



A REVIEW ON 3DTV: HISTORY, TECHNOLOGY, ISSUES AND FUTURE

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ABSTRACT In the past recent years, the stereoscopic 3D content were produced and filmed in various media programme formats in huge numbers, particularly in the entertainment filed. Electronic consumable giants like Sony, Samsung, LG and Panasonic have drastically increased manufacturing of Smart TV's and 3DTV's. This review paper, traces the emergence of 3DTV and its various kinds of technologies involved in it and its effects on the viewing audience. Some of the viewers who watch 3d stereoscopic movies in 3DTV reports, that they have visual discomfort during the viewing of the S3D content. This paper also discusses the distribution of 3d content through different modes of media formats like 3D broadcasting, 3D DVD, 3D Blu-ray and other 3d video files.

KEYWORDS : 3DTV, Broadcasting 3D, visual discomfort, Stereoscopic3D

INTRODUCTION

One of the reasons and the major contributor of the stereoscopic display's increase in the home entertainment is James Cameron *Avatar* (2009). As the movie created a major impact on the audience and made curious about the S3D content. On the other side, the television display technology was also able to match the standard of theatrical experience in the viewing experience of 3DTV. Moreover the TV manufacturer's research and development departments periodical update their technology and ergonomics of the 3DTV, to cater needs of the stereoscopic enthusiastic.

The history of the stereoscopy dates back to 1833, which the device "Mirror Stereoscope" was developed by Charles Wheatstone [1, 2]. The idea behind stereoscopic video or image is to create depth in the perception of human vision. Two video/images are captured with two cameras with a distance, which is equal to the distance of two eyes of human. These two video images are fused together to give an overlapped images. The overlapped images are seen by the human eye, where the two images, each one of the image reaches the respective left eye and the right eye. Later, once the image reaches its respective eye, the human brain fuses these images from the left and right eye and stimulates the depth.

This paper attempts to discuss the emergence of 3DTV and its other technological advancement in disseminating the 3D content. It also discusses about the future scope of 3DTV and its reception. The researcher tends to analyse and discuss the significant effect of discomfort in viewing 3DTV.

Emergence of 3DTV

The early stage of 3DTV in 1928 was demonstrated by John L Baird of Scotland, who was also responsible for the broadcast of live television images in January 1926 and making it as the first public exhibition of the medium [3]. Unfortunately Baird's experiment on 3DTV doesn't have the commercial viability, as because it can entertain only one at a time in front of the TV sets. Another engineer named Leslie Gould was also experimenting on 3DTV in 1931 (Novak 2012). He developed and demonstrated using neon tubes, a revolving shutter drum and a TV receiver to televise the 3D image. During the early 1950's the TV sets has increased drastically and seems to be threat to the Movie industry. In 1947 "Robinson Crusoe" was produced and released by the Russians. To draw the back the audience to movie theatres, Hollywood planned to produce more 3D movies to retain its glory. In 1952 "Bwana Devil" (1952) was produced, it was the first feature length motion picture in 3D and "House of wax" was in 1953. Between the 1952 and 1955 around 46 six 3D films were made produced in Hollywood. Later these 3D films lost their glory and reception from the audience due to poor quality of image [4].

TYPES OF TECHNOLOGY IN 3DTV

(i) Anaglyph 3D technology with red & blue glasses

One of the early technology was the two-color Anaglyphic 3D, which uses two differently coloured glasses, mostly one in cyan and other in red. The other anaglyphic lenses are yellow and blue, or green and magenta. Anaglyphic 3D is, where the two shots (images) are coloured differently and superimposed each other and wearing a coloured

glasses filters the colour, as one eye can see one image and other can see the other image [5]. And the coloured corrected shots (images) combines together to give a depth perception in the human eye. The Anaglyphic 3D video content can play in any normal standard analogue colour TV and other digital TV's and normal display systems with the help of coloured glasses.

(ii) Active 3D technology with shutter glasses

Active 3D is one of the costliest technologies, which uses active shutter glasses and it is synchronized with the images displayed on the TV screen. An external power is provided to make the LCD shutter open and close alternative for both the eyes respectively [5]. As the synchronizing speed is high and it matches and paired with the TV screen, the movement of the shutter will not be noticed by the user. The advantage of the active shutter glass is the resolution with full HD 1080P. The disadvantage of the active shutter glass is bulkier and heavier than the other passive glasses [6].

(iii) Polarized 3D technology with polarized glasses

Passive 3D is one of the technologies, which is used in the cinema theatres to screen stereoscopic 3D movies with a specialized silver screen for projecting the content. Passive 3D separates the sub- frame, which is shown in the screen by using a circular-polarized glass and other polarized filter is laid on the front of the TV screen [7]. The polarized filters on both the ends make sure that each eye sees alternate lines on the displayed image. This creates a sub frame for the respective intended eye. The advantage of the passive glass is very cheap and lighter and more comfortable than the active shutter glass. The disadvantage of the passive 3d is the resolution is cut to half in a full HD [6].

3D TV CHANNELS

In 1953 "Space patrol" a science fiction programme was the first experimental 3DTV broadcast in Los Angeles by KECA channel. After that during December 1980, a 1953 3D feature film "Miss Sadie Thompson" was the first modern 3DTV broadcast by SelectTV at Los Angeles. An experimental study was carried out to test the possibility of the future broadcasting services of stereoscopic television system with HDTV facilities. It was found that the quality was superior to the conventional 2D TV systems. It is also found that a larger screen size is required for the effective stereoscopic vision through psychological study [8]. A series of nine popular shows was telecasted in 3D by ABC in 1997. Popular programmes like "America's funniest Home videos" and "Sabrina the teenage witch". In these programmes only the beginning and end only were actually 3D [4]. Another experiment was tested in 1998 to demonstrate the Nagano winter games in Japan to transmit stereoscopically recorded lives images. During the 2002 FIFA world cup using the terrestrial and satellite network an experiment was carried in Korea/Japan [9].

