Search & Rescue Coordinated Intelligence Systems

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

SRCIS

"Perfectly balanced... As all things should be."

Yavanni Ensley

Younghoon Cho

Jaylin "Pop" Ollivierre

OVERVIEW

- Progress Matrix
  - Milestone 6

Yavanni Ensley
Younghoon Cho
Jaylin "Pop" Ollivierre

DIAGRAM

High Level

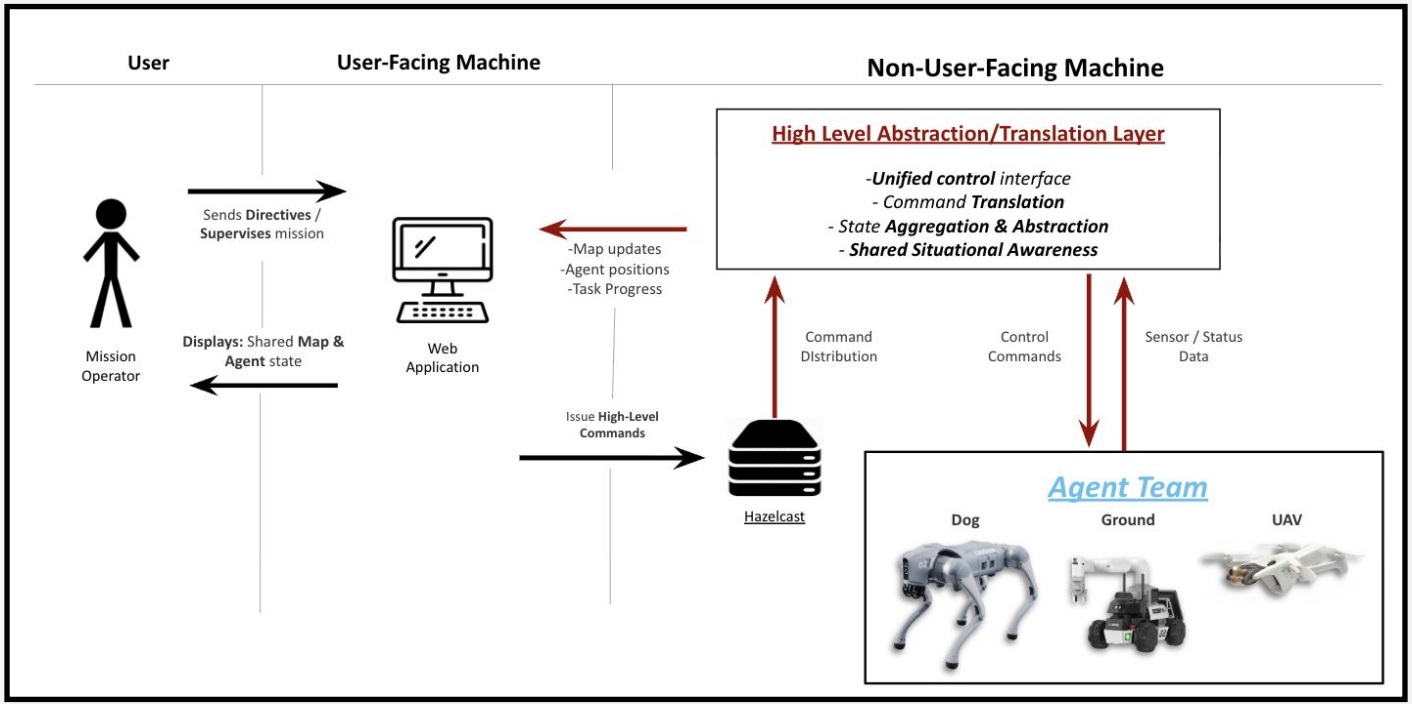

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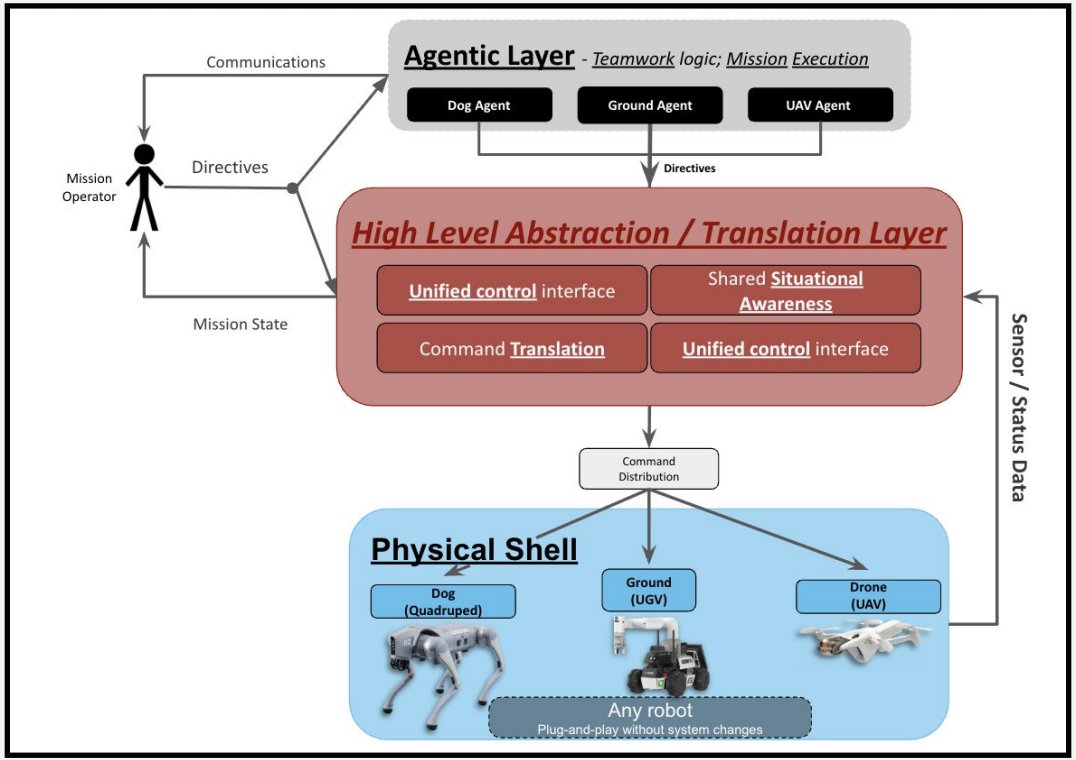
DIAGRAM

System interaction



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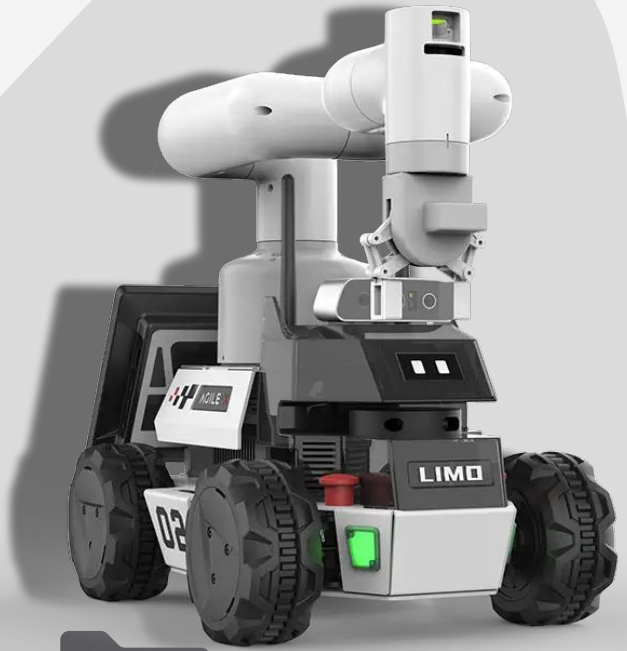

M6

Progress Matrix

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M6 Progress Matrix

Completed Tasks

Task	Completion	Yav	Young	Pop
Target Sharing	*100%*	50%	25%	25%
Multi-agent Coordination	*100%*	60%	20%	20%
Integrating custom ROS Driver w/ UAV	*100%*	40%	60%	0%
Integrating custom ROS Driver w/ quadruped	*100%*	40%	0%	60%
Concurrent Map Sharing	*100%*	60%	20%	20%
Mission Command Structure	*100%*	40%	0%	60%
Target engagement algorithm	*100%*	33%	33%	33%
Full-dress Demo	*100%*	33%	33%	33%
Performance Statistics	*100%*	33%	33%	33%

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M6 Progress Matrix

Completed Tasks

Target sharing

- takes long time for robot to calculate route
- Robots gather map info when no target is present

Multi-agent coordination

- Drone(parrot)
- Unitree Go2

- make code for Limos work for Unitree
- add skyview of drone for mapping

Integrating custom ROS Driver w/ Drone and GO2

-Drone is able to do replicate SLAM using IMU sensor data
- Both Agents were able to implement base driver

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M6 Progress Matrix

Completed Tasks

Concurrent Map Sharing

- Agents are able to do effective map construction using loss function

Mission Command Structure

- AI agent is available to conduct simple commands

Full-dress Demo + Poster

- Poster and got feedback from customer(Professor)
- constructed map for demo

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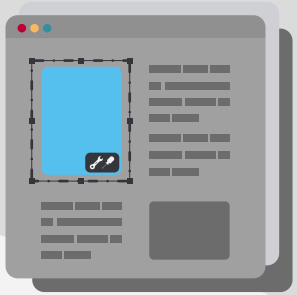

