ECE196 Electromagnetic Cannon

Meet Team #1

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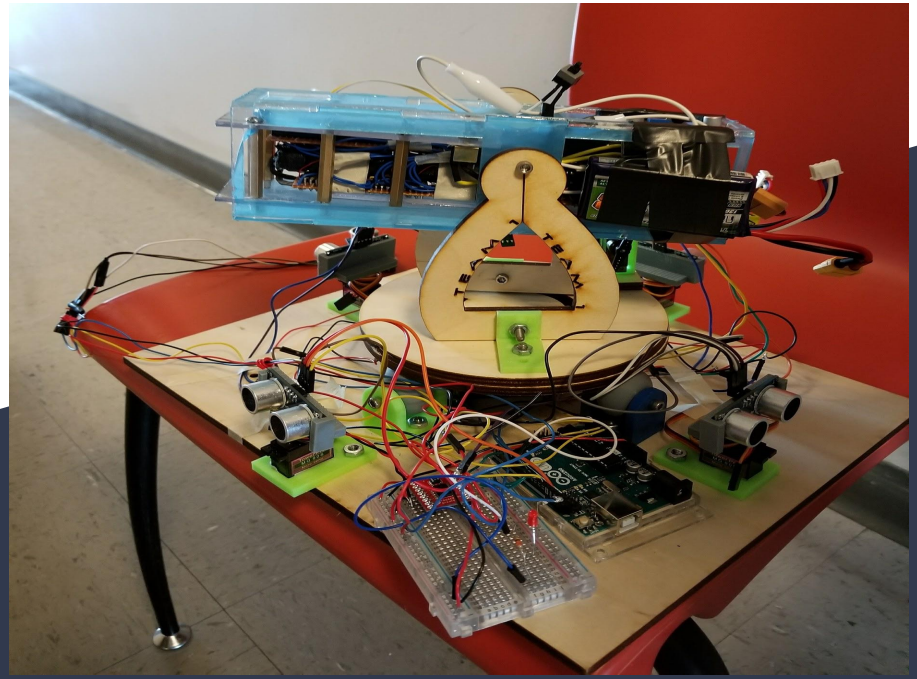
Intelligent Security System



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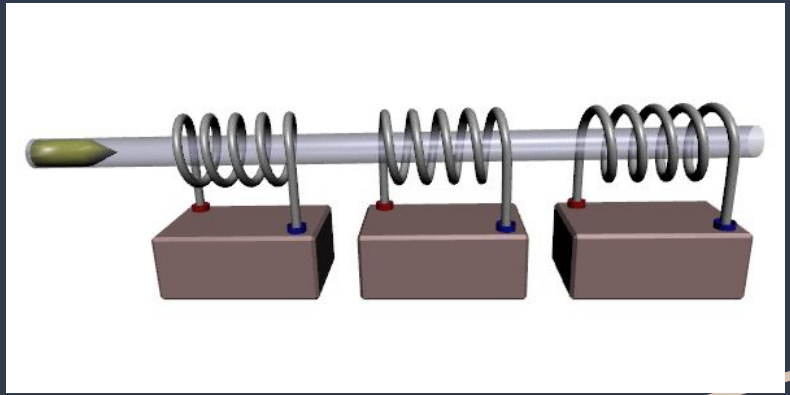
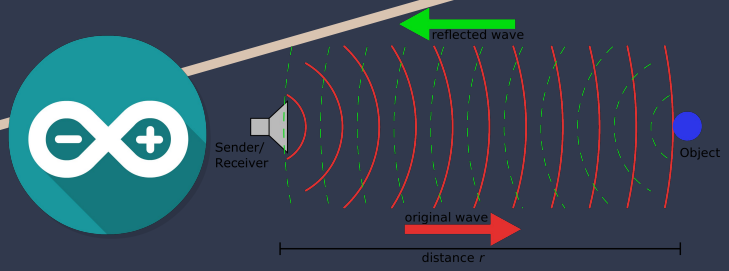
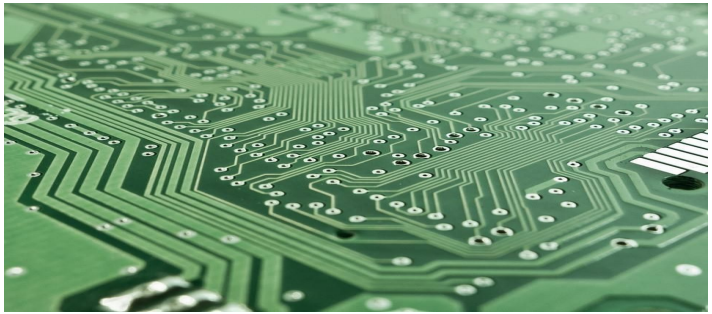
Project Description & Originality



