Design and Development of an Affect-Sensitive Horror Game

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Introduction

The relation of Brain-Computer Interfaces and games has given more freedom to game designers [6]. Games are no longer dependent on the storyline established but also to the information provided by the BCI. To be able to apply real time adaptation of the emotional state of the gamer, BCI games present the possibility for players to control or adapt a game based on the activities mapped out from distinguishing the activities in different regions of the brain [6].

With the improved interface, computer-based interactive activities have paved way to the exciting enhancements and innovations in the cross-media circulation of horror genre [4]. Horror is an interesting genre because of the expectation of a gamer that he is meant to be scared or frightened and this affects his perceptual and cognitive processes. Invoking fear in a BCI game can be considered an exciting innovation to the horror genre given its thrust towards videogames [4].

With this research, we hope to classify fear and brain activity related to it through a BCI-device and isolate it from other emotions by answering the questions in determining the signs of fear within brain activity and which elements in games evoke fear from players. Using this information, we aim to design and develop a horror game that can adapt to the information on fear from the BCI.

Methods

I. EEG Stabilization and Pattern Recognition

Instrument

The Neural Impulse Actuator is one of the latest technologies in Brain Computer Interface devices and one that is readily available in the laboratory. It has three bands that are attached and centered on the participants' forehead. There are three frequency centers for each brainwave frequency band. Theta brainfingers are centered at 1.95Hz, 3.55 Hz and 5.2Hz. The three alpha frequency centers are at 7.75Hz, 9.5Hz, and 11.25Hz while beta brainfingers are centered at 16.5Hz, 21.25Hz and 25.0Hz.

Procedure

A four minute and seventeen second video clip taken from a scene from the Thai horror movie shutter was shown to the six participants with age range from 16-21 to find patterns on the alpha, theta and beta wave channels. Frightening moments as fear stimuli that occur during the 2:50, 3:15, 3:17, 3:41, 3:50, 4:12 minute mark are noted to coincide with their effects. Observations regarding the participant's behavior and reactions are recorded during the testing itself and questionnaires are given out after to determine quantitatively the effectiveness of the horror tactics used. Results of the testing are recorded with a Screen Capture program. Participants with more frightened reactions should generate higher beta.

II. Fear Detection Phase

EEG Data will be analyzed to compute for the relative power of beta and alpha wave formula of Shin Park et. Al. [19] which are defined as follows:

$$\text{Relative power of beta wave} = Be / (Th + Al + Be)$$
$$\text{Relative power of alpha wave} = Al / (Th + Al + Be)$$

There is a decrease in the relative power of alpha wave in the temporal lobe and an increase of the relative power of beta wave in the temporal lobe in the fear states. The arousal decreases only at the right side in the fear state. The right brain is not aroused even though the fear emotion is introduced. Fear only activates the left brain and the following formula can be used to compute the value for fear.

FEAR = R. P. of Beta Wave / R. P. of Alpha Wave

III. Game Design and Development

Because the main goal of the research game is for testing purposes, the game design document is still in its preliminary stages. Adobe Flash and SWFSheet will be used to make the sprites and sprite sheets to be used in the game, and Stock-Free images will be used for level art and graphic art animation. C# and XNA will be used for the development of the game itself.

The decision for it to be set in a realistic setting such as a university gives the game more impact because of its familiarity to our game testers.

The story revolves around a protagonist who gets trapped inside the college campus after stumbling upon a cursed diary. His only way of escape is to find the items related to the invisible entity haunting him which are scattered throughout the different areas in the campus. Finding all the items will lead him to a direct confrontation with the entity in hopes of breaking free from the curse.

The game design will use mainly shock tactics and disturbing audio and visual representations to stimulate fear. This will be done through a mainly point-and-click game, with the player viewing everything in first-person. The player will have to navigate the game in order to reach the puzzle areas. Each building will have its own puzzle where one has to complete the task before going to the next level. Each puzzle will incorporate the different horror elements (such as the sudden appearance of scary apparitions, shattering of picture frames, etc.).

Completing the main objective in an area of the game will allow the player to move on and navigate to another area.

