A review of emotionally-adaptive game design

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Abstract. This research paper reviews the latest research in the field on emotionally adaptive game design. Adaptive gaming has been around for some time now, but the emotionally adaptive gaming is a new less explored area. As quantification and real time capturing of emotions correctly is still haven't been done successfully.There is much debate in capturing user's emotions itself. Though there have been attempts to capture the game player's physiological data using bio-signals like blood pressure,respiration rate have been done but these approaches are not perfect. Video games also have multiple elements which they can change to provide a more immersive experience to the player, and these change can be based on the player's interaction with the game. This research paper reviews the various technique, frameworks and arguments proposed by the researchers in the field of emotionally adaptive game design.

Keywords: Adaptive video games · Video Games · Emotionally Adaptive gaming.

1 Introduction

Video games have been around since the 1940s, but became increasing popular since 1980s, when the arcade games became popular. Video games are now multi-billion dollar industry and one of the most innovative ones as well. The game industry is one of that implement the technologies which enhance user experience, ranging from using artificial intelligence to control non-player characters to using virtual reality headsets. An adaptive application is an application which is capable of changing its behaviour in real-time to create a more personalised experience for the user. The latest video games try to adapt themselves to each individual user to provide a more customized experience which suits the users experience and objectives. All the user-centric customization qualifies the video games to be called as adaptive application. The next step in this quest for customization changing the mechanics of the game based on users emotions to make the overall game play enjoyable for all sets of users.

Emotions experiences by the player during the game-play are important to maintain his/her flow in the game [1].The game players interest, attention and satisfaction can be improved by controlling his/her emotions by the elements of the game-play [2]. A lot of techniques are available to decode the player's emotional state, it can be done by analysing the interactions of the player with the

game itself or by measuring the changes in player's psycho-physiological features. Adjusting various features of the game to playing types or styles can increase playing satisfaction and motivation [2].Thus, capturing emotional responses of players during game-play has potential to allow game-developers and designers to add more granularity to the customization. In this paper, we have reviewed the work done in the field of emotionally adaptive game design.

2 Methodology

Before going into the description and evaluation of the research work, the methodology of the data collection has been explained. This research involves three steps 1) identification and collection of the state of the art-research 2) cluster the research work based the the content, proposed analysis and objectives 3) analyse the research work and provide critical review. Google scholar and web-of-science was used to conduct the search for the specific research. The search string was - Creating an "Emotionally" "Adaptive" "Game". Based on the top 20 search results, multiple related research books/articles were selected. These resources fall under one of the three groups, research accessing emotionally adaptive games [2], research exploring player centric game design by using adaptive systems and artificial intelligence [3] [4] and ones which explore the emotionally adaptive gaming design [5] [6] [7].

Looking at the years when these research work were published, it is clear that the trend of developing adaptive games is quiet recent and have been around for last 20 years only. When looking at emotionally adaptive game design, these has even more recent, these came around last 10 years. The most resent of all the research selected was published in 2016 [2], which access the engagement of player in an emotionally adaptive game, which make sense according to chronological order of technology life cycle, from design, development to assessment.

3 Adaptive game

The [3] research paper discussed the need for developing a player adaptive game application. It discuss about how all the players are different inherently, they have their own preferences for the speed of game play, capabilities, and experiences. Even though two players might have similar abilities if game playing, the techniques selected by these players are almost always different for completing the in-game challenges. This research also provide examples about various player-centric game designs. It elaborates the three important player-centric approaches taken by games, first one is providing game-play control to user, like difficulty setting toggle. Second one is using in-game support systems in forms of boosts, clues, NPC (non-player character) guidance etc based on player performance. The third one is using dynamic technology that is responsive to individual player. The third approach was used by "Max Payne" (Take 2 Interactive, 2001) [8], where the difficulty of level are automatically altered in real time based on

player's performance. for b which A lot of game design incorporate providing game-play control example difficulty setting to the players.

The paper [3] also introduces a framework for adaptive games. According to [3], a game can adapt to the player through by changing 1) player's character 2) NPC character 3) game's state or environment. This research defines an on-line adaptive gaming system framework which constantly monitor player performance to update the game. The framework involves user modelling and re-modelling to extract most useful information. The framework initializes by modelling the player and categorizing them to an population profile. Their game-play is constantly monitored and player's profile can be re-categorized to a new population profile accordingly. This research also stresses on the re-categorization because of concept drift [9] [10]

The second paper [4] also introduces a framework to improve the game's AI through offline learning framework which can potentially enhance the dynamic scripting technique by improving the rulebase through the addition of offline discovered strategies and tactics. Dynamic scripting is an unsupervised learning technique where the rules which control the computer controlled opponent characters are extracted from the rulebase, which is the collection of all the applicable rules based on the player performance.

4 Emotionally adaptive game design

Design elements of an emotionally adaptive game is discussed below.

Quantification of player's emotions The toughest and most important task of an emotionally adaptive game is to quantify the player's emotions. This paper [6] provides a good discussion about the opinions of the two schools of thought for the same, i.e discreet model and dimensional model. The discrete emotion model states that all the basic emotions, anger, sadness, fear exists as unique states where as dimensional states that all the emotions can be characterised in two-dimensional space consisting of degree of valence and arousal. (sometimes dominance is added as third dimension). However,paper [7] introduces another definition of emotion quantification. According to this definition, there exists two main orthogonal dimensions, negative activation (NA) and positive activation (PA) that represents a 45 degree rotation of the valence and arousal axis. Then NA axis extends from arousing negative emotions where as low-arousing positive emotions extends the (PA) [7]. Another paper [5] states that the usage of term emotional adaptive gaming is flawed in itself. This research believes that there is no perfect emotional model and no explicit and absolute ways of measuring the emotions effectively. This study emphasises on using bio-signal adaptive gaming' instead of emotionally adaptive gaming.

Approaches on emotionally adaptive gaming The paper [6] states that an idea emotionally adaptive game will continuously measure the emotional data

and feed it to the system which will then make adaptations. All of this is done to maintain flow or immersion into the game-play. The authors also believe that there are no games which actually capture the emotions but stress on stress manipulation, which involves integration of player's physiological data into the game themselves. It also stresses on the detailed specification of the system's input and output. The authors have decided to use an intuitive "psychologically validated templates", game speed. This research aims to modify the game speed to see emotional response of the players. This research use 'Pacman' as the base game for the implementation due to ease of code modification and it's popularity. The emotions during the game-play were reported by the player's themselves. The research also collected psychological data like blood pressure, respiration rate etc. to study the relationship between the emotions, game-play and physiological response. This research focuses on analysing the emotional impact of change in game-play, rather than on development of an emotionally adaptive game.

The [5] paper presents it's learning's, methods and approaches the researcher have taken during the development of emotionally adaptive games. The research has utilized biofeedback technology, which consists of capturing player's bio-signals and other complementary data through accelerometers, gestures, voice and images. This research emphasises on the importance of balance between game challenges and it' reward. A game which adapt to the player's emotions can lead to the player's manipulating their emotions, the psychological signals to be precise, to beat the game. This is not desirable and developers should consider this while utilizing these signals. This research also emphasize the limits of using some statistical algorithms to analyse these psychological signals on the go because of the computing limitations. Finally, this research emphasises the development of good sensors which do not hinder the game play, for example "sniper gloves" which have GSR (galvic skin response) sensors, which measure arousal. In a nutshell, research provided the learnings it had gathered while developing emotionally adaptive games.

The third paper [7] provide a detail account of an emotionally adaptive game development. The researchers have developed a first person shooter game called "EMOShooter" which is a simple psychophysiologically adaptive game which uses player's psychophysiological signals to influence the ease of use of game controls which in turn changes the difficulty of the game.

5 Conclusion

From this research review, we can say that the field of emotionally adaptive games is still yet not fully developed. There are multiple limitations ranging from capturing of user emotions to adapting the applications in real-time which need to be solved before we can see a truly emotionally adaptive game. There has been attempts to use psychophysiologically data using multiple sensors (heart beat sensot, GSR) etc to quantify the emotions, the quantification of emotions is still not done completely.

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