Evidence 2 - Review 2

Modeling of Multi-Agent Systems with Computer Graphics

Grupo 101

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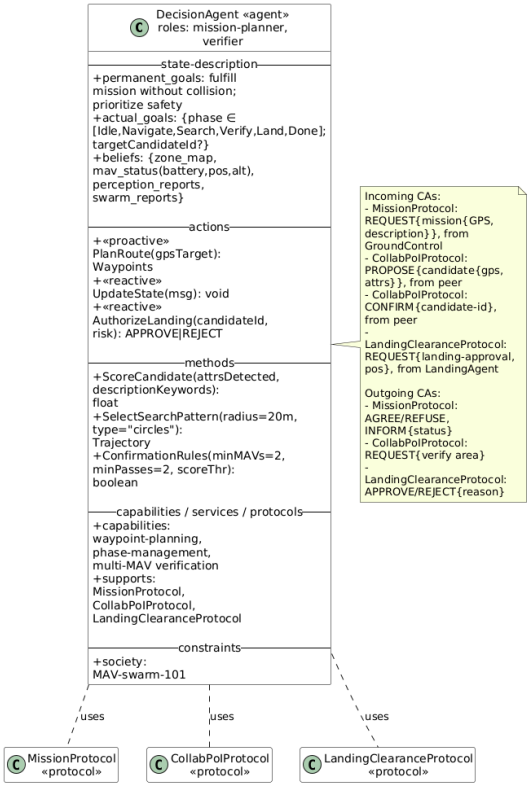
1. Description

The challenge consists of designing a multi-agent system to identify and locate a Person of Interest (PoI) using multiple MAVs (Micro Aerial Vehicles). The MAVs must receive a description of the target, travel to a designated GPS area, detect the individual using aerial vision, and execute a landing maneuver nearby. The solution must also account for imperfect AI-based recognition, requiring strategies for error handling and agent collaboration.

2. Agent UML diagrams

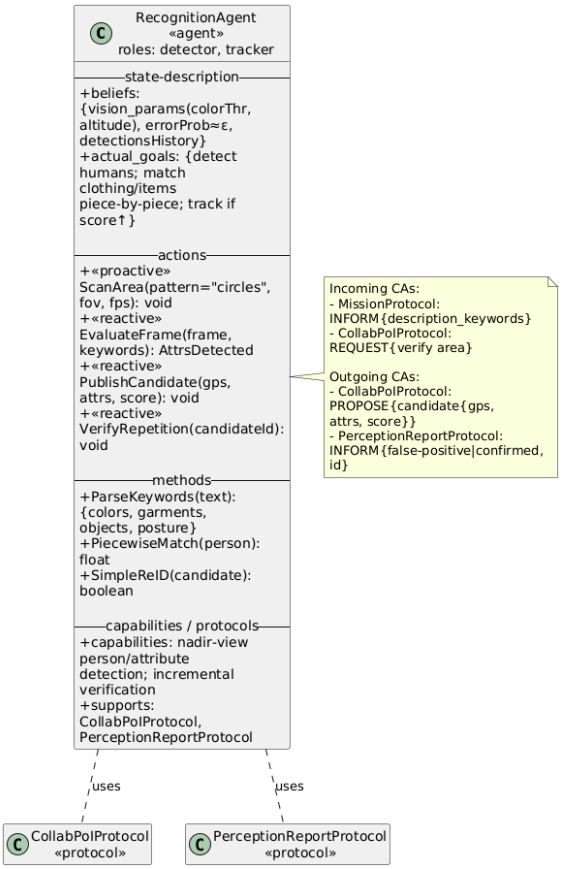
Multiple changes were made from the version presented in the Review 1, which only had a simple class diagram that did not model the behaviors of each of the 3 agents, rather the MAV as a whole. For the Review 2 we have designed a class diagram for each agent, and a sequence - protocol diagram that illustrates the interactions between them.

Figure 2.1 - Decision Agent Class Diagram



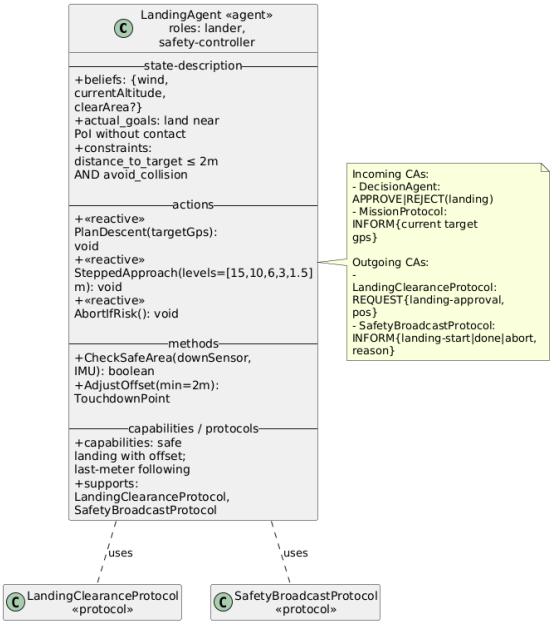
Description: The Decision Agent manages the overall logic of the MAV. It responds to the missions set by ground control, uses coordinates as waypoints, and is the source of information to other agents. Among its main purposes is the landing approval, search patterns, and subject detections cross-checking.

