Encourage Players to Smile While Playing Games Bring More Enjoyment

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***Abstract*—This paper presents a video game system with a smile interface designed to promote the player experience. We introduce a new mechanism to an existing endless runner game, "Runner." Such mechanism allows smiles to be taken as an input to the game system, for triggering boosting period. To detect smiles, a deep-learning facial recognition toolkit named Affdex, by Affectiva, is employed. Evaluation on player experience was done using a shorten version of Game User Experience Satisfaction Scale. Three different game modes are compared: Standard Mode (no smile and boosting), Smile Mode (with smile for boosting), and Auto Mode (auto boosting, without smile). Our results show that the presence of the smile mechanism leads to more enjoyable gameplay.**

***Index Terms*—Player experience, Endless runner game, Smile.**

I. Introduction

Facial expressions are non-verbal human universal languages. A person can have many facial expressions, but six major ones are happiness, surprise, fear, anger, disgust, and sadness [1]. Happiness can refer to enjoyment and satisfaction whether in small or big moments. Smiling is a facial expression that humans frequently manifest when there is joy, amusement, pleasure, or happiness. In several studies [2]–[4], a smile could lead to positive emotions. One study found that a smile could prevent stress [5] and lead to healthy mental well-being. Another study by Tsujita et al. [6] found that performing smiles in a daily fashion can enhance the positive mood.

An existing study by Bennet et al. [7] reported that there is a possibility that smiling could improve a person's immune system by blocking the production of stress hormones (such as cortisol) and increasing the release of immuno-enhancers (such as beta-endorphin). Previous work stated that computer interaction interfaces should be associated with emotion and give feedback to the user [8]. One of the emotion-interactions between humans and computers is smile detection. With recent advancements in image processing, facial expression detection can be done with a few hardware requirements, e.g., Affdex by Affectiva [9] that allows detection of various facial expressions (i.e. smile), to be done in real-time through a webcam. Prior studies [10]–[12] have indicated that Affdex could perform well in detecting smiles. They found that enhancing a video game with a mechanism that allows the player's smile to be detected as an input to the game system could enhance the player's positive mood. We define such a mechanism as a smile mechanism.

Based on these findings, this paper presents a game that encourages the player to smile. Our hypothesis is that this kind of game can enhance the player experience. We embed in an endless runner video game a smile interface using Affdex by Affectiva. In user evaluation, we compare different versions of the game through the assessment of players' experience using the Game User Experience Satisfaction Scale (GUESS) [13].

II. Existing Work

Bernhaupt et al. [14] built a video game that allows the player to smile at the camera. Their results showed that a smile has effects to increase the positive mood and decrease the negative mood. However, for user experience, some of their results yielded negative experience, which was caused by some players whose positions or angles were hard to be detected by the camera. The negative experience was emphasized by the feeling of the players who were concerned whether they correctly performed the smile. Rather than trying to solve the problem of smile detection accuracy, our study attempts to circumvent the aforementioned negative experience issue from a game-design perspective. Instead of making a video game that uses a smile as the only input or forces the player to smile for a long time, we propose a smile mechanism as an additional input to grant bonus points to the player if they smile, with our aim to enhance the gameplay experience.

Another study by Hernandez et al. [15] found that letting the participants know the objective could make them feel more comfortable during such interactions. Their setting allows the participants to engage in social interaction, which also encourages them to smile. However, unlike our current work, an analysis of the relationship between the introduced smile mechanism and the player experience was not investigated in their work.

III. Game System

The game used in this study is "Runner" [16],an endless runner game where the player's character mainly does three actions: catch a coin, jump and crouch. This game procedurally generates platforms (i.e., segments horizontally connected to

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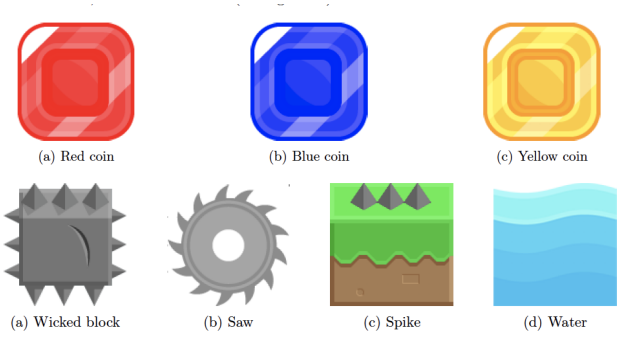

Fig. 1. Coin and trap elements

form the game stage) and keeps the character moving forward (rightward) in a never-ending level (all objects except the player's character and the wicked block trap are non-movable). The player only has one life to make the character run as far as they can, without touching any trap. The score is proportional to the running distance and the number of collected coins.

There are two major elements in this game: coins and traps (Fig. 1). Coins are game objects that give the player an additional score if they are successfully picked by the character. On the contrary, traps are game objects that serve as obstacles. A level ends when the character collides with a trap of any type. More details about these elements are described as follows:

- **Red coin**: The player must extend the character's left arm to collect it.
- **Blue coin**: The player must extend the character's right arm to collect it.
- **Yellow coin**: This coin type has two positions: on the platform's ground and in the air above the ground. To collect it the character has to 'jump' for the floating yellow coin and 'crouch' for the on-the-ground coin.
- **Wicked block and Saw**: The character has to crouch to pass them.
- **Spike and Water**: The character has to jump to avoid them.

In this study, the game has three modes. The first mode is "Standard", the second mode is "Smile" and the third mode is "Auto". Demo videos of these modes are available on YouTube[1]. Their descriptions are given below.

A. Standard Mode

In this mode, the player has four keyboard controls as follows:

- **Key "A"**: Collect a red coin.
- **Key "D"**: Collect a blue coin.
- **Key "S"**: Bend down to avoid hitting a floating trap.
- **Key "Space-bar"**: Jump to collect a yellow coin or avoid a trap on the ground.

[1]https://tinyurl.com/runnercog2020

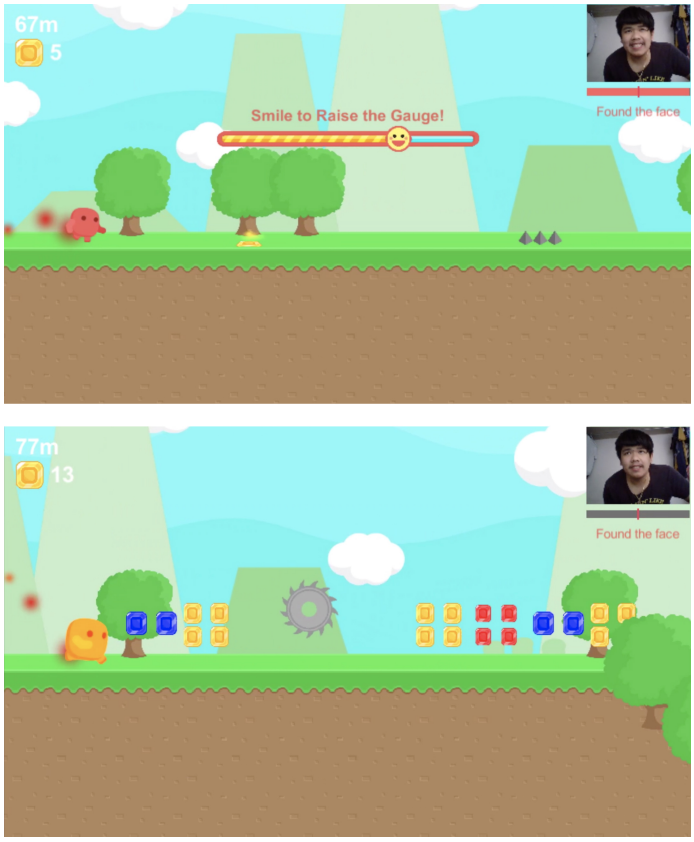

Fig. 2. Smile mode game interface

B. Smile Mode

In this mode, in addition to the above four controls, the smile expression is utilized. Affdex can detect this kind of expression via a web-camera from the player when the corners of the player's mouth have raised up while the mouth is opened. When a smile is fully detected, the character will be invulnerable during a so-called boosting period where its color and size will become orange, and bigger, respectively.

The design of this mode (Fig. 2) is in the following. This mode has a bonus gauge, serving as a smile meter, displayed on the top of the screen with the text "Smile to raise the gauge" to let the player know their smile status. The bonus gauge is triggered every 15 seconds from the beginning of the current gameplay. If the player performs a smile expression correctly, a smile emoticon will be raised and moved to the right side of the gauge. To achieve the full gauge, the player has to continue smiling to fill it. When the gauge is full, a boosting period starts at which the gauge will temporarily disappear and a number of yellow, red, and blue coins will emerge to the scene. This period lasts for 3 seconds, and near the end of this period, the character will flicker to warn the player and return to its normal size and speed. Both 15 and 3 seconds above are emphatically determined.

C. Auto Mode

Auto Mode is added for evaluation purpose. This mode is included in comparison to examine whether effects on gameplay experience stem from smiling or the presence of boosting periods. In this mode, the player has the same four keyboard controls as in the previously described modes. What differs here is that he or she does not have to perform any smile interaction to activate the gauge. When times come, a bonus gauge will be automatically raised. After that, the game enters the boosting period with the same effects as those in Smile Mode.

IV. Experiment

The goal of this experiment is to verify if playing the game with the keyboard plus smiles (Smile Mode) gives the player better experience than playing the game with only the keyboard (both Standard Mode and Auto Mode). There were 24 participants, with ages between 20-25 years, who were undergraduate and graduate students at Bangkok University, Thailand. The experiment was set up as shown in Fig. 3. All participants used a laptop to play. They played all game in the same game resolution and same game graphic quality. The participants were divided into six groups (four members in each).

These six groups played games in three modes in a different order based on Latin Square as follows:

- Standard → Smile → Auto
- Auto → Standard → Smile
- Smile → Auto → Standard
- Standard → Auto → Smile
- Smile → Standard → Auto
- Auto → Smile → Standard

Each participant in each group played all the three modes following the order assigned for their group. All participants received a tutorial and training at the beginning of the experiment. Each game mode lasts two minutes. If the character of a participant dies before the said two minutes, the participant can replay until the end of the given time slot. But because the character only has one life in each trial, if it dies, the score and running distance will be reset to zero.

Once finishing one of the three modes, each participant proceeded to answering a 5-point Likert scale questionaire (with 1 = Strongly Disagree and 5 = Strongly Agree). This questionnaire was a shorten version of GUESS, containing three sub-scales: Engrossment, Enjoyment and Personal Gratification. Then, the participant had to take a rest for one minute before playing the next mode. The questionnaire was done on *SurveyMonkey*. The order of questions was randomly shuffled by the system. Furthermore, statistics on scores, the number of deaths, and the number of gauge activations were logged.

V. Results

The average value of the GUESS factors in use comparing the three modes are shown in Fig. 4. The statistics of four parameters from the game log – the average number of deaths *(Death)*, the score summation from all games *(SumScore)*, the highest score in one game *(HighScore)*, and the number of times the boosting period is activated *(Activated)* – are shown in Table I. Results from statistical tests regarding their differences are shown in Table II.

Fig. 3. Experiment setup consisting of one member from each group

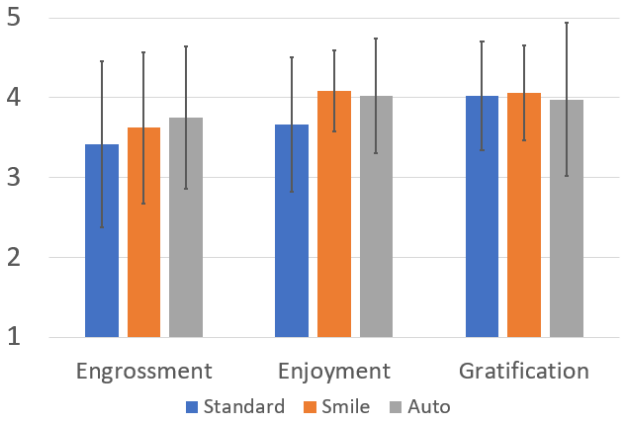

Fig. 4. Average value with the error bar of GUESS factors.

A. Differences between game modes

Non-parametric statistical tests were used. Friedman Test reported no significant difference in the GUESS factors when considering all the three groups. On the other hand, there were significant differences among the three groups in most game parameters.

According to results from Wilcoxon Signed-Rank Test, it was found that players significantly enjoy Smile Mode more than Standard Mode (p = .011). Average Deaths show that the player's character tends to die more on Smile Mode and less in Auto Mode, and a significant difference was found for this pair (p = .010) indicating that playing by smiling may degrade the performance of the players. Nevertheless, they obtained a better score when boosting periods were presented (cf. Table I).

B. Pearson Correlations

In Standard and Auto Modes, Enjoyment was positively correlated with Gratification at a 99% confidence interval (p = .002 and 000, respectively). However, this relation was not supported in Smile Mode (p = .143).

TABLE I
AVERAGE DEATHS, SCORES, AND ACTIVATED TIMES.

	Death	SumScore	HighScore	Activated
Standard	2.08	490.92	353.08	-
Smile	2.83	627.50	370.33	2.04
Auto	1.42	734.71	547.67	3.29

TABLE II
P-VALUES FROM WILCOXON SIGNED-RANK TEST AND FRIEDMAN TEST.

Name	Wilcoxon			Friedman
	Pair A	Pair B	Pair C	
Engrossment	.352	.603	.128	.582
Enjoyment	**.011**	.603	.928	.275
Personal Gratification	.703	.779	.849	.959
Death	.222	**.010**	.136	.250
Sum Score	**.001**	**.002**	**.000**	**.000**
High score	.794	**.027**	**.001**	**.001**
Activated	-	**.010**	-	**.000**

Pair Type: (A) Standard & Smile, **(B)** Smile & Auto, **(C)** Standard & Auto. Based on Bonferroni Adjustment, a difference reported by Friedman Test is considered significant when p-value $<$ .05/3 or .017.

In Smile Mode, *Activated* was positively correlated with *SumScore* (p = .007) and *HighScore* (p = .001), and negatively correlated with Death (p = .043). This indicates that the boosting period significantly increased the score of the players and made their character died less. However, *Activated* negatively affected Engrossment (p = .007), which indicates that smiling could distract players from immersion into the game.

In Auto Mode, *Activated* was positively correlated with HighScore (p = .000), but not *SumScore* (p = .059), and was negatively correlated with *Death* (p = .024). Surprisingly, participants were found to perceive higher Gratification as *Death* increased (p = .047). Although slightly failing to pass the test at a 95% confidence interval, *Death* was also positively correlated with Enjoyment (p = .052). We conjecture that automatically raising of the gauge might reduce the game difficulty and thus negatively affect the player experience of some players; both *SumScore* and *HighScore* were also negatively correlated to the three GUESS factors, although statistically insignificant.

VI. CONCLUSIONS

We proposed a game system that encourages the player to smile, promote health, and improve the gameplay experience. We introduced to an endless runner game a smile interface for activating a boosting period that grants bonus scores. A game mode with smiling was found improving the enjoyment, which is substantiated by our experimental results.

When boosting periods were activated by smiling, it was found the engrossment factor decreased as the player activated such a period more often. This implies that smiling can be a distraction from the game immersion, and thus future work should lie in designing a way to promote smiles while maintaining engrossment.

This game system can be applied to encourage people to smile. The system can also be used to practice a smile expression since the player has to properly interact with the system to enter a boosting period. Findings regarding player experience and relationships with other variables in this work can be utilized to further improve the player game experience of other game systems. For future work, exploration on how player experience correlated with stress and other psychological factors with a larger number of participants is one promising direction. We will continue our study on the effectiveness of the proposed system in terms of mental health promotion.

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