In India during October 2006 "Mayavi" a Tamil serial was the first 3D serial on Indian Television telecasted by the Tamil satellite channel Jaya TV and produced by GV films. It had 26 episodes which aired on only Saturdays. It was one of the major breakthroughs in Indian TV serials, which is different from the normal soaps telecasted at that period, as this was fantasy and superhero story. Due to the huge

response for the first episode, it was decided to go for few more episodes. As this was before the period of 3D enabled TV, Anaglyph 3D was broadcasted. Around 40 lakhs of Anaglyph glasses were sold by the distributors all around TamilNadu state, India [10].

3D Ready TV

The 3D ready sets are capable of displaying both the 2D and 3D contents, and you can enable the 3D mode in these just a click away in your remote. It can detect a 3D signal from an external source. These TV's usually comes with HDMI 1.4 and a refresh rate of 120 Hz minimum outputs [11]. During 2010 and 2011 many TV manufacturers like Sony, LG, Samsung, Panasonic, Phillips and Onida increased their production of 3DTV. These TV's either had an Active 3D or Passive 3D. Some had different variant TV sets adapting both the technology as consumer can have option of selecting any technology from the same brand.

During this time many satellite TV started their 3D broadcasting. Sky 3D is the world's first 3D channel started broadcasting nationwide in South Korea on 1st January 2010. Discovery communications, Sony, ESPN, Fox Sports, and BBC were the channels which went on to broadcast 3D programmes. These 3D channels broadcasted live sports like FIFA world cup, Wimbledon, 2012 summer Olympic etc., [11]. Stereoscopic 3D content is also available in various media format like 3D DVD, 3D Blu-ray, and other YouTube 3D videos and other stereoscopic 3D portals, where you can download the video content.

Another two important initiatives was carried out in 2001 and 2003 respectively to cater the needs of the 3D market in the future. (i) The development of improvised compression technologies like 3D audio/visual coding (3DAV) was established by the MPEG committee[9].(ii) A 3D consortium was established to boost the prospective market for 3D Technologies by Japanese electronics companies NTT Data, Sanyo Electric, Sharp, Sony and Itochu.

A Project called "Advanced Three-Dimensional Television System Technologies" (ATTEST) was proposed by the European Information Society Technologies to have a modern approach to the three-dimensional broadcast television (Fehn 2005). ATTEST 3D TV concept consists of five different functional building blocks. The building blocks namely as follows (1) 3D content creation; (2) 3D video coding; (3) Transmission; (4) 'virtual' view synthesis; (5) 3D display (Fehn 2005). The below illustration explains, the signal processing and data transmission chain of ATTEST 3DTV and its fundamental ideas.

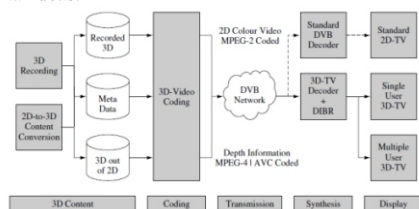


Fig (1). ATTEST 3DTV concept of transmission chain (Fehn.,C, 2005, p.27)

VISUAL DISCOMFORT

One of the major problems with stereoscopic display, 3D Cinema and 3DTV is the visual discomfort. Many experiments, surveys and studies has found out that significant amount of visual fatigue is encountered by the audience due to various factors. Researchers have reviewed many researches on stereoscopic displays and found the cause of visual discomfort and listed and categorized four major factors (i) anomalies of binocular vision (ii) dichoptic errors (iii) conflict between convergence eye movement and accommodation functions and (iv) excessive binocular parallax.[12,16,17,18]. In a lab-based study, that researchers found that there was a minor effect of gender, with females seems to be more encountered towards the adverse effect after viewing stereoscopic 3D video content [13]. Another study by Yang et.al (2012) also found that female reporting negative effects than male. The cause of discomfort to some of the audience's experience who viewed stereoscopic 3D is not that much clear [14].

FUTURE OF 3DTV

The 3D ready TV has drastically increased, as the 3DTV manufacturer's thought that this technology will have a great impact on

the audience viewership. According to isuppli market research, it is found that the shipment forecast for (2010-2015) was enormous and they predict a sale of 159.2million in 2015[15]. But in turn, due to some adverse effect on viewing S3D, it couldn't draw the attention that much from the home viewers. As the audience felt that the 2D seems to be more comfortable than the S3D, even though it had depth perception. Most of the 3D channels broadcaster pulled back as the reception was not as expected. Slowly some of the 3DTV manufacturers also reduced their production. The Alternate may be the Glasses free 3DTV, the Autostereocopy TV which uses lenticular system and doesn't require a glasses to watch. Already Phillips, Samsung, LG, Sony, Toshiba and Panasonic have brought Auto3D to the market. This Auto 3D may be the successful one, as there is no adverse effect to the viewers.

CONCLUSION

This review paper discussed and traced the history of 3DTV and the technology involved in displaying the stereoscopic 3D content and also discussed the broadcasting of the 3D channels. Moreover the paper reviewed and established the current scenario of the 3DTV and its scope for the future in entertaining the audience. The adverse effect was there in viewing the stereoscopic 3D content and it seems to be negative aