Digital Twin Simulation Environment Development for Smart Cities

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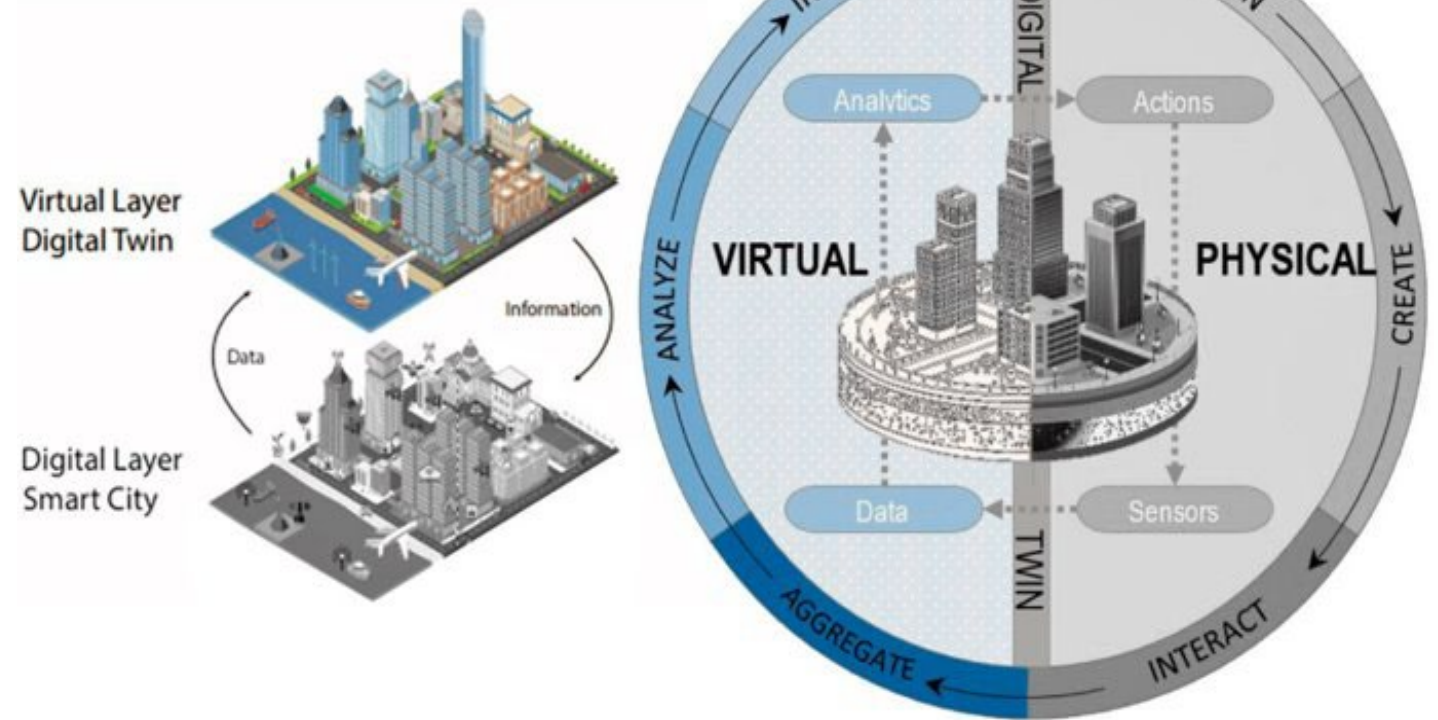
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Digital Twin

*"A digital twin is a dynamic **virtual copy of a physical asset, process, system or environment** that looks like and behaves identically to its real-world counterpart."* [1]

[1] *Technologies, U. (n.d.). Digital Twins. Unity.* https://unity.com/solutions/digital-twins

