

Human-autonomous teamwork of ground and air vehicles

Team Members:

- Yavanni Ensley – yensley2022@my.fit.edu
- Jaylin Ollivierre – jollivierre2022@my.fit.edu
- Younghoon Cho – ycho2021@my.fit.edu

Advisor: Thomas Eskridge – teskridge@fit.edu

Client: Thomas Eskridge – FIT Faculty

Date of Meeting: 01/26/2026

Goal and motivation:

The goal of **SRCIS** is to develop an intelligent system that has multiple robots collaborate, capitalizing on each of their strengths and capabilities to recognize the target and successfully rescue and secure it. The system practices the entire process, but during runtime, human cooperation (guidance) can be provided. This human-in-the-loop approach enhances system efficiency, leading to more effective and reliable actions.

Approach:

- **Continuous compositional control**
 - The purpose of this feature is to enable the user to be in multiple places simultaneously. The user will be able to jump between agents to assist them and keep them on task. This will be helpful because users may be able to speed up task completion by communicating what they can see to the neighboring agents.
- **Interface with natural language processing**
 - This functionality will allow agents to receive information from other agents and translate it into a form meaningful to them. Each agent has its own meaning of movements. The goal is for the agents to process what others are sending and interpret how that scales to their abilities.
- **Multi-agent teamwork with Predator-Prey Dynamics**
 - This functionality will add purpose to the autonomy. There will be an agent whose purpose is to evade the pursuing agents. This predator-prey dynamic gives the robots in pursuit a better task orientation, working together to find the best way to corner the target.
 - This means the robots can work together to find the best or most efficient way to complete a task as a team.

Novel features/functionality:

- **Multi-Agent Coordination**
 - It is important for the agents to understand their capabilities and have knowledge of their neighbors'. The efficiency and speed of a task's completion can be hindered if an agent spends too much time trying to accomplish something that is not feasible for it to attempt. We will mediate this by creating a way for each team member to know what they are capable of doing, as well as what their teammates can do. **A bidomain pursuit.**
- **Human in the Loop Adaptive Guidance**

- During the SRCIS loop, the system can operate the entire loop autonomously. However, with human guidance during the runtime, this will lead to reducing unnecessary exploration, recognizing the target more confidently, improving the system efficiency and reliability.
- **Dynamic Role Assignment**
 - We have identified the robots' strengths and limitations. Based on the information, the system will be programmed to assign roles to each agent.
- **Distributed Situational Awareness**
 - This functionality is novel because it will allow multiple agents to input their perspectives for the purpose of creating a larger picture of what the environment is like. The senses each of the robots are able to provide, will be shared amongst the others; this gives a general idea of what the environment is like to each of them so the others can get an idea of what they could encounter.
 - Created a GUI frontend to display this data.
- **Target Centered cooperative Target tracking**
 - Rather than independently tracking a target, SRCIS employs target-centered cooperative tracking, where multiple agents coordinate to surround, constrain, and intercept a moving target. This enables not only robust target tracking, but also active containment, increasing the likelihood of successful rescue and securement.

