Instituto Tecnológico y de Estudios Superiores de Monterrey

Modeling of Multi-Agent Systems with Computer Graphics (101)

Evidence 2. Progress and presentation of the challenge.

Review 2

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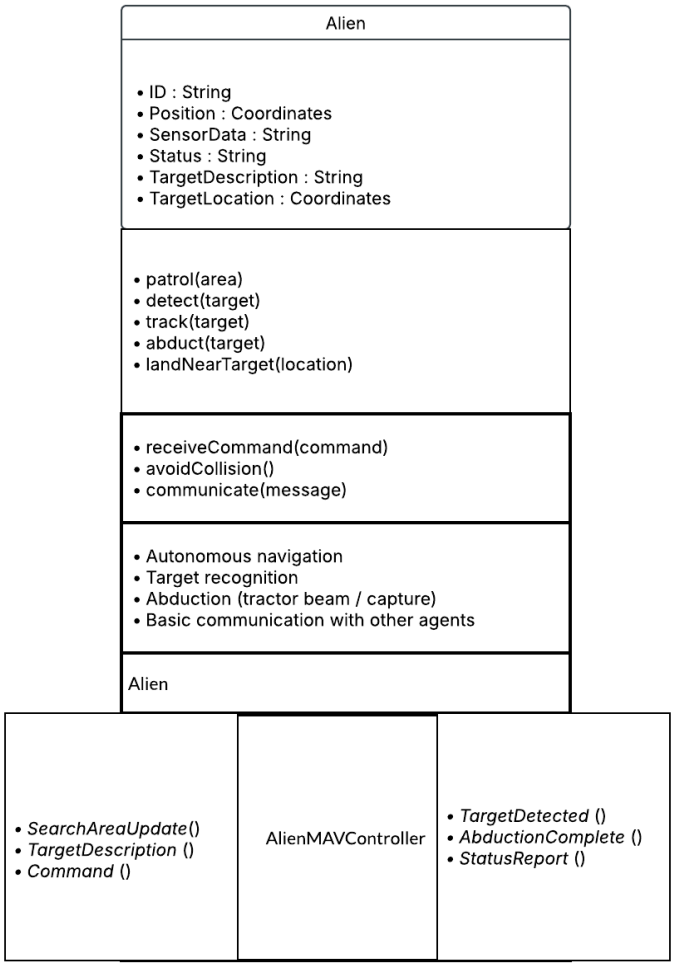
Description of the challenge

The goal comprises building a multi-agent system to enable an autonomous Micro Aerial Vehicle (MAV) in the form of a UFO-type spacecraft to locate and recognize a "person of interest" in a given mountainous forest terrain. The target individual sought is hiding behind a mountain, making the task more difficult because the UAV must alter its navigation from an obstacled non-level terrain.

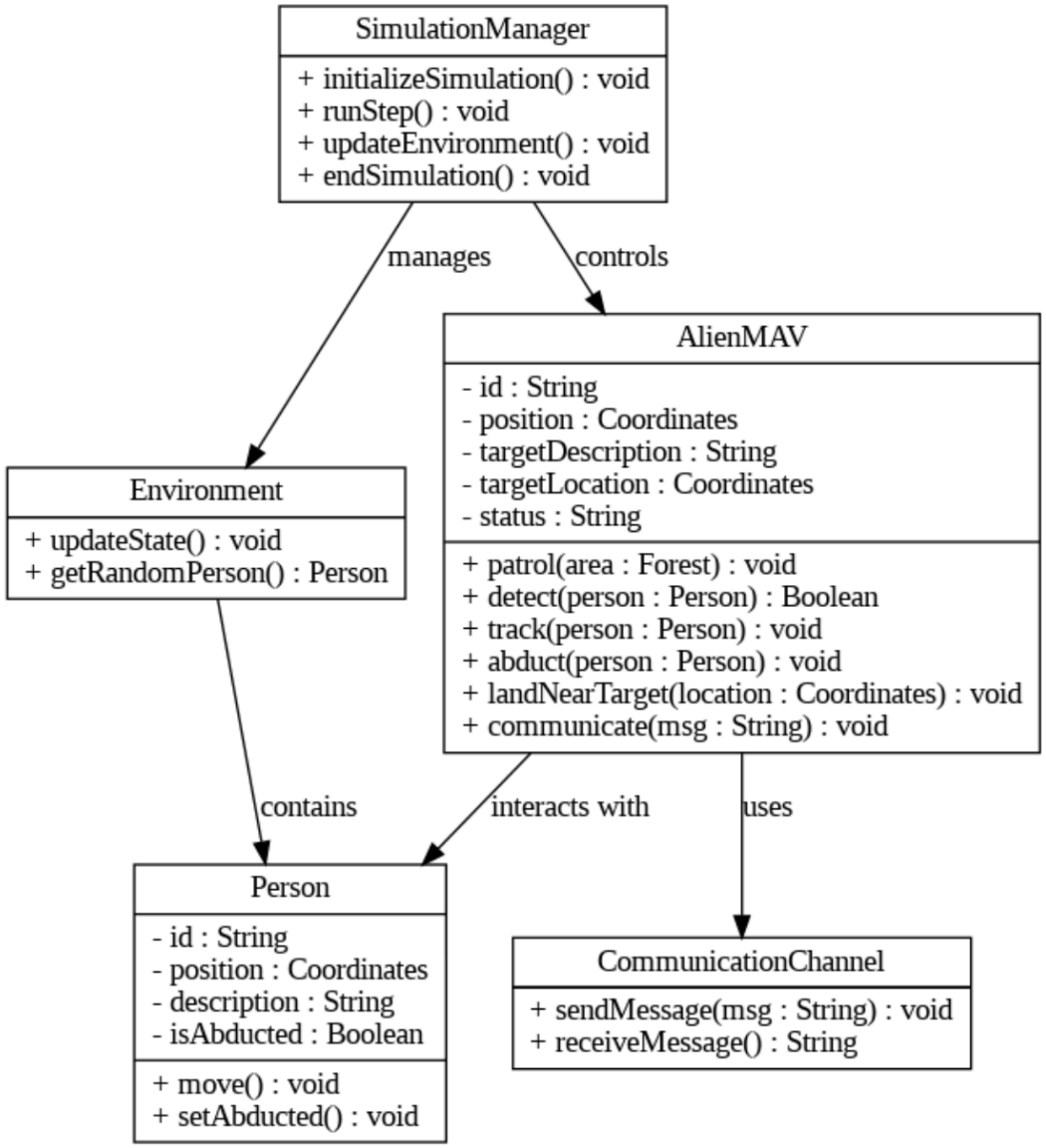
The MAV will be given a text description of the target (example: "person wearing an orange jacket and a yellow helmet") and the target GPS position.

