

Real-Time Human Directed Multi-Agent Task Planning in a Simulated Hazardous Environment

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Abstract — Context: Designing the core autonomous behaviour for characters in a video game where those characters are expected by the player to perform tasks for themselves poses many interesting challenges. This paper explores the tasks faced when developing a capable and somewhat convincing set of Artificial Intelligence routines within a simulated zombie epidemic real-time strategy game with player allocated goals. **Aims:** As the game player doesn't have direct control over the characters, but instead can assign tasks, algorithms to allow the characters to plan and implement those tasks in a cooperative and efficient manor will need to be designed. These algorithms must not be computationally expensive to allow for many agents to act in real-time, and also express superficially convincing human-like behaviours. **Method:** At least two conceptually distinct designs for character behaviour will be designed, and additionally several slight variations of each. These will all be compared in terms of the ability for characters to achieve assigned tasks, avoid threats, and system resource usage. A hybrid between the main designs may be explored if one is not universally better than the other. **Proposed Solution:** A Subsumptive architecture will initially be explored, followed by a Belief-Desires-Intentions model. Following this, each approach will be adapted to experiment with different character behaviours and strategies including weighting self defence against fleeing, and group formation approaches.

Keywords — AI, BDI, cooperative, multi-agent, subsumptive, task planning, video game

I INTRODUCTION

Video game worlds are often populated with Non-Player Characters (or NPCS), the behaviour of which can make or break the game. A great deal of effort is required when designing the routines used by these characters if they are to satisfy some major requirements; they should behave with approximate rationality, opponent characters should provide an appropriate challenge for the player, and if the characters represent humans (or at least animals) they should act in a believable way. For Real-Time Strategy (or RTS) games the difficulty is further accentuated by the necessity of the game to support perhaps hundreds or even thousands of these characters in an environment simultaneously. This combines the previous three requirements with a fourth: efficiency.

This project aims to explore possible implementations of an NPC behaviour system designed to realise the central gameplay of a work-in-progress RTS game. The components of the game that existed prior to the beginning of this project form a zombie epidemic simulation. A city environment is procedurally generated, producing buildings separated by streets. When this process is complete, a number of human characters are dispersed around the environment, a fraction of which initialise as a zombie. The simulation then begins, with the zombies navigating

towards the nearest visible human, and humans attempting to run away from danger if any is present (and otherwise just wandering randomly). If a zombie catches up to a human it may attack it, reducing a stored health value for that human and infecting that human with some probability. If a human loses all their health and is infected, they become a zombie too. Later on in the project a player will be able to assign actions for the humans to complete, such as instructing a group to navigate to a specific location, or to construct barricades out of material found in buildings.

The conflict is clearly one-sided, not least because the zombies are smarter than the humans. The humans have little regard for their surroundings other than the locations of visible enemies, and so often run directly into the inner corners of walls. This would obviously not a sufficient behaviour; looking at the core requirements for a decent NPC it fails at being rational, at being an appropriate challenge (they can't possibly defend themselves), and certainly don't act like humans. Their only redeeming quality is that their simple AI isn't too computationally expensive, so thousands of them can be supported simultaneously.

II DESIGN

This section presents the proposed solutions of the problems in detail. The design details should all be placed in this section. You may create a number of subsections, each focusing on one issue.

This section should be up to 8 pages in length. The rest of this section shows the formats of subsections as well as some general formatting information. You should also consult the Word template.

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The font used for the main text should be Times New Roman (Times) and the font size should be 12. The first line of all paragraphs should be indented by 0.25in, except for the first paragraph of each section, subsection, subsubsection etc. (the paragraph immediately after the header) where no indentation is needed.

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Table 1: UNITS FOR MAGNETIC PROPERTIES

Symbol	Quantity	Conversion from Gaussian
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C *References*

The list of cited references should appear at the end of the report, ordered alphabetically by the surnames of the first authors. The default style for references cited in the main text is the

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