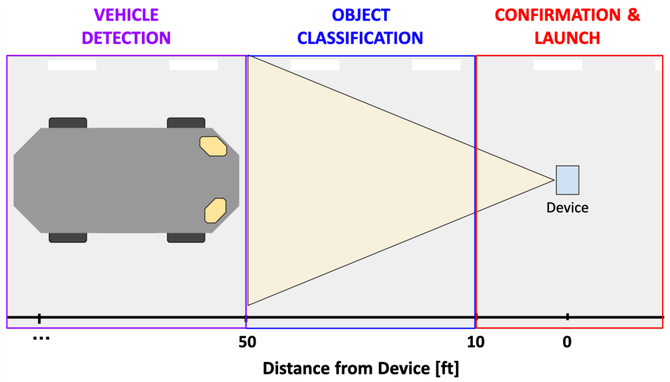
Project R.O.C.K.

Remote Observation and Covert Kinetics Device

Zach Akin-Amland | Gage Barclay | Branson Camp | Taylor Ferguson | Jack Foster | Ella Giammo | Michael Gray | Derek Iannapollo | Anne Nguyen | Whitney Valencia

Mission:

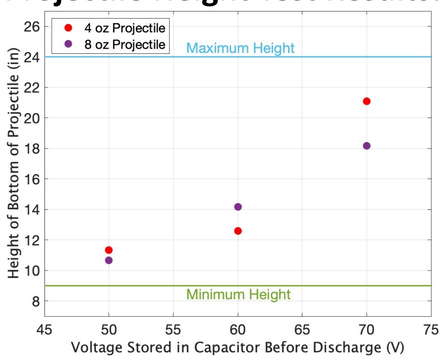
Enhance military capabilities by developing a covert, single-use autonomous system that reduces risk to service members during intelligence, surveillance, and reconnaissance operations

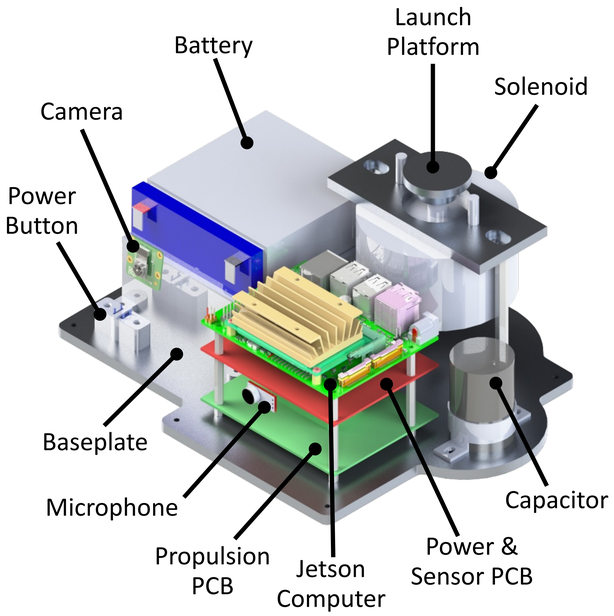


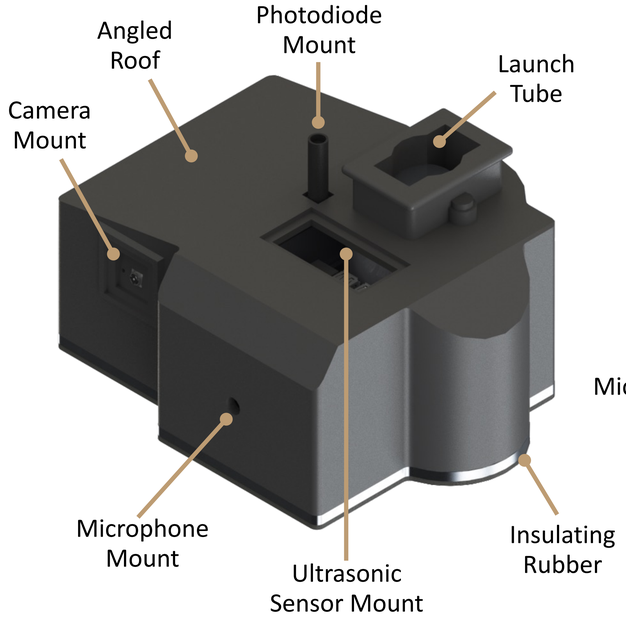
Key Requirements:

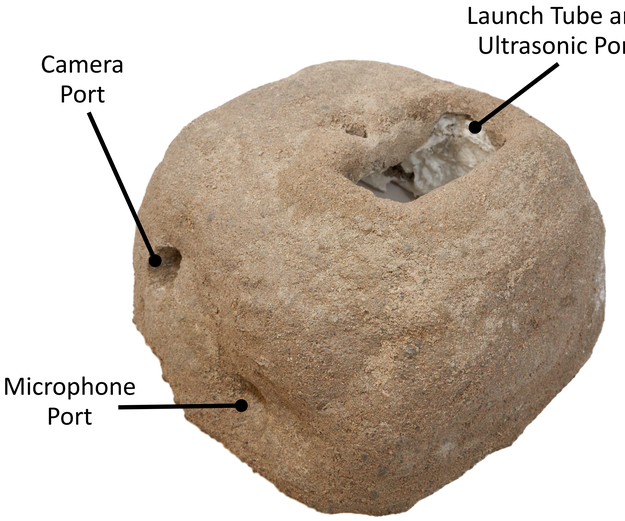
- ✓ Able to hit vehicles traveling 30 MPH
- ✓ Will detect, classify, and trigger launch if a vehicle approaches and drives over the device
- ✓ Will not trigger launch if an object other than vehicle approaches device
- ✓ Will actively sense and able to launch for a minimum of 36 daylight hours
- ✓ Not recognizable from the surrounding environment
- ✗ Maximum size envelope of 12 in X 12 in X 6 in
- ✓ Protected from ingress of dust and water sufficient to cause harm
- ✓ Survive ambient temperatures of 0 °F to 110 °F for up to 4 hours
- ✓ Survive surface temperatures of 0 °F to 175 °F for up to 4 hours

Projectile Height Test Results:

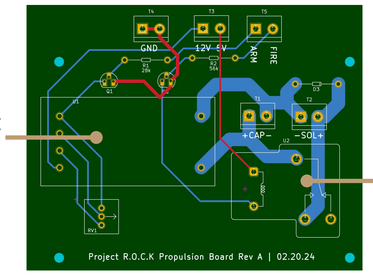




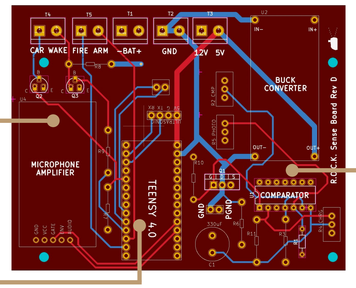




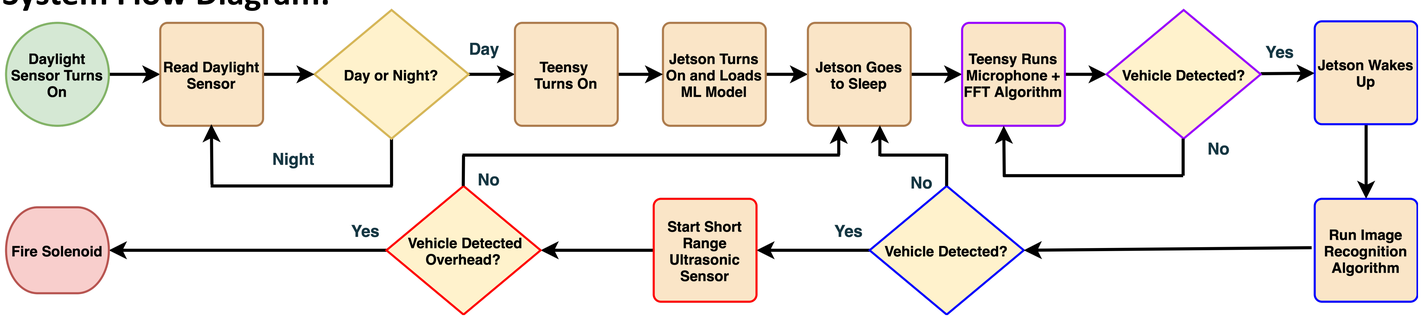
Propulsion PCB:



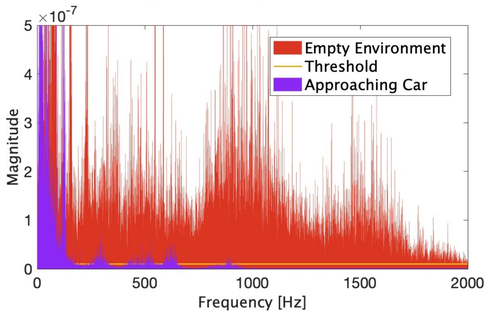
Power & Sensor PCB:



System Flow Diagram:



Long-Range Analysis:



Sound profiles of a car approaching the device (in purple) compared with the environment (in red)

Medium-Range Test Results:

POV of the camera looking out of the external shell identifying a car with a confidence rating of 93%

Design Description:

Sensing

- Detect an oncoming object from 50+ ft
- Classify the object to verify presence of an approaching vehicle between 50-10 ft
- Identify the overhead vehicle and signal propulsion subsystem to launch
- 3-tier sensing system
  - **Long-Range:** Microphone and fast Fourier transform (FTT) algorithm
  - **Medium-Range:** Camera and YOLOv7 object detection algorithm
  - **Short-Range:** Ultrasonic sensor

Energy

- Power device for 36+ daylight hours
- **Daylight Sensor:** Photodiode
- **Battery:** 12V 6Ah Rechargeable sealed lead acid (SLA)

Propulsion

- Launches a 4-8 oz projectile 9-24 in
- Utilizes 70-80 Volts discharged through a 10,000 µF capacitor
- Sealed linear actuating solenoid

Future Iteration:

- Design an attachable projectile
- Minimize size envelope using smaller capacitor, solenoid, and computers
- Update the launch tube waterproofing with passive, mechanical doors
- Update the short-range sensor to a magnetometer

A Special Thank You To Dr. Brandon Conover, the United States Army Research Office, Dr. Nicole Xu, the Greeley-Weld County Airport, Donaldson Filtration Solutions, and Sam Uyemura