Play Experience Enhancement Using Emotional Feedback

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Abstract

Abstract less than or equal to 1 page one page stating what the thesis is about highlight the contributions of the thesis

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List of Abbreviations

TT	Thought Technology
GSR	Galvanic Skin Response
EMG	Electromyography
HR	Heart Rate
BVP	Blood Volume Pulse
EDA	Electrodermal Activity
HCI	Human Computer Interaction
AV	Arousal/Valence
NPC	Non-Player Character
Mod	Modification
CSV	Camma Separated Values

Chapter 1

Introduction

Since computers are playing a significant role in our daily life, the need for a more friendly and natural communication interface between human and computer has continiously increased. Making computers capabale of perceiving the situation in terms of most human specific factors and responding dependent to this perception is of major steps to acquire this goal. If computers could recognize the situation the same way as human does, they would be much more natural to communicate. Emotions are of important and mysterious human attributes that have a great effect on people's day to day behavior. Researchs from neuroscience, psychology, and cognitive science, suggests that emotion plays critical roles in rational and intelligent behavior [16]. Apparently, emotion interacts with thinking in ways that are nonobvious but important for intelligent functioning [16]. Scientists have amassed evidence that emotional skills are a basic component of intelligence, especially for learning preferences and adapting to what is important [13, 8] People used to express their emotions through facial expressions, body movement, gestures and tone of voice and expect others understand and answer to their affective state. But sometimes there is a distinction between inner emotional experiences and the outward emotional expressions [15]. Some emotions can be hard to recognise by humans, and inner emotional experiences may not be expressed outwardly [9]. Recent extensive investigations of physiological signals for emotion detection have been providing encouraging results where affective states are directly related to change in inner bodily signals [9]. However whether we can use physiological patterns to recognise distinct emotions is still a question [16, 4].

Although the study of affective computing has increased considerably during the last years, few have applied their research to play technologies [21]. Emotional component of human computer interaction in video games is surprisingly important. Game players frequently turn to the console in their search for an emotional experience [18]. There are numerous benefits such technology could bring video game experience, like: The ability to generate game content dynamically with respect to the affective state of the player, the ability to communicate the affective state of the game player to third parties and adoption of new game mechanics based on the affective state of the player [21]. This work concentrates on developing a real-time emotion recognition system for play technologies which can quantify player instant emotional state during a play experience The rest of the paper is organized as follows: in Section 2 we outline different emotion recognition theories with an overview of physiology sensors. In Section 3 we demonstrate some implementation details of the system. We then describe the experimental setup in Section 4 before giving our results in Section 5. Finally, we give conclusions in Section 6.

Chapter 2

Human and Play Technologies

2.1 Affect and Emotion

Using emotional responses to increase the level of users interaction with a real-time play technology requires an effective technique to identifying specific emotion states within an emotional space. Major existing emotion models in the psychology literature includes: basic emotion theory [6, 7] , dimensional emotion theory [10, 19] and models from appraisal theory (e.g., [17]) [23]

Basic emotion theory identifies anger, disgust, fear, happiness, sadness, and surprise [14] as the concise set of primary emotions. These are actually the least six universal categories researchers agreed upon [22]. It also claims these primary emotions are distinguishable from each other and other affective phenomena [5]. On the other hand dimensional emotion theory argues that all emotional states reside in a two-dimensional space, defined by arousal and valence.

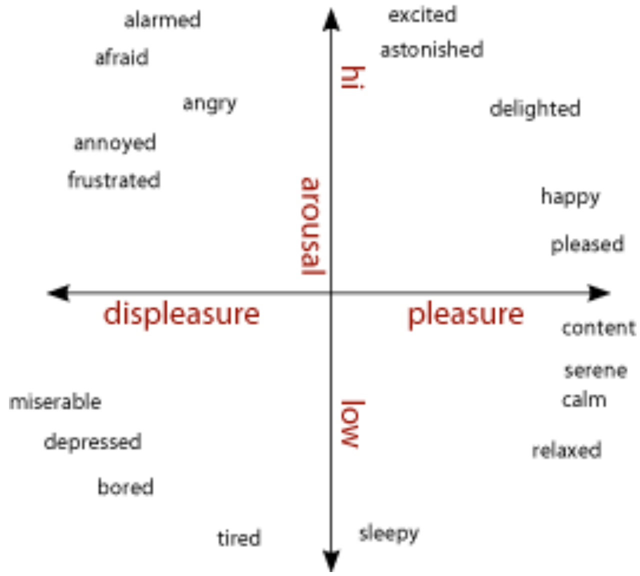
While there are various opinions on identifying emotional states, classification into discrete emotions [5], or locating emotions along multiple axes [20, 10], both had limited success in using physiology to identify emotional states [3].

Lang used a 2-D space defined by arousal and valence (pleasure) (AV space) to classify emotions [10]. Valence can be described as a subjective feeling of pleasantness or unpleasantness while arousal is the subjective state feeling activated or deactivated [1]. Using an arousal-valence space to create the Affect Grid, Russell believed that arousal and valence are cognitive dimensions of individual emotion states. Affect is a broad definition that includes feelings, moods, sentiments etc. and is commonly used to define the concept of emotion [15]. Russell's model has two "axes" that might be labeled as displeasure/pleasure (horizontal axis) and low/high arousal (vertical axis) It is not easy to map affective states into distinctive emotional states, However these models can provide a mapping between predefined states and the level of arousal and valence [22], Figure 2.1.

Both mentioned models for identifying emotions convey some practical issues in emotion measurement. In a HCI context, the stimuli for potential emotions may vary less than in human-human interaction (e.g., participant verbal expressions and body language) [23] and also the combination of evoked emotions [14]. However with help of physiological signals and the fuzzy logic in the model we are going to use, such issues

[1] Photo credit: http://imagine-it.org/gamessurvey/

Figure 2.1: Russell's circumplex model with two axes of arousal and valence [1].



with our dimentional emotion models would be minimized. Though it is anticipated to observe different range of evoked emotions while interacting with play technologies compared to interacting with other humans in daily life. [23]. However our dimensional emotion models suffers some other problems. One problems is that arousal and valence are not independent and one can impact the other [12]. Continuously capturing emotional experiences in this applied setting is of its other hallmarks. Subjective measures based on dimensional emotion theory, such as the Affect Grid [20] and the Self-Assessment Manikin [2], allow for quick assessments of user emotional experiences but they may aggregate responses over the course of many events [23]. This work uses Mandryk et al. version of AV space [12].

2.2 Measuring Affect

2.3 Affect and Play Technologies

2.4 Real Time Game Adaptation

Playing video games as a kind of entertainment would help people to have new internal experiences. The virtual world of video games let adults to play as new rolls and enjoy filling their heads with new thoughts and emotions. Some people value the sensation

Games are opportunities for development and design of environments therefore the player can interactively experience various emotions and mental conditions. This interactive experience in contrast to cinema and other major types of entertainment is what makes them exceptional

Chapter 3

Customizing Play Experience in Real-Time

3.1 Adaptive Game Design

3.1.1 Player

3.1.2 NPCs

3.1.3 Environment

3.2 Phisiological Signals

3.2.1 Heart Rate

3.2.2 Galvanic Skin Response

3.2.3 Facial Electromyography

3.3 Real-Time Affect Engine

3.3.1 Fuzzy Logic for Space Transformation

3.3.2 Physiological Signals to Arousal and Valence

Chapter 4

Implementation and Integration

4.1 Recognising Emotion

Heart rate (HR), blood pressure, respiration, electrodermal activity (EDA) and galvanic skin response (GSR), as well as facial EMG (Electromyography) are of physiological variables correlated with various emotions most. Interpreting physiological measures into emotion state can be deficult, due to noisy and inaccurate signals, however recent on-going studies in this area by Mandryk and Atkins [12] presented a method to continuously identifying emotional states of the user while playing a computer game. Using the dimentional emotion model and the fuzzy logic, based on a set of physiologcial measures, in its first phase, their fuzzy model transforms GSR, HR, facial EMG (for fowning and smiling) into arousal and valence variables. In the second phase another fuzzy logic model is used to transform arousal and valence variables into five basic emotion states including: boredom, challenge, excitement, frustration and fun. Their study successfully revealed self-reported emotion states for fun, boredom and excitement are following the trends generated by their fuzzy transformation. The advantage of continiously and quantitatively assessing user's emotional state during an entire play by their fuzzy logic model is what makes their model perfect to be in incorporated with real-time play technologies. Therefore exposeing user's emotional state as a new class of uncontious inputs to the play technology.

