Development and Evaluation on Night Forest Virtual Reality as Innovative Nyctophobia Treatment

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Abstract. Nyctophobia is an exaggerated fear that arises when a person is in the dark or at nighttime. In psychology, cognitive behavioral therapy is commonly used to treat a person who is accustomed to face his/her fears by giving positive suggestions of the fears, then confront the fears until he/she no longer feels anxious. This paper presents the storyboard and prototype development of Virtual Reality (VR) Night Forest application which aims to provide an alternative tool for Nyctophobia treatment. The adventure game which is located in a forest at nighttime is used as a new means to allow the user to become familiar with darkness. In the game, the user is made aware of the wonderful experience of hearing natural sounds such as footsteps, bird and door sounds. The user, as a boy scout, is then assigned to look for logs in the forest with different lighting levels. The storyboards are implemented on Mobile VR Apps. The experimental study shows that fear level of female users remains high compared with male users. Nevertheless, the repeated use of the game can positively motivate users to train themselves to get comfortable in darkness. In the experiment, the usability assessment concerning virtual reality user interfaces is presented using Sutcliffe approach.

1. Introduction

Fear is a natural experience for everyone, both adults and children. However, some people sometimes have an overreaction when facing their fears. Such an excessive fear is characteristic of phobia. Phobia is a state of fear or panic that is so great against a thing, a person, or a situation that is considered harmless by others[1]. One of the most discussed phobias for consulting is Nyctophobia, or fear of darkness[2].

In psychology, the therapy methods commonly used to cope with Nyctophobia is Cognitive Behavioral Therapy (CBT). The CBT approach leads patients to become accustomed to confronting their fears by giving positive suggestions of their fears until they no longer feel anxious[3]. The process of changing the perspective on cognitive aspect becomes the early success key to treat Nyctophobia. Then, the behavioral alteration as a manifestation of cognitive change becomes the benchmark for the success of this therapy. In the therapy process, the patient is invited to the real environment to deal with their fears. But psychiatrists are sometimes difficult to provide a variety of real environments that are appropriate to overcome Nyctophobia.

Virtual Reality (VR) as a technology that provides a 3D virtual environment can be an alternative solution to bring the real world ambience. Not only the environment, but VR also
provides interaction between human and machine, which cannot be carried out using 3D or 360 videos [4]. Some researchers have presented their successful works related to the use of VR, such as in medical education [5], ecodesign education [6], engineering education [7], and height phobia therapy [8].

This experiment, therefore, presents VR game application development by evaluating the game user interface using Sutcliffe’s usability testing. The genre of the game is adventure game application with a boy scout who has a mission to look for logs in the forest at nighttime. The place and time (forest at nighttime) is chosen as a VR object because this situation can be one of the frightening places and times for people who are afraid of the dark. Gradually, we hope that people who have fears towards darkness can get used to it and think positively about any events that may occur at night. The VR game used in this research is manufactured by Game engine Unity and Blender. Systematically, the paper is divided into five sections: The next section of this paper describes a review of some related literatures such as forest description, cognitive behavioral therapy and usability testing. Following this, the storyboard and design application are explained in the third section. Some implementations and evaluations of the proposed Nyctophobia treatment are shown in the fourth section. The ending section sums up the work is and describes some potential developments for future research.

2. Related Work

2.1. Phobia and Therapy Method
The phobia is defined as a combination of anxiety and fear [1]. Anxiety is an individual response to an unpleasant situation, while fear is defined as a reaction to the danger that occurs. There are three types of phobias according to Statistical Manual of Mental Disorder (DSM-V), i.e. social phobia, specific phobia, and agrophobia [9]. Social phobia is caused by feelings of fear towards the judgment of others. Specific phobia is a form of fear that makes a person feel uncomfortable regarding a particular situation, thing or place [1]. Agoraphobia is a feeling of fear caused by feeling that there is no way out. Fear of darkness (Nyctophobia) is a specific form of phobia against darkness that can provide excessive anxiety at nighttime or in darkness. Fear of darkness is usually experienced by women, children or someone who has a bad experience during the night [10]. Such a bad experience can be obtained from direct or indirect learning. Direct learning means that a person suffers a bad incident when he/she is the dark, while indirect learning means someone hears from someone else a bad event while in darkness.

