Multi-Agent Emergency Evacuation System

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The problem

This project focuses on developing a multi-agent system using SPADE or JADE to manage and coordinate emergency evacuations in large buildings or complexes. The system will simulate various agents representing occupants, emergency responders, and building management systems, working together to ensure a safe and efficient evacuation during emergencies.

In scenarios like fires, a decentralized approach is essential for real-time coordination and adaptability, overcoming the limitations of traditional centralized systems. The agents autonomously handle key aspects of evacuation, such as guiding occupants, managing exits, and coordinating emergency responders.

Overall Sketch

Occupants

People that are within the building who need to evacuate. There are two types: the occupants who know all the exits and can guide themselves, and the occupants who don't and are less autonomous.

Building Management

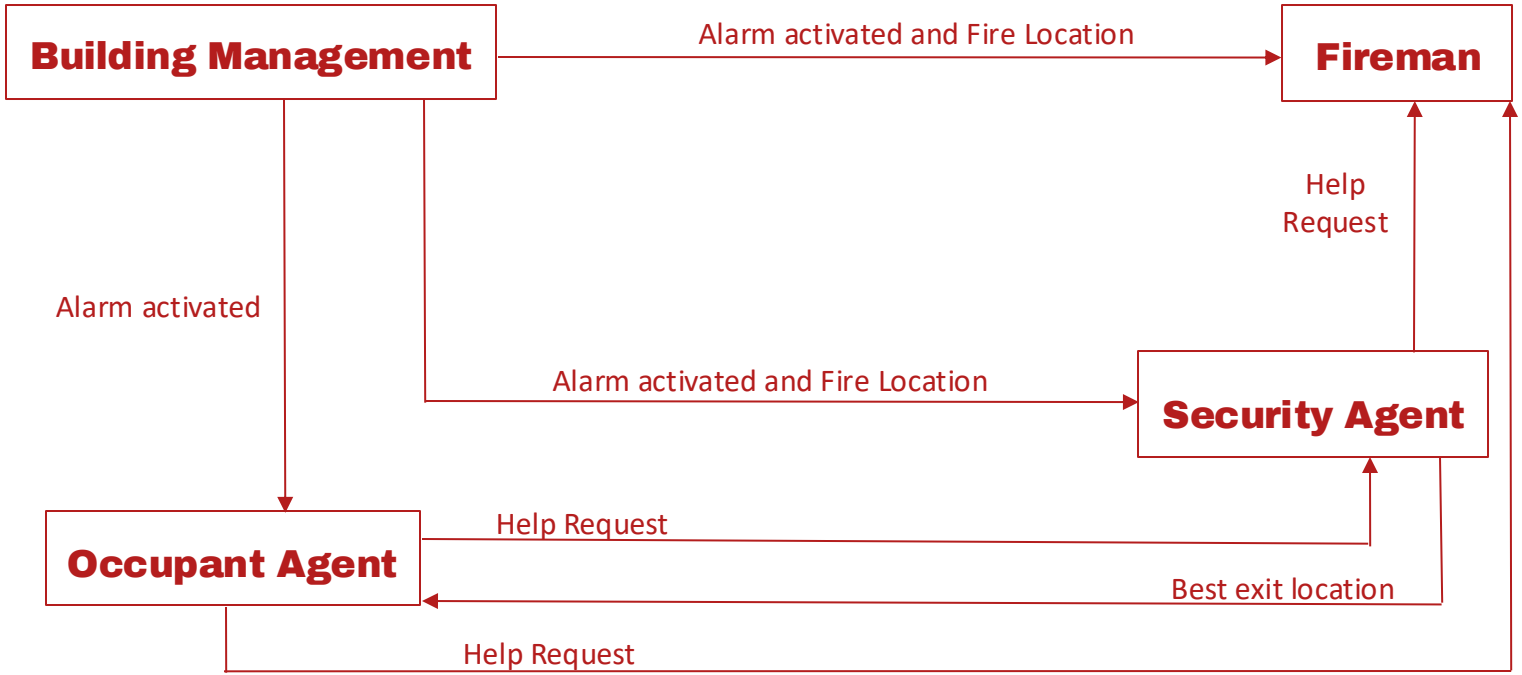
Agents that oversee the building's infrastructure, such as lighting, alarms, and exits. They deliver real-time updates to all the other agents, regulate building systems, and ensure compliance with safety procedures.

Emergency Responders

These agents represent emergency personnel such as fireman and security agents. They coordinate evacuation efforts, assist occupants, and manage the safe flow of people to exits. They also respond to incidents and provide support where needed.

Interaction and communication protocols 03

If fire starts, the alarm is activated by the Building Management System.



Agent architectures and strategies

Occupants

Knowledge = 1

- Are unaware of the building structure;
- Ask help if they see another occupant/fireman/security
- Run away from fire

Knowledge = 2

- Are aware of the building structure;
- Are autonomous at calculating/recalculating emergency routes
- Help another occupant

Agent architectures and strategies

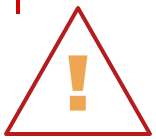
Strategies:

- Occupants with knowledge of the building assist others when they see them using the Bresenham algorithm.
- Occupants without knowledge call for help from the firefighters.
- Security personnel patrol the area when the fire starts and provide the best route to occupants (using Dijkstra's algorithm).
- Firefighters extinguish the fire and rush to help when they hear calls for assistance.
- Occupants head to an exit when they can see it directly.

Establishing communication protocols

*20 tries for each map

	Map 1:	Map 2:
Number of Occupant Agents:	8	16
Number of Deaths:	1	3
Number of People who evacuated:	6	10
Number of Survivors:	7	5



Conclusions:

Our evacuation strategy is highly efficient for small buildings where occupants with less knowledge can easily spot someone to assist them. However, as the building size increases, the number of fatalities in this scenario also rises. This happens due to the firefighters' lack of knowledge about these occupants' locations and the inefficiency of the security personnel during their patrols.

Even so, our system simulates a realistic scenario, where during a fire, agents try to save themselves by helping each other and escaping the flames. The results were satisfactory, and the strategies proved to be efficient.