Performance Metrics

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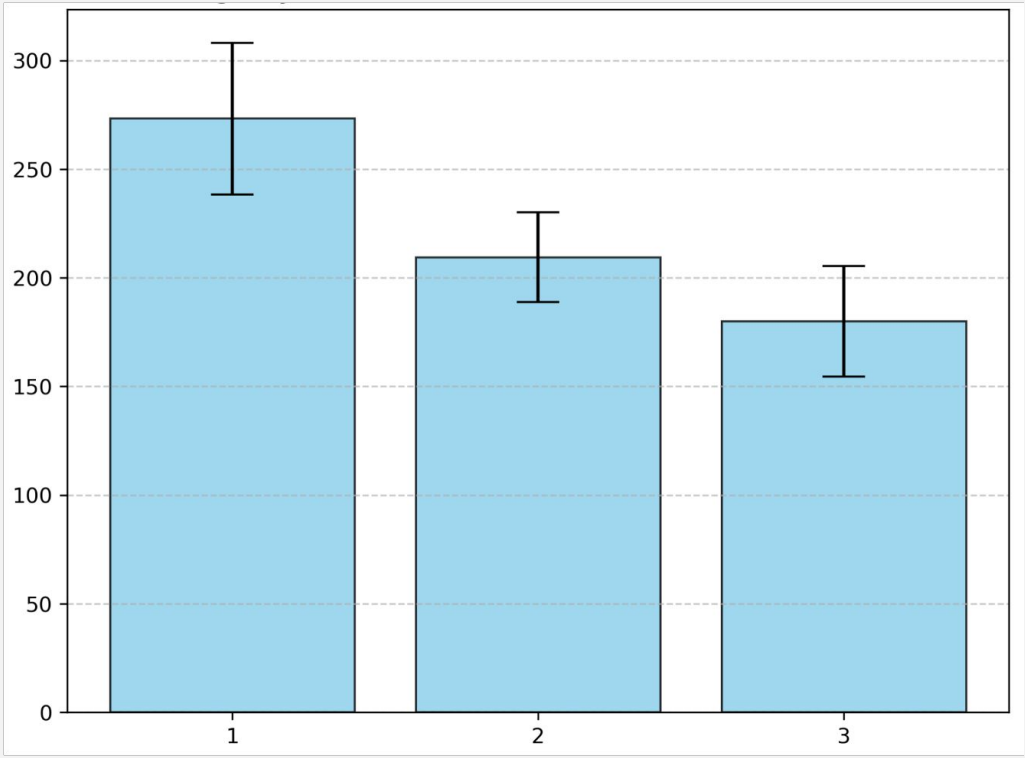
Performance Metrics

Demo Map



X axis: number of robots
Y axis: Average Time

5 trials for each condition

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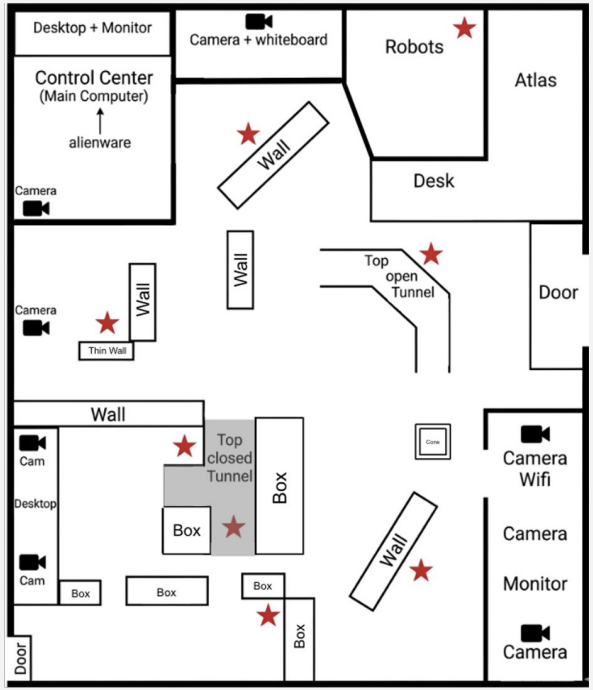
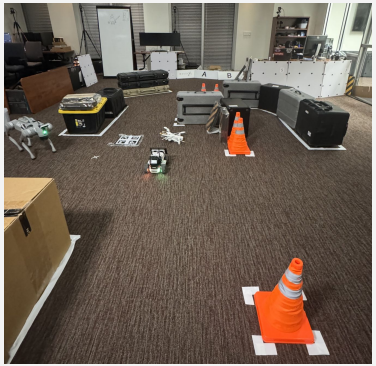
Performance Metrics

