DEMO PAPER: Deep Reinforcement Learning for Real-Time Fear Induction in an SCP-087-Inspired Horror Game

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***Abstract*—This demo paper presents a novel approach to inducing fear in a horror game inspired by the SCP-087 creepypasta. The game features an infinite staircase that players must descend, with horror events triggered by real-time valence arousal values, as measured by facial expression detection. Deep reinforcement learning is used to train an AI agent to trigger these events and maintain players' valence arousal values at a certain level. The approach uses recent valence arousal values and game environment features as inputs to a neural network that outputs actions for the AI agent. As time constraints limited our ability to conduct thorough experiments, we present a prototype of our approach in this paper. While the results are preliminary, we believe that our prototype demonstrates the potential of our approach to induce fear in players using real-time facial expression detection and deep reinforcement learning. Future work will involve more extensive testing and refinement of our approach.**

***Index Terms*—Deep reinforcement learning, horror game, SCP-087, facial expression detection, valence arousal values, real-time fear induction**

I. Introduction

Horror games have become increasingly popular in recent years, offering players an immersive and thrilling experience that can induce fear and excitement. However, creating a truly scary and immersive horror game is no easy feat as it requires careful design and attention to detail to ensure that players remain engaged and invested in the experience.

To realize the goal of creating an immersive and personalized horror game, we introduce a new approach inspired by the SCP-087. Our game features an infinite staircase that players must descend, with scary events triggered based on the player's real-time valence arousal values, as measured by facial expression detection. We use deep reinforcement learning to train an AI agent to trigger these events in response to the player's emotions, with the aim of inducing fear and maintaining player engagement.

By utilizing real-time facial expression detection and deep reinforcement learning, we aim to create a more personalized and immersive game experience that adapts based on the player's reactions. This approach has the potential for wider applications beyond horror games, as it could be used in other game genres and interactive environments.

In this demo paper, we present a prototype of our approach that demonstrates its potential for inducing fear in players. We believe that this approach offers a valuable contribution to the field of horror game design and machine learning in game development.

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II. Game Environment

A. SCP-087

SCP-087 [1] is a fictional staircase from a horror story within the SCP Foundation universe. The SCP-087 game is a video game adaptation of the original story, where players must navigate the infinite staircase while facing various frightening events and creatures. Its straightforward yet compelling concept has made it a popular source of inspiration for horror game developers. In this demo paper, we used Unity to create our own game inspired by SCP-087, enabling us to easily build and modify the game. Shown as Figure 1.

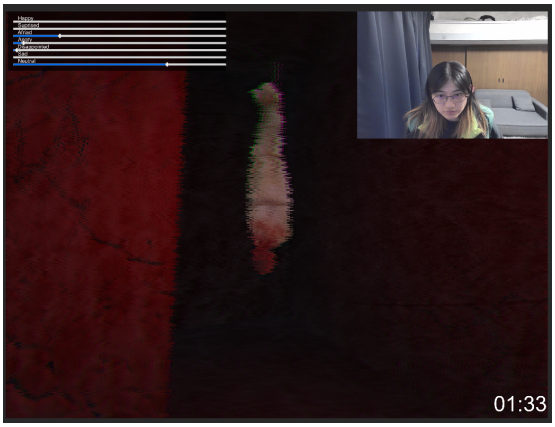

Fig. 1. SCP-087 with Facial expression Detection

B. Game Triggering Events

In order to create a more immersive horror game experience, it's not enough to simply scare the player. We also need

to consider the player's emotional state and use a variety of events to create a more dynamic gameplay experience, which means including events that increase the player's tension and concentration, as well as events that provide a brief respite from the horror to prevent the player from becoming overwhelmed. To achieve this goal, we have designed and implemented a range of events with different purposes in our horror game.

- **Scary events that shock the player:** 1) Jump Scares, 2) NFC Sprint to Player, 3) Sudden loud sound effects,
- **Tense events that keep the player alert:** 1) Screen glitches 2) Creepy NFC movements 3) Creepy sound effects (food steps, wall stretching, crying.) 4) Darker environment
- **Relaxing events that help ease the player's nerves:** 1) Brighter environment 2) Less frequency of events are triggered

C. Player real-time emotion

In this study, we employed a webcam to capture the real-time changes in the player's emotions during gameplay. To analyze the arousal and valence levels, and OpenCV [2] is selected to analyze the player's arousal and valence levels.

As individuals react differently when they are focused or scared, personalizing the game experience is crucial for defining a clear reward for Deep Reinforcement Learning. To achieve this, we need to personalize the reward by having the player watch a horror video similar to our game and record their arousal and valence values while they watch. With this preparation, we can determine the range of arousal and valence values we need to maintain to keep the player's emotions at the desired level.

III. Method – Deep Reinforcement learning

Deep reinforcement learning is a powerful technique that has successfully solved complex tasks in many fields, including game playing [3] [4], robotics, and natural language processing. For this specific research on horror game AI, the research involves a complex interaction between the player, the environment, and game events. This approach can learn to make decisions that optimize a specific reward by considering the current state of the game, the actions of the player, and the effect of the game events on the player's emotions.

In this way, it is possible to create an adaptive game that adjusts to the player's emotional state and provides a more personalized and immersive experience. Additionally, deep reinforcement learning can automate the game design process by generating and optimizing game events and environments, reducing the time and cost required to create a great horror game.

A. Deep Q-Networks (DQN)

Deep Q-Networks(DQN) is a popular deep reinforcement learning algorithm that is frequently used in video games. [5] It uses a neural network to approximate the optimal action-value function, which gives the expected cumulative reward for taking a particular action in a particular state. In this research, DQN is suitable to learn the optimal sequence of events to keep the player's arousal and valence within the desired range. The agent would take the current state of the game (the distance between players with NFC, the time elapsed since the game started or the last event triggered, etc.), the player's current arousal valence as input to the neural network, and the output would be the Q-value for each possible game events. (e.g., jump scare event, sound effect, etc) mentioned previously. The agent would then choose the event with the highest Q-value and execute it while gameplay. During training the network, the agent should explore the environment by taking random actions since the game is simple and does not have many limitations. The experience gained from each action (game events, the time elapsed since the game started or the last event was triggered, the player's position, the change in player's emotion) should be stored in a replay buffer. Periodically, the agent is able to sample from the reply buffer and update the neural network weights using a variant of the Q-learning algorithm. Through this process, the agent should be able to maximize the expected cumulative reward by choosing the optimal sequence of events, so that the game can keep the player's arousal and valence within the desired range.

IV. Conclusion

In conclusion, we have proposed a prototype that horror game AI built with incorporated Deep Reinforcement Learning to personalize the gaming experience for players and provide a more immersive game experience for players. we believe that using real-time biofeedback from players can precisely help create a personalized game to improve the game experience. Besides, we should be able to improve the game's decision-making process and create a more immersive experience for the player by using Deep Q-Networks. Although this project is a prototype, it demonstrates the potential for combining game development with deep reinforcement learning to create personalized, engaging gaming experiences. Further research and development can build upon this work and explore the possibilities of deep reinforcement learning in game design.

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