

Video Game Seizure Rating: a Qualitative Approach to Measure Photosensitive Seizures on a Video Game

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Abstract— One of the issues on a video game is creating several light patterns and quick movement that potentially makes a player feels dizzy, motion sickness or even seizure. On the game industry, the seizure information warning is displayed when the game is started and already purchased. This information is considered late, since in order to understand the potential of seizure, the player should buy and play the video game first. This paper proposes an effort to measure the potential of seizure by qualitatively measuring the playing environment and the game content. As a result, the paper proposes a video game seizure rating (VGS rating). The VGS rating will help parents or video game players to measure the potential of seizure without buying or playing the video game. VGS rating has 10 attributes to measure the potential of seizure on a video game. As a result, the proposed method has mean and standard deviation with similar result of the questionnaire method. Therefore, the VGS rating can be used to measure the video game seizure rating without need to play the video game

Keywords: video game, video game seizure, qualitative rating

I. INTRODUCTION

One of the health risks that can be experienced by the video game player is photosensitive seizure [1]. Photosensitive seizure is related directly with impaired physical condition in the form of seizures or traits such as motion sickness and dizziness caused by the quick movement of the light and sparkle patterns [2]. This symptom is not only happening on the video game but also on the television broadcast, videos, and any multimedia product [3]. However, video game has more potential to create photosensitive seizure due to its activities that has dynamic movement and involves instant interaction with the viewer.

On a video game, this effect is named as video-game-induced seizure or simply video game seizure (VGS). VGS happens more on man rather than a woman [4]. It has several specific symptoms for video game such as the screen position when playing a game, playing distance, and in-game movements [5]. On a video game industry, a video game that might have a photosensitive seizure is indicated by a warning dialog before the game is played. Although it sufficient, it has several disadvantages such as:

- In order to understand the potential warning on a video game, the video game should be purchased and played first to understand the effect of the VGS to the video game player.

- The current detection process is shown from the warning dialog on a video game and unfortunately some of indie video game don't have this kind of information. Furthermore, several video reviews such as YouTube Gaming channel don't show this VGS information.
- The current seizure measurement is measured for television broadcast or film. It might be insufficient, since the video games provide more interactivity to play, various movement, and flash colors.

Therefore, this research makes an effort to measure the video game seizure rating through qualitative approach. The reason why the qualitative approach used is described at Section II. The research result will have parents, video game players, or society to measure the health effects of video games especially in terms of video game seizure.

II. RESEARCH POSITION

Photosensitive seizure is already measured through a software called automatic video analyzer. It is created to identify the case that makes more than 700 children having seizures after watching Pocket Monster Film [3]. Automatic video analyzer works to evaluate several characteristics that makes photosensitive seizure happens. The characteristics then summarized by three main aspects which are light patterns, picture statistics, and video flickering [6]. On this step, researchers already characterize the photosensitive seizure but it only for television broadcast standard which is ITU-R BT 1702 [2][3]. Further research shows that the light sensitivity is depends based on human physical health [7]. It means that the effects different from one people to the others based on physical condition and the environment. The environment is defined any external effects that can make seizure happens such as screen size, screen type (LCD, LED, Plasma), and backlight [8]. The combination of physical condition and environment is called as the visual system. On extreme condition the photosensitive seizure can make epilepsy [9].

Television broadcast and video game have so many similarities. Both are part of entertainment industry that utilize the human visual system and brain processing. However, video game takes the experience further by maximizing interaction through body movement (i.e. Kinect and Wii), controller (Gamepad and Joystick), or integrated sensor on a smartphone [10]. Although it has benefits for some people, video game can

have serious effects on health such as depression, addiction, violence, and seizures [11][12][5]. The situation is taken seriously by video game vendor such as Microsoft (Xbox), Sony (PlayStation), and Nintendo (Wii) by providing health and safety gaming guide [13][14][15]. The guides deliver how to take care the health effects on a video game especially on seizures. Seizures need to be taken seriously on a video game since its existence is different from one player to another and it is called as video game seizure (VGS). Currently, the information is shown by the warning sign before the game is played and not all games have the information about the seizure information. The European study proof that some of video games genres have potentially make seizures because of stress, fatigue, or human health [1]. It means that some video game titles have potential to create a seizure while the others have no potential at all. The question is what kind of seizures that happens on a video game? A research shows that the video game seizure sensitive is also photo seizure sensitive even 25% have a higher effects than photosensitive seizures [16]. However, the detail of what kind of aspects video game and others environment that related with the experiment is not described.

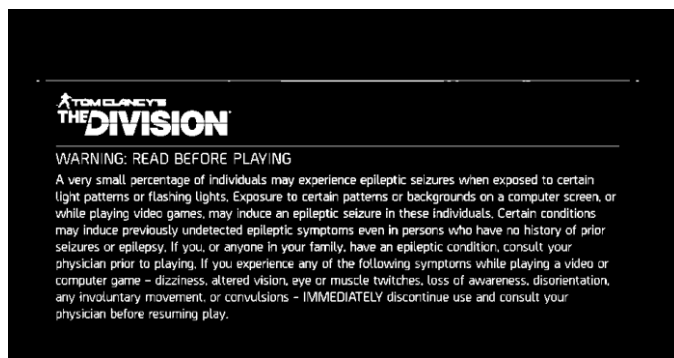


Fig. 1. The first video game that show potential seizure screen

An effort to quantifying video game seizures is done on several approaches. The first approaches is to understand the characteristic the flashing television images [6]. Although it is not directly on video games, the research shows a fundamental aspect how television becomes a source of evidence on seizures. The research shows the flashes frequency, opposing changing in luminance, area of flashes, and color are the main variables that makes seizures. The automatic way to detect the flashing video content is already developed, the proposed method is ITU-R BT. 1702 compliant [2]. Although it is not described for video game, the flashing content is also happening on a video game. The specific measurement of video game seizure is done through eye tracking and SSQ (simulator sickness questionnaire) on a racing video game [17]. The result shows that night driving is higher than morning driving.

Based on the previous researches, there are several potential questions to discuss such as:

1. It is shown that the VGS happens because of a combination between of the game content and the surrounding environment. The real question is what factors that make VGS happens internally and externally?

2. Until now the seizure effects are known by purchasing and playing the game itself. Is there any way to measure the seizure potential effects before the game is played or purchased?

III. RESEARCH METHOD

The research is done through three main steps which are parameters identification, composing the rating measurement, and validate the rating approach. As mentioned in the introduction, the VGS rating is a main contribution of this paper. VGS rating is a rating in numbers based on several key components.

A. Parameters identification

There are two factors categories which are internal factors and external factors. Internal factors are several factors that related within the game content such as gameplay, game genre, and others. External factors are several factors that related with the playing environment such as lightning condition, playing distance, and others. Both factor is justified based on study literature. The internal factors are composed by analyzing game design content that potentially make a seizure [10][4], understanding the genre of games and the playing model [18][19], and current symptoms that makes VGS happens [5][20][16]. The external factors are composed by analyzing playing environment such as type of screen, screen sizes, and health-safety condition [7][14][15][13].

B. Rating Measurements

Rating measurements is done by summing each parameters and then scaling the value between zero to one. The parameters contain two main parameters category namely internal parameters and external parameters based on the previous researches [2][17][6]. As a result, the video game seizure will be symbolized as vgs (x, y) where x is internal parameters and y is external parameters.

C. Validate the VGS rating

VGS rating is validated through experiment. The case study will validate the seizures rating by comparing the result from Questionnaire with VGS rating calculation. The validation activity is done through several steps such as:

1. Experiment setup. The experiment setup will use XBOX 360 console video games. The console is selected rather than a PC to provide maximum experience on gameplay with consistent 30fps-60fps on gameplay.
2. Creating a list of modern game that will be used for the experiment. The modern game will be chosen from various top genres that best seller on a video game which are shooter, action, sports, racing, and fighting. There are five games chosen. Each game represents a genre of a video game. The games are Battlefield 4 (First Person Shooting), FIFA Soccer World Cup (Sport), Forza Horizon 2 (Racing), Gears of Wars 3 (Action), and Injustice (Fighting).

