



# Tecnológico de Monterrey

**Instituto Tecnológico y de Estudios Superiores de Monterrey**

*Guadalajara campus*

**Modeling of multi-agent systems with computers graphics (gpo 301)**

**Individual document**

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## **Analysis of the developed solution**

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For the solution my team and I developed, we chose a multi-agent model because the problem required several independent specialized roles working at the same time, such as mapping, inspecting, and collecting tomatoes, while we chose for almost all our agents to be hybrid since we needed them to have a reactive component to allow them to react to sudden changes such as collision but we needed the planning that using a BDI would provide. Even though each agent works independently, their combined actions allow us to achieve the final goal of the project which is early detection of anomalies, removal of infected tomatoes, and an efficient harvesting of healthy crops. The main variables we considered were the size of the map, the number of tomatoes and their distribution within the greenhouse, the agent distance (position compared to a determined tomato) and their workload. These factors influenced how agents negotiated tasks, classified the tomatoes, avoided collisions, and planned their routes, since all those variables could affect the navigation of the greenhouse, the task allocation and the mapping of our environment.

For the graphic design, we selected a greenhouse environment to imitate real conditions, while robots represented the workforce inside it, while we also kept the visible grid because it clearly shows movement, agent decisions, and the effect of each protocol, making interactions easy to follow.

The final solution works well because it is modular and scalable, we can expand the map, increase the number of tomatoes, or add more collectors and inspectors, and the system remains functional and without interference between the agents.

However, our solution for the challenge still has disadvantages and points that could be improved, such as very basic classification rules (in reality, detecting infections requires deeper knowledge and likely AI-based image detection), and movement that can become congested in tight areas like corners, however that would require a lot more of time compared to the five weeks we had for the challenge.

To reduce these issues, future improvements could include refining movement coordination and using AI classification trained with real images of tomato infections, allowing the simulation to use more detailed tomato states and make better decisions.

## **Reflection of my learning process**

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Comparing the experience gained in the course to my initial expectations, I consider them to have been achieved. I had very little prior knowledge, almost nothing, of Blender and Unity, so now, having the ability to implement models, import them, and make them work using these programs, I feel that I have learned the basic concepts quite well. Regarding multi-agent systems, and considering the limited class time, I believe I learned the fundamental aspects

necessary to implement my agents in the simulation and make them work toward a common goal.

In Blender I was able to create models, add materials and textures, and customize them to improve their quality so they could be exported to Unity. Within Unity, I learned to create a scene, write scripts, and configure objects so they could interact correctly. I also learned how to integrate the agents' behaviors, connect the communication protocols, and with that make the simulations work as I intended.