EVIDENCE 2 MODELING OF MULTI-AGENT SYSTEMS WITH COMPUTER GRAPHICS

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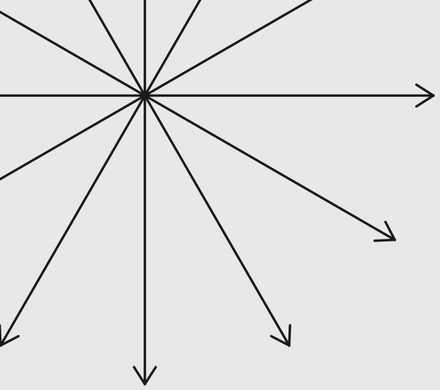


Problem

Coordinated patrolling is a major challenge in many aspects of security, especially in urban areas. Coordination and effective communication between all actors in charge of monitoring an area is crucial.

How can we achieve coordinated patrol taking advantage of technological advances?

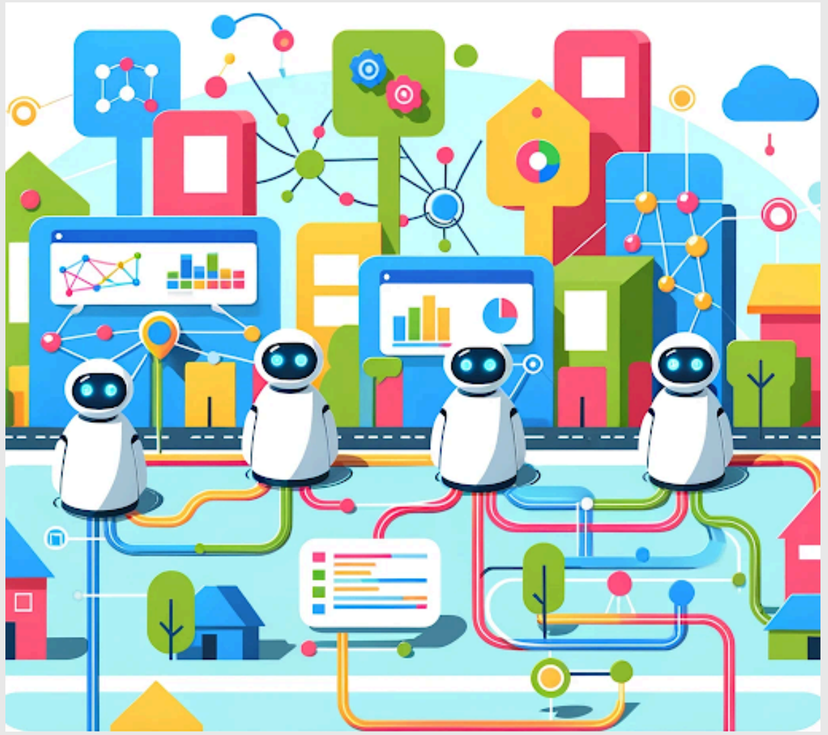
Agents

Context

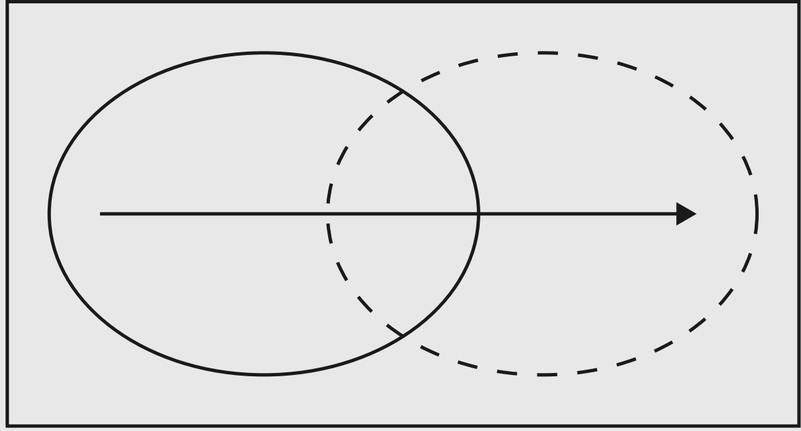
Multi-agent systems are computational systems that consist of multiple agents interacting in an environment.

An agent is an autonomous entity capable of acting independently to perceive the environment, make decisions, act and communicate with other agents.