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Introduction

*This project aims to develop **data-enabled agent models** and **virtual simulation environments***
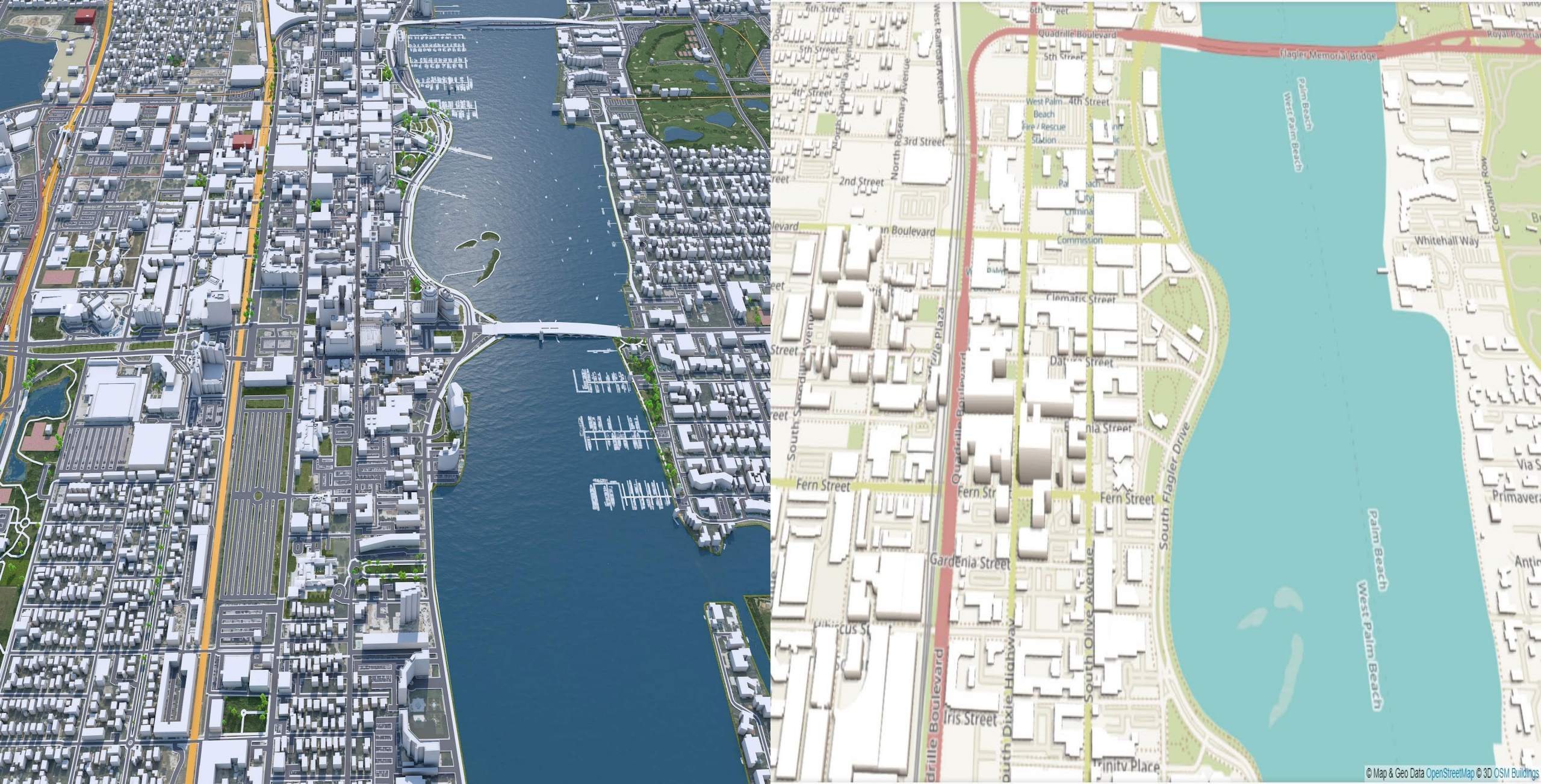
Objectives