Figure 2.2 - Recognition Agent Class Diagram



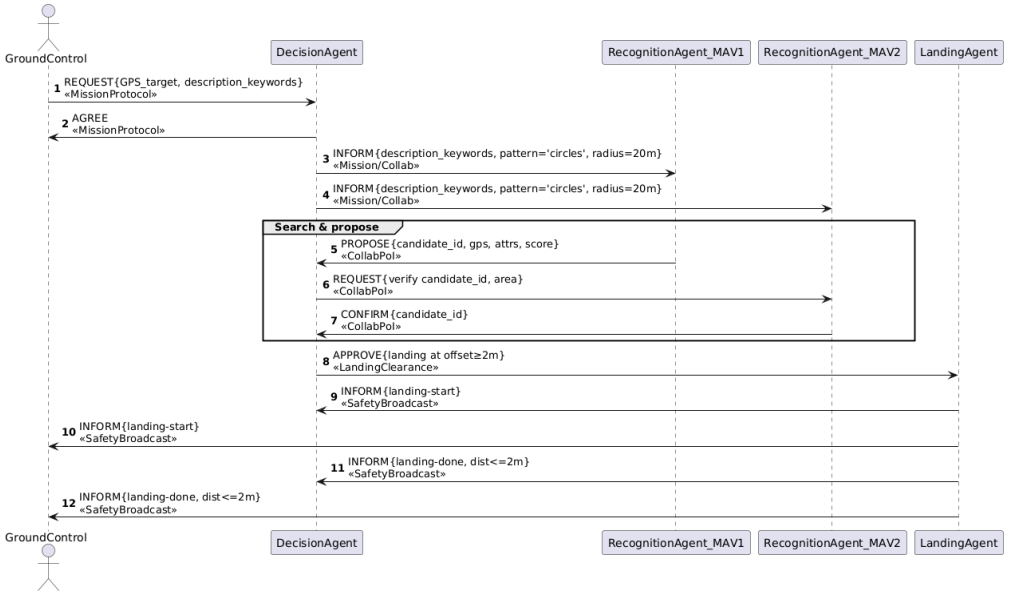
Description: The Recognition Agent perceives and interprets the environment through the device camera through recognition parameters obtained from processing the target description. After continuously scanning the environment, the detected candidates are proposed to the Decision Agent which verifies with other MAVs.

Figure 2.3 - Landing Agent Class Diagram



Description: The Landing Agent ensures that the MAV can perform a safe landing near the person of interest, done by executing a slow descent to ground within a 3 meter radius from the target.

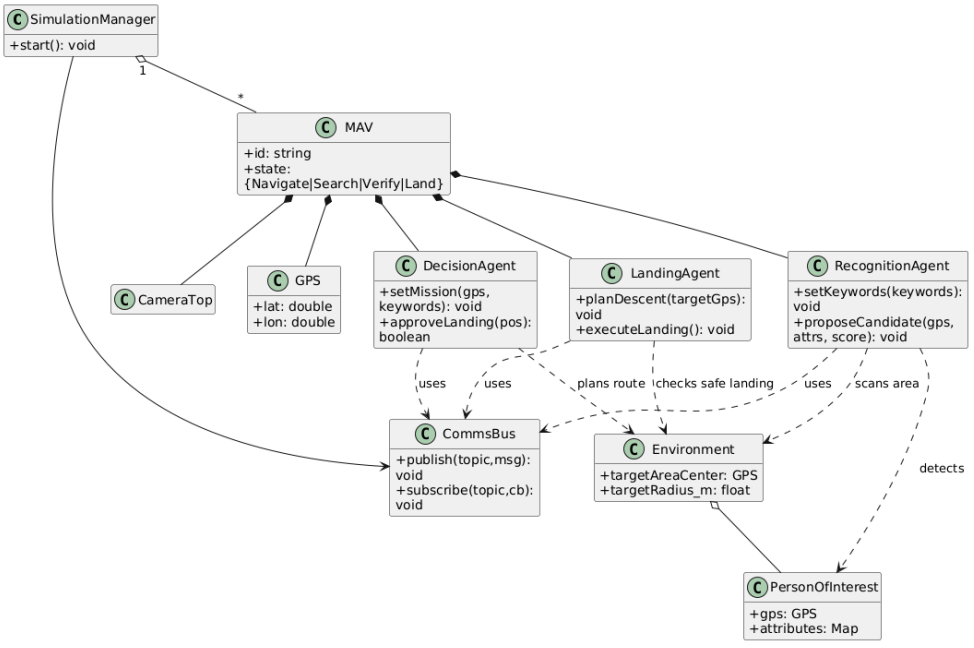
Figure 2.4 - Agent Interaction Protocol Diagram



