Interactive Horror Gaming: Integrating Facial Expression Recognition to Enhance Player Engagement and Immersion

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***Abstract*—This research aims to investigate the feasibility and effectiveness of integrating facial expression recognition into horror games to enhance player engagement and immersion. Specifically, we propose to build a horror game that triggers events based on the player's real-time emotional reactions captured through a camera and analyzed by a trained network. By detecting the player's emotional state, the game can adjust its intensity and provide an experience that adapts to the player's emotional response.**

The study will involve developing a prototype horror game that incorporates real-time facial expression recognition technology and testing it with a group of participants. The study will use both quantitative and qualitative methods to evaluate the effectiveness of the proposed approach. Quantitative data will be collected through surveys and game metrics to measure the game's effectiveness in enhancing engagement and immersion. Qualitative data will be collected through interviews and observations to gain insights into the player's experience of the game.

The results of this study have the potential to inform the development of interactive horror games that incorporate real-time facial expression recognition technology, providing players with a more immersive and engaging experience. This research has implications for the gaming industry, as well as for the broader fields of emotion recognition and affective computing.

***Index Terms*—horror game, facial expression, interactive**

I. Introduction

Horror games are known for their ability to evoke strong emotional responses from players, such as fear, anxiety, and disgust [1]. However, the effectiveness of a horror game in eliciting these emotions depends on the player's engagement with the game. To enhance player engagement and immersion, this research explores the use of real-time emotional response detection in a horror game. The game is developed with Unity and utilizes MoodMe, an asset that enables real-time facial detection and analysis of emotions. By analyzing a player's emotional response, the game can adapt to the player's individual emotional state, creating a more immersive gameplay experience. The game is inspired by the popular horror game SCP087 and features an infinite staircase that the player must descend, with various horror events triggered along the way. The game incorporates time, sound effects, light effects, and jump scares to create a sense of tension and dread. This research aims to explore the potential of using real-time emotional response detection in game design and to investigate how this technology can enhance the immersive horror game experience. By doing so, this research may contribute to the development of more engaging and immersive horror games that are tailored to the individual player's emotional response.

II. Background

Researchers have been exploring the use of real-time emotions of players to enhance game design and create more immersive experiences. For example, Andrew et al. [2] have implemented the adjustment of difficulty levels in the popular game Five Nights at Freddy's using the AFFDEX SDK from Affectiva. Similarly, Nogueira et al. [3] conducted research on biofeedback modulation of affective player experiences in vanishing scares. These studies highlight the potential of using real-time emotion of players analysis to personalize gameplay and enhance the emotional engagement of players in video games. In this research, we aim to explore the possibility of utilizing real-time facial expressions of players to trigger different horror game events, thereby creating a more immersive game environment. By leveraging the emotional responses of players in real-time, we seek to enhance the gameplay experience and create a more personalized and engaging horror game.

A. Game SCP-087

SCP-087 is a popular horror game that was created by Haversine in 2012. The game is based on the fictional SCP Foundation, which is a collaborative writing project that describes a fictional organization responsible for containing and researching paranormal phenomena [4].

In the game SCP-087, the player takes on the role of an unidentified person who is exploring an endless staircase that descends into the depths of a dark, foreboding building. As the player descends deeper into the staircase, strange and terrifying sounds can be heard, and the player may encounter frightening paranormal phenomena. The game is designed to be simple, yet suspenseful, with no real objective other than to continue descending the staircase.

SCP-087 has become popular among horror game fans for its ability to create a sense of dread and tension through its atmospheric design and use of sound effects. The game has also inspired other horror games and films, and has become a staple in the horror gaming community.

For this study, we use a similar in-house developed game. It features an infinite staircase, from which the player is unable to escape once they enter. The screenshot of game is shown below as Figure 1.

Fig. 1. SCP-087 with Facial expression Detection

B. MoodMe 4 Emotions (bad moments editions) Barracuda SDK

MoodMe asset for the Unity game engine enables real-time facial detection and analysis of emotions. The software utilizes computer vision and machine learning algorithms to capture and interpret facial expressions and can detect a range of emotions, including anger, disgust, fear, happiness, and sadness.

MoodMe is designed to be integrated into video games and other interactive applications to create a more personalized and immersive experience for users. The software is capable of analyzing emotional responses in real-time, allowing for immediate adaptation and response to a user's emotional state.

MoodMe has the potential to revolutionize the way that video games are designed and played, by allowing game developers to tailor the gameplay experience to the individual emotional response of each player. The software has been used in various applications, from marketing and advertising to virtual reality and gaming.

III. Preparation

A. Events

In our game, we designed three levels of events shown in table I to provide different levels of feedback to the player in real-time. Level 1 events are designed to be less intense, creating a sense of alertness and encouraging the player to pay attention to changes in the game environment. These events may include footstep sound effects, subtle screen glitches, and distant crying sounds.