3. Creating a group that will be execute the experiment. Each group will have two participants. The member should not a hard-core gamer (playing a video game less than five-to-six hours / day) and commit to join the experiment session. There will be three groups.
4. The experiment session is done in five sessions. Each session will be executed in three batches in the same hours, same games, and in different days. Each batch will be executed on 30 minutes with a break time for 10 minutes for each player. Each batch will be played by two players in one group.
5. The session is recorded using Elgato Game Capture HD60 with HDMI interface. The result of the game capture is uncompressed AVI and compressed MP4 format.
6. The environment is composed to common light levels with 250-300 lux and uses 32-inch television with 1-meter distance within player and room size 4x3 meter.
7. Requesting the players to write the experience through Questionnaire. The Questionnaire will ask 10 question with Likert scale that have similar question with the VGS rating such as:
 - a. Is the brightness of the video game you played makes your eyes hurt/tired?
 - b. Are you feeling dizzy or nausea when looking at the movement which happened in the video game?
 - c. Is the flashing in the video game such as explosion, lightning, etc., make your eyes hard to see or seeing blurred images?
 - d. Is the video game has 3D environment?
 - e. Are you feeling uncomfortable after played the video game such as shaky or feeling sick?
 - f. Are you playing the video game with a distance less than one meter to the screen?
 - g. Are you playing in the room with sufficient light?
 - h. Is the screen that you are using is too big compared with the room size?
 - i. Are you feeling that the television provides a screen color and saturation that makes you dizzy or sick?
 - j. Are you having a lack of sleep on the last night, got a flu, or feeling tired before you play?
8. There are 6 questionnaires and 3 videos recording for each games. The result is calculated and averaged.
9. Comparing the questionnaire results with the VGS rating values. The result of the questionnaire is converted into 10 scale so that it can be compared with the VGS rating values.

IV. VGS RATING

A. Measuring video game seizure rating

The VGS rating is structured by two main attributes categories which are external and internal. The attributes are

derived from previous researches. Table 1 shows the internal and the external attributes on the VGS ratings.

TABLE I. ATTRIBUTES ON VGS RATING

Factor	VGS Attributes		
	Name	Description	Range Values
Internal	Game Brightness	The intensity of light from video games. It follows the video game setting standard	0-1
Internal	Game Movement	How many movements when playing a game. Puzzle has less movement, while Action and Adventures have a lot of movement. The movement is measured on compression ratio between uncompressed and compressed video	0-1
Internal	Flashing Content	How many flashing content that happens on a video game? The flashing content is measured with PEAT (Photosensitive Epilepsy Analysis Tool). PEAT can be downloaded at http://trace.wisc.edu/peat/ . The Maximum value on the peat is between 0 – 3.4	0-1
Internal	Game Types	Game type which are 3D or 2D. 2D provides lowest value 0, and 3D gives the highest value 1.	0-1
Internal	Game Genre	The genre of the game ranked with the most potential to make VGS (identified with PSE Information sign before playing a game) and with the least potential to make VGS such as puzzle game	0-1
External	Screen to player distance	How far the distance between player and the television. More than 1 M will give lowest value (0) and less than 0.5 M will give the highest value	0-1
External	Screen size	Less than 12 inch will give lowest value, while more than 88 inch will give highest value	0-1
External	Type of Screen	The modern screen with recommended refresh rate (>72 kHz) will give lowest value such as LCD, LED, and plasma. While the conventional screen like a CRT will give the highest value	0-1
External	Player Condition	This is yes/no condition if the player feel healthy then the lowest value will be given, but if the player feel unsure about his condition the highest value will be given	0-1

As mentioned on section III.B, the VGS rating is symbolized as $vgs(x,y)$ where x is internal factor and y is external factor. The

equation is shown at Equation I. The result will have values of 0 to 10 with the decimal data type.

$$vgs(x, y) = \sum_{n=1}^5 x + \sum_{n=1}^5 y$$

Equation 1. VGS Rating equation

In order to measure the VGS rating for a game. The player should prepare several stuffs that related with the game such as video review of the game that can be obtained through YouTube, measuring the surrounding environment based on Table II, and PEAT software to measure the video review. Table II shows the look-up table for each attributes.

