BASTION Broad Area Seismic Transducer and Infrared Optical Network

DESIGN CENTER COLORADO

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Motivation

- Current security systems are location specific, expensive, require human monitoring, and time-consuming to set up
- Design a rapidly deployable remote sensor package that can survive impact, self-orient, and autonomously detect and differentiate between humans and vehicles for at least 30 days

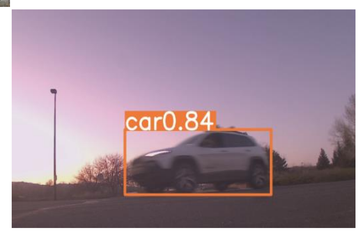
Key Requirements

Identify vehicles and people at 10 m	✓
90% detection rate and data transmission	✓
IP54 (weather proofing) rating	**TBD**
Operational range of –20 to 60 °C	**TBD**
Single user deployable weighing <16 kg	✓
Withstand a 1.2 m drop and self-orient	✓
Operate for at least 30 days	✓

Testing and Results

- 100% success rate for positive detections within 15 m
- Detected vehicles and people at various speeds and directions of travel
- Passive system alerted up to 80 m away
- Test results met range specifications
- The device survived a max force of 160 G's when it was dropped on its side from 1.4 m

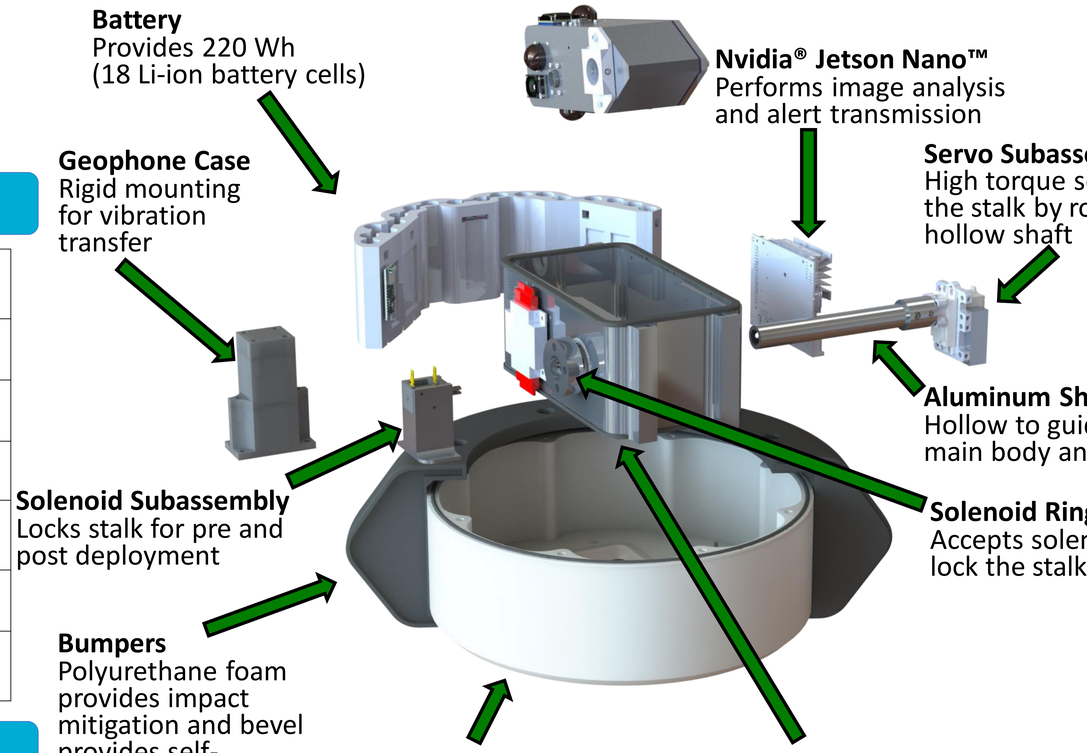
This image is of a person walking at 20 meters from the device



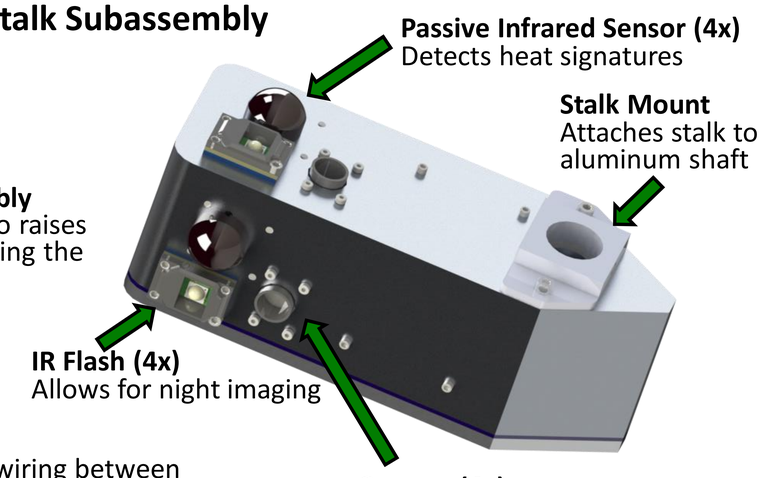
This image is of a vehicle moving 18.6 km/h at 10 meters from the device

Design

Main Assembly



Stalk Subassembly



Passive Classification

Passive Infrared Sensor (PIR)
Detects motion by measuring changes in infrared radiation

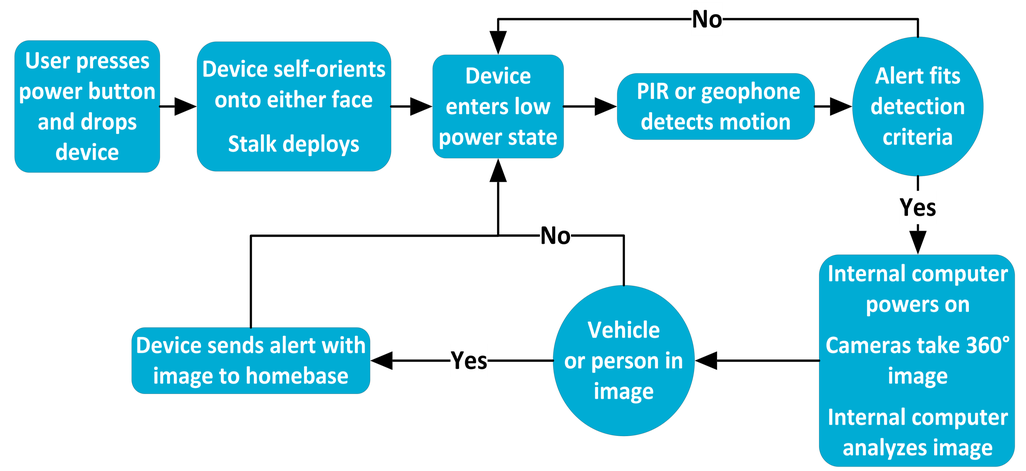
Geophone
Detects motion by measuring vibrations through the ground; uses select frequencies to discern between humans and vehicles

Active Classification

Camera System
Four cameras to acquire 360° picture of the surroundings

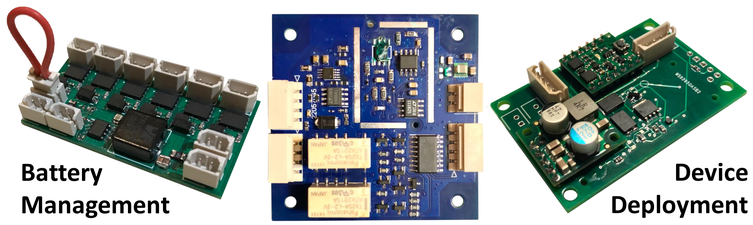
Image Recognition
Camera images analyzed to differentiate between vehicles and people using the YOLOv8 model

System Flowchart



Electronics

- Custom designed electronics for <20mW ultra-low power passive operation
- Integrated in-house battery module for energy density
- Analog geophone detection circuit designed from ground up for high sensitivity and ultra-low power with high voltage front-end protection
- A total of 18 PCBs spread across 8 custom designs



Battery Management | **Analog Geophone Circuit** | **Device Deployment**

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