

Developing fire evacuation simulation through BDI-based modelling and simulation

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Abstract. Fire evacuation simulation is used to simulate the fire evacuation procedures by involving human-like agents. In this paper, the fire evacuation simulation is designed and developed by adopting the BDI agent plug-in. BDI (Belief, Desires, Intentions) is a technique used in modelling the multi-agent system. A tool and BDI methodology are introduced to help in modelling human behaviour and the decision making of an agent. In this paper, the usability of the BDI methodology and BDI agent plug-in tool is studied through a case study of a fire evacuation environment. The case study covers the three main components needed in a fire evacuation simulation: the fire (the spread of the fire and smoke), the building layout (the classroom and physical objects), and the human-like multi-agents. Using the Unity game engine, a fire evacuation simulation system is built based on the requirements, methodology, and design. The usability of the BDI agent plug-in tool can be proven by observing the results of the fire evacuation simulation and the reaction of agents when encountering the fire situation. However, there are also some limitations of this fire evacuation simulation. Therefore, there are works to be done to develop a more realistic fire evacuation simulation and more human-like multi-agents in future.

1. Introduction

Fire evacuation procedures are the procedures to be used in case of fire. A fire drill is conducted to practice the emergency procedures when there is a fire. However, there are some limitations when conducting fire drills. For example, conducting a fire drill is costly, and there is a risk that participants get injured. Besides, the number to examine the fire evacuation scenarios is also limited [1]. To overcome the insufficiency of fire drill, fire simulation is introduced. Fire evacuation simulation has imitated the situations where the occupants (the agents) evacuate from the building in case of fire [1]. The advantages of using fire simulation are that the participants (the agents) will not risk getting injured when exposed to various fire situations.

From the review by [2], several models have been introduced for evacuation simulations. They are flow-based modelling, cellular automata, and agent-based simulation. Work has been done to introduce BDI methodology and UnityBDI plug-in for BDI-based social simulation. With the methodology, developers can analyse and design complex human behaviour in simulation. Meanwhile, the developer can use the BDI plug-in to model human behaviour as a non-player character in the fire evacuation simulation. The tool is integrated with Unity3D and developed with a simple analysis component so that the end-users can observe the real-time simulation and results of the evacuation.