Cognitive Behavioral Therapy (CBT) is a therapy technique that changes not only the patient’s habits, but also the patient’s point of view and belief in his own fears [3]. This method works by changing their mindset about dark situation and inviting the patient to confront the object or situation that causes his fear. The CBT process is to provide relaxation to the feared phobia. It also provides training to patients to face fears gradually, ranging from the mildest to the most frightening stage. In the case of Nyctophobia, the sufferer will be forced to fight his fear of darkness. Patients will be conditioned to be in an environment that can trigger fear in darkness and then they will gradually be aided with the use of some lighting to the dark environment.

2.2. Virtual Reality
Virtual reality is an environmental simulation that can stimulate the user as if he/she is in the real world [8]. It is also a technology that runs in real time and is interactive in nature because virtual reality can detect the user’s movement and change the virtual world itself. Its interactivity and ability to detect the user’s movement add more value to the user’s experience. As a therapy tool, virtual reality has its own advantages, as the therapist can have more control in the therapy process. Besides providing a sense of security to the user, it is also cheaper and has more secure privacy for the user.
Previous researches [8, 11] show that storyboard development is becoming important to provide scenarios and guidelines for developer and designer team. Literature review is used as an early step to collect appropriate information about the problem and its solution. Afterwards, experts from related field are involved to construct the storyboard. Designer and developer team then implement the storyboard using game engines such as Unity and Blender [12]. Unity is a software used to create 3D video games and embed other interactive contents such as 3D animations, architectural and floating button. Blender is free software used to create 3D objects.

In a general sense, forest is defined as a collection of trees that at certain density and extent can create a local climate and ecological conditions that are different from outside [13]. Today, forests have been reduced up to the size of three football fields every minute [14]. Not very many people have the experience in talking a walk in the forest, particularly those living in the city. Therefore, only very few people know or feel the atmosphere of the forest. This could be one of the reasons why people prefer to stay away from the forest. An environment that is rare or has never been encountered can principally cause fear.

2.3. Usability Testing

Heuristic evaluation is a method of usability engineering to review and rate user interface design. The evaluation method developed by Jakob Nielsen aims to find the weaknesses of the existing interface design on a single software [15]. The heuristic evaluation is conducted to a small group of evaluators to assess user interface based on predetermined heuristic principles. Heuristic evaluation can also be applied to virtual reality applications [16]. Based on Nielson’s heuristic principles, Sutcliffe and Gault make modifications and adjustments to Nielson’s heuristic principles to be applied to the virtual reality application interface. The adjustment process produces 12 heuristic principles that can review the virtual reality environment.

The measurement scale used in the questionnaire and the evaluation form is the Likert Scale. The indicators of Likert Scale are: 5 (very good), 4 (good), 3 (neutral), 2 (not good), and 1 (not very good). The conversion result of the questionnaire is then used to compute the central tendency value. Central tendency is a value that represents the average value of the approval of all respondents for each statement item. The statement pointed with its central tendency value $\geq 3.50$ indicates the whole student approves the statement and vice versa. If the central tendency value is $< 3.50$ then the statement is not approved by all respondents [17].

3. Methodology

3.1. General Application Design

This application visualizes 3D objects that are set up to form a virtual environment. This application will then show the virtual environment to users using Google Cardboard devices. Users will feel the same sensation with the real world and therefore the virtual environment can serve as a therapy tool for people with Nyctophobia. The previously obtained data is used as therapy scenarios development. The place and time of the situation is the forest at nighttime because it is often portrayed a scary place in films or stories.

At the first page, system shows main menu and forest situation. Then, user explore and read the control information (Informasi Kendali). Also, user read and navigate simulation instruction (Petunjuk Simulasi). After that, user choose Start (Mulai) button or Exit (Keluar). After user select the Start (Mulai) button, system shows the level of situation and user choose one of four situation (Situasi) button or Menu button.

There are four levels of simulations that this application is based on: the number of stages of additional light sources, the number of logs to be collected, and the objects added. The level of simulation is made for people with phobias to gradually get used to darkness. On the first level, System display the start point and show the forest situation at nighttime with several light sources (torches). Beside, user can see some floating buttons (Compas and info). To complete
this level, user need to collect one log in the forest map and go back to the start point. For walking experience, user utilize the joystick control and Google cardboard. For sound effect (SFX), we embed foot step sound. On the second level, torch lighting sources are reduced, and there are two logs to be collected and the addition of owl’s objects and sounds. On the third level, torch lighting sources are further reduced, and there are three logs to be collected and there is an addition of wooden house objects. On the fourth level, the source of light is only the flashlight, and there are four logs to be collected. Figure 1 visualize the user interface of this Night Forest application. The storyboard design is used to illustrate what the app will visually show to the user.