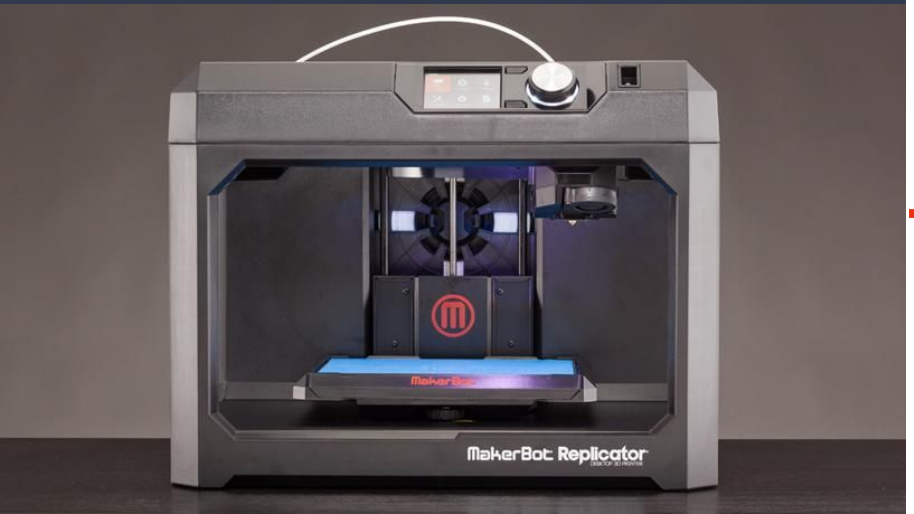


- Electromagnetic Cannon
- Fires ferromagnetic projectiles
- Cannon will sit on a servo-powered disk that can rotate around to aim said cannon
- Ultrasonic sensors will be used to find targets



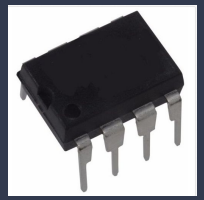
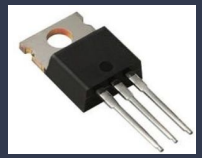
- Combines the functions of a variety of different components to achieve a goal
- Focuses on learning how to use different components and have them work in unison with one another rather than function of a single component

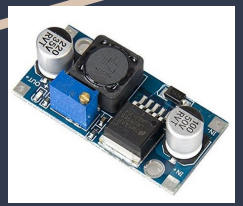
Project Learning Objectives



- Improve Arduino skills as well as learn new programming techniques
- Circuit building skills are improved throughout the project's construction
- Utilize 3D Printing and laser cutting as they are required for the building of the structure
- How to operate different parts and distinct functions to work together to complete a bigger task

Project Cost, Budget, Justification



Arduino nano	$4.00
PCB boards	$7.00
High torque servos	$12.00
Ultrasonic sensors	$8.75
Driver chips (UCC37322P)	$14.00
Mosfets (IRF3205)	$14.25
Enameled copper wire coil	$8.76
High Voltage diodes	$5.00
250V/8A fuses	$7.00
1 DC-DC module power supply	$5.50
90C Lipo battery	$19.00

