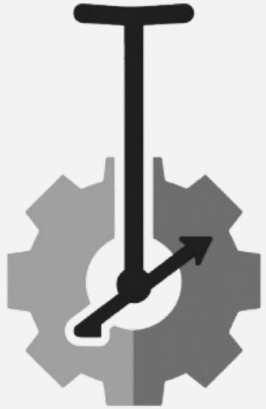
Search & Rescue Coordinated Intelligence Systems

The autonomous teamwork of ground and air assets in a mission-oriented environment



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OVERVIEW

- Goal and Motivation
  - Approach
    - Novel features
      - Algorithms & Challenges
        - Tasks

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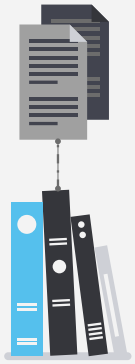
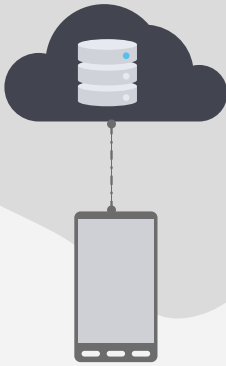


Goal and Motivation



The overall goal of the group is to create a team of agents capable of working with humans to effectively complete tasks. Urban Search and Rescue Demo The team task would be to successfully corner/capture the evading agent by leveraging one another's strengths and weaknesses, as one does on a team.

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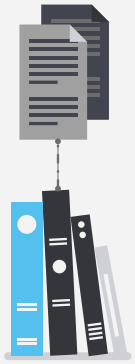
Approach



Continuous compositional control

Provide the user with the ability to be in multiple places simultaneously.

Agents and operators seamlessly collaborate.

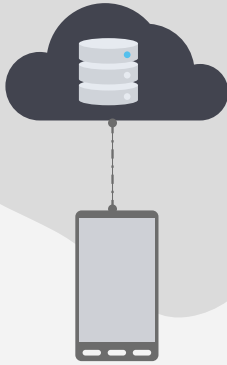
Agentic Interface

Agents and users can communicate through natural language.

Allows agents to “think” or “reason” about the situation.

Predator-prey Simulation

This predator-prey dynamic gives the robots, in pursuit, a better task orientation by working together to find the best way to corner the target.



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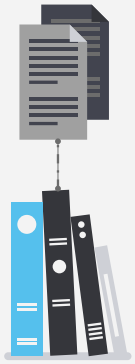
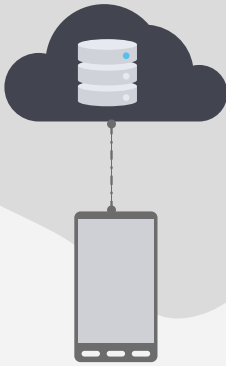


Novel Features



Multi-Agent Coordination

Agents must understand both their capabilities and that of their neighbors'.

Agents must work together to complete their tasks.

Dynamic Role Assignment

Agents are able to dynamically elect a "leader" to organize efforts.

Roles are not strict and rely on fluid structures.

Distributed Situational Awareness

Agents can communicate their understanding of the situation.

Includes things like terrain, positions, and targeting.

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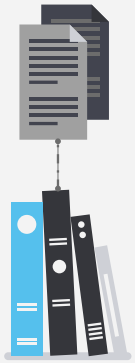
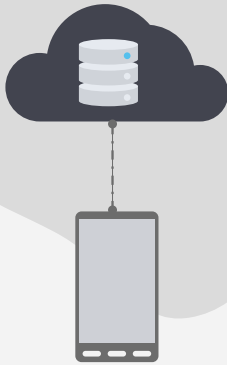
Algorithms & Tools





OpenCV

ROS2

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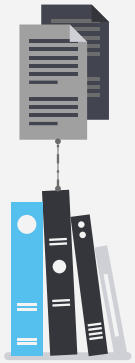
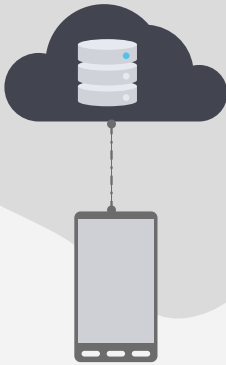


Challenges



Comp. Control w/ Predator & Prey

Creating an algorithm to both autonomously hunt but also integrate with seamlessly with teamwork is difficult

Concurrent Map sharing

Synchronizing the situation information between humans and agents can be difficult to solve.