TABLE II. ATTRIBUTES ON VGS RATING

Attributes	VGS Attributes		
	Lowest (0)	How to get the value	Highest (1)
Game Brightness	Dark (0)	By default, the brightness of any game is set to 60% (0.6). This number is obtained from an average brightness setting that can be seen and adjusted on a game screen setting	100% (1)
Game Movement	Near to Zero (0)	The value is obtained by dividing compressed video with uncompressed video. In theory, the compressed video should be lower than uncompressed video. Therefore, the numbers should be near with zero.	No change in video size (1)
Flashing content	Near to zero (0)	The PEAT analysis will have the value between 0-3.4. If the PEAT analysis result is 2.4 then the value of this VGS attributes is 2.4 / 3.4 (0.7)	Having values of 3.4 on PEAT tool (1)
Game Types	2D (0)	2D games will have 0 value, 3D games will have 1 value. 2.5D games like street fighter V or Assassin Creed China will have 0.5 value	3D (1)
Game Genre	Puzzle Game (0)	Based on 25 times of experiment the rank of this value are Board Game (0.1), Strategy (0.2), Role Playing Game (0.3), Fighting (0.4), Simulation (0.5), Sport (0.6), Adventure (0.7), Arcade Racing (0.8), and 3 rd View Action (0.9)	First Person Shooter (1)
Screen Distance	>= 1 m (0)	If the person is in the front on TV at 0.75 m than it will get 0.67 rating (0.5/0.75)	<= 0.5 m (1)
Screen size	<= 12 inch (0)	If the player plays with 48-inch television it has 0.55 rating (48 / 88)	>= 88 inch (1)
Type of screen	OLED (0)	LED (0.25), LCD (0.5), Plasma (0.75)	CRT (1)
Player Condition	Well (0)	Unknown (0.5)	Tired, Lack of Sleep (1)

The highest number of VGS rating is 10 and the lowest number of VGS rating is 0. Both numbers are rarely achieved. Based on the range numbers. The VGS rating is categorized as shown on Table III. There are three categories namely low potential, medium potential, and high potential for video game seizure. The result is obtained by summarize each attribute result with the Equation 1.

TABLE III. VGS RATING RESULT

VGS Rating	Rating Range	Description
Low	>0 - <= 3	The game has low potential to generate video game seizure
Medium	>3 - <=6	The game has a potential to generate video game seizure
High	>6 - <=10	The game has high a potential to generate video game seizure

B. Validating the video game seizure rating

As mentioned on the Section III.c, the result of each game rating is displayed on Table IV. As shown on the Table IV, it is shown the VGS rating technique provides similar end result with Questionnaire result.

TABLE IV. VGS RATING AND QUESTIONNAIRE RESULT COMPARISON

Games	VGS Rating	Questionnaire Result	Rating
Battlefield 4	4.53	5.68	Medium
FIFA World Cup	4.16	3.60	Medium
Forza Horizon 2	4.48	4.84	Medium
Gears of War 3	4.64	5.24	Medium
Injustice	4.13	3.80	Medium

To determine the result correlation between the two methods, a Pearson's correlation was run. The result shown there was a very strong, positive correlation between VGS rating and questionnaire result ($r = .92$ and $p < .001$).

The mean and standard deviation of VGS rating were 4.388 and 0.205 respectively while the mean and standard deviation of questionnaire result were 4.632 and 0.808, as shown on Table V. From this calculation, it can be inferred that the data was not spread too far, knowing that VGS rating has a scale of 1 to 10, which make a difference of 0.8 still won't make a drastic change to the end result.

TABLE V. VGS RATING VALIDATION

	VGS Rating	Questionnaire Result
Mean	4.388	4.632
Standard Deviation	0.205270553	0.808515

V. CONCLUSION AND RESEARCH DISCUSSION

This research makes an effort to measure video game seizure potential by creating measurement technique namely video game seizure rating (VGS rating). The VGS rating will help the people too aware and to prevent seizure, motion sickness syndrome, or photo sensitive seizure before playing the video games. Based on the research it is concluded that:

- VGS rating consider two main attributes which are five internal attributes from the game itself and five external attributes from surrounding environment. The attributes are obtained from the previous researches.
- VGS rating has three grades which are low rating, medium rating, and high rating. The detail of the rating is shown on Table III.
- Based on the validation process, the VGS rating is compared with Questionnaire and provides a similar mean and standard deviation result.

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