

Chapter 16

Bio–Affective Computer Interface for Game Interaction

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ABSTRACT

Affective bio-feedback can be an important instrument to enhance the game experience. Several studies have provided evidence of the usefulness of physiological signals for affective gaming; however, due to the limited knowledge about the distinctive autonomic signatures for every emotion, the pattern matching models employed are limited in the number of emotions they are able to classify. This paper presents a bio-affective gaming interface (BAGI) that can be used to customize a game experience according to the player's emotional response. Its architecture offers important characteristics for gaming that are important because they make possible the reusability of previous findings and the inclusion of new models to the system. In order to prove the effectiveness of BAGI, two different types of neural networks have been trained to recognize emotions. They were incorporated into the system to customize, in real-time, the computer wallpaper according to the emotion experienced by the user. Best results were obtained with a probabilistic neural network with accuracy results of 84.46% on the training data and 78.38% on the validation for new independent data sets.

INTRODUCTION

Physiological signals offer a promising medium to interact in a natural and intuitive way with the game environment. In addition of being reliable, sensible and provide real time feedback, physiological signals offer an insight into hu-

man's physical and mental state which can be used to enrich the game interaction. Common physiological measures already used in gaming or Human Computer Interaction (HCI) include: cardiovascular, electrodermal, muscular tension, ocular, skin temperature, brain activity and respiration measures. The game industry has already seen their potential and several research studies

DOI: 10.4018/978-1-4666-0029-4.ch016

have been conducted to investigate the best way to use them.

One of the earliest commercial examples of a bio-adaptive interface used in commercial games can be seen in “Tetris 64”, released for the Nintendo 64 platform. In “Tetris 64” a sensor is placed at the player’s ear to monitor the heart rate, the game speeds up or slows down depending on the player’s cardiovascular activity. A more modern commercial example is “Relax & Race” by Vyro games. In “Relax & Race” the game takes the form of a race between two characters: stress and the player. The game senses the electrodermal activity (EDA) of the player and increases the speed of the character as the player relaxes.

There are also several research studies that explore physiological signals in gaming. Touns et al. (2006) for example use electrodermal and electromyographic (EMG) activity as an indication of increased attention, effort and stress in team game play. In their game, the computer opponents sense the physiological signals and pursue players with higher activation levels. One interesting feature of this study was that the physiological information was provided to the team coordinator thus he could modify the game strategy. Another study that also uses EDA and EMG activity was carried out by Predinger et al. (2006) where the emotional response of a character was adapted according to physiological responses of the player in a virtual card game.

Gilleade et al. (2005) proposed that the identification of emotions, through physiological signals, can provide means to the Artificial Intelligence (AI) of the game for automatically: i) assist (e.g., when the player is frustrated), challenge (e.g., when the player is bored), emote (to enhance the game experience of the player). In their studies they developed a game that monitors the cardiovascular activity to increase or decrease the number of threats in a game.

Educational games and tutoring systems have also employed the use of physiological signals to provide affective feedback to the system and

adapt according to the student emotional state (Conati, 2002).

Research in brain activity has led to the creation of brain-computer interfaces (BCI) which have been used as a game interface control for an immersive 3D gaming environment (Lalor et al., 2005) and for moving a ball on a table in Brainball (Hjelm & Browall, 2000). Ko et al. (2009) presented the emotion recognition capabilities for games of three currently available portable BCI devices: NIA, Emotive EPOC and Mind Set.

Respiration measures have also been used to interact with games. Arroyo and Romano (2009) developed a simple balloon game where the player blows up a virtual balloon with his chest expansion and contraction while breathing. Table 1 presents a summary of some games that recognize emotions by the use of physiological signals.

There are two important observations from the literature reviewed:

- i) Most of the emotion recognition systems (ERS) follow an ad hoc strategy (i.e., they provide a solution designed for a specific problem or task, non generalizable, and which is not easily adaptable to other purposes).
- ii) There are very few multi-category discrimination emotion recognition systems implemented in real-time. All the emotion recognition systems of the games presented in Table 1 are aimed to identify the presence or absence of a particular emotion, or to discriminate among small sets of opposite emotions.

Nowadays, games are being produced for a great variety of domains including: entertainment, training, medical therapies, education and socialization. Users are more demanding in their expectations, and current games involve more photographic realism, cinematic sequences and new interaction methods. Emotions recognition systems can contribute to enhance the emotional

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