**Advancements and Benefits of Stereoscopic 3D (S3D) in Games Development**

Mohammad Ahmadi¹, Tomas Trescak², Babak Bashari Rad¹ and Leysham D. Doobree¹

¹Department of Computing, Technology and Engineering, Asia Pacific University of Technology and Innovation Technology Park Malaysia, Bukit Jalil – 57000, Kuala Lumpur, Malaysia; ahmadi@apu.edu.my, dr.babak.basharirad@apu.edu.my, ddoobree@gmail.com

²School of Computing, Engineering and Mathematics, Western Sydney University Parramatta NSW –2150, Australia; t.trescak@westernsydney.edu.au

**Abstract**

Stereoscopic 3D (S3D) has been developed years ago more in the movie industry and the gaming industry. This paper evaluates the benefits versus the adverse effects that it has on people and conclude whether it is worth considering in the gaming industry. To achieve the desired outcome, we are going to review past studies conducted by researchers and then cumulate the solutions that they have given to finally decide on whether it is worth considering in the industry. The research that was conducted showed that many papers have discussed a specific problem and tested a few hypotheses and eventually came up with a solution. This paper has summarised the previous papers where the solutions were found and then, has chosen the once that upon application can eventually enhance the experience of the viewer. Many of the researchers have discussed about the depth adjustments, parallax errors and quality of experience. Hence suggesting that, these are the most important factors to be focused on if we want to remove the discomforts.

**Keyword:** Anaglyph, Game Depth, Gaming, Graphic Card, Interactive Game, Immersion, Monoscopic, Playing Discomfort, Polarization, Quality of Experience, Stereoscopic 3D-Virtual Reality, S3D

**1. Introduction**

Stereoscopic 3D (S3D) has been developed few years back but its applications are more towards the movie industry and the gaming industry could benefit a lot from. It can be achieved through three most used methods namely the use of Anaglyph, Polarization or the Eclipse method (Active Shutter System). Even though the systems are used by cinemas around the world, people still feel the discomfort that is a side effect of it. In the gaming industry, the technology has not been exploited to its full potential. When considering the benefits that this technology could bring to this industry and the immersion of the player in the game, change in the player decision and pathways is noticeable.

**2. Industrial Development of Stereoscopic 3D**

The gaming industry had started the development of Stereoscopic 3D in games but never went in depth with the development of the technology. The main reason behind the downfall in the market is focused towards the compatibility of the system to its hardware. Nvidia had monopoly of the market with its 3D Vision but had little takers as the expenses that had to be made were considerable when evaluated by some people. When AMD released its HD3D technology which revealed more affordable to people, the market was still sceptical to this technology as AMD never released any glasses with its technology. Their product uses the glasses that are specific to the monitor itself and
hence reducing the cost for many even though the quality provided was not that good as compared to the 3D Vision. To be able to use the AMD technology, the latter has to ensure that his graphics card is compatible to with it and has the appropriate display. On setting up the system, the person has to either install TriDef or iZ3D so that the conversion to S3D is done through either of these softwares.

Nvidia provides full support for its product and keeps it in check with the software updates so that it can be compatible with every games being released. The game that Nvidia mostly focuses on to promote the product is the Batman Arkham Asylum which is 3D Vision ready whereas AMD has created its system to make it compatible to cover a wider range but is not as effective to all games. The depth added to games enables more precision in games. Namely FIFA which is a sport game tends to lack in terms of depth and with the additional depth, the player is able to tackle more precisely.

3. Recent Advancement in Stereoscopic 3D

Development of a game technique for Television (TV) sets that can render games in S3D despite the lack of processing power, no graphics processing unit, low storage capacity, therefore processing is difficult. The techniques that they used can be applied for the creation of games for other platforms such as mobile phones and tablets.

However, the evaluation of the game during implementation in different 3D techniques has not been evaluated to know which is more immersive to the viewer. Hence, tests on the different types S3D that is available on the market to compare the immersion level of the viewers. The technologies tested were auto stereoscopic 3D, polarized passive glasses and active shutter glasses. They tested using 55 inch TVs and the focus factors for this project are the picture quality, perception of depth and visual discomfort felt by the user. The result has shown that auto stereoscopic was the best terms of visual comfort as there is no need to wear any glasses but the higher performance and immersion of active shutter glasses has been noticed due to its reduced discomfort on the viewer.

4. Game Implementation

New experiences were looked into, whereby; the main topic they discussed was the creation of a game specific to S3D. They emphasized the necessity of a game being built for that technology should be design from the beginning. Most games readily available are in 2D and the converted to 3D, hence the quality of the game is deteriorated and causes frame loss.

Since Nvidia 3D Vision provides the depth adjustment option to the viewer, investigation of the belief that “the more stereo, the better experience”. This statement has been tested with a sample of people and the results concluded that stereo is dependent on the person viewing experience. For movies, the depth cannot be adjusted but for games, the depth has to be adjusted accordingly to avoid discomfort. Each game has its own amount of depth to be applied also known as the ‘Sweet Spot’. Research results have shown that an average amount of stereo increased the viewers’ alertness to the game compared to a more elevated one.

Stereoscopic games created specifically for the technology is not common as rendering and coding are different when compared to regular games. Development of a game using Havok Vision Engine. The game play consists of the player flying in space ship and avoiding obstacles. The time that the player takes is recorded. The architecture gives the player has the ability to adjust the perceptual settings in the game. Depth has been added to provide the player more immersion in the game.

They have used 3 different techniques in the creation of the game, namely, S3D specific GUI, depth cues and parallax budgets. After creation of the game, two samples of people were created, one who will be using monoscopic 3D vision and the other using Stereoscopic 3D vision, hence acquiring more accurate information on the effectiveness of the system. They however hypothesized that the game experience would be better in the S3D group and an increase in the focus of the player will be noticed. It was also considered that cyber sickness would be reduced and performance of the game would be better as compared to a real-time conversion. Finally, the human behavior playing in stereoscopic would be different from those in monoscopic.

Results analyzed at the end of the testing have shown that players’ decisions changed when using S3D. Based on the implementation of a game specific to S3D has the use of Havok Vision engine.

5. Benefits of Stereoscopic 3D in Games

Since the release of S3D on the market, researchers have been trying to prove the impact of this technology in the
gaming field. The technology mostly affected the TV and movie industry with the implementation of it in that field. Hence, undertaking a research is to prove the potential immersion of S3D. They have had sixty people attempt this method in three different games and comparing it to monoscopic. The research has shown that the S3D is preferred by the participants while increasing immersion in the game as well as increasing discomfort symptoms to the player. And also shows an increase in the players' mental activity. The test results have provided evidence that discomfort is dependent on the person's gender and the game being played.

Apart from the game and monitor, other aspects have to considered when come to the immersion of the player; hence evaluating how the player experience is affected by different input methods, namely, a standard mouse, laser pointer and hand gestures. Results have proven that the player had better interaction using the laser pointer. They specified that the market is more oriented towards Quality of Experience (QoE) in regards to content delivery method rather than focusing on the viewer interaction with the system. They then concluded by showing that the size, distance and pointing method used have a significant importance in the QoE of the viewer.

Another testing has been carried out whereby they have come up with a population sample and had them play a game in S3D but the game had improved GUI, visual comfort concepts applied and game mechanics that are directly related to depth in the game. The test has shown too brought up new patterns in gameplay, whereby the player would have taken another path if the game was in 2D. Hence concluding that behavior of the player in the game is dependent on the game where the level of design is without affecting the person any further.

6. Discomfort Perceived by Users

The application of Stereoscopic 3D can be further developed for the games industry but the reason why this is lacking, is because of the people being prone to cyber sickness. Stereoscopic 3D has been developing to Personal Computers (PCs) but the investigation carried out, showed that over the years and implementation has been mainly focused in movie industry. Information acquired over time has demonstrated that discomforts were caused by different key elements of S3D, namely, parallax errors, depth and inconsistencies in the knowledge of S3D.

Focus brought on the impact the frame rate has on S3D. They said: “Frame cancellation comes from the conflict between two depth cues: stereo disparity and occlusion with the screen border”, meaning that there is an error when the images are interposed in their position, so they suggested to render only the parts that are in the screen to enhance the quality of the image and reduce processing power needed. Testing has shown that all the subjects have liked the method used. However, another cause of discomfort that may arise was believed to be caused by active movements while playing a game, for example, playing S3D using Kinect is believed to increase the amount of discomfort perceived by the player but test samples conducted have proved to be against the hypothesis.

Studies regarding parallax variations and motion speed to determine how it affects player discomfort and concluded that even though the parallax is high, it is not enough to cause any noticeable adverse effects to the viewer but when combining it with high speed motion, the effects become more prone. On the other hand, investigation on the effects of S3D on individuals that use the technology to play game and on those that uses it for simulation purposes. The results have shown that whether simulation or gaming, the discomforts are still present but the performance of the S3D simulation is better.

Other possible causes of discomfort have been considered. They have taken in account the position of the stereoscopic object in relation to the viewer position, meaning far, near or both. The research revealed that people tend to prefer when both far and near objects are in the movie. But when combining the position of the objects to the viewer seat location in a cinema, the feelings of dizziness occur. Another occurrence during the study showed that people wearing corrective glasses in addition to 3D glasses suffered from eye fatigue.

Visual discomfort in S3D can be reduced but at the same time not losing the immersion level of the game. This is what was researched and hence decided to adjust the parallax error that occurs in the image display of the left eye and the right eye and changed the difference range of each eye separately without changing the overall result, therefore resulting in beneficial effects on the player and the results of the process was noticeable.

Recent research conducted, regarding the effect of response of the human brain to watching S3D. Results suggested that passive S3D did not cause much difference in the viewer neural activity and hence they deduced that the fact of looking at a video in S3D was probably not the cause of visual fatigue as results obtained were normal.
Advancements and Benefits of Stereoscopic 3D (S3D) in Games Development

7. Conclusion

The development companies still have improvements to make when it comes to hardware but still the availability of the system is not hard to find even though the price remains high. The two main companies responsible for this system in the gaming industry have been provided with two different hardware's and each have their pros and cons but the level on immersion in both stays better compared to the movie industry.

The good side of this technology is the immersion provided to the player, whereby the person can play game more accurately in cases such as FIFA and have a better experience while playing it. The gaming industry has much to develop in terms of S3D and the rise of the technology will provide more benefit to the gaming industry. Several researchers have made different test and the results obtained when implementing it in game have proven to be more favorable and tend to attract more attention of the person.

Based on research made, we can conclude that S3D can bring better to the gaming industry by applying solutions that have been mentioned by the researchers. The techniques that they have used to reduce the amount of discomfort for the player to enjoy more the immersion of the latter in the game have proven to be a success; hence application of these should definitely bring the technology to the front in the gaming industry. The discomforts are not the same for all people, some feel it more than others but still caution has to be exercised when first starting to use the technology.

To conclude, Stereoscopic 3D technology is worth considering. When evaluating the benefits compared to the side effects, it is neglectable in most cases. Research has suggested that out of the three S3D systems, the polarized system gives less discomfort but also less immersion whereas the active system gives out a little more discomfort but much more immersion than the passive.

8. References


