

# MULTI-AGENT SYSTEM FOR ANOMALY DETECTION IN CROPS

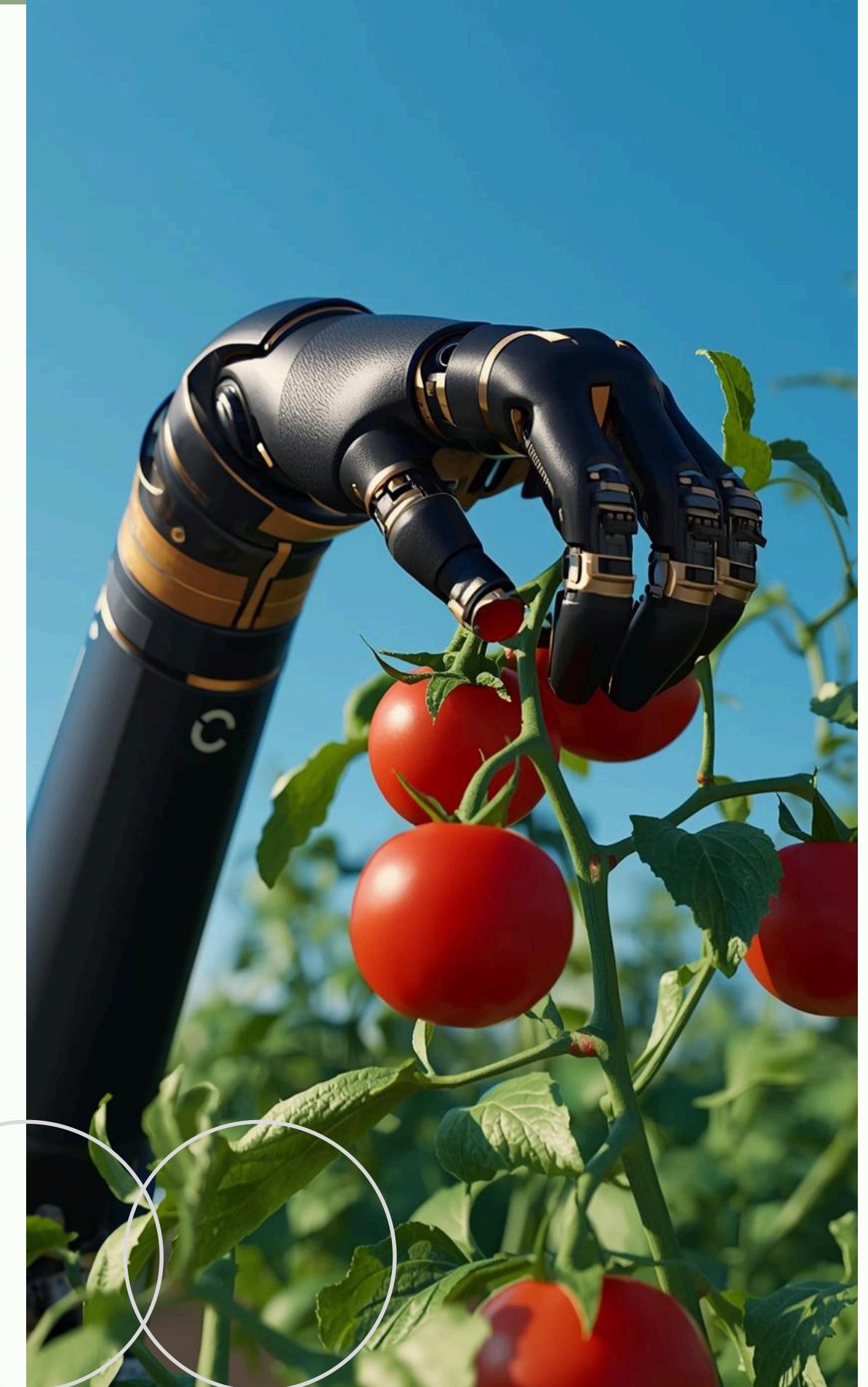
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# CONTEXT

Crops represent nearly 80% of the human diet, yet between 20% and 40% of annual agricultural production is lost due to pests, diseases, and labor shortages. High-turnover crops, such as tomatoes, strawberries, and cucumbers, require rapid and timely intervention, and late detection of anomalies leads to wasted resources, reduced productivity, and lower farmer income.



# OBJECTIVES

- Develop a multi-agent system simulation in Unity designed to detect, classify, and manage anomalies in a virtual crop field.
- Implement the behavior, coordination, and interaction of autonomous agents within a controlled environment.
- Demonstrate coordinated behavior through communication protocols and decision-making models.

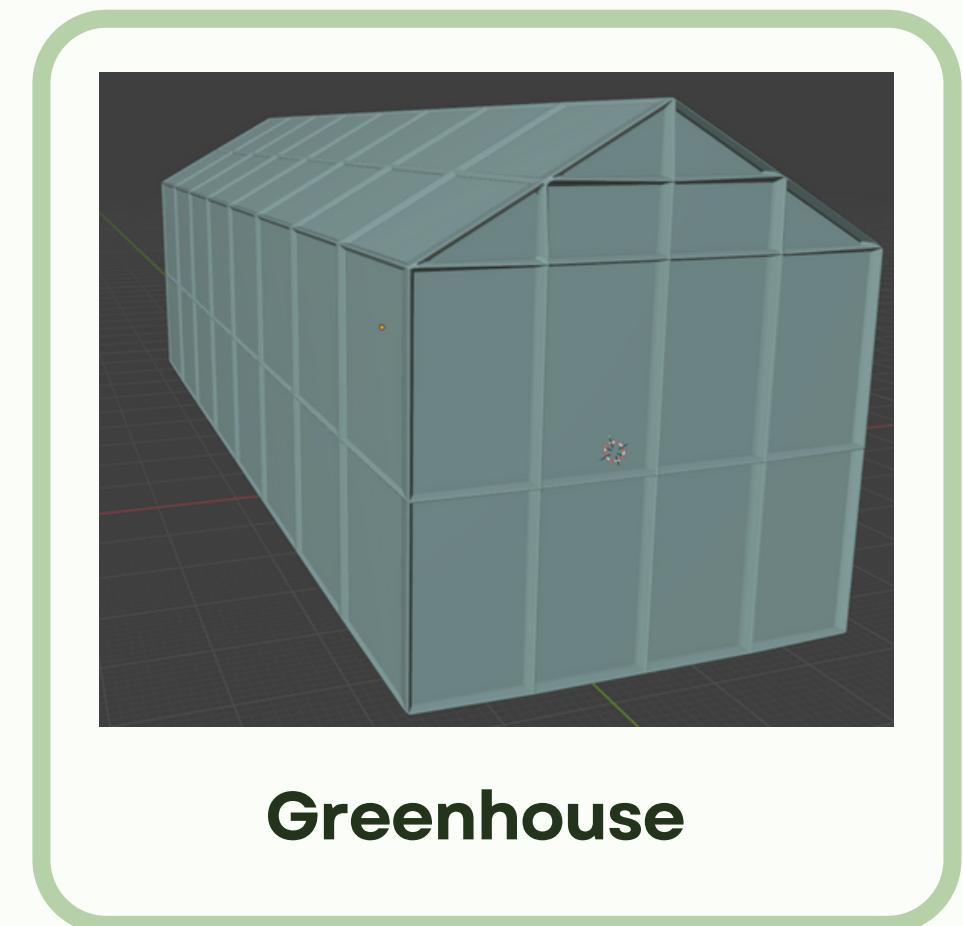
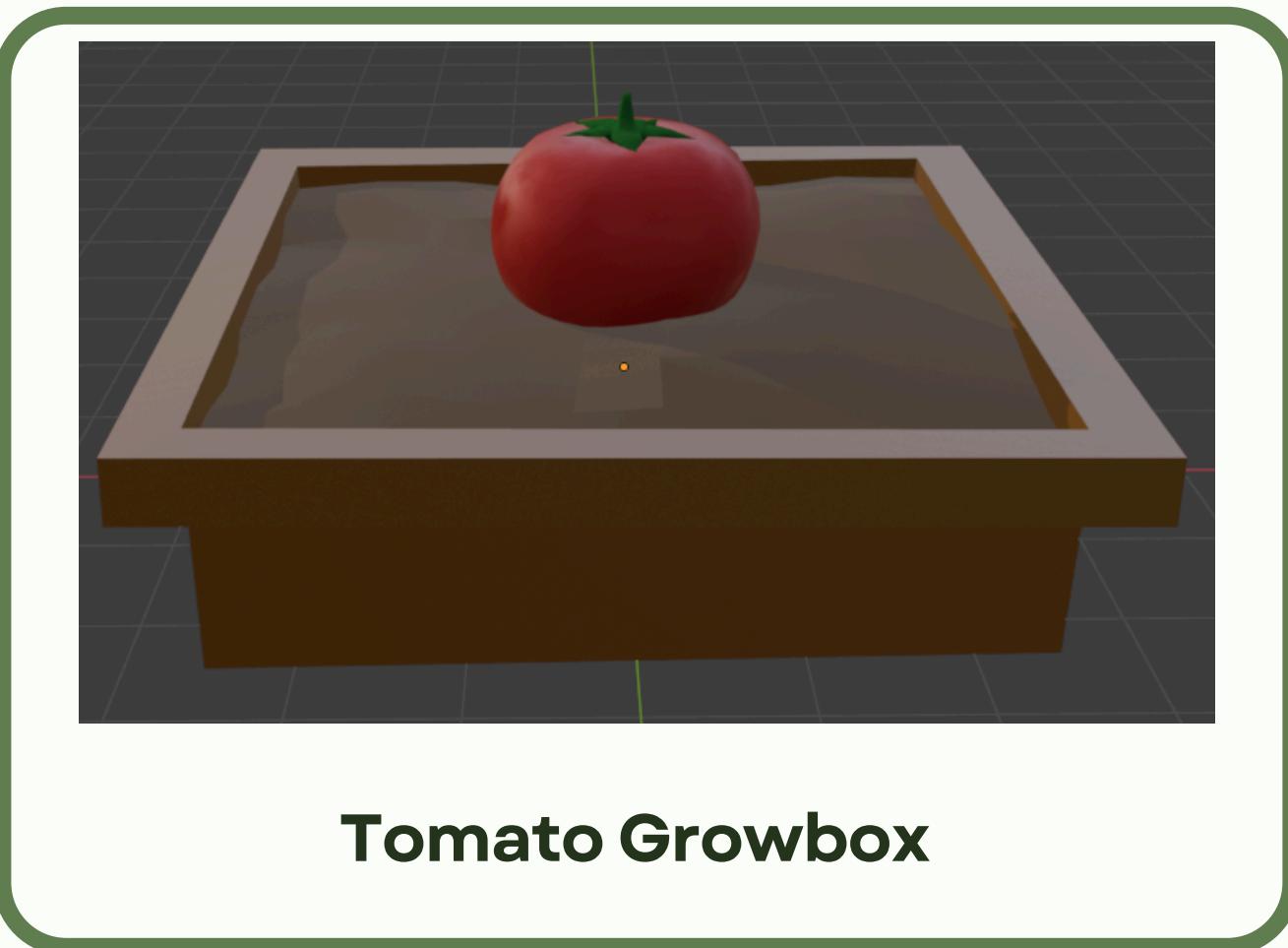
