Virtual Worlds for Serious Applications (VS-GAMES'12)

Towards a Biocybernetic Approach for Serious Games

Real-time Psychophysiological Inferences for Adaptive Agents in Serious Games

Neil Suttie\textsuperscript{a}, Sandy Louchart\textsuperscript{a}\textsuperscript{*}, Theodore Lim\textsuperscript{a}, Jim Ritchie\textsuperscript{a}

\textsuperscript{a} Heriot-Watt University, Edinburgh EH14 4AS, Scotland, UK

Abstract

In this article we discuss the possible use of real-time psychophysiology towards the design and implementation of an adaptive affective agent for Serious Games. This work is still in its early stages and this position article aims to present a reflection on the technical and methodological conditions to be met so as to conduct successfully this research. Our hypothesis is that, through the combination of psycho-physiological measurements and in-game behaviour/achievement monitoring, we should be able to identify whether or content is contributing to an efficient and engaging educational experience.

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1. Introduction

Serious Games (SGs) have the potential to offer both an effective and motivating educational experience. However, not all SGs can be said to be effective or suitable for all learners. We know that effective learning is conditioned by learning preferences [1] and studies such as those conducted by O’Neill et al. [2] and Rowe et al. [3] have shown that Serious Games do not necessarily guarantee successful learning and may even prove tangential to the learning process.

We believe that the ability to the preferences and abilities of an individual learner is key to securing successful learning strategies for future SGs. Furthermore, player affect and affect related states such as motivation, empathy and attention are also known to play a key role in influencing learning outcomes [4]. For these

* Corresponding author. Tel.: +44 0 131 451 3424; fax: +44 0 131 451 3327.
E-mail address: S.Louchart@hw.ac.uk.
reasons, the development of Serious Game adaptive technologies is a non-trivial task and requires that we must consider: user competency, real-time performance constraints, user flow or engagement and finally, that we correctly structure and balance the learning content within the game to prevent breaking the game experience [5].

While encompassing aspects of psycho-physiological monitoring and pedagogy, our multi-disciplinary approach will primarily focus on developing AI planning for dynamic contextual environments.

2. System Proposal

Adaptation for Serious Games can be described as occurring at either the macro or micro level [6]. Macro level adaptations include: game narrative, environment and gameplay mechanics. While, micro level adaptations involve providing player with feedback and guidance. Thus, we argue that a system such as the one we propose to develop should require both micro and macro level considerations towards an adaptive SG. In this context, we propose to develop an adaptive system based on the following three main components:

- Psycho-physiological inputs to inform the system of changes in the user internal state.
- Adaptive AI technology which utilises these inputs to create a virtual representation of the player.
- A serious game as to investigate the potential for such adaptive AI to promote efficient learning.

These components describe a biocybernetic control loop where psycho-physiological data from the player is gathered so as to determine a learner’s internal state with a SG and simulate the potential impact of alternative approaches on the learner. The control may act on both negative (avoid an undesirable state) and positive (approach a positive state) basis, as described in [7] and such an approach would necessitate the implementation of both control mechanisms.

In the context of this research, the aim is not to advance the state-of-the-art in terms of psycho-physiological practice but to identify specific signals allowing for the detection of aspects of player state that can be correlated by analysis of behaviour or performance. Developing a system capable of making long term macro level adaptations based on physiological inference would also represent a novel approach to planning artificial Intelligence (AI) for SG research.

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References