4.2 Affect Engine

This project has developed a real-time emotion detection system which can continiously detect and recognise user's emotional state. The system uses Blood Volume Pulse (BVP), Galvanic Skin Response (GSR) and Electromyography (EMG; for frowning and smiling), to classify human affective states in 2-dimensional valence/arousal space, Figure 2. The system has three modules, Figure 4: The Blood Volume Pulse (BVP) signal is a relative measure of the amount of blood owing in a vessel. From BVP we calculated heart rate and heart rate variability. The heart rate is known to re ect emotional activity and has been used to differentiate between both negative and positive emotions as well as different arousal levels [11] The Galvanic Skin Response (GSR) sensor to measure the skin's conductance (between two electrodes and is a function of sweat gland activity and the skin's pore size). As a person becomes more or less stressed, the skin's conductance increases or decreases proportionally [15].

The sensor module includes a Thought Technology ProComp Infinity encoder [11] connected to PC with a USB cable. SensorLib is the basic module which receives and filters raw physiological inputs. Then filtered signals are fuzzified by the use of 22 fuzzy rules in the first phase of transformation. Then generated arousal and valence values are transformed into emotion values using another 67 fuzzy rules in the second pass [12]. Appliactions such as games can easily integrate the system where emotion recognition can offer adaptive control to maintain user interest and engagement. Once connected via sensors to the emotion recognition system, the affective state of the user can be captured continuously and in real-time and it can be monitored on a displayed 2-dimenstional graph of valance and arousal, Figure 1.

4.3 Inegration With Valve Source Engine

4.3.1 Level Design

4.3.2 The Director

Chapter 5

Experimentation

5.1 Participants

Data were recorded from 15 male and 2 female University students, aged between 18 and 32 (M = 25.00, SD = 3.875). As part of the experiment procedure demographic data were collected with special respect to the suggestions made by [?]. Of the participants 94.1% were right-handed. 41.2% of participants rated their computer skills as Advanced while the rest of 58.8% rated their skills as Intermediate. 35.3% of participants have described themselves playing video games every day, while 41.2% of them described themselves playing video games a few times per week and 17% have been playing video games a few times per month and the rest of 5.9% have been playing video games a few times per year. All participants have used PC as gaming system while 76.48% of them also have used at least one of the four popular console platforms (XBox360, PS3, PS2, Wii) for gaming. All of participants had at least some experience with 3D shooting games like First Person Shooters. 47.1% have described themselves playing 3D shooting games many times, while another 41.2% described themselves as experts in 3D shooting games; Only a total of 11.8% had limited or intermediate experience with 3D shooting games. Among the participants only 5.9% had intermediate experience in using mouse in games, 35.3% of them declared using mouse in games for many times and other 58.8% of them described themselves as experts in doing that.

5.2 Design

A four condition (standard, player, NPC, environment) play session was employed to evaluate performance and excitement as dependent variables. The order 4 Latin square used to permute conditions between participants was as the following:

a b c d

b c d a

c d a b

d a b c

5.3 Procedure

All experiments were conducted on weekdays, with the first slot beginning at 11:00h and the last ending at 18:30h. Participants were contacted to choose their preferred time slots while general time for one experimental session was 1:30 hours with setup and cleanup. Participants were invited to a laboratory, after a brief introduction of the experimental procedure, and becoming aware of the data being collected during the session, they were asked to fill out and sign informed consent form, this was the only paper form used during the experiment. Then the GSR sensors were attached to participant's hand.

Attached GSR sensors wired to the signal decoder brings limitations for participants while moving and using their hand. To diminish noisy signals and make participants feel comfortable under these limitations, the GSR sensors were attached to the hand that was handling the mouse during the game. While fingers dealing with mouse were quite steady compared to the other hand handling the keyboard, those fingers used to press the left and right mouse buttons were usually most comfortable ones for attaching GSR sensors. Some participants used index and middle fingers to press mouse buttons and others used index and ring fingers to do that.