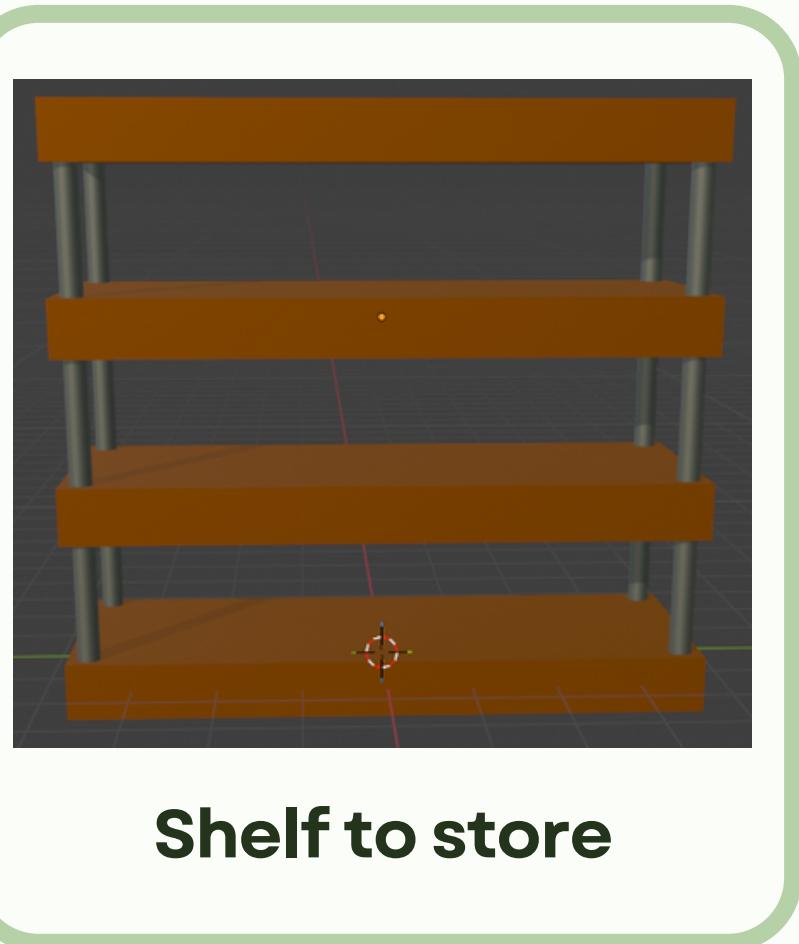