Description: The Agent Interaction Protocol diagram models how the three agents exchange communicative acts. It shows the sequence from start to finish, and even illustrates how agents can exchange information to cross-verify the identification of the target.

3. Simulation

Figure 3.1 - Simulation UML class diagram



Description: The Simulation UML Class Diagram illustrates an overview of the simulation. It includes the MAV and its three main agents along with the GPS and camera, provides an overview of the environment containing the target, and it incorporates a communication bus to represent the exchange of messages between MAVs.

4. MAV agents

4.1 - Receiving Instructions

In our model, the MAVs are designed to receive mission commands directly from the Control Center using a wireless communication protocol. These instructions are not just plain data but a structured message that includes both the description of the target (the Person of Interest) and the specific GPS coordinates where the search will begin. Once the MAV gets this input, it doesn't simply store the information, it interprets it immediately. The GPS data is transformed into navigation waypoints, while the description is translated into recognition parameters for the onboard AI system. This way, from the very beginning, the MAV has a clear plan of action, where it needs to go and what features it must detect.

4.2 - Navigation to GPS Location

For navigation, the MAVs rely primarily on GPS based waypoint following. Each waypoint works like a checkpoint that guides the MAV step by step to the target zone. To make this process reliable, we incorporate a simple path planning algorithm that allows the MAV to adjust its course dynamically. The MAVs also use data from onboard IMU sensors (gyroscope and accelerometer) to continuously stabilize their flight and correct any deviations caused by wind or external disturbances. This way, they can reach the designated area efficiently and with precision.

4.3 - Person Identification Strategy

Once in the target zone, identification becomes the critical task. Each MAV carries an AI camera that looks for human figures and compares them with the target's characteristics, for example, clothing color or an estimated height. Because the AI is imperfect and can sometimes misclassify, we decided not to trust a single detection. Instead, the MAV performs repeated scanning passes and cross-verifies its findings with other MAVs. This teamwork reduces errors and increases confidence in the detection process.

4.5 - Landing Near the Person

Once the Person of Interest is confirmed, the MAV executes a safe landing sequence. The strategy is to land within a radius of about 2–3 meters from the person, never directly on top. The descent is gradual and controlled, lowering altitude step by step to avoid instability. This method reduces risks while still placing the MAV close enough to complete its mission successfully.

4.6 - Communication & Collaboration

The MAVs share information through a peer to peer protocol. If one MAV detects a possible match, it immediately broadcasts the GPS coordinates to the rest of the swarm. The other MAVs then fly over the same location to confirm or reject the detection. Only when there is agreement among several MAVs does the system officially confirm the Person of Interest and authorize the landing sequence. This process minimizes false positives and highlights the advantage of swarm intelligence for solving complex real-world problems.

5. Team

5.1 - Review 2 work plan

Figure 5.1 - Task table

Task	Member	Time	Output
AUML Agent Class Diagrams	Ana, Emilio	3h	Diagrams (Decision, Recognition, Landing Agents)
AUML Interaction Protocol	Marijo	3h	Sequence of communicative acts (MISSION, SEARCH, CANDIDATE, LAND)
Simulation UML Class Diagram	Jozef, Emilio, Ana	2h	Implementation-level UML (MAV, agents, sensors, environment)
MAV descriptions	Emilio, Baltazar, Jozef	2h	Concise text: mission intake, GPS nav, recognition, landing, collaboration
Diagram descriptions	Ana	1h	Short section highlighting changes from R1 to R2 and characteristics
Final PDF Assembly & Repo Tag	Ana, Emilio	2h	Complete document, consistent formatting, tag "REVIEW 2"

Description: The task table organizes in a clear way the roles each member took during the realization of this deliverable, by including the specific tasks, produced outputs, and estimated times.

5.2 - Learning acquired

The team learnt various new things during the realization of this review; among them, things related to Agent UML diagrams such as modeling Agents not only as a component of the system but also as their own entity, with their own roles, goals, and tasks. It is also worth mentioning the vast experience gained by the group in designing the interactions where messages are represented by performatives.