Total = **$102.50**

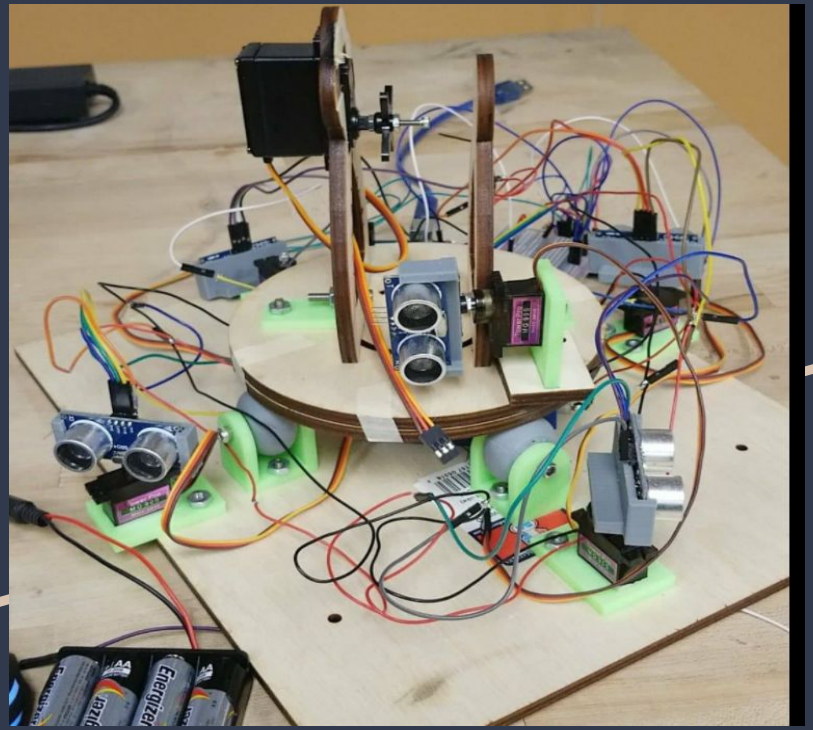
- Parts chosen for functionality: working with voltages & driving currents
- Several items arrive in packs/bulk
- Spare circuit parts very useful

Project Major Build Steps

Modular design:

1) Base structure design
2) Target sensing and servo control
3) Cannon prototyping (breadboard)
4) Multistage build
5) Mounting cannon with the base

Build Steps (pt 1)

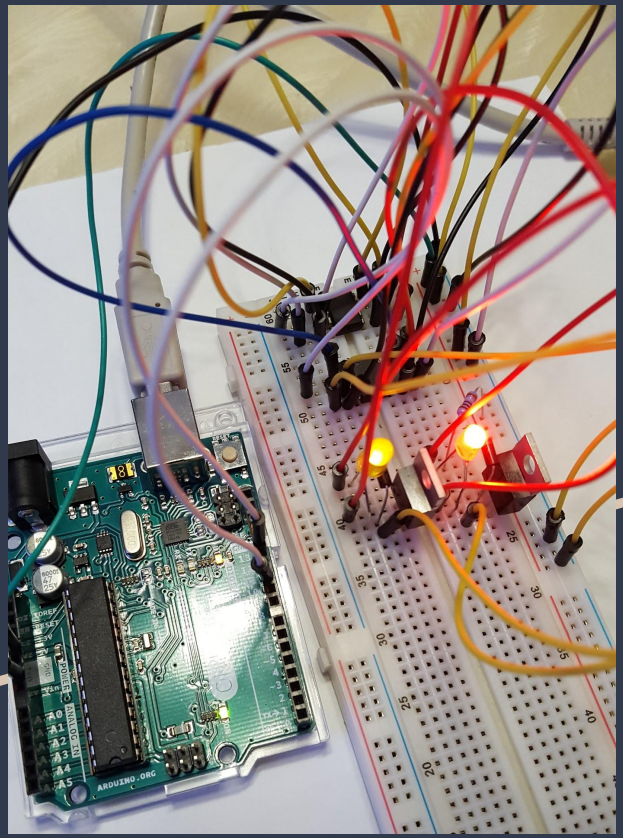


2 members focus on building and coding detection

<u>Key Milestones:</u>

- Design & create a stable base (CAD/Solidworks)
- Have a structure that can easily rotate and adjust position
- Integrate with EM cannon together and operate with arduino
- Code for detection and rotation

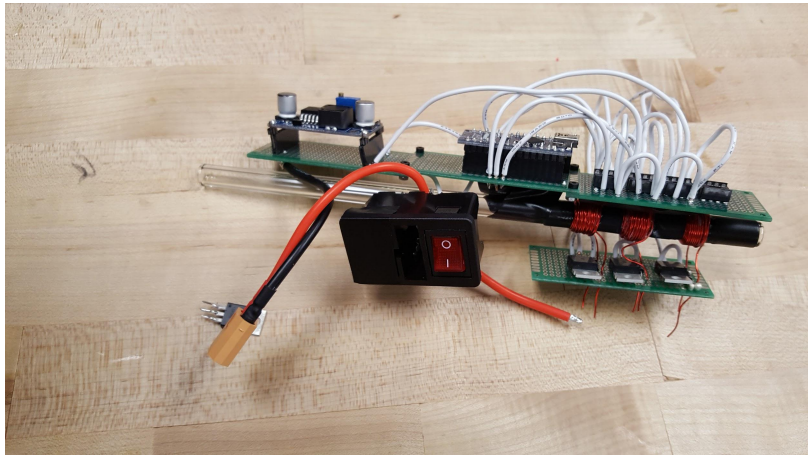
Build Steps (pt 2)



Simultaneously, the remaining half of the team design/construct the gun itself.