Figure 1. The Storyboard of Night Forest Application

3.2. Hardware and Software Envirotment
For constructing game application, gaming computer with specification that is used are as follows: AMD A6 7400K CPU @ 3.5 GHz for processor, 8 GB of RAM, 500 GB, AMD Radeon R5 for Graphical Processing Unit, and Windows 7 as operating system. In addition, Blender and Unity 5 version 5.6.0.1b is used to create 3D Objects and virtual reality environment. Moreover, Monodevelop version 5.9.6, Google VR SDK version 1.30 and Standard Asset Unity were also implemented. For experimentation and evaluation, a smartphone device with specifications as follows was used: Octa-core 1.4 GHz Cortex-A53 for processor, 3 GB RAM, 32 GB of storage, Adreno 505 for Graphical Processing Unit and Android version 6.0.1 Marshmallow.

4. Experiments and Result
There are three categories of evaluation: changes in fear level in the darkness before and while using the application, user’s motivation to fight fear in darkness, and usability of the application. The tests involved 12 men and 18 women with ages between 18-25 years old.

The first test was to look at changes in the user’s level of fear of darkness before and while using the application. The author separates the fear data between male and female users to see the relevance of gender difference in Nyctophobia. Figures 2 explains that women have the darkness fear level higher than men. Then, we measured the fear level of the treatment application while they used it. Most men feel a little scared. On the other hand, the most women still challenges to overcome their fear while using the treatment application. It could be happen because men are more familiar with the VR technology and game. So that, men could be more adaptive.

The second testing is performing motivational tests to find out how much influence can the use of the application motivate a person to fight Nyctophobia. The graphs in Figures 3 explain
that the application can motivate the users to be braver in facing darkness and it can make them get used to darkness.

The third testing is usability testing which was conducted by three experts in the field of human computer interaction. The assessment was carried out using Likert Scale with five scores. Based on Likert Scale described in section 2, the results of the central tendency acquisition of each category can be concluded that the application obtained a good value in average (as shown in Table 1). However, the category of clear entry and exit point obtained the smallest value because the respondent has a little bit of a problem finding the exit point. On the other hand, psychologists suggest that the application does not provide an exit point until the patient finished one part of the scenario.

Interviews with psychologist were aimed at asking for responses on the developed applications. The response requested is about whether or not the application can be used as a therapy tool for people with Nyctophobia. The conclusions of the interviews are as follows: the therapeutic scenario applied to this application can be used as a therapy tool to treat Nyctophobia, this application can be used as a home assignment to the patients to treat their Nyctophobia, the light source on level 1 needs to be added so that the patient is not too surprised, the simulation level needs to be added so that the reduction of the light source is done more gradually, and pre-relaxation needs to be embedded in the application.

5. Conclusion and Suggestion
The experiment has created a virtual reality game application which successfully simulates four levels of forest situation at nighttime. The night forest situation in the application can be an alternative solution as a therapy tool for Nyctophobia. The experimental study shows that female users tend to have a higher level of fear than male users. The game application can provide motivation to the users to be braver in facing darkness and to get used to being in the
Table 1. Usability Testing Result

| Categories                                      | Central tendency | Indicator  |
|------------------------------------------------|-----------------|------------|
| Natural engagement                             | 4               | Good       |
| Compatibility with user’s task and domain      | 4.67            | Very Good  |
| Natural expression of action                   | 4               | Good       |
| Close coordination of action and representation| 4.67            | Very Good  |
| Realistic feedback                             | 4               | Good       |
| Faithful viewpoint                             | 4               | Very Good  |
| Navigation and orientation support             | 4.33            | Very Good  |
| Clear entry and exit point                    | 3.67            | Good       |
| Consistent departures                          | 4               | Very Good  |
| Support of learning                            | 4.33            | Very Good  |
| Sense of presence                              | 4               | Very Good  |
| Clear turn-taking                              | N/A             | N/A        |

dark. The Sutcliffe's usability testing shows that the user interface and interaction of application have good values in the average of twelve categories. However, the improvement of Night Forest application is still needed to enhance the effectiveness of the process of the designed Nyctophobia therapy. For future study, research in the perspective of psychology is required to evaluate the application further and more comprehensively.

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