Having GSR sensors attached, participants were seated in a comfortable office chair, which was adjusted according to their individual height. They were then led to fill out the initial game demographic questionnaire. To keep GSR sensors attached during the experiment, all questionnaires after attaching GSR sensors were filled out using mouse and the same computer system. After the demographic questionnaire, participants were asked to self-assess their arousal, valence and dominance level using the self assessment manikin (SAM) questionnaire [**?**]. Filling initial questionnaires after attaching GSR sensors was meant to give enough time (approximately 5 minutes) to the participant to get used to the sensors before playing the game. Participants then have been taken to a tour in the game. Different game mechanics were shown to them, and they were given about 1 minute, dependent to their experience, to make themselves comfortable with it. Some participants didn't need this time due to prior experience and asked to skip that. Then, participants played four different game conditions described before. Each game condition was set to take 5 minutes. After each condition, participants were asked to write their comments about particular changes they noticed under that condition and its effect on their gameplay. Then they were asked to filled out the intrinsic motivation inventory (IMI) questionnaire, the player experience of need satisfaction (PENS) questionnaire and the game experience questionnaire (GEQ) to rate their experience. Filling the questionnaires between conditions was done during the minimum 7 minutes of resting time before the next condition begins. The resting time was meant to restore players baseline signals. GSR sensors were recording players signals during both the play and the resting sessions from the beginning of the first condition to the ending of the last condition. After completion of the experiment, sensors were removed. The participants were debriefed and compensated $15 Canadian dollars and escorted out of the lab.

5.4 Materials and Measures

5.4.1 Game Experience Questionnaire

5.4.2 Self-Assessment-Manikin Valence Scales

5.4.3 Intrinsic Motivation Inventory

5.4.4 Player Experience of Need Satisfaction

5.4.5 Game Engagement Questionnaire

This study has been run during three weeks, each session took about 45 minutes. 17 participants of moderate to expert FPS players were asked to play the game under four different conditions: No Adaptation, Player Adapted, NPC Adapted and Environment Adapted. The order of played conditions was circulated between different players. Participants did not know what different conditions exists and which condition they are currently playing, at the start of the play session, they were required to press one of the four buttons on the entrance ramp labeled 1 to 4, and when any one of these buttons were pressed, the Affect engine started calibrating players signals for 60 seconds, during the calibration mode, no adjustment no any of game parameters is applied, no matter which condition is being played. After the one minute of calibration the system decides the standard range of signal for player's excitement value. After that except for the condition number 1 which is the no adaptation mode, the captured excitement value is normalized in the calibrated player range of excitement into a value between 0 and 1, and this value is then used to adjust the game parameters, this process of capturing, adjusting and applying the signal value would continue for 3 minutes until the next cycle of calibrating and adjustment starts. The player is required to play every condition for at least 5 minutes to ensure capturing of a complete cycle of calibrating and adjustment. After playing each condition, the player is asked to rest for 7 minutes, during this time the player is asked to fill out between condition questionnaires, which tries to ask the participant to self-estimate his affect level. The Player Mode is labeled as condition number 2, the NPC mode is labeled as condition number 3 and the Environment mode is labeled as condition number 4. From the 17 participants in this study, one has been lacking adequate level of expertise and therefore was unable to continue doing the required tasks at the expected level and therefore his results was not usable for this study. The image of signal values for this participant is depicted at the following:

An image of a regular participant signal values is depicted at the following. In this image from left to right the light blue line shows different conditions being played, and when the light blue line is declining towards its base value, that is the period that participant is asked to stop playing and instead relaxing and filling out the questionnaires. The blue line is the normalized GSR signal value of the participants which is used as an estimation of his excitement level. The yellow green and pink lines are showing the three different modes of Player, NPC and Environment parameters being adapted

Following image is the GSR signal of players playing different conditions from 1 to 4. From left to right the conditions are the Default, Player, NPC and the Environment mode. This signals are all based to an initial start value of 100, during the play experience, some of them had gone bellow the start point and some other had risen above that. Also the start time for each different condition is shifted 500 seconds times the number of condition, from 0.

The following image is the average of GSR values for players in four different conditions from left to right: Default, Player, NPC and Environment modes

Chapter 6

Discussion

5 to 10 pages talk for the discussion State what you've done and what you've found Summarize contributions (achievements and impact) Outline open issues/directions for future work

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Appendix A

Fuzzy Functions

put fuzzy functions here