Configuration for Engagement Studies of Computer and Video Games

Method for the study of physiological responses of in-game player experience

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Abstract

Computer and video games are unique systems in which participants often interact with for the mere enjoyment of doing so. Engagement is reported to be key factor in the player experience. To understand this engagement and correlation between player engagement and computer and video games, a multi-nodal approach is required. This paper offers an introductory summary of one of the approaches in a multi-nodal framework. The approach presented here is the study of physiological responses of in-game player experience. Other components of a multi-nodal approach covered briefly in this paper are literature studies, the study of player accounts and the study of in-game metric data from computer and video games.

The approach described here is the study of real-time data acquisition from physiological responses generated during play sessions. The data acquisition is generated through, Eye-tracking, using a Tobii X2-30 Eye-tracker, EEG, with the Emotive EEG, Neuroheadset, and the measuring of heart rate variability.

The real-time physiological data acquisition from the play session is conducted and displayed together with a player screen record of the gameplay on a "4K," extreme high-resolution 3840 × 2160 pixel display. This allows users to record the play-session and the acquisition data all on one display. This provides optimized access to synchronized data when recorded sessions are later under review for analysis. The 4K display is four times larger than conventional HD displays. The configuration used is using a generic PC "Quad-CORE" equipped computer with an AMD "V7900" graphics card operating on Microsoft Windows 7. The four Display-Port outputs from the card are converted to four DVI's, which are connected to the "DM-3410-A", 4K Astrodesign monitor. The physiological data acquisition is operated by the PC and displayed in the separate fields on the screen.

This method of studying the physiological responses of in-game player experience provides a large spectrum of multi-nodal data coupled with optimized display and review capabilities. This data together with the other approaches in a multi-nodal framework can help researchers and designers in gaining further knowledge about correlations between player engagement and computer and video games.

Keywords

4K display system, engagement, computer and video games, physiological data acquisition, multi-nodal framework.

INTRODUCTION

To provide the larger context of which the study of physiological responses is a part of, this paper will describe the overall set up and approach of the study of engagement in games. Thereafter a more detailed description of the acquisition of real time data from the physiological responses in players
will be provided. The Configuration for Engagement Studies of Computer and Video Games is a multi-nodal study. The study in its entirety is comprised of several areas. These areas are literature studies, verbal behaviors, non-verbal behaviors and self reported data. The focus of the paper is on the non-verbal behaviors while the others will be explained briefly in order to describe the larger framework of and context of the study. The different methods with-in the multi-nodal approach examine the question of engagement in different ways. This is to provide both a component based data set while offering the possibility of a more holistic approach. This is motivated by the concept of games as consisting of both significant components that can be experienced independently and or together in a synthesis of form towards an overall experience or gestalt.

The verbal behaviors covered in the study are in-game social interaction and communication via voice and voice-over-internet protocol service (VoIP) software that allows computer users to speak on a chat channel with fellow users, much like a telephone conference call. Commonly used examples in computer games are Skype, and TeamSpeak where users will often wear a headset with an integrated microphone.

The non-verbal behaviors will be described more in detail later in the paper. These are in-game data acquisitions methods as listed below:

1. Facial Expressions. The current set is done with the use of Video based systems such as the Noldus (FaceReader) 5.0.
2. The Physiological responses: The set up consists of:
   a. Gaze, Eye tracking: Tobii X2-30 Eye Tracker
   b. Temperature and galvanism in fingers.
   c. EEG: Emotive Neuroheadset, 3D Brain Activity Map
   d. Heart rate variability

The Self reported Data is gathered from players before, during and after play sessions. It is also collected in a general surveys and interviews examining memorable experiences over a five year span of time. This is done in regards to specific gaming experiences and or games that created significantly memorable experiences of engagement.

The Self reported Data is:
   a. Expectation Measure
   b. After-Scenario Questionnaire
   c. Post session ratings
   d. Specific attribute assessment
   e. Long-term references
   f. Surveys

GENERAL DISCUSSION,
As the study of participant engagement is in the area of games a definition of terms and scope is required. The definition of the term game and the scope of the game components and the game as a whole will be described in this section.