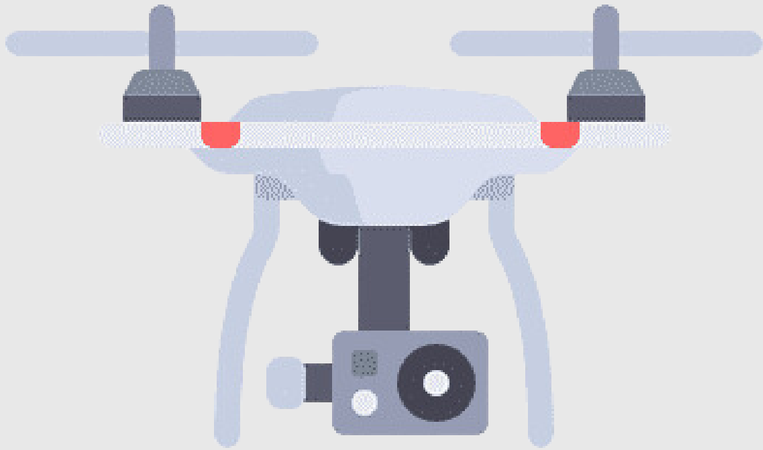
The environment is the space where our agents exist, interact and can perceive information from it.



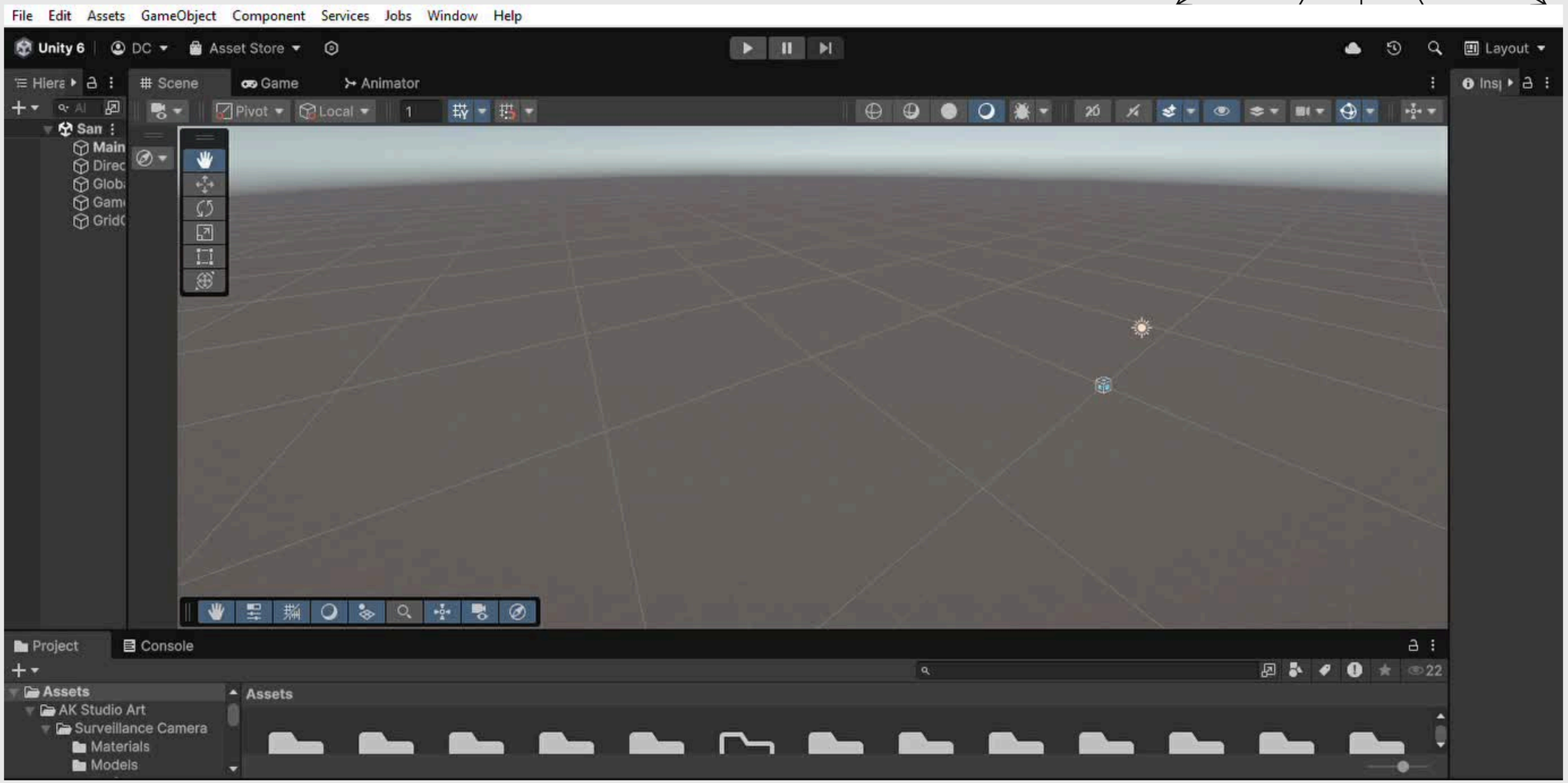
Our Solution



- 4 Agents (Drone, Camera, Security Personnel, Robber)
- Drone and camera have built-in cameras (computer vision)
- Both drones and cameras can detect Robbers, only drones alert security agents
- Drone landing station at the center of the network
- The drone can fly at different heights
- Security catches the robbers and they disappear from the simulation.



Our simulation



Log Examples

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Drone's Visual Analysis:
I am currently flying at position (10, 10) at a height of 1 units. I can see 2 individuals with black caps, potentially suspects. There is one police of
ficer in navy uniform within my field of view.
Suspects are primarily on the left side of my view.
Maintaining routine surveillance pattern.
- Robber 1 detected: Area = 56.00, Position = (86, 113)
- Robber 2 detected: Area = 56.00, Position = (42, 98)
- Police 1 detected: Area = 80.00, Position = (67, 143)
Agent 4 as Surveillant sent REPORT_VISION to Agent 8
Agent 8 as Controller sent REQUEST_CONTROL to Agent 4
Security 8 requested control of Drone 4
Drone 4 detected suspicious activity.
