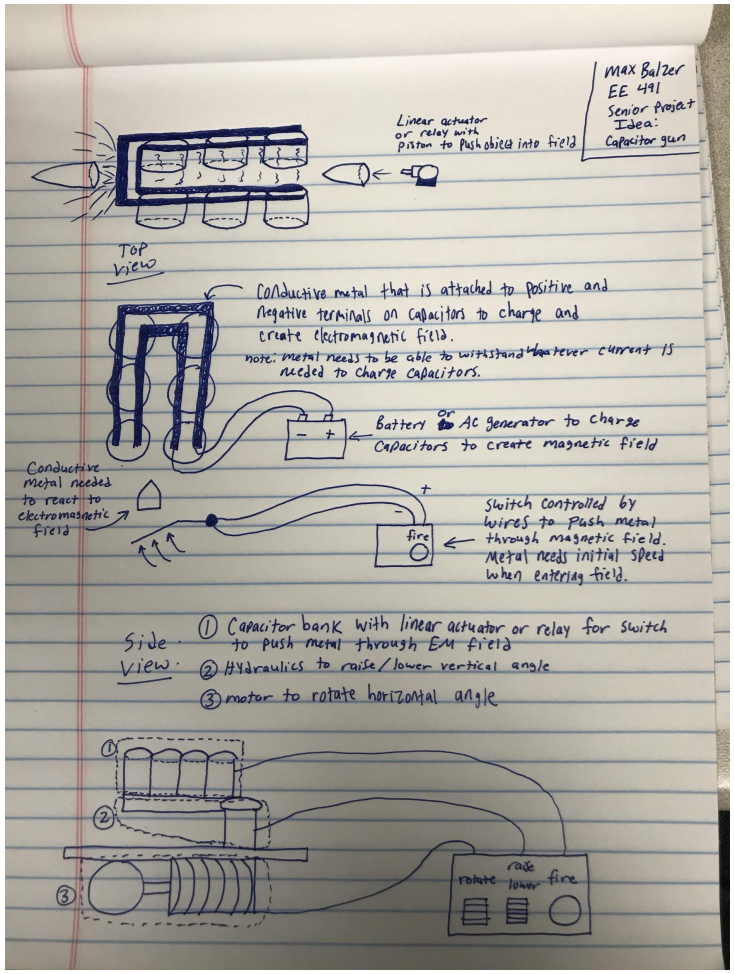


Prototype

- 2 aluminum alloy rails connected by polycarbonate
- Mounted on wood
- Powered by 2x450V 16000 uF capacitors in parallel
- Charged by Lt3751 charging circuit
- 12VDC input from Deep-cycle battery
- 2-4” Aluminum rectangular prism projectiles

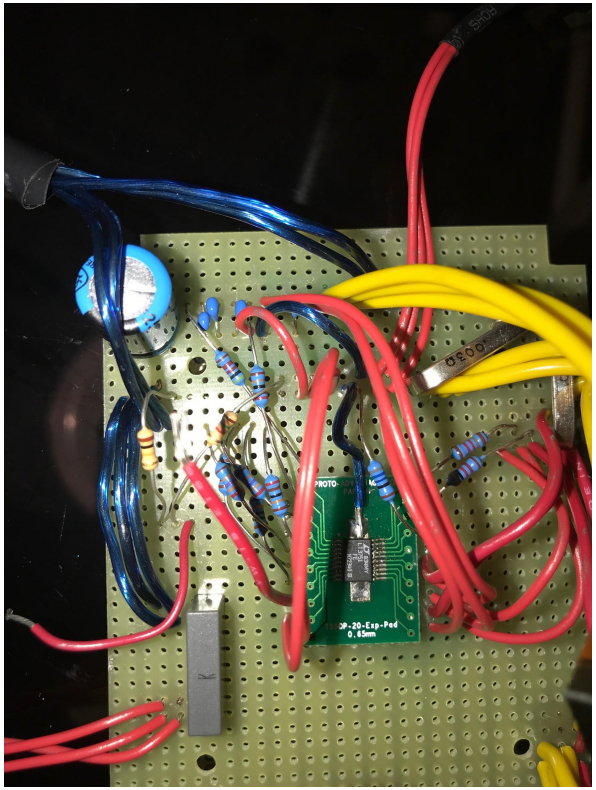
Test Plan

- Create and test charging circuit
- Create and test small-scale and large scale design
- Create and test projectile designs



Current status

- Design is fully built
- Charging circuit is not functional



Contributions

- Overall design
  - Max Balzer
  - Brett Nelson
  - Zachee Saleng

- Charging circuit
  - Bret Tomoson
  - Grant Larson
  - Mark Fowler

Next semester plans

1. Charging Circuit
2. Test small-scale prototype
3. Convert to full-size design