Florida Tech

Human-autonomous teamwork of ground and air vehicles

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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. We would like for our demonstration to include autonomous ground and air vehicles working together for the purpose of a search-and-rescue-esque mission; this would involve the multiple agents in pursuit of a single agent. 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.

Approach

1

Continuous composition control

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

The user will have the ability to jump between different agents to assist / keep the agents on task.

Users may be able to speed up the process of task completion by communicating what they can see to the neighboring agents.

2

Interface with natural language processing

Allow agents to receive information from other agents and translate it into a manner that is meaningful to them.

The goal is for the agents to make independent decisions.

3

Multi-agent system with Predator-Prey Dynamics

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 by working together to find the best way to corner the target.

Novel features/functionalities

1

Multi-Agent Coordination

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

We are going to create a way for each member of the team to know what it is capable of doing, as well as what its teammates have the ability to do.

A bidomain pursuit.

2

Dynamic Role Assignment

Once the agents have identified their strengths and weaknesses as a team, they can then start assigning roles based on known capabilities.

Initially, the human operator will assign roles. Eventually, the agents will self-organize as part of the team.

3

Distributed Situational Awareness

Allows for 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.

Algorithms and Tools Used

Python

Ros2

OpenCV

Pytorch

Pandas & Numpy

Rust

Ros2

Backend processes

Javascript & HTML

Frontend GUI

LLMs

For use as a research tool

Useful for NLP

Assistance for boilerplate code generation

Github

Collaboration

Version control

General Challenges

1 Generalization of the ROS2

ROS2 standardized the channels with which you can communicate with various robots but does not create conventions for commands such as “move forward”.

Part of our product will be creating an abstraction layer to lay a stable foundation for the control and operation of various types of robots.

2 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.

Target audiences

Milestone 1

- Direct control of robots(ROS2)
- Isolate factors that are relevant to our final demonstration and find methods to implement them with the minimal work.
- Using prebuilt blocks, implement a basic search algorithm for the robot to find a stationary target
- Enable human-robot cooperation to locate the stationary target (no obstacle avoidance)
- Demonstration of USAR with independent team members

Milestone 2

- Randomly moving target
- Test the robots autonomous method for locating a moving target
- Allow for information about the target to pass between the robots
- Adjust performance measures, and define expectations to build on natural language processing (Each robot will have its own understanding)
- Demonstration of USAR with coordinated and collaborative team members

Milestone 3

- Implement prey algorithm
- Force robots to collaborate to pin the prey
- Further adjust performance measures
- Full demonstration of predator & prey algorithm

Task Matrix for Milestone 1

	Yav	Young	Pop
Direct control of robots	Interface	ROS2 commands	Bridge
Isolation of factors	Interface toolkits	Search Algorithms/Techniques	Robot Visualization
Using prebuilt blocks	Connect the interface	Apply search algorithm	Implement the visualization
Enabled human-robot coop.	50%	25%	25%
Abstract Wrapper Layer	33%	33%	33%
Compare and select tools	Programs	Documents/presentations	Communication, task calendar
Requirement Document	50%	25%	25%
Design Document	25%	25%	50%
Test Plan	25%	50%	25%

Ask us anything!