SECURITY ALERT: Security personnel 8 confirmed a threat detected by Drone 4.
- Pursuing robber at (3, 13)
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127.0.0.1 - - [29/Nov/2024 01:39:55] "POST /process-vision HTTP/1.1" 200 -
127.0.0.1 - - [29/Nov/2024 01:39:55] "POST /camera-vision HTTP/1.1" 200 -
Step 4: Camera 5 detected Robber 10 moving from (7, 1) to (6, 1)
Watcher 2 patrolling towards (7, 16). Now at (14, 13).
Watcher 3 patrolling towards (2, 5). Now at (8, 14).
127.0.0.1 - - [29/Nov/2024 01:39:55] "GET /simulation-state HTTP/1.1" 200 -
127.0.0.1 - - [29/Nov/2024 01:39:55] "POST /camera-vision HTTP/1.1" 200 -
127.0.0.1 - - [29/Nov/2024 01:39:55] "POST /camera-vision HTTP/1.1" 200 -
127.0.0.1 - - [29/Nov/2024 01:39:55] "POST /camera-vision HTTP/1.1" 200 -
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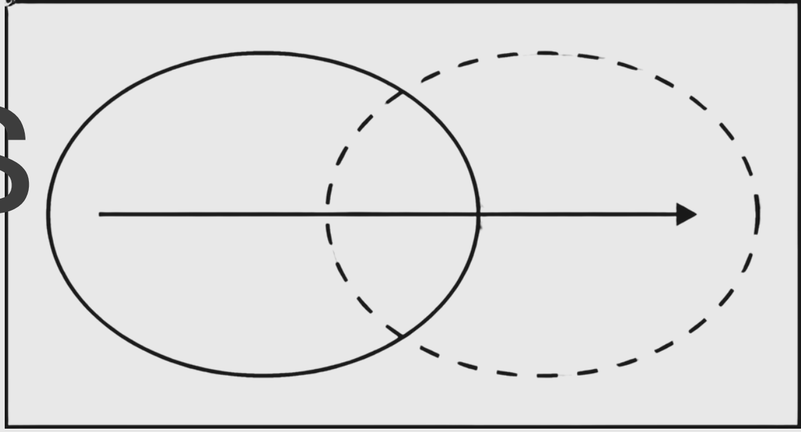
Technical Facts



- BDI Architecture for Drone Agent
- FIPA ACL communication (message structure, performance types, protocol categories, role-based communication)
- Role-based agent design
- Computer Vision with YOLO and OpenCV for Drone and Camera
- Image capture and processing, detection analysis system.
- Backend server with Python Flask for endpoints
- Visualization with Unity, HTTP communication with server.