# SOLUTION

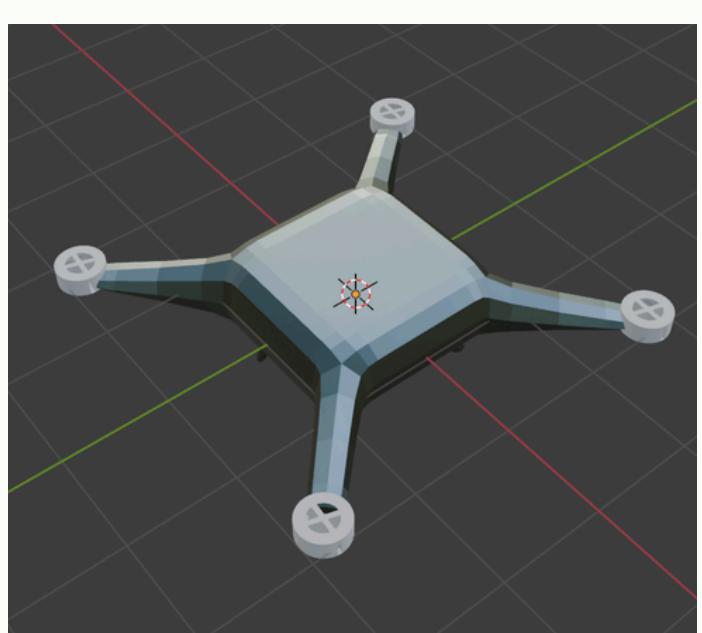
Our solution uses a hybrid multi-agent system because MAS lets us divide the problem into roles that work independently but coordinate when needed. This mirrors real agricultural workflows where multiple persons operate at once. In this solution one agents maps the environment, another inspects and classifies tomatoes, and the units of the final agent collect them. Through hybrid reasoning and path planning, the system detects anomalies, assigns tasks, and navigates inside the greenhouse.