Develop
- Develop a *city infrastructure environment* based on real 3d data

Define
- Define *pathfinding behaviors* of agents

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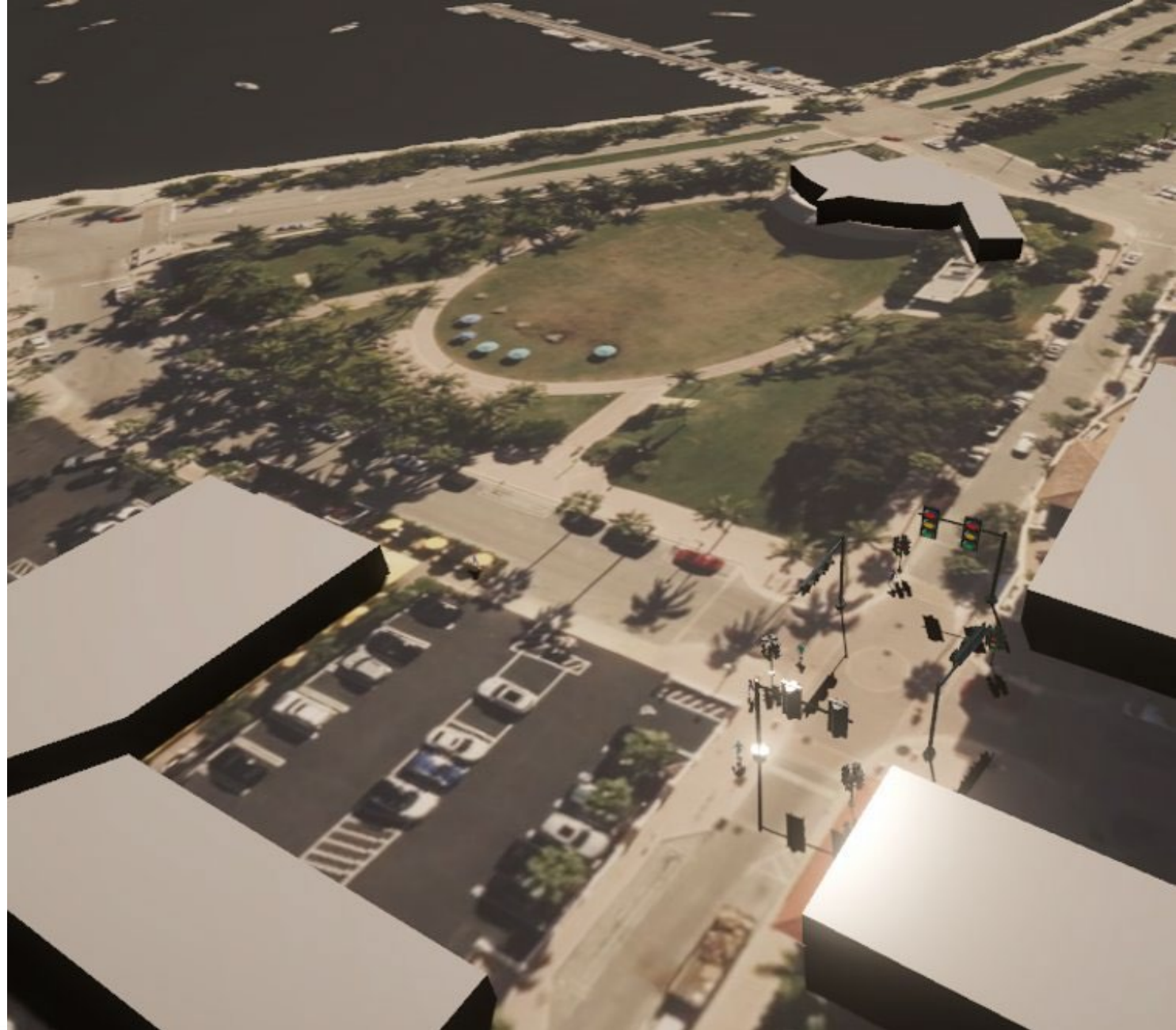
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Digital Twin Environment

*Created using **real, 3d data:***

- ***City of West Palm Beach***
- *3d mapping (x, y, and z axes)*
- *Photogrammetry*

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Defining Agent Behavior

Waypoint Pathfinding

- Place game objects which *map the agent's route* & avoid objects

- Each waypoint is connected

- Path is mapped, taking into account *how far the agent has traveled + distance to its destination*

AI agent with waypoints attached

```
2 references
void UpdateDestination()
{
    target = waypoints[waypointIndex].position;
    agent.SetDestination(target);
}

1 reference
void IterateWaypointIndex()
{
    waypointIndex++;

    if (waypointIndex == waypoints.Length)
    {
        waypointIndex = 0;
    }
}
```