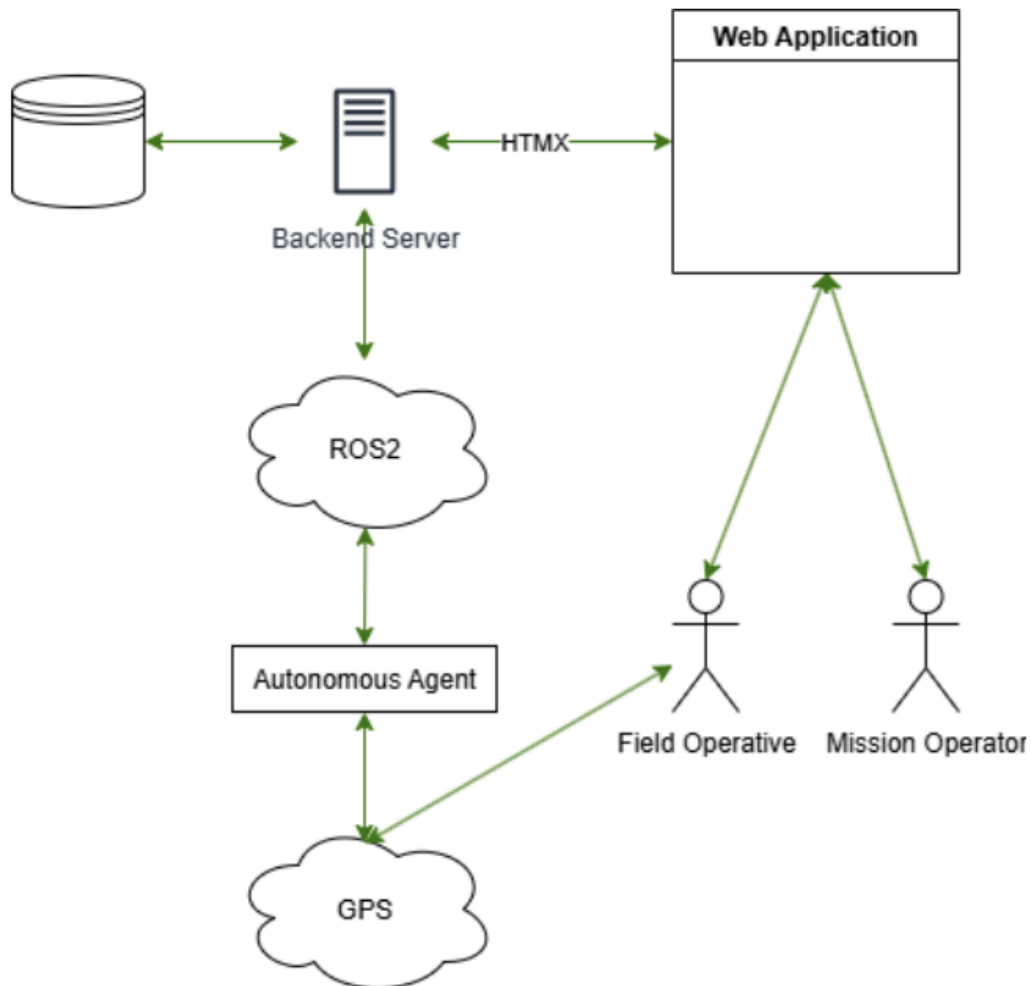
Algorithms and tools:

- Python
 - ROS2
 - OpenCV
 - PyTorch
 - Pandas & numpy
- JavaScript & HTML
 - Frontend GUI
- Github
 - Collaboration and version control
- LLMs
 - Powerful research tool
 - Useful for NLP
 - Assistance for boilerplate code generation

Technical Challenges:

- Compositional control of predator & prey simulation
 - Creating an algorithm for a robot to run away and another to search is relatively simple, but to allow seamless human-robot cooperation is significantly harder.
- Concurrent Map sharing
 - During system development, we identified that maintaining a consistent and concurrent shared map across all agents is essential for the search and rescue algorithm to function correctly. Ensuring real-time synchronization while preserving map accuracy presents a significant technical challenge that must be addressed to enable reliable multi-agent coordination.

Design: system architecture diagram



Evaluation:

1. Speed
 - a. Time to converge on target (check each combination)
2. Accuracy
 - a. Target identification accuracy
 - b. Map consistency across agents
3. Human-in-the-Loop
 - a. Task completion time with vs. without guidance
 - i. Check the reduction of unnecessary exploration

Progress Summary

Module	Completion	To-do
GUI	50%	Integrate map and agent views, add notifications and agentic control
Predator-Prey	50%	Algorithm for agents to “hunt” the prey

Milestone 4 (Feb 23):

- **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**
- **Demonstration Prototype**

Milestone 5 (Mar 30):

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

Milestone 6 (Apr 20):

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

Task matrix for Milestone 4:

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

- **Drone integration (Parrot)**
Setup parrot using the correct operating system or bypassing it. Also, develop code to move the drone in the air with caution.
- **Unitree GO2 setup**
Setup Unitree with ethernet cable (Official document). After, manipulate the LIMO code for the basic operations and generate code that only the Unitree can do.
- **Multi-agent coordination**
After realizing that multi-agent coordination will be the most important and time-consuming task, we have split it into four major tasks.
 - **Concurrent Map sharing + updating**
By using SLAM developed in milestone 3, we will be able to have one map that has all information including
 - Robots (LIMO, Unitree, Parrot)
 - Target
 - Local objects
 - **Efficient Target Sharing (if found)**
When a target is found, the robot will inform the Robot operator and will notify all of the other robots.
 - **An algorithm for robots to head to the target**
There will be multiple robots, so create an efficient algorithm for the robots to

surround the target robot.

- **Robot Operator**

When the robot sends the target image(Aruco), to the operator and the operator will decide whether to continue to proceed or not(confidence rate). This will be essential for the future when the target is an object, not an Aruco.

Approval from Faculty Advisor

"I have discussed with the team and approve this project plan. I will evaluate the progress and assign a grade for each of the three milestones."

Signature: Thomas Eskridge Date: 1/26/2026