# OBJECTS IN OUR SYSTEM



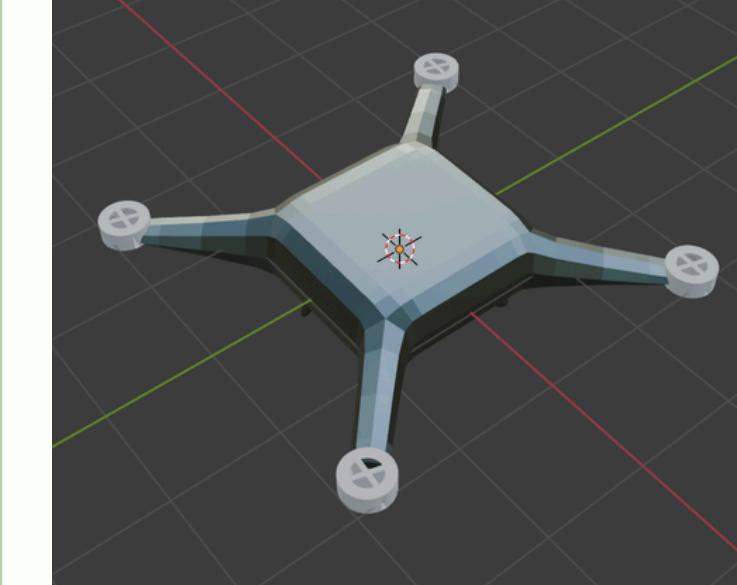
# AGENTS IN OUR SYSTEM



**Map Agent**

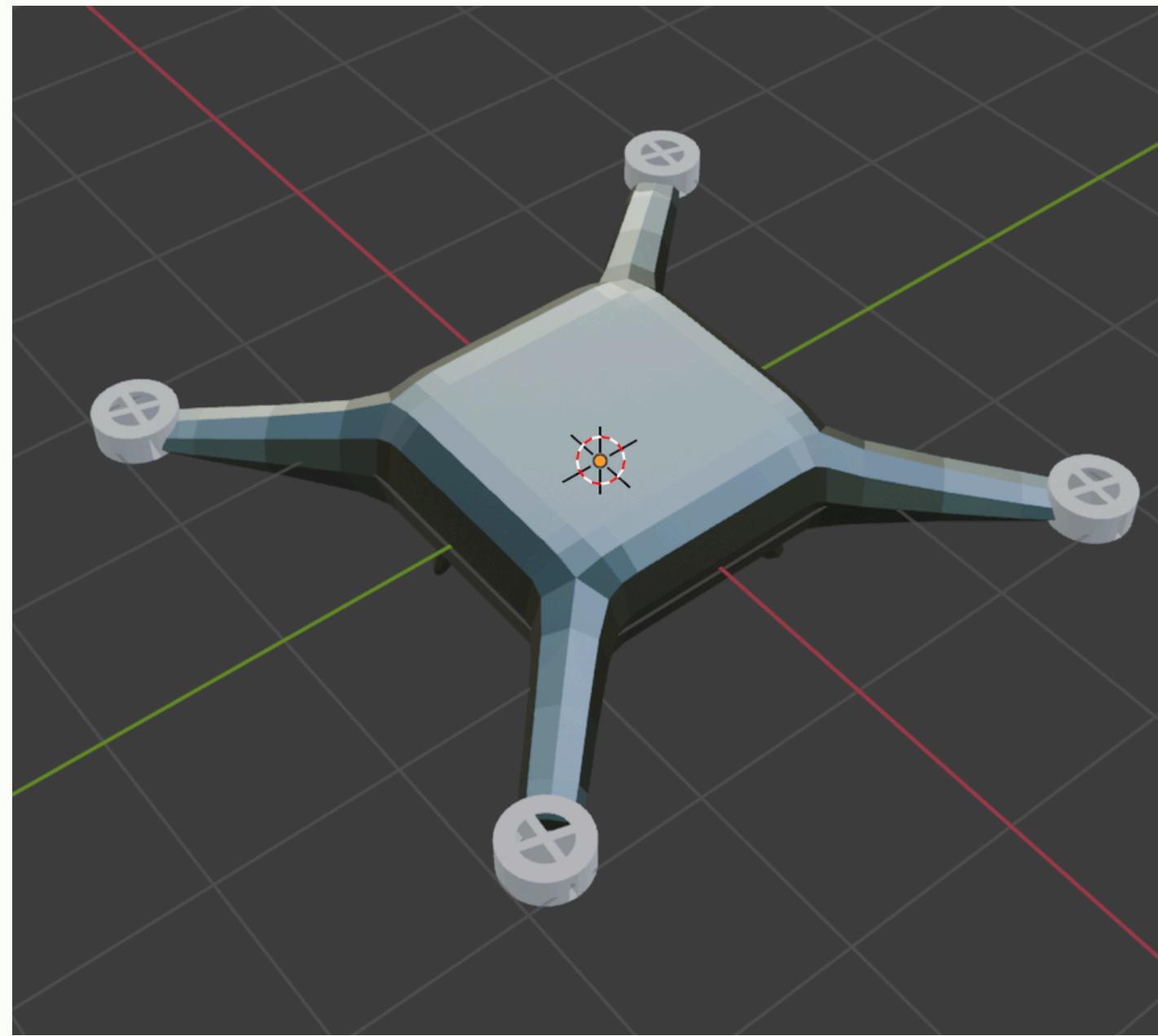


**Collector Robots (3 units)**



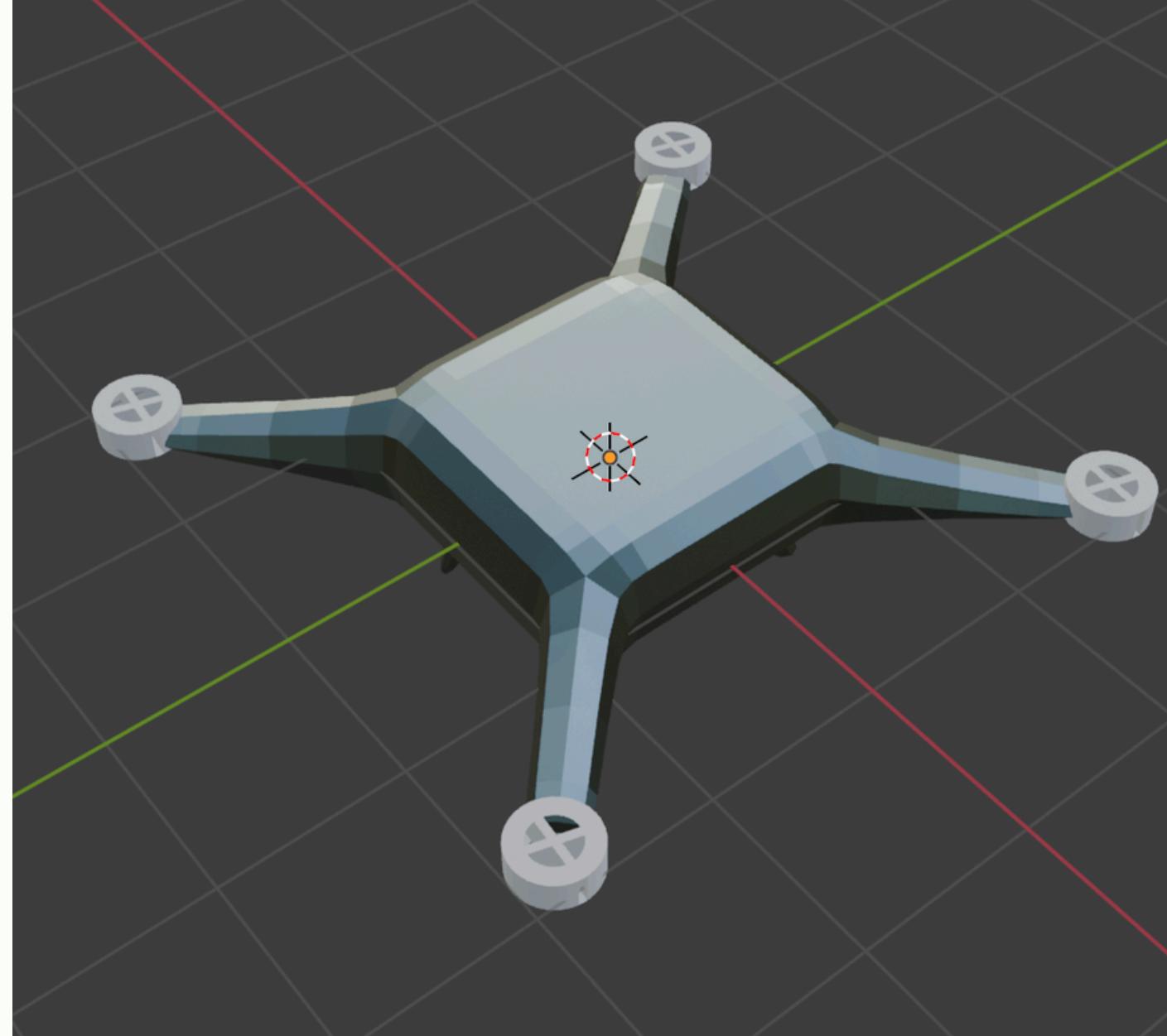