C# implementation of waypoint pathfinding

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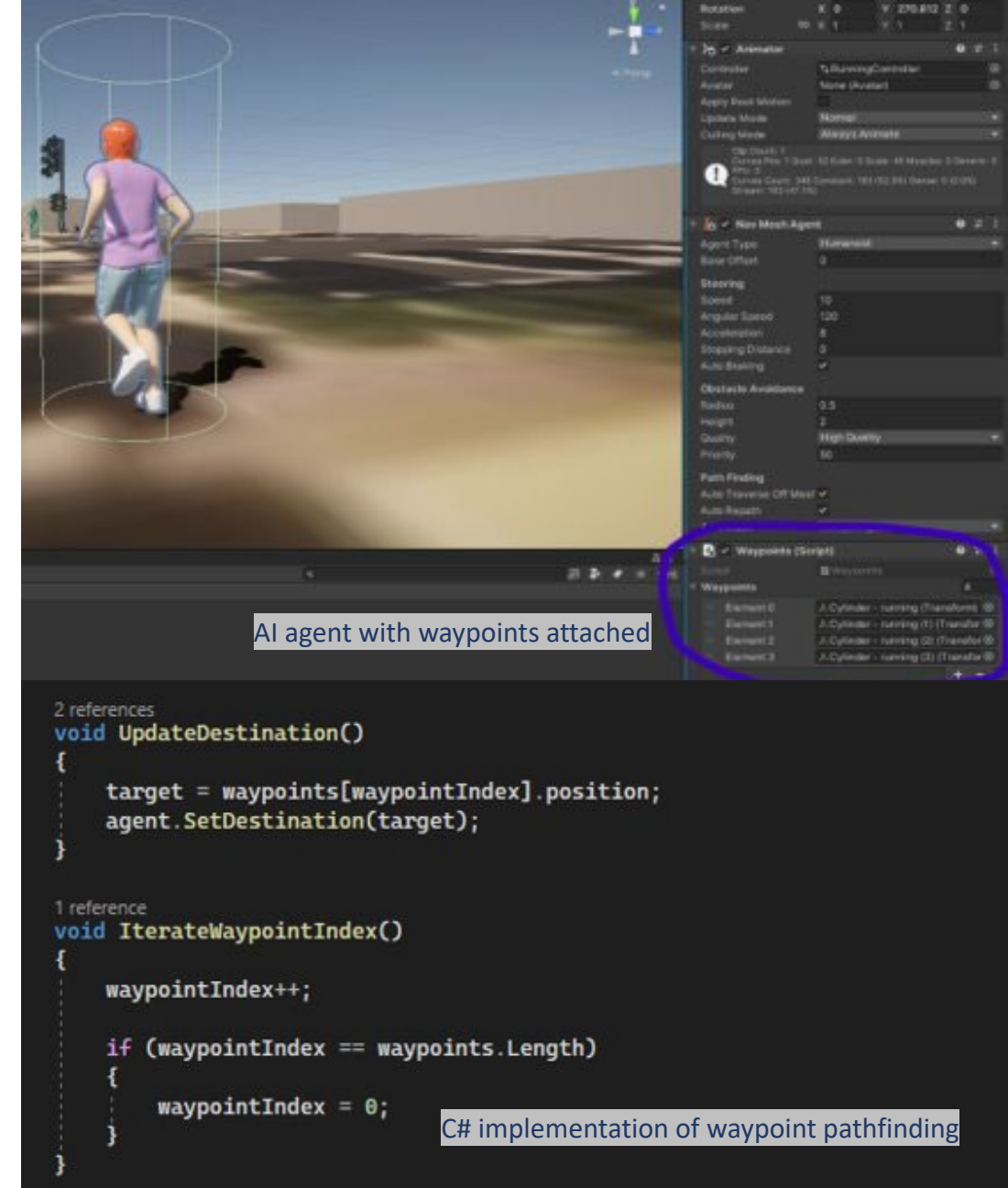
Agent Interactions

Adjusting the radius around an agent can determine its **avoidance of other agents** (and vice versa)

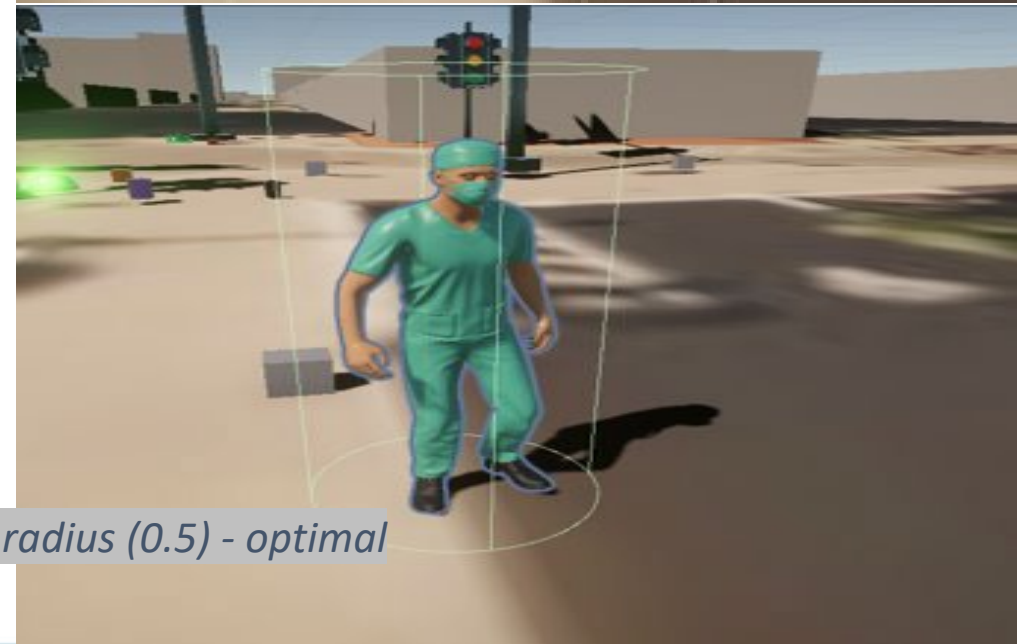larger radius (3) - **less** effective avoidance (stalling)

Other behaviors

- *Pausing before crossing the street*
- *Walking*
- *Running*

small radius (0.5) - optimal

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Conclusion

Future Applications

- **Pedestrian – vehicle interactions**

A more realistic virtual environment

- **Crowds/groups** of pedestrians on certain days and times (morning, afternoon, evening)

- Detailed sidewalks, trees, etc.

More pedestrians, behaviors and interactions (children, wheelchairs and canes, guide dogs, etc.)

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Questions & Feedback