Demo Map





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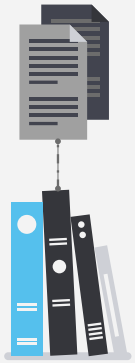
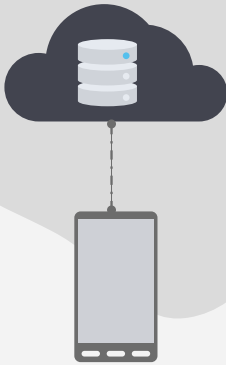
Demo Map

Demo Video





Link

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Demo Video

Poster

NORTHROP GRUMMAN
ENGINEERING & SCIENCE
STUDENT DESIGN SHOWCASE
FLORIDA TECH

SRCIS: Human-Robot Collaboration in Urban Search and Rescue Operations

A unified multi-robot system that improves speed and coordination in urban search and rescue missions.

Younghoon Cho, Yavanni Ensley, Jaylin Ollivierre
Faculty Advisor: Dr. Thomas Eskridge
Dept. of Electrical Engineering and Computer Science, Florida Institute of Technology

INTRODUCTION

Search and Rescue Coordinated Intelligence System (SRCIS) is a human-agent system designed to:

- Improve the effectiveness of real-time search and rescue operations.
- Integrate human judgement with robotic autonomy and capabilities
- Enable coordinated action and adaptive response in dynamic environments.

NOVELTY

FEMA Urban Search and Rescue (US&R) Task Forces are composed of approximately 70 personel, demanding significant resources and coordination to conduct effective operations.[1] SRCIS is intended to augment, not replace, these teams by extending human reasoning through autonomous agents. By leveraging strengths and capabilities from both humans and robots, the system improves the efficiency and effectiveness of US&R operations.

ACCOMPLISHMENTS

Agentic Control Layer

- Enabling autonomous ***agents*** to ***collaborate*** with ***human*** decision-makers
- Establishing a team dynamic and distributing responsibility across the team

High-Level Abstraction Layer

- Allowing ***interoperability*** across platforms

FEATURES

Abstraction Layer

- Provides a *common interface* for task execution *across* robotic *platforms*
- Transforms high-level commands into platform-specific instructions

Heirarchical Communication Approach

- *Low level:* Control signals from direct input
- *High level:* GUI with controls for Mission Operator interaction

Continuous Compositional Control

- Grants precedence to human operator directives
- Supports *adaptive* human-robot *collaboration*

Shared Situational Map

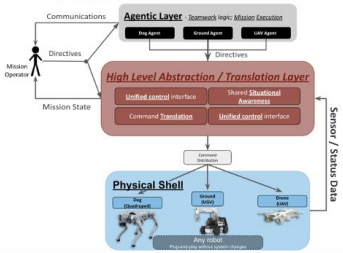
- *Real-time shared global map* integrating positions of team and detected targets
- *Reduces redundant search* coverage

Cooperative Target Engagement

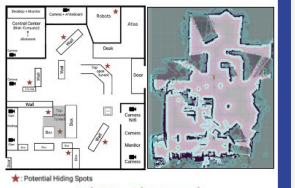
- Multi-agent *path coordination for target interception* and containment

ARTIFACTS

High Level Abstraction Layer Diagram

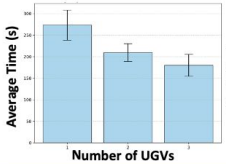


Lab Map



Lab Map Photograph (From Top to Bottom)

Average Time to Scan the Map by Number of UGVs (5 trials each w/ Std. Dev)



Increasing the number of UGVs resulted in a reduced average task completion time

[1] Federal Emergency Management Agency. (n.d.). Urban search & rescue. U.S. Department of Homeland Security. https://www.fema.gov/emergency-managers/national-preparedness/frameworks/urban-search-rescue

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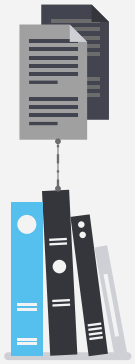
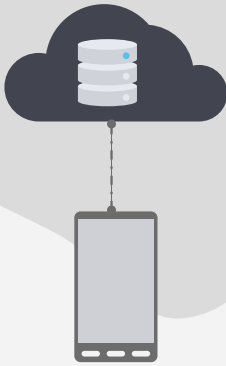


Lessons Learned



Time management and task estimation

Problem decomposition

Test your equipment early and often

QUESTIONS?

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