Key Milestones:

- Understanding core principles of how coilgun functions
- Design safety (fuses, # stages)
- Successful prototyping and basic firing operation
- Add coding features (choosing right delay time)



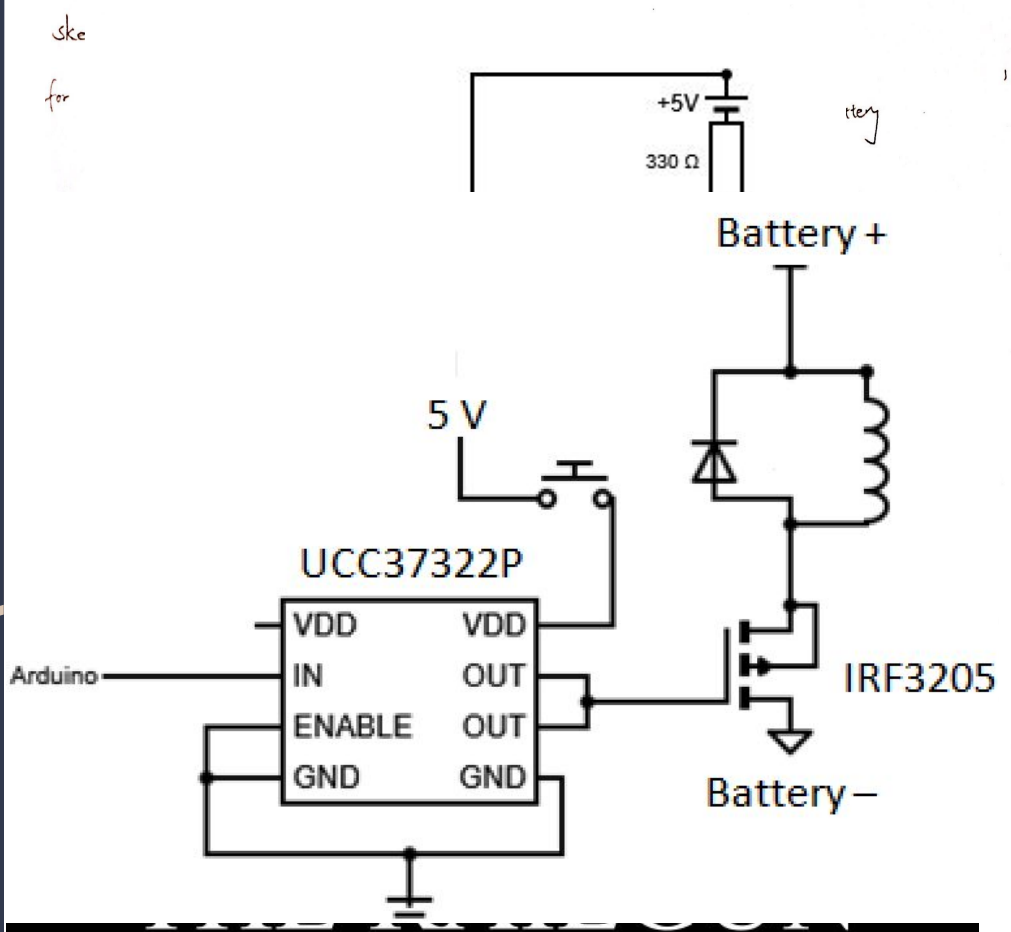
Electromagnetic gun breakdown

3 stages acceleration

Each stage:

one segment of coil + one IRF3205 MOSFET + one UCC37322P Driver + one 1N4001 high voltage diode