(Co-operative localization, feature recognition, etc,)

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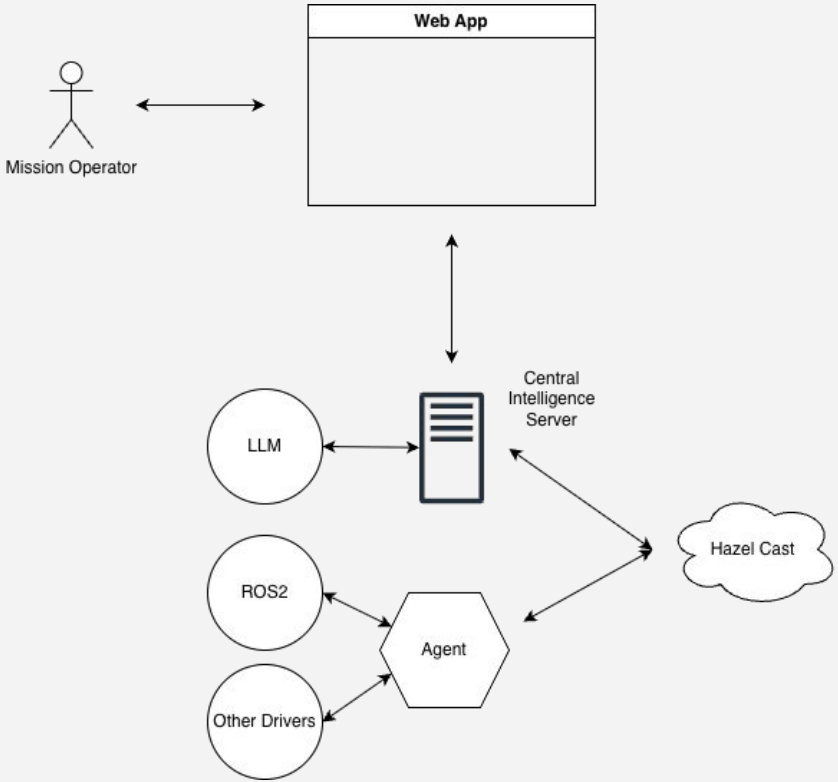
Design



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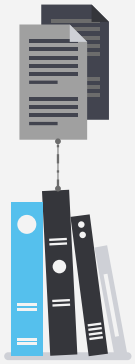
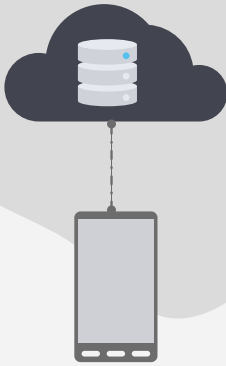


Evaluation



Speed

Time to converge on target or capture the prey

Accuracy

Target identification accuracy

Map consistency between agents

Human-in-the-Loop

Task completion time with and without human cooperation

Ease of use for novice operators

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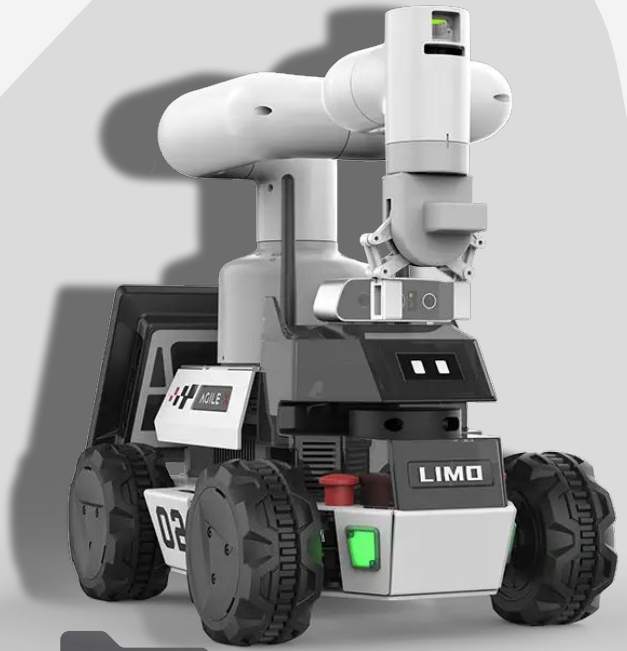