**Inspector Drone**

# MAP AGENT



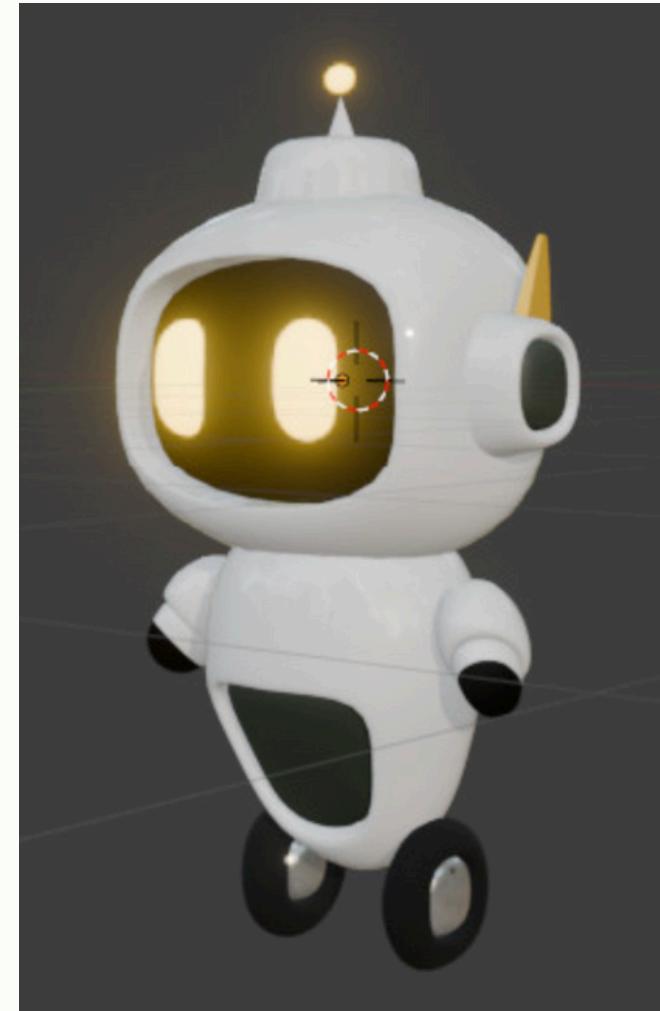
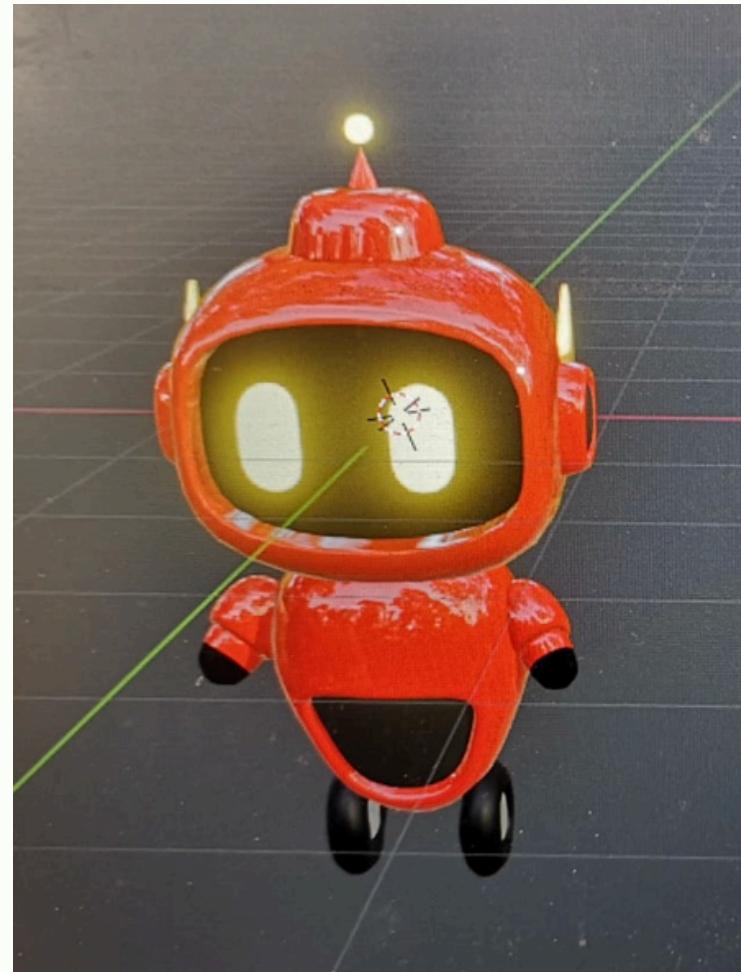
- Centralizes spatial knowledge for all agents
- Maintains and broadcasts global map information: such as plant positions and walkable areas

# INSPECTOR DRONE



- Continuously patrols the grid and scans plants
- Detects newly spawned tomatoes and their state (healthy/defective)
- Enables collector assignment
- Broadcasts tomato information