Improved agent UML diagrams



Changes: We transformed the original MAV diagram, which focused on searching and identifying a person of interest, into a simplified Alien Abduction Agent model. The role changed from reconnaissance to abduction, while the state description was streamlined to only include essential attributes such as ID, position, sensor data, status, target description, and target location. Actions were adjusted from scanning and recognizing individuals to patrolling, detecting, tracking, abducting, and landing near the target. Methods were simplified to communication and basic control functions like receiving commands, avoiding collisions, and exchanging messages. Capabilities were also redefined, shifting from computer vision interpretation and precise landing to more direct competencies such as autonomous navigation, target recognition, abduction, and basic communication. Additionally, the society name was updated to AlienAgents with the agent head defined as AlienMAVController. Finally, explicit communication channels (C1) were introduced: the left side handles incoming messages such as search area updates and commands, while the right side outputs detections, abduction confirmations, and status reports, making the agent's interactions with others in the society much clearer.

Class diagram



MAV Agent

1. How MAVs receive and interpret instructions

Description:

MAVs receive instructions through a centralized command from the SimulationManager or through peer-to-peer messages via a communication channel. Each instruction consists of a target task (e.g., move to a location, scan an area, track a person). The MAV interprets the instruction using an internal task interpreter, which parses the task type and generates a sequence of low-level actions (move, scan, communicate).

2. Strategy to navigate to a specific GPS location

Description:

The MAV uses a simple waypoint navigation strategy. Given a GPS target, the MAV calculates a straight-line path and breaks it into intermediate waypoints. At each timestep, it moves toward the next waypoint, adjusting for obstacles or environmental constraints. The MAV updates its position continuously and recalculates if deviations occur.

3. Strategy to identify characteristics from a person

Description:

The MAV uses its AI camera with probabilistic recognition. At each observation step:

1. Scan the area below within the camera's field of view.
2. Detect objects that match human characteristics.
3. Compare features (e.g., color, shape, size) with target description.
4. Assign a confidence score; a recognition threshold determines if the person is likely a match.

Since the AI is imperfect, the MAV may re-observe from multiple angles or coordinate with other MAVs to increase certainty.

4. Strategy to land near the person

Description:

The MAV first identifies a safe landing zone near the target. The landing algorithm:

1. Hover above the person and scan for obstacles or unsafe surfaces.
2. Choose a landing point with enough clearance.
3. Slowly descend while continuously checking for movement or obstacles.
4. Finalize landing once MAV is within a small radius from the target and stability is confirmed.

5. Strategy to communicate and collaborate

Description:

MAVs communicate using a message queue system (CommunicationChannel). Collaboration involves:

1. Broadcasting observed locations of persons or obstacles.
2. Sharing probability scores of person recognition.
3. Coordinating to divide search areas to maximize coverage.
4. Requesting assistance from nearby MAVs if uncertain or blocked.

The strategy ensures redundancy and distributed intelligence, reducing the chance of missing a target due to imperfect sensing.