M4-6 Progress Matrix

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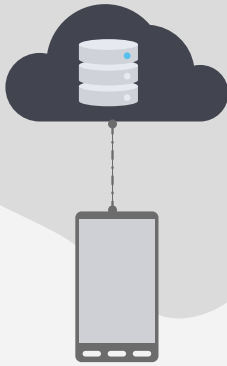
M4-6 Progress Matrix

Completed Tasks



Milestone 4

Note:
-Drone integration(Parrot)
-Unitree GO2 setup
Multi-agent coordination
- Concurrent Map sharing + updating
- Efficient Target Sharing (if found)
- Algorithm for robots to head to target
-Robot Operator

Milestone 5

Note:
-Complete GUI for system control/monitoring
- Dynamic role assignment based on agent performance
-Demonstration of SRCIS
-Semi-Performance evaluation
- Agent optimization based on role (Unitree, Limo, Parrot)
- Improved Multi-agent coordination

Milestone 6

Note:
- Fully integrated SRCIS (From milestone 5)
- Full Performance evaluation
- Final system demonstration

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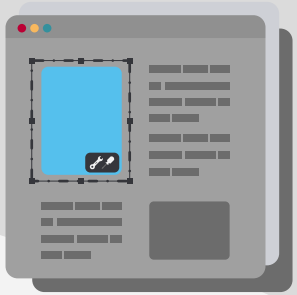

M4

Task Matrix and Rollovers

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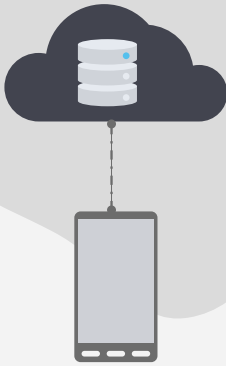

Drone Integration

Note:
-Made ROS2 code for drones, but could not run the code due to **lack of** connection **support for macOS.**

Multi-agent Coordination

Note:
-Repairing the Limos posed as a **blocker** for this task.

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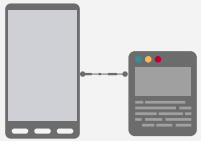
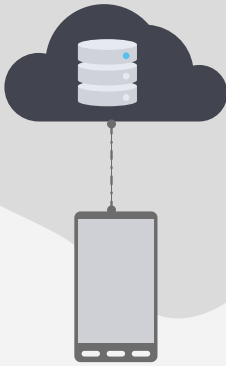
Task	Yav	Young	Pop
Drone integration (Parrot)	33%	33%	33%
Multi-agent Coordination	33%	33%	33%
Unitree Go2 Setup	33%	33%	33%
Concurrent Map Sharing	33%	33%	33%
Target Sharing	33%	33%	33%
Target engagement algorithm	33%	33%	33%
Robot Operator	33%	33%	33%





Concurrent Map Sharing

Note:
-Build a map that contains relevant information
-Robots in network, Target(s), and Local objects

Target Sharing

Note:
-When a target is found, the robot will inform the Robot Operator and notify the other agents.

Target Engagement Algorithm

Note:
-Create an efficient algorithm for the robots to collaborate and surround the target.

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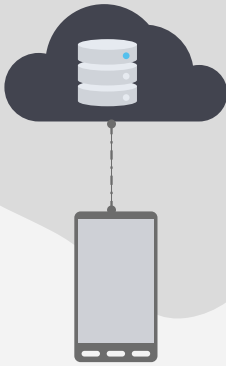

Unitree Go2 Setup

Note:
-**All three** Unitree **Go2's have been** powered on and **tested** to ensure all functions work as intended.
-Need to reverse engineering the code to integrate with our Hazelcast setup.

Robot Operator

Note:
When the robot sends the target ArUco, the operator will decide the confidence level.

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QUESTIONS?