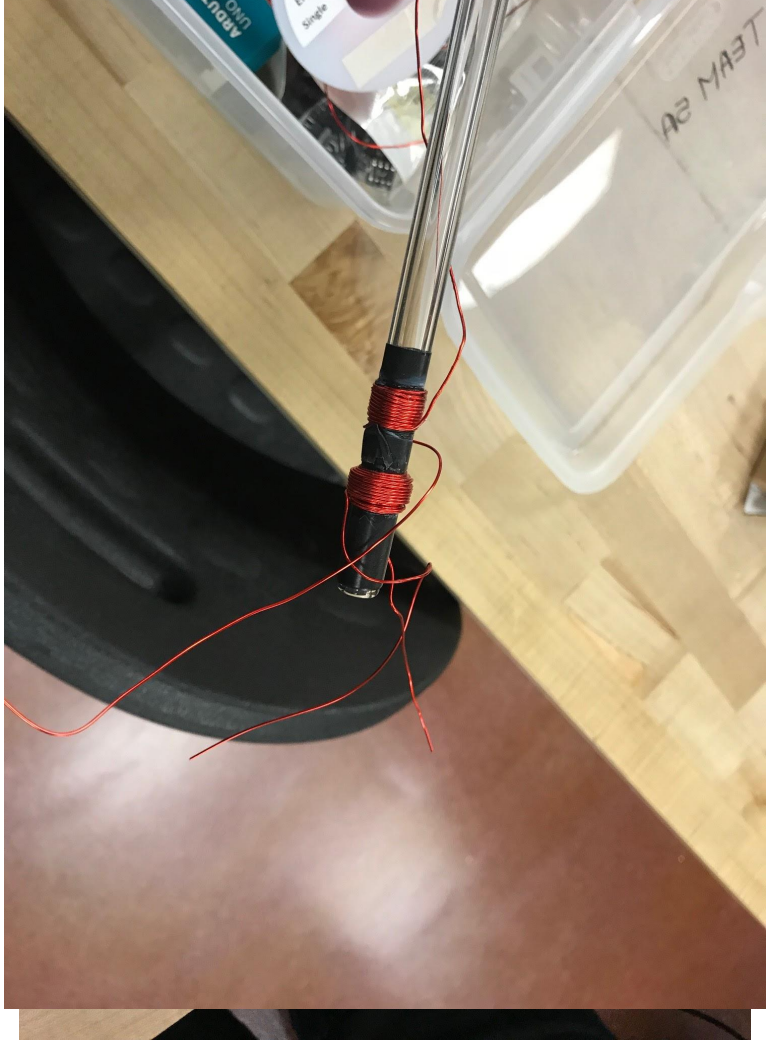
3 Stages + dock circuit + Arduino =



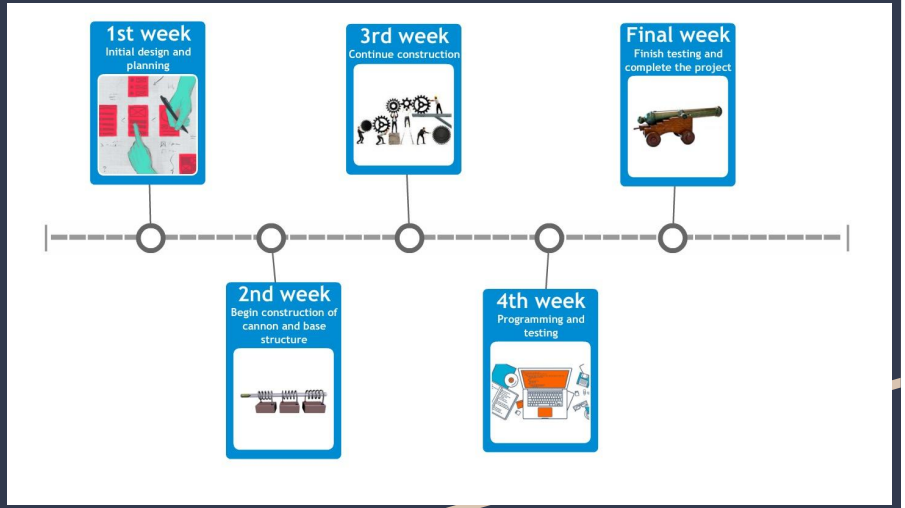
With a gun so powerful that it destroys its own shells, you can succeed in life, whatever you choose to do.

Soldering devices on breadboard

Wrapping wires on the glass tube



Project Timeline



Week 1) Test individual parts and learned how to use said parts, also created rough drafts of the cannon and base frameworks.

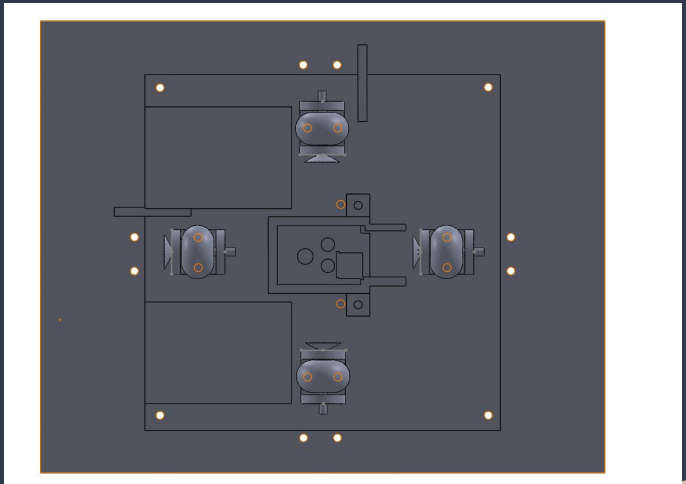
Week 2) Initial application of the different parts all together, getting them to communicate & work w/ each other. Finished cannon framework.

