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Subject Review of Tomas Plch's Thesis

Delft University of Technology

Faculty of Electrical Engineering,
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Man-Machine Interaction

To Prof. RNDr. Jan Kratochvil

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Dear Jan Kratochvil,

Please find my report on the thesis of Tomas Plch's thesis, titled *Believable decision making in large scale open world games for ambient characters* below.

Kind regards,

Koen Hindriks

A handwritten signature in blue ink, appearing to read 'Koen Hindriks', with a horizontal line underneath.

Report

General description of the thesis

The thesis reports research about a range of techniques to enhance and improve the design and development of non-player character (NPC) behaviors in role playing games. The work is motivated by the need to make these characters appear more realistic and more interesting from a human player's point of view. Techniques are introduced to facilitate the design and implementation of NPCs that play 'stories' independently of human player interaction. The main research contribution is the extension and enhancement of well-known behavior trees for scripting gaming characters into so-called stateful behavior trees. The usefulness and effectiveness of the reported work is illustrated by means of a set of realistic scenarios in a commercial RPG, supported by video material that visually illustrates the application of the techniques. A major result is that the thesis shows the techniques are ready for application in commercial RPGs.

Structure and presentation

The thesis consists of 11 chapters (160 pages including bibliographic references and appendices). The structure matches what is expected of a thesis. It includes an introductory and an analysis chapter introducing the research domain, and presents an evaluation of the proposed approach. The document is clearly structured, accessible, and includes figures, schemes, and tables to illustrate and support the material presented.

Relevance of the problem addressed

The main problem that is tackled in the research is a well-known problem in gaming that has been very difficult to address. The problem is how to make NPCs appear more realistic and natural in large and complex gaming environments. The only way of addressing this problem so far has been to handcraft the behavior for each and every type of these NPCs in a game. This approach does not scale and requires enormous amounts of developer effort. The work presented to addresses this problem builds on the literature that is available and proposes a new and original approach for dealing with it. The demonstration of the use of the work reported in a commercial game moreover clearly shows the relevance of the work for the gaming industry, and more broadly will have implications for the design and development of future games.

Originality and significance of the scientific results

The work is original in terms of the new techniques as well as in terms of the level of detail to which these techniques have been researched and applied in realistic games. The work not only introduces an extension of behavior trees with state but also adds techniques for modelling knowledge that can be reused throughout game design. The behavior injection technique is particularly interesting and appears to facilitate a more dynamic approach to behavior design of NPCs. The evaluation with more than 15 developers of a gaming company also is very significant in that it demonstrates that the techniques can be applied by industry. The industry deployment evaluation adds to this by demonstrating that also performance wise it is feasible to apply the proposed techniques in practice. It would have been useful if the work would have more clearly discussed and summarized the main findings here but overall the results presented look very promising.

The work could have perhaps been framed differently to more clearly highlight the contributions even better. Although the motivating context for creating more 'believable characters' is clear, the work itself appears to be aimed more at providing developers with useful techniques to enhance the decision-making and behavior of NPCs. An in depth analysis of the notion of believability is missing and moreover the evaluation chapter also rather focusses on developers rather than human game players. The work thus contributes perhaps only more indirectly to the believability of NPCs but first and foremost extends and adds new and original tools to the toolbox of gaming developers. The work of visual state behavior trees is very interesting in this regard and opens up many interesting and useful opportunities for

future research. The claim that the work is superior in terms of expressiveness therefore is still hard to evaluate and future work will still be needed to validate this claim.

The extension of behavior trees with many features such as state, variables and messaging is a major contribution of the thesis. The work is presented in depth and great detail and considers many aspects of developing state behavior trees into a useful and powerful language for gaming development. It would have been useful if the syntax would have been introduced in detail too. Another question that could have been discussed in more detail is the relation between the semantics of the language and the CGE. In what sense is the language proposed independent of the game itself? For example, how are references to send a message to all characters in a particular area resolved? The messaging mechanism proposed is rich but also quite complicated. It would have been useful to evaluate this aspect with developers in detail too.

The work on knowledge graphs for games also is particularly interesting. A framework is developed to access different types of knowledge for annotating a virtual world. This work provides a significant extension of existing approaches for developing games. A question that is not addressed is why the author chooses to develop its own type of knowledge graph instead of building on existing technology for storing and querying knowledge graphs.

Overall evaluation

Overall the thesis presents a coherent piece of work. I consider the thesis to clearly demonstrate the author's ability to perform creative scientific work. The work presented is original and significantly goes beyond the current state-of-the-art in gaming by offering a more generic toolbox to gaming developers that is moreover ready for deployment in the gaming industry. By aiming for both industrial-level strength and new original techniques for behavior design the work provides a unique contribution to improve realism in RPGs.