Progress Evaluation: Milestone 2

Human-autonomous teamwork of ground and air vehicles

Team Members
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Faculty Advisor & Client
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Milestone 2 task matrix:

Task	Completion %	Yav	Young	Pop
Complete repair of LIMO robots	25%	33%	33%	33%
Defining robot capabilities	75%	25%	25%	50%
Enabled human-robot cooperation to locate the stationary target	100%	33%	33%	33%
Interface prototype from the design document	100%	50%	25%	25%
Abstract Wrapper Layer	100%	33%	33%	33%
Experimentation with aerial drones	100%	25%	50%	25%
Complete Control of Ground Vehicles	100%	33%	34%	33%

Discussion of accomplished tasks / Contribution:

- **Pop:**
  - **Abstract Wrapper Layer -** This task was the baseline for completing the other tasks in this milestone. In this task, we wanted to create a demonstration of how our robots were supposed to operate, using turtlesim. We used Hazelcast instead of a Python web server. Hazelcast is the real-time data platform that we utilized to manage our distributed messaging for the agents. We discovered that Hazelcast would make multi-agent control easier to manage because of its publish/subscribe messaging model with clusters of members. The combination of asynchronous publishing, dynamic subscriptions, and listeners gave us a more scalable data management and messaging system. Hazelcast's pub/sub messaging keeps the messages in the order that they were sent, so message collisions will not occur. The asynchronous publishing keeps the operation from waiting for the members of a cluster to process the message.
  - **Complete Control of Ground Vehicles -** We can now drive the robots from our interface and visually see what the robots see. The abstract wrapper layer assisted in this task's completion due to the camera publisher and move commands. We created a base driver to publish to the topics in turtlesim that can easily be translated to the LIMOs. The base driver has a listener for the camera and movement messages. The LIMOS subscribes to the Hazelcast topics like the command queue, and publishes to a distributed map for its camera (i.e., *camera/color/img_raw*).
- **Yav:**
  - **Interface Prototype -** We have the Interface functional and capable of controlling the LIMO. We have functional screen and keyboard controls; there is a live camera feed from the robot. The main focus was to have all of the interactive portions working together for the user side of our system, and our interface meets the criteria for this milestone.
  - **Robot Repair -** I worked to repair our robots and coordinated with Tom Eskridge and the Design Center to get the wheels picked up.
- **Young:**
  - **Experimentation with Aerial Drones -** This task consisted of power-testing the drones, piloting them with their default control methods. Once we confirmed they worked, we looked at which drones were ROS2 compatible to expedite the process of integrating them with the other vehicles on our interface. Since we have Hazelcast, if the drones are not ROS2 compatible, we have to create a new topic with drivers for the drones containing the available topics.
  - **Enabled human-robot cooperation to locate the stationary target -** The human contribution is moving the agent to the target; the robot's contribution is identifying the target. The requirement to meet for the completion of this task was to have the LIMO identify a specific colored target.

Next milestone task matrix:

Task	Yav	Young	Pop	To do
Complete repair of LIMO robots	33%	33%	33%	Reassemble wheels , update & install software for remaining LIMOs
Defining robot capabilities	33%	33%	33%	Search for Parrot, Unitree's capability and their specs
Multi-agent view in the interface	33%	33%	33%	Show multiple cameras in the control-website
Autonomously find a moving target	33%	33%	33%	Upgrade current target algorithm to track moving target
Demonstrate multi-agent coordination	33%	33%	33%	Make the system capable for multiple robots running concurrently
Drone integration	33%	33%	33%	Develop code for drone operation(Basic)

Discussion of planned tasks for the next Milestone:

- **Complete repair of LIMO robots** - After receiving the upgraded wheels from the design lab, we must reinstall and test all LIMO robots. We discovered that the motors for the LIMO wheels are specific to direction and have specific connectors: M1, M2, M3, and M4. Since the order is important, we have marked their respective positions and will do the same for the other 5 LIMOs that need repair.

- **Defining robot capabilities** - We would like to have more robot accessibility and capabilities. This means we have to do more research on our other agents, i.e., Parrot (drone) and Unitree (four-legged walking dog). Once complete, we will have other capabilities like flight or undulating-terrain traversal.

- **Multi-agent view in the interface** - Develop a multi-camera interface on the frontend to display simultaneous video feeds from multiple robots. Will lead to enhanced real-time multi-agent monitoring. This would also include a feature to cycle through the robots available on the interface.

- **Autonomously find a moving target** - Upgrade the currently developed stationary target detection to a moving target. Ideally, we want the robot to use the Roomba algorithm to scan the environment and identify the target it has been instructed to engage.

- **Demonstrate multi-agent coordination** - As part of the development of a demonstration scenario, enable more than two robots to operate at the same time to enhance efficiency and search area.

- **Drone integration** - Make basic ROS2 control nodes for drone capability. Once complete, the drone will be able to work simultaneously with the LIMO and communicate its location to the central intelligence command.

Date(s) of meeting(s) with Client during the current milestone:

- See faculty advisor dates below

Client feedback on the current milestone

- See faculty advisor feedback below

Date(s) of meeting(s) with Faculty Advisor during the current milestone:

- 10/2/25
- 10/16/25

Faculty Advisor feedback on each task for the current Milestone

- Abstract Wrapper Layer: pivot to Hazelcast was made quickly and seems to be effective
- Complete control of ground vehicles: It is a good idea to have the AWL and control components usable in both simulation and with the actual robots. This should help development later on, too.
- Interface Prototype: This looks good and will be extended to handle human-agent compositional control
- Robot repair: This has been very useful to the lab in general.
- Experimentation with aerial drones: The integration with ground robot capabilities will be very interesting.
- Enabled human-robot cooperation to locate the stationary target: This is a great first step in creating a compelling demo.

Faculty Advisor Signature: ____Thomas C Eskridge_______________ Date: ___10/27/2025__

Evaluation by Faculty Advisor

- Faculty Advisor: detach and return this page to Dr. Chan (HC 209) or email the scores to pkc@cs.fit.edu
- Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

Yav Ensley	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Young Cho	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Pop Ollivierre	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10