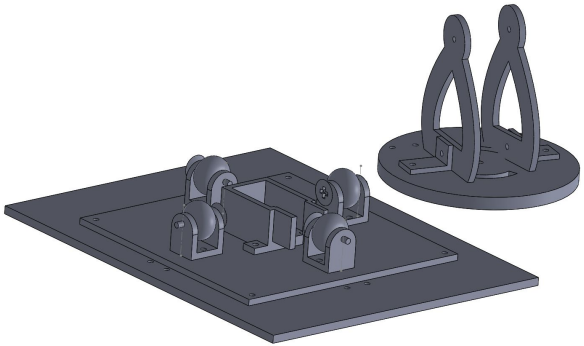
Week 3) Testing and debugging of the network of all the parts working together in order to achieve the goal of the project. Base framework still a WIP

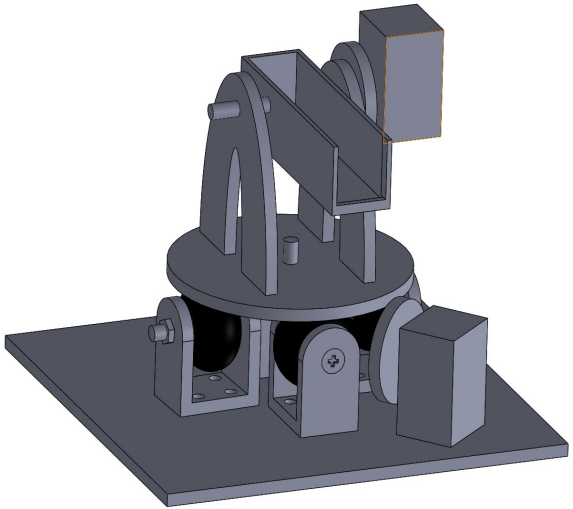
Week 4) Finished debugging the code for the working of all the different parts of the project and cannon base framework is finished. Assembly of the cannon base begins.

Week 5) Mounting electromagnetic cannon on the disk. Communicating Arduino nano on the cannon and the Arduino uno on the disk. Making fire process smoother.