A widely accepted definition of what a game is still not agreed on in the field of Game Studies or Game Design. There are many approaches and many corresponding definitions. The definition used in this study and for the framework at large is the result of previous studies as described in the paper: Descriptive Methodology of Design (DMD) for the Game Design Process and Game Design Educations [1]. This definition is not a universal and definitive definition of what games are, but instead a working description of what games are to provide a framework for the study. This was necessary in order to define the area in which different aspects of game design and the subsequent engagement in players will be mapped out. The description was formed to meet the criteria of being general enough to catch all game variations, (so that none are excluded) and specific enough to catch only game variations (so that no other phenomena are included). The description is meant to be agile enough to describe many different game variations while accommodating adoption, and further development as required. An additional requirement is to while allow for other models to be combined and incorporated into the framework.

Statement 1. Provides a working definition of “Games” and of the components in games, while statement 2, provides a definition of the phenomena often referred to as “Serious games. This definition is included as the difference between the two is often a source of confusion. Statement 2 serves as a secondary definition and is changed only areas required to make a distinction between the working definition of “games” and “Serious Games”.

Statement 1.
Description of the term; “Game”
A Game is an artifact and/or an event comprised of a limited context, representation and system in which voluntary participants receive feedback when interacting with the system through choices and actions in pursuit of quantifiable system-specific goal/s in negotiation of other participants and/or system-elements for the enjoyment of doing so.
Statement 2.

**Description of the term “Serious Game”**

A Serious game is an artifact and/or an event comprised of a limited context, representation and system in which participants receive feedback when interacting with the system through choices and actions in pursuit of quantifiable system-specific goal/s in negotiating of other participants and/or system-elements by enjoyable means to gain skills, knowledge or insights transferable to none game contexts.

Engagement is a desired state in the players of games and often has impact on or is a result of the overall experience of the game. As in the study and design of games, the study of engagement in games is aided by examining the components of the game in relation to engagement and the entire experiential gestalt.

This is done in relation to the concept of the embodiment of form coming together as a unified entity. Although a designed artifact consists of many components it is able to be experienced as a synthesis of form or “Gestalt” that is more and different than the sum of its parts.

Aristotle suggested a unity of action under the larger subject; "definition of tragedy". Aristotle writes in the Poetics; “As therefore, in the other imitative arts, the imitation is one when the object imitated is one, so the plot, being an imitation of an action, must imitate one action and that a whole, the structural union of the parts being such that, if any one of them is displaced or removed, the whole will be disjoined and disturbed. For a thing whose presence or absence makes no visible difference, is not an organic part of the whole.

In games, the artifact and the event are embodied in the experiential object as a whole.

This requires not only a study of the different aspects of the game playing experience in its temporal real-time form but also the experience as a whole and the memory of that experience over time.

The continued focus of this paper will be in the physiological aspects occurring in players during game play sessions and the method of measuring, recording and displaying this data for analysis.

This is the study from real-time data acquisition from physiological responses generated during play sessions. The data acquisition is generated through, Eye-tracking, using a Tobii X2-30 Eye-tracker, EEG, with the Emotive EEG, Neuroheadset, and the measuring of heart rate variability.

The real-time physiological data acquisition from the play session is conducted and displayed together with a player screen record of the gameplay on a “4K,” extreme high-resolution 3840 × 2160 pixel display. This allows users to record the play-session and the acquisition data all on one display. This provides optimized access to synchronized data when recorded sessions are later under review for analysis. The 4K display is four times larger than conventional HD displays. The configuration used is using a generic PC "Quad-CORE" equipped computer with an AMD "V7900" graphics card operating on Microsoft Windows 7. The four Display-Port outputs from the card are converted to four DVIs, which are connected to the "DM-3410-A", 4K Astrodesign monitor. The physiological data acquisition is operated by the PC and displayed in the separate fields on the screen.

(See figures 1-2)
DATA ACQUISITION METHOD

Much of the data acquisition methods in the multi-nodal framework overlap each other. This overlapping is an intentional aspect of the arrangement in order to provide finer granularity and multiple data sets from multiple perspectives thus providing a larger and perhaps more robust statistical database from which to study.