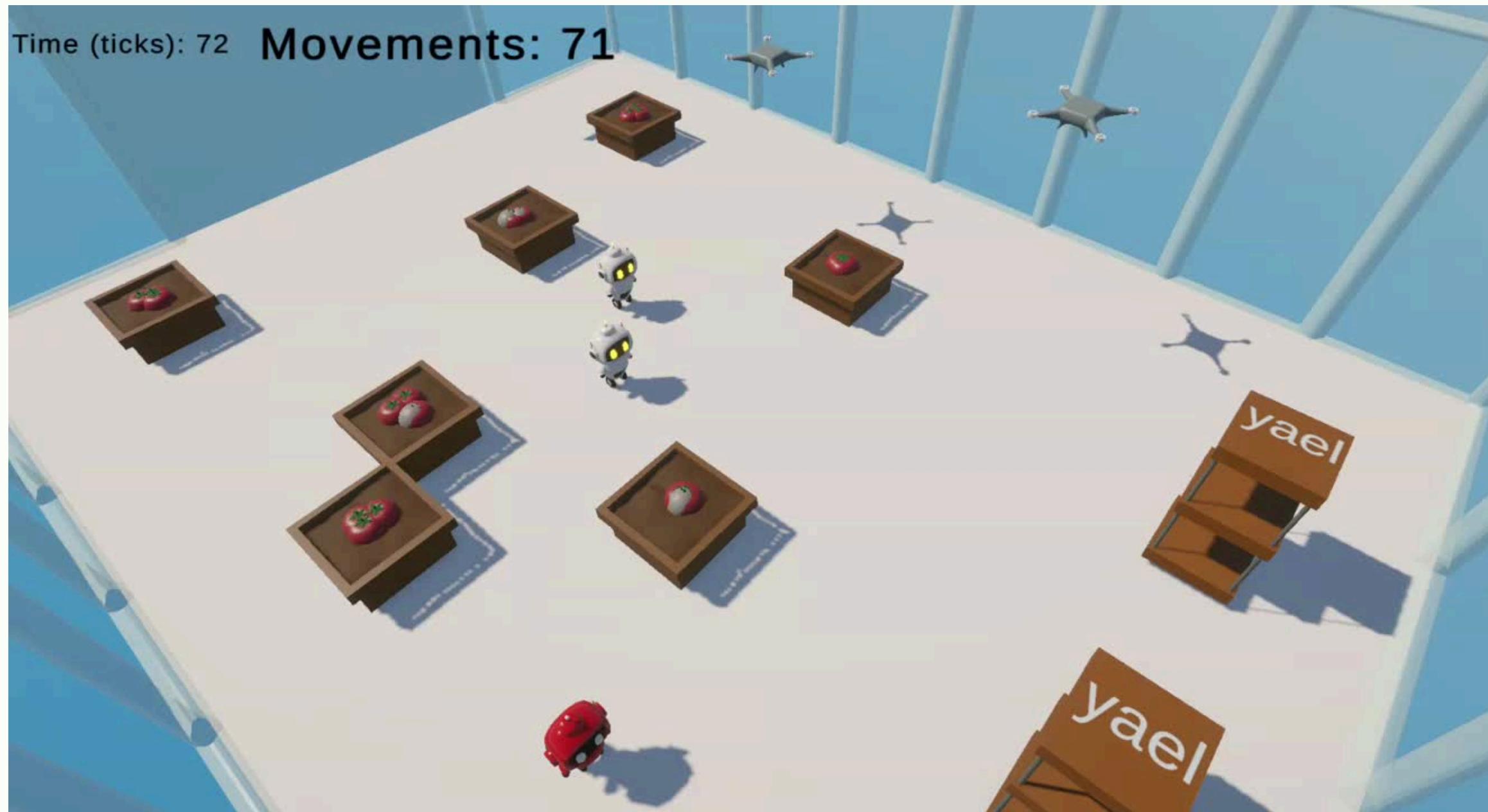
# COLLECTOR ROBOTS



**Collector Robots (3 units)**

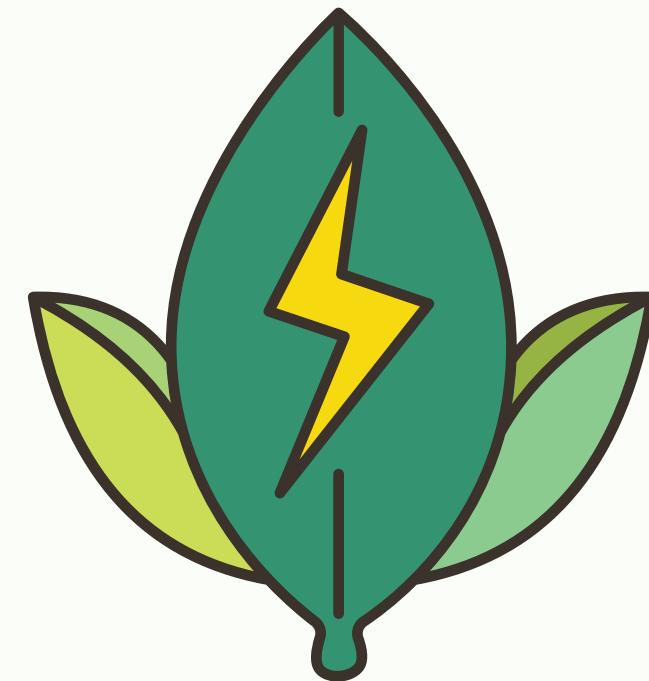
- 1 Defective Collector (red)
- 2 Healthy Collectors (white)
- Receive tasks from the inspector
- Move using paths generated from the shared map.
- Only one collector may approach a plant at a time
- Capacity-limited (carry X tomatoes)
- Deposits tomatoes when full or when no more are accessible

# VIDEO - SIMULATION



# RESULTS

This MAS solution addresses one of the main concerns of our training partners by helping the early detection of infections in crops, minimizing losses, optimizing the use of agricultural resources, and reducing dependence on human labor that typically lacks specialized knowledge about detecting anomalies.



# CONCLUSION



Our simulation demonstrates a functional multi-agent architecture capable of detecting, classifying, and collecting tomatoes in a dynamic environment. The integration of a Map Agent, a mobile Inspector Drone, and multiple Collector Robots allows a coordinated workflow driven by autonomous reasoning and pathfinding.



MUCHAS  
GRACIAS

THANKS!  
*DANKE!*