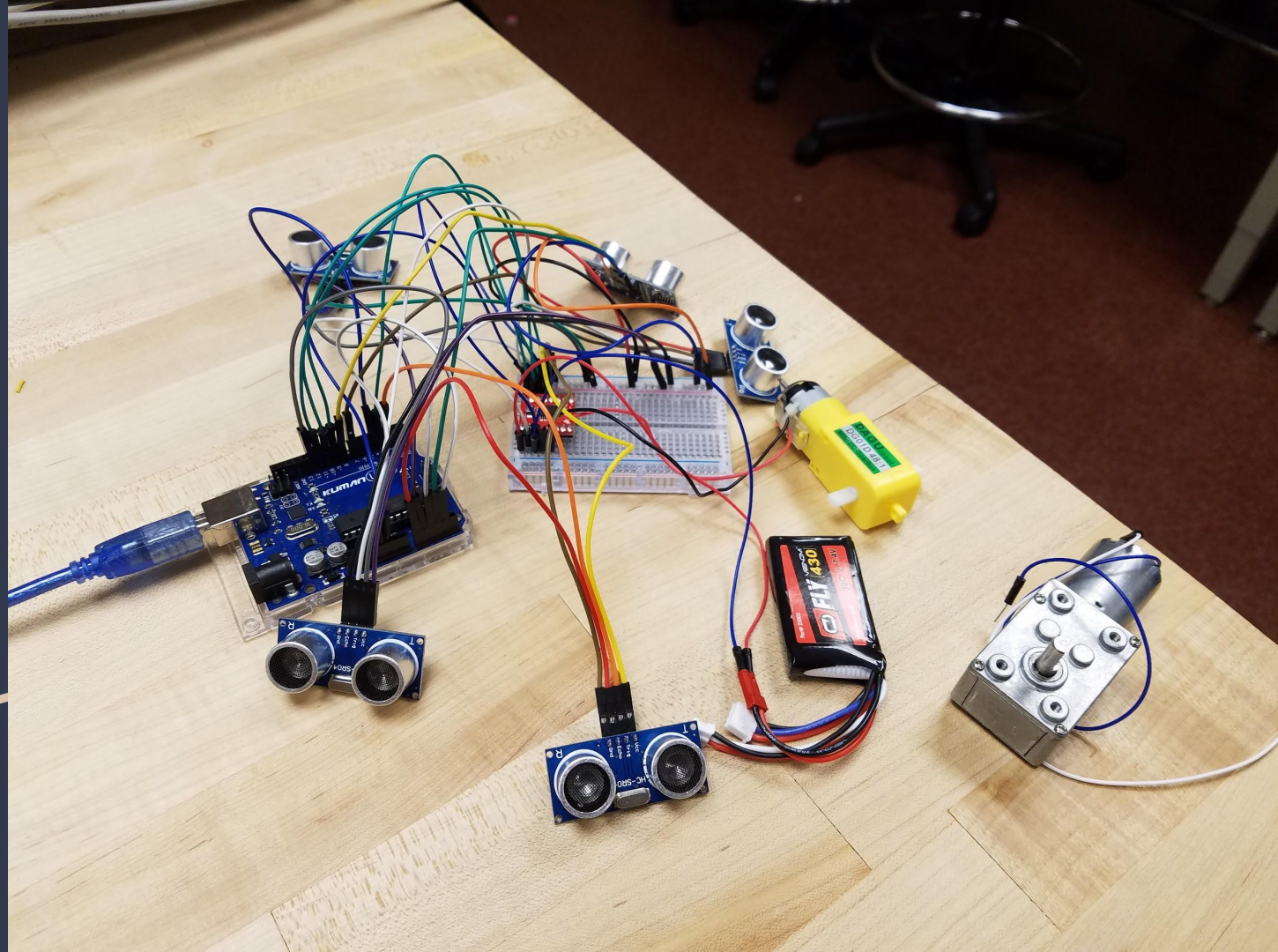
Project Schematics (Mechanical)



