

# Using Biometric Measurement in Real-Time as a Sympathetic System in Computer Games

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## ABSTRACT

*With the increasing potential for gaming hardware and peripherals to support biometrics, their application within the games industry for software and design should be considered. This paper assesses the ability to use a form of biometric measurement, heart rate, in real-time to improve the challenge and enjoyment of a game by catering it to individuals of varying ability. While the findings of this study are valuable to game developers interested in providing additional dimensions to gameplay and testing, they may also be useful for those researching medical or therapeutic applications for games. The results suggest that although the tested game was inherently challenging and enjoyable, the adaptive affective gameplay was not altering the game enough to induce strong physiological or emotional responses from participants. Biofeedback games lend themselves to medical applications, but adaptive affective games can be used to respond sympathetically to the player without requiring direct control of physiological responses as a form of input.*

*Keywords: Adaptive Affective Games, Biometrics, Heart Rate, Real-Time, Sympathetic Video Game*

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## INTRODUCTION

The field of biometrics is a relatively new area within the games industry and as such, the research and standardisation of equipment are on-going.

The following research looks towards the hypothesis that an adaptive affective game can be created using a basic biometric device that will consistently create adequate challenge for any player and ultimately provide a more enjoyable experience.

## LITERATURE REVIEW

### Biometrics

Identification is the common ancestor to all biometric applications. The seminal programs adopting the use of biometrics were predominantly used for the purposes of security and identity of subjects in criminal justice (National Science and Technology Council, 2006). While these areas are still being actively researched (Planet Biometrics, 2012), identification

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through biometrics serves a purpose in more diverse applications and has surfaced recently within the context of video games.

Biometrics by definition refers to “a measurable biological and behavioural characteristic that can be used for automated recognition” (National Science and Technology Council, 2010). Put simply, the use of biometrics enables people and software to recognise a specific individual from their physical data. The characteristics that can be measured fall into two categories: behavioural (voluntary, e.g. gestures) and biological (involuntary, e.g. heart rate; Fairclough, 2007).

This study will focus on biological characteristics and in particular, psychophysiological responses, which are often measured to interpret emotions. Psychophysiological responses include: heart rate, skin conductance and muscle activity (Kivikangas, et al., 2011).

The current use of biometrics in video game hardware is limited. Motion controls recognise gestures from an individual, tracking movement data and mapping it to the screen for gameplay and control of system interfaces. In some cases such as Microsoft’s full body motion sensor, Kinect, voice recognition and facial recognition are used for player profiles and to avoid disturbance from the surrounding environment (Microsoft, 2012).

In contrast to the commercial application of biometrics, the field has been covered extensively in both applied psychology research and within the field of game evaluation (Kivikangas, et al., 2011).

## Biofeedback

Within the field of human-computer interaction (HCI), biofeedback is one application of biometrics in games. The key feature of biofeedback is awareness of control; it directly shows the player how their physiological responses are affecting the game in real-time (Bersak, et al., 2001).

The key applications of biofeedback within the field of computer games identified in literature are: therapeutic software, motivational exercise and as a direct input device within games.

Notable uses of therapeutic biofeedback include its clinical applications, aiding the treatment of medical conditions and as a form of pain relief (University of Washington Seattle and U.W. Harborview Burn Center). It can also be used in other types of therapeutic software, such as Wild Divine, where it is used for meditation and reducing stress levels (Wild Divine, 2012).

Nenonen et al. created a game to play whilst exercising to be used as a motivational tool, which took player heart rate readings to adjust variables in gameplay (Nenonen, et al., 2007). Participants were very aware of how the system worked, giving them a tactical advantage. This worked well within the realm of fitness games and achieved its objective; motivating players to increase their heart rate. However, the inherent exploitability of biofeedback could make it difficult to fit into a more traditional game where finer control over input is required for gameplay.

The use of biofeedback as a way to augment traditional game input is illustrated in several papers.

Bersak et al. created a racing game where the player’s stress levels, measured using galvanic skin response (GSR), directly affect the speed of a dragon. The game uses a ‘relax-to-win’ mechanic, and heavily featured competition between players to stimulate heart rate increase through tension and stress (Bersak, et al., 2001).

In contrast to Bersak, Nacke et al. used a large variety of both direct and indirect physiological controls to enhance gameplay as forms of input. In this case, biological responses were mapped to background variables in gameplay and behavioural responses were mapped to controls in conjunction with a standard game controller (Nacke, Kalyn, Lough, & Mandryk, 2011).

Current biometric hardware can require a significant amount of time and expertise to set up and calibrate. When used as direct input devices in games, the controls can be tiring, obtrusive and uncomfortable (Nacke, Kalyn, Lough, & Mandryk, 2011). Even though biofeedback can add extra dimensions to gameplay,

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