The Noldus FaceReader analyses automatically facial expression as it occurs in users. It can record videos and mark interesting events. An individual line graph shows the intensity of the recorded emotions and can be displayed in sync with the video of the test participant and the stimulus, providing an overview. When working with multiple test participants, a summary line graph or pie chart is displayed and synchronized with the stimulus based on (marker) selection. (See figure 3)

Fig 3. The FaceReader interface, showing the test participant’s face, the facial expressions, and a number of properties.

The Noldus FaceReader can be used for a large variety of test scenarios and stimuli dimensions offering a comprehensive method for gaze accuracy and precision measurements to facilitate performance comparisons of different remote eye tracking systems. The Tobii has a dual camera system that tracks both eyes with automatic selection of bright or dark pupil eye tracking, which accommodates for large variations in experimental conditions and ethnicity. This capability ensures low participant data loss and allows for study involving with a wide cross-section of the population. The Sampling rate is 30 Hz (std. dev. approx. 2 Hz) System latency 50 – 70 ms. and the time to tracking recovery for blinks is immediate.

The data sample output (for each eye) is a Time stamp, Eye position, Gaze point and Pupil diameter. (See figure 4)

Fig 4.

The Emotiv EEG is a high resolution, multi-channel portable EEG with access to raw EEG data. Brain activity data is often collected through the use of electroencephalography (EEG). This to investigate the brain by reading electric fields generated in neuron groups in the cortex when active. [2]. An Emotiv EEG headset (Emotiv Systems Inc., San Francisco, CA, USA) is used to record electroencephalograph data, (EEG). The Emotiv EEG is also able to reliably capture P300 signals even though the accuracy of high-end systems is superior. In this data acquisition, the electric fields generated by neurons are measured at the scalp. The headset is fitted with 14 felt-tipped electrodes and 2 reference electrodes that are saturated in a saline solution and connects wirelessly to most PCs. The electrodes are placed in roughly the widely used 10-20 system and are labeled as such [3]. In addition by using EEG headset, we can get Raw Data and use The Affective Suite on the control panel, which detects (Engagement/Boredom, Meditation, Frustration and Instantaneous Excitement). The processing and analysis of EEG generated data can be done either through time domain analysis and/or spectral analysis.

The Tobii X2-30 Eye Tracker can be used for a large variety of test scenarios and stimuli dimensions offering a comprehensive method for gaze accuracy and precision measurements to facilitate performance comparisons of different remote eye tracking systems. The Tobii has a dual camera system that tracks both eyes with automatic selection of bright or dark pupil eye tracking, which accommodates for large variations in experimental conditions and ethnicity. This capability ensures low participant data loss and allows for study involving with a wide cross-section of the population. The Sampling rate is 30 Hz (std. dev. approx. 2 Hz) System latency 50 – 70 ms. and the time to tracking recovery for blinks is immediate.

The data sample output (for each eye) is a Time stamp, Eye position, Gaze point and Pupil diameter. (See figure 4)

Fig 4.

Metric Data and Game Analytics.

In addition to these systems there are also HCI & input device recordings and metric data and game analytics. These track players in-put though the keyboard and mouse and also the avatars movements and actions and the in-game camera in the game space. This can be thousands of interactions during a play session as players interact with the system.

Consider, for example, players in a typical fantasy MMORPG like World of Warcraft: Measuring user behavior could involve logging the position of the player’s character, its current health, mana, stamina, the time of any buffs affecting it, the active action (running, swinging an axe), the mode (in combat, trading, traveling), the attitude of any NPC enemies toward the player, the player character name, race, level, equipment, currency, and so on -- all these bits of information simply flow from the installed game client to the collection servers.

(Game Analytics, Maximizing the Value of Player Data, Magy Seif El-Nasr, Anders Drachen, Alessandro Canossa)
Fig 5.

The Configuration for Engagement Studies of Computer and Video Games and the central synchronizing and data retrieval (CSDR) is described in the illustration above. (See fig. 5)

FURTHER WORK
Additional work will be in conducting tests with multiple test subjects and comparing results between conclusions from literature studies, the self reported data from the subjects and the nonverbal in-game player data.

Descriptive Methodology of Design (DMD) for the Game Design Process and Game Design Educations, IWAIT, 2013
