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Navigation Key Using Face Expression in Endless Game

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Abstract

This research conducted to analyze whether emotions can replace traditional game input and whether using emotions as game input can increase user involvement in playing games by emphasizing emotions in game design and emotional detection using facial expression recognition (FER). As has been stated by several researchers that emotions in games affect the user experience. Authors identified an increase in user experience using the term engagement used in the measurement questionnaire of the game engagement questionnaire (GEQ). And the results of this GEQ used as the final evaluation of this study.

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1. Introduction

Emotion is a crucial aspect for the game ¹. Because the game is made to make the player feel an emotion according to a game theme created in example like a horror game theme which, of course, wants the player to feel a tense or frightened emotion, and all the emotions generated when playing the game are made to make the players feel happy to play the game. Emotions also play an important role in user experience and by emphasizing emotions in game design will increase the interactivity of users in playing the game ².

There are several recent studies reporting findings that facial signs and expressions can provide insights into the analysis and classification of emotional states ^{3 4}. Already long ago Darwin argued that facial expressions are universal, i.e. most emotions are expressed in the same way on the human face regardless of race or culture ^{5 6}. What is meant

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by facial expression is a change that occurs on the face in response to a person's internal emotional state, both in personal and in social conditions ¹. Therefore it is our pick emotion recognition by a computer through facial expression recognition, where the emotion recognition process carried out by analyzing the facial expression.

There have been many studies conducted in facial expression field, but most professional publication writers refer to the classification of facial features that was introduced by Ekman. This is because unlike other emotions (in his period Darwin identified more than 40 expressions), they are easily and unambiguously identifiable. The following is a classification model of 6 emotions by Ekman ⁷: Happiness, Sadness, Surprise, Fear, Anger, Disgust. Later Ekman ⁸ added a neutral expression to the previously mentioned six emotions.

This method of classifying emotions has gained a relatively high popularity. The main advantage is that facial expressions related to basic emotions are easily recognizable and they can be described even by ordinary people – non psychologists. In 1978, Ekman and Friesen developed Facial Action Coding System (FACS) to encode facial expressions, where the facial movements are described by a set of action units (AU). Each AU is based on the affinity of the muscles. This mimic coding system is manually executed using a set of rules. Entries are static images of the mimetic, often representing the peak of the expression ⁹. And FACS can be used as a model for facial expression recognition. Facial expression recognition is divided into three stages: face acquisition, facial features extraction, and facial expression recognition ¹⁰.

Then emotions and games can be connected through affective game. Affective gaming has received much attention lately, as the gaming community recognizes the importance of emotion in the development of more engaging games ^{11 12 13}. The 'engaging' word is come from 'engagement', where the term 'engagement' is used as a generic indicator of game involvement ¹⁴. Recently, researchers have been interested in how the affective (i.e., emotional) state of a game player can be brought into computer and video game experiences ¹¹. Research in the field of affective game is a derivative of affective computing research in the field of gaming. The term affective computing began to be introduced globally in the academia world since 1997 by Picard. In his book, Picard (1997) defines affective computing as "computing that relates to, arises from, or deliberately influences emotions". The three core areas of affective computing provide methods and techniques directly relevant to affective game design: emotion sensing and recognition; computational models of emotion; and emotion expression by synthetic agents and robots ¹³.

Affect-focused game design is a new approach in game design emphasizes the affective state of the user. Other aspects of game design are also influenced, especially the visual and auditory aspects of the game, which also greatly affect the affective state of the user. There are several interesting research questions to be investigated: (1) whether emotion can be user input in the game? (2) what are effective sensors used as a tool to capture and analyze the emotions of the user and used for games?.

This study aims to discuss and analyze whether emotion can replace traditional game user input such as keyboard, mouse, and other inputs, and whether using emotion as user game input can improve user experience, because emotions also play an important role in user experience as proposed by Gilleade and Dix (2004) ², where the user experience size here uses 'engagement' where the term 'engagement' is used as a general indicator of game involvement measured using the Game Engagement Questionnaire (GEQ) ¹⁴.

1.1. Related Work

Andry Chowanda (2013), in his paper "Emowars: interactive game input using facial expressions," ¹. Discuss and analyze whether emotions as game inputs can replace traditional users game input, and whether it can increase user interactivity in playing games. Here the author makes a game design that uses input in the form of emotional expressions of the player. The results of this research evaluation show that users still prefer traditional input games, and the user still feels not too interactive.

Andry Chowanda et al. (2016), in their paper "Playing with social and emotional game companions," ¹⁵. Presenting findings of empirical studies that explore game experience players by applying ERISA framework in games. Where players interact with NPCs who are given emotion in RPG games. The results showed that NPCs who can feel and

show emotion can have emotional relationships with the players, and can improve the player's experience while playing the game.

2. Method

2.1. Game Design

This stage aims to design games that use emotion as game input. At this stage is done design for the mechanism/rules that will apply in this game, and will discuss about the technology to be used in this game which will be related to the next stage that is facial expression recognition. The possible output from this stage is a game that is ready to be evaluated based on the objectives stated in the introduction.

For this game we chose the endless running game / endless game genre. For those who don't know, endless running games are games where you constantly 'run' through the game until the obstacle stops you with the point is to achieve the highest score possible. We choose this genre based on our observations on Google Play where games with this genre occupy positions 1, 4, and 6 in top 10 free games on August 2018 (see Fig. 1). But all the games are still using traditional input that only uses physical interaction by touching the touch screen or pressing a button, therefore we are interested in implementing endless running games / endless games with different inputs in the form of player emotions.

Fig. 1. The 10 best-selling free games on Google Play August 2018, three of which are endless running game / endless games.

The game design method used is affect-focused game design which is a game design that emphasizes the affective state of the user / player. In this game we emphasize the player's emotions to be the game input used as a navigation key or the main character's driving controller in the game. This emotion is obtained through the player's facial expressions, here we use the emotional expression of happiness which is indicated by the smile of the player caught by the camera, we use the emotional expression of happiness because it is most easily detected by FER with the highest detection success rate.

2.2. Facial Expression Recognition (FER)

This stage aims to design facial expression recognition as technology input that will be used in the first stage. Because we compare individual approaches, we find that ubiquitous hardware, available in most computer systems (classic webcam), allows to obtain important information about human facial expression.

We decided to use the Affectiva SDK. The advantage of using such a solution is the fact that we do not have to deal with the training dataset in the final phase of the recognition process (classification). SDK solution from Affectiva works on the principle of the extended facial expression model at the following points ⁹:

- Facial detection and detection of significant facial features,
- Extraction of facial features,
- Classification of facial action points,
- Emotional prototype modelling using EMFACS.

Facial detection and extraction of significant facial features - performed using the Viola-Jones Detection algorithm. Facial actions - Histogram of Oriented Gradient (HOG) is extracted from the image area of interest defined by the face orientation points. Emotional expressions - in this case, anger, fear, joy, sadness, surprise, and contempt are based on combinations of face action. This encoding was based on the emotional EMFACS face coding system.

2.3. Game Engagement Questionnaire (GEQ)

This stage aims to design the correct method of research evaluation based on the evaluation method carried out by similar previous studies, where we used Likert scale quantitative data collection using the GEQ.

The GEQ fills a gap in the measurement of video game-playing effects by providing a psychometrically strong measure of the type of engagement elicited while playing video games. Where the term 'engagement' will be used as a generic indicator of game involvement in this questionnaire. Other relevant and more technical terms include immersion, presence, flow, psychological absorption, and dissociation. These can be conceptualized as representing a progression of ever-deeper engagement in game-playing.

The GEQ subsections consists of:

A. Immersion

Immersion is typically used to describe the experience of becoming engaged in the game-playing experience while retaining some awareness of one's surroundings ^{16 17}.

B. Presence

Definitional consensus is still emerging, but presence has been commonly defined in the following terms: (1) being in a normal state of consciousness and (2) having the experience of being inside a virtual environment ^{18 19 20 21}.

C. Flow

Flow is the term used to describe the feelings of enjoyment that occur when a balance between skill and challenge is achieved in the process of performing an intrinsically rewarding activity ^{22 23 24}.

D. Psychological Absorption

Psychological absorption is the term used to describe total engagement in the present experience ²⁵. In contrast to immersion and presence, and in common with flow, being in a state of psychological absorption induces an altered state of consciousness.

From each sub-sections described above, there are detailed questions in the table below.

Table 1. Contains detailed questions from the GEQ used in the trials.

ABSORPTION	1. I feel scared to lose.
	2. I lose track of where I am.
	3. I feel different.
	4. Time seems to stand still or stop.
	5. I feel spaced out.
FLOW	6. I don't answer when someone talk.
	7. I can't tell I getting tired.
	8. If someone talk to me I don't hear.
	9. I feel like I can't stop playing.
	10. The game feels real.

	11. I get wound up.
	12. Playing seems automatic.
	13. I play without thinking how to play.
	14. Playing make me feel calm.
PRESENCE	15. Thing seems to happen automatically.
	16. My thought go fast.
	17. I play longer than I meant to.
	18. I lose track of time.
IMMERSION	19. I really get into the game.

3. Result and discussion

3.1. Game Design

Game play on this game is simple, that is endless running game where the main character of the game will go on endlessly and the player must make an avoidance movement so as not to hit the obstacles facing. It's just that there are two navigation key input modes in this game where in "Traditional Input" mode is a physical button on the keyboard or mouse that will make the main character in the game move up when pressing the button and will move down if not pressing the button, while in "FER input" mode uses facial expressions of players where the main characters in the game will move up when the player smiles or shows happiness emotions and the main characters in the game will move down when the player does not smile or show emotions other than happiness.

Fig. 2. The main menu in the game where players can choose the game input mode.

Fig. 3. (a) Player's smile expression / happiness emotion detection by FER; (b) Main character move up if FER detect player's smile expression / happiness emotion.

Fig. 4. (a) Player's neutral emotion / besides happiness emotion detection by FER; (b) Main character move down if FER not detect player's *smile expression / happiness* emotion.

3.2. Trial and Questionnaire Results

The authors examines using a quantitative approach where researchers will work with numbers as statistical data from the results of a game evaluation in the form of a questionnaire and a qualitative approach where researchers will analyze respondent's perceptions of game evaluation. Here we use the Game Engagement Questionnaire (GEQ).

With 30 respondents consisting of university students and randomly selected people over the age of 18. Where respondents were asked to try each game mode for approximately 5 minutes after that they were required to fill out a questionnaire, and answer short interviews about the lack of features, and balancing of gameplay. To avoid bias the game trial mode sequence is random for all respondents.

Experiments were carried out more often in room 325 of the Anggrek Campus of Bina Nusantara University, but sometimes it was also done in several other places which made it possible to experiment. This trial was carried out in early March to 10 August, with results as below.

The Shapiro-Wilk test is applied to all data and indicates that data is more likely to come from normally distributed populations. Therefore we apply Paired t-Test which can be seen in the results in (see Fig. 5) where it gets results (Significant) *Sig. (2-tailed)*: Probability / *p* value of the t-Paired test: Result = 0.770. Meaning: There is no difference in 'engagement' between the use of traditional input and FER input. Cause: *p* value > 0.05 (95% confidence). *Mean*: -1,233. Negative Value: This means that there is a tendency to use traditional inputs with an average trend of 1,233.

Paired Samples Test								
		Paired Differences						
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df
					Lower	Upper		
Pair 1	Tradisional- FER	-1.233	22.880	4.177	-9.777	7.310	-.295	29
							Sig. (2-tailed)	
							.770	

Fig. 5. Paired t-Test result.

4. Conclusion

From the evaluation of this research, we can draw the conclusion that the game input facial expression recognition (FER) as the main input of the game, where emotional expressions are used as navigation keys to move the main character does not improve game engagement and most experimental participants still feel more comfortable using traditional input. According to our observations from the results of questionnaires and interviews, if only emphasizing emotions as the main input in the form of navigation keys like this is still less able to improve game engagement, it may require the use of emotions emphasized in other features of the game, not only in the form of main input. And it was concluded that FER input could not replace traditional input as the main input.

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