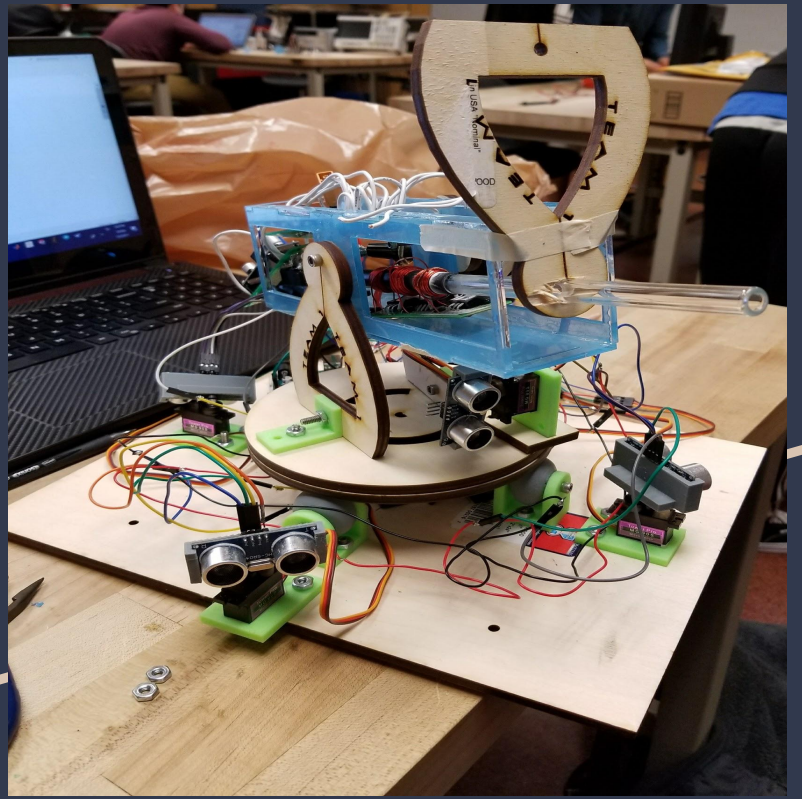


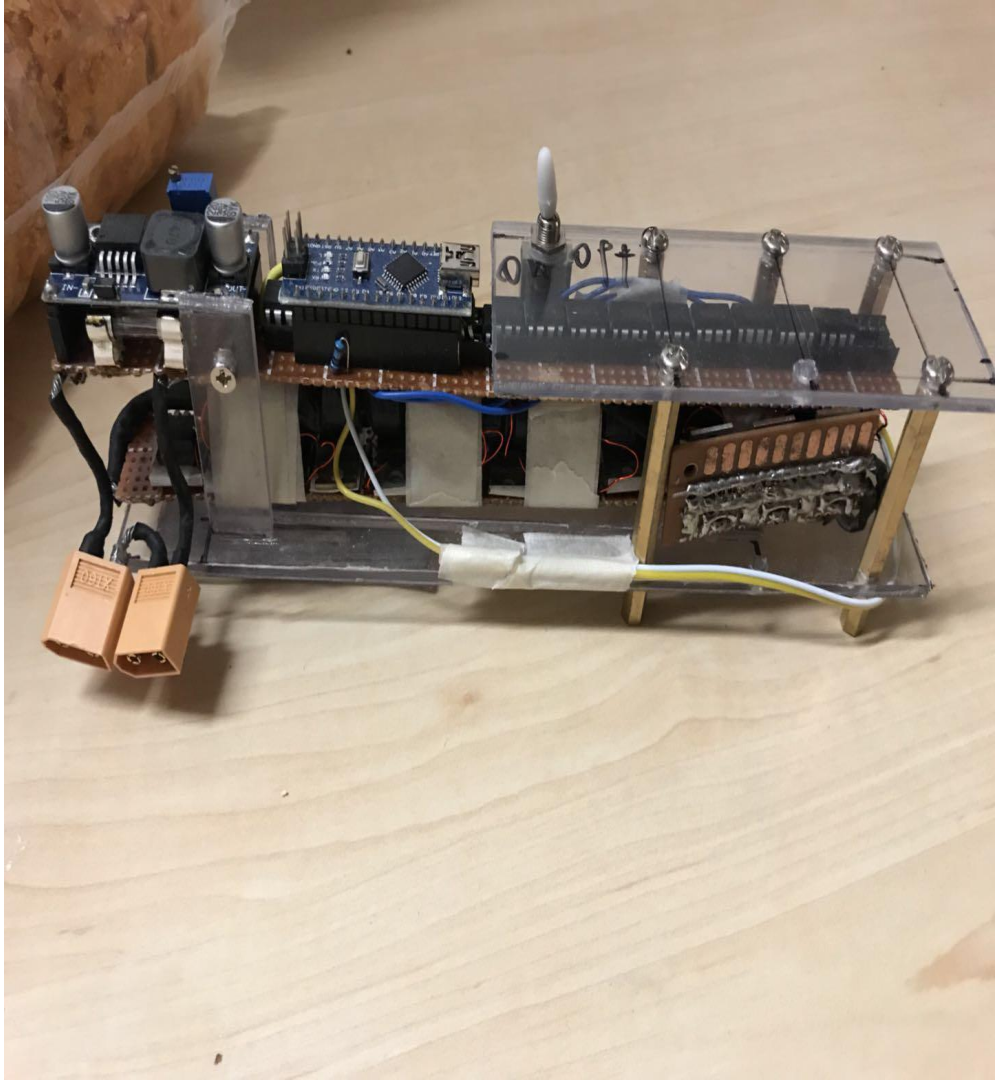


Circuitry between the sensors and the motor



Final Project





Project challenges

- When we powered the cannon the first time, the fuses burned off.
- When we turned coil on, the projectile was not accelerated.
- When we kept the battery and switch on for one minute, overheat
- Servos don’t rotate 360 degrees which reduced mobility
- Wires get tangled and inhibit platform rotation.
- Stationary sensors have a reduced field of detection

Project Resources

The principle of electromagnetic coilgun:
https://en.wikipedia.org/wiki/Coilgun

https://diyhacking.com/make-coil-gun-without-camera/
http://www.nutsvolts.com/magazine/article/electromagnetic_coil_launcher_project

The principle of the arduino / ultrasonic sensor:
http://www.instructables.com/id/Arduino-and-ultrasonic-sensor-control-servo-and-di/

https://forum.arduino.cc/index.php?topic=125711.0
http://www.themakersworkbench.com/tutorial/triggering-servo-using-hc-sr04-distance-sensor-and-arduino

How to Work the Motor
http://bildr.org/2012/04/tb6612fng-arduino/

Thank you.
FIRE!
HOLY
$#!+!!!