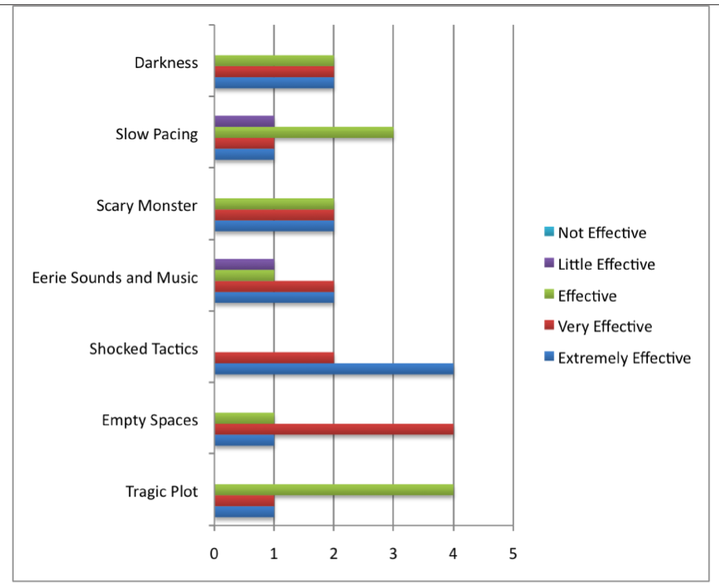
The game will use a modified mini-game engine developed for another affect-sensitive game [18]. The game contains classes that facilitate quick level creation, such as Areas, InteractiveObjects, and other class you will need in order to design a stage. The objects are then hard-coded into the game using methods defined in these classes. Behaviors of the objects are also specified using the same method. A "Power" class is used in order to get the data from the Brainfingers device and integrate it into the game.

Results

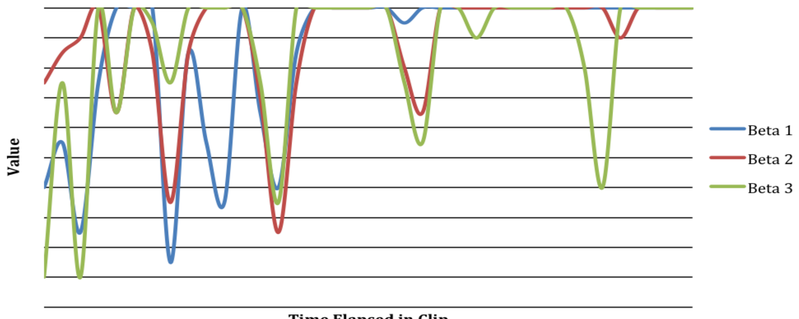
Most frightening moments in the horror clip:

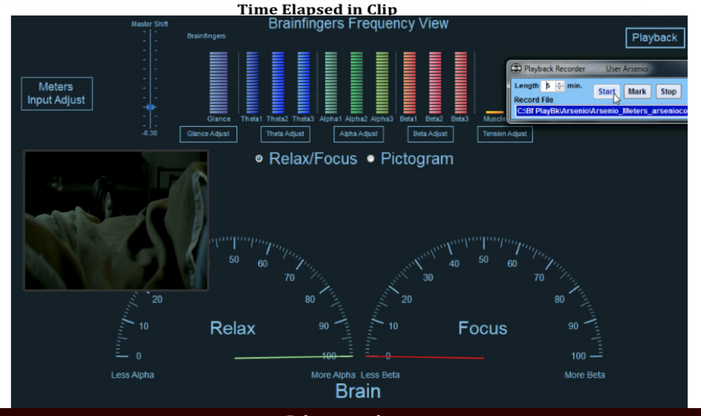
- Scary creature pulling the blanket from the protagonist
- Scary creature and protagonist suddenly look at each other face to face
- Protagonist looking for the scary creature when she disappeared

Most effective horror elements that they would like to see in a horror game based on the clip was darkness, scary monster, eerie sounds and music and shocked tactics. These methods are incorporated in the game when the player becomes scared.



In accordance with the reactions of the participants with their corresponding brain waves, beta waves increase during the frightening moments. For participants who are less frightened, beta waves can be observed decreasing. While a high alpha wave should generally mean a more restful state, alpha waves also increased at some frightening moments. Theta waves are associated to creativity and anxiety and would also increase at maximum level during the most frightening moment for the participant. Theta waves have a possible proportional correlation with fear.





Discussion

At this stage of the study, tests have been conducted to detect fear from brain signals recorded through the OCZ-NIA. The data from the Brainfingers system, that were manually recorded, made analysis difficult because of quantity and accuracy concerns. Human error is taken into account given the extensive encoding of the data from all the tests. Analyzing the answers to the questionnaire was also challenging given its subjective nature. Pinpointing the instances that the test subjects were referring to raised similar concerns with the researchers. Moreover, fear detection has not been fully accomplished because fear has not been totally isolated from the other brain activities that the signals interpret.

Design of the horror game to be used for this study has been accounted for in the Game Design Document [not included]. Development, however, poses serious concerns with how the integration will occur knowing that fear detection is not yet fully accomplished. It is observed in the results that stage levels that incur anxiety will be more effective in inducing fear.

The research questions that were mentioned earlier in this paper involved the signs of fear and detection accuracy, elements in games that evoke fear, and parts of the game wherein the information from the BCI-device can be applied.

Through the questionnaire that was handed to the test subjects, elements of the clip that they believe to evoke fear have been laid out in the results section. Aspects of the game wherein the OCZ-NIA can be applied, the researchers believe, are the same elements or at least the same kind of elements.

We suggest future researchers to further develop the game design and engine and to create test cases for the game. Experimenting with other BCIs such as EMOTIV would make an interesting and evaluative comparison for a more accurate detection of emotions.

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