Autonomous Device For Ground-Based Warfighter Protection

United States Army Research Office • University of Colorado Boulder

Liam Vlasimsky • Abby Browne • Wilson Long • Ben Massik • Thomas Gira • Nate DeCecco • Steele Brizzolara-Dove • Gabe Williams • Jaskrit Singh

Background
- Proof of concept on viability of an autonomous vehicle with active protection systems
- Prior Design Center Colorado projects:
  - Year 1: Deployable shield subsystem
  - Year 2: Drivetrain subsystem

Objectives
- Physically integrate projects from Years 1 & 2
- Autonomous Movement
- Obstacle Avoidance
- Personnel Detection and Identification
- Speech Commands
- Arm Signal Commands
- Follows GPS Waypoints

Stereo Vision Cameras
- Luxonix Oak-D
  - Global Shutter Stereo Vision
  - 4k Color Camera
  - 9 DOF IMU with Magnetometer, Accelerometer and Gyroscope
  - Onboard VPU

Exploded View
- Shields
  - Power source changed from wall to battery power

Sensor Mount
- Plate for mounting cameras to vehicle
- ¾” 6061 Aluminum
- Waterjet

Microphone
- Voice commands
- JLab Talk Go Microphone

Base Plate
- Connects shields to drivetrain subsystem
- ¾” 6061 aluminum plate
- Waterjet then tapped and countersunk

Sensor Tower
- Raises cameras to see over shield
- 300 series 80/20 aluminum

Mounting Plate
- Used for mounting tower to pre-existing holes
- ¾” 6061 aluminum
- Waterjet then tapped and countersunk

Electronics Housing Box
- Housing for electronics under the vehicle
- Laser cut acrylic to mirror electronics box of wheel subsystem

Software
- Implements custom Robot Operating System (ROS2) nodes
  - Simulation
  - Motor Controller
  - Camera
  - Speech Recognition
  - Robot Controller
- State Machine
  - Defending
  - Following
  - Leading
  - Navigate Alone

States
- Enemy
- Defending
- Following
- Leading

Simulation
- Disparity Map

Person Detection and Classification
- Human Pose Detection

Testing
- Autonomous Capabilities
  - Navigation/Obstacle Avoidance
  - Threat Detection
- Command Capabilities
  - Speech/Visual Recognition
  - Autonomous Following
- Defensive Capabilities
  - Defensive Deployment
  - Movement
- Redundancy
  - Mechanical
  - Electrical

Lessons Learned
- Flexibility is crucial, team needed to adapt to new challenges
- Fully research any work done by past teams

Future Work
- Use high end computer for image processing and decision making
- Increase motor power rating and battery capacity
- Implement dedicated magnetometer