Level 2 events, on the other hand, are more intense and designed to shock or scare the player in a short amount of time. These events may include jump scares, vital screen glitches, and sudden, loud sound effects.

Finally, level 3 events are designed to help the player relax and release tension. These events may include making the environment brighter and reducing the frequency of events. By providing different levels of events, we aim to create a more immersive and engaging gameplay experience that responds to the player's emotional state.

TABLE I
Game Events

Event Level	**Feature**	**Events**
Level 1	Less intense, alert, attention	footstep sound effects, subtle screen glitches, and distant crying sounds
Level 2	Intense, shock, scary	jump scares, strong screen glitches, and sudden, loud sound effects
Level 3	Calm, relax	make environment brighter, reduce frequency of events

B. Triggers

To capture and utilize the emotions of players as triggers, it is necessary to define the appropriate triggers. As a horror game, we chose to use the MoodMe 4 Bad Emotions asset, which includes the emotions of anger, disgust, fear, and neutrality (see our triggers for game events in the table II).

When a player exhibits high levels of anger, we trigger level 1 events to create a sense of tension, or level 3 events to help calm them down. In cases of disgust, if the player becomes too disengaged or bored, we trigger level 2 events to shock them and regain their interest. Similarly, for cases of fear, we use level 3 events to help the player relax and feel calmer.

We also aim to avoid having the player remain in a neutral emotional state for too long. If a player remains neutral for an extended period of time, we trigger level 1 and level 2 events to make the game more interactive and engaging. By using a range of emotional triggers and event levels, we aim to create dynamic and immersive gameplay experience that responds to the emotional state of the player.

TABLE II
Game Triggers

Emotions	**Conditions**	**triggered events**
Anger	>0.1, for 30 frames	Level 1, 3
Disgust	>0.05, for 10 frames	Level 2
Scared	>0.1, for 30 frames	Level 3
Neutral	<0.8, for 1000 frames	Level 1, 2

It's important to note that the emotion values provided by MoodMe are expressed as percentages of the four emotions (anger, disgust, fear, and neutrality) detected. To determine appropriate thresholds for detecting emotions, we conducted a pretest with three participants, including one developer, who

played the game while recording all emotion values using the MoodMe SDK. This allowed us to establish threshold values for different emotions. During the pretest, it was observed that when participants played the game without intentionally making facial expressions, but rather naturally revealing their feelings, the values for emotions other than "neutral" ranged from 0.05 to 0.32. However, when participants deliberately made facial expressions, the values typically ranged from 0.08 to 0.6. Therefore, a threshold of approximately 0.1 was set for detecting these emotions. Additionally, the neutral value exceeded 0.8 in most cases, so we have set 0.8 as the threshold for detecting neutrality as well.

Additionally, we have implemented a mechanism in the game that ensures only one event is triggered at a time. This means that once an event is triggered, other events will not be triggered until the current event is fully processed. Furthermore, the timer for event triggers will also be reset after each event has finished, ensuring that events are not triggered too frequently and allowing for more immersive and balanced gameplay experience.

EXPERIMENTS

To assess the effectiveness of our emotion-based event-triggering system, we conducted an experiment in which participants played two versions of the game. Each playthrough lasted three minutes.

In the first version, the game triggered random events of varying intensity levels at random intervals (between 5 and 15 seconds) after the player collided with a particular object.

In the second version, we used MoodMe to capture the players' real-time emotions and trigger different levels of events accordingly. We recorded the participants' emotional responses throughout both versions of the game and asked them to complete a questionnaire afterward.

C. Questionnaire

We designed our questionnaire to assess the following aspects:

- Perception of the difference between the two versions of the game.
- Awareness of their own emotions triggering the events in the game.
- Evaluation of game immersion.
- Overall experience of playing the game.

We asked participants to provide their opinions and feedback on these aspects to gather valuable insights for our research.

RESULT

There were a total of 17 participants in the experiment, with 10 of them being male and the remaining participants being female. The participants were not informed about which version of the game was which, and they were not told how the trigger system worked until after completing the experiment. The result are shown as Table III.

We captured the occurrences of intense negative emotions (such as anger, fear, and disgust) during gameplay for both versions of the game. Out of the 17 participants, 12 of them showed higher levels of emotional responses while playing the game with emotion triggers, which suggests that our game effectively stimulates players' emotions.

TABLE III
EXPERIMENT RESULT

Aspect	Description	Result
Perception of Difference	Noticed difference due to different triggers	29.4%
Perception of Difference	Felt some parts of the game were different	29.4%
Perception of Difference	Total participants who felt a difference	70.6%
Awareness of Own Emotions	Aware of emotions during gameplay	47.1%
Awareness of Own Emotions	Felt emotions triggered game events	41.2%
Awareness of Own Emotions	Participants not paying attention to emotions	52.9%
Evaluation of Game Immersion	Preferred game with emotion triggers	58.8%
Evaluation of Game Immersion	Preferred game with random triggers	35.3%
Evaluation of Game Immersion	Both versions equally immersive	5.9%
Evaluation of Game Immersion	Average score for more immersive version	6/10
Evaluation of Game Immersion	Most common rating for more immersive version	7/10
Emotional Responses	Higher emotional responses in game with emotion triggers	70.6%
Emotional Responses	Higher emotional responses in game with random triggers	23.5%
Emotional Responses	No significant emotional changes in either version	5.9%

Regarding the perception of the difference between the two versions of the game, In total 12 participants sense the difference between the two versions of the game, 5 of them feel certain differences due to the events being triggered differently, while the rest mentioned noticing differences in the frequency and order of events, etc. This indicates that the emotion-triggered game is impactful and noticeable.

As for the awareness of their own emotions triggering the events in the game, 8 participants reported being conscious of their own feelings during gameplay, and 7 of them felt that their emotions somehow triggered game events. This also suggests that the game's integration of emotion triggers may not be fully mature, as players are noticing the game's reliance on their emotions rather than becoming fully immersed in gameplay. However, it is positive that the game is able to accurately detect changes in the player's emotions, resulting in the player noticing the emotion triggers.

Regarding the evaluation of game immersion, 10 participants believed that the version of the game with emotion triggers was more immersive, while 6 participants held the opposite view. On a scale of 1 to 10, where 1 represented the least immersive and 10 represented the most immersive, the average score given by participants who found the emotion-triggered version more immersive was 6, with the most

frequently rated score being 7. Among the 10 participants who found the emotion-triggered version more immersive, 6 of them were not accustomed to horror games or movies, while the remaining participants were familiar with horror games or movies. Among the 6 participants who found the random-triggered version more immersive, 2 of them were not accustomed to horror games or movies, and the rest were familiar with horror games or movies. The participant who felt both versions were equally immersive was also familiar with horror games or movies. This indicates that our emotion-triggered game is capable of creating an immersive experience for testers who are not familiar with horror games or media. However, it may not yet be able to create a fully immersive experience for players who are accustomed to horror themes and sensations.

Overall, the results suggest that the use of emotion triggers in the game had a significant impact on participants' perception of difference, awareness of their own emotions, evaluation of game immersion, and emotional responses during gameplay. These findings highlight the potential effectiveness of emotion-based event-triggering systems in enhancing the player experience in video games. However, some participants provided feedback regarding the accuracy of the emotion detection and the limited number of events, resulting in some events repeating multiple times during gameplay. This feedback indicated that the perceived impressiveness of the game was reduced due to these issues.

Conclusion

Based on the results of our experiment, it can be concluded that the use of an emotion-based event-triggering system in the game has an impact on players' perception of game immersion. Participants reported being able to perceive differences between the two versions of the game, with the majority of them indicating that the game with emotion triggers was more immersive. Additionally, some participants reported being aware of their own emotions triggering events in the game. However, there were also concerns raised about the accuracy of the emotion detection and the limited number of events, which negatively affected the impressiveness of the game. Therefore, further improvements in the accuracy of emotion detection and diversification of event triggers could enhance the overall effectiveness of the emotion-based event-triggering system in future implementations.

Discussion

As we develop the game and conduct experiments, we have observed that players' facial expressions are not easily expressed when they are concentrating. Additionally, the network trained to recognize facial expressions may have relied heavily on exaggerated emotion data, resulting in minimal changes in intensity values unless the player opens their mouth. Therefore, in the future, we may consider building a specialized model for horror games that can detect subtle changes in facial expressions to better capture players' emotions. This will allow for a more accurate and immersive experience in the game. Alternatively, we could explore other approaches to improve the detection of facial expressions during moments of concentration in order to enhance the overall gameplay experience. Additionally, refining the training data used for the facial expression recognition model could also be considered to account for more nuanced expressions in different contexts. Further research and experimentation will be needed to develop a robust solution for accurately detecting emotions in horror games.

In future iterations of the game, we plan to address the concerns raised by participants by adding more events to the game and reducing the game time to minimize potential boredom during gameplay. Additionally, we will continue to refine the emotion detection algorithms to improve the accuracy of emotion recognition, and consider expanding the range of emotions detected to provide a more comprehensive and nuanced experience for players. Further research could also explore the impact of other game design elements, such as audio and visual cues, on the effectiveness of the emotion-based event-triggering system. In a summary, this study provides insights into the potential of using emotion-based event triggering in games and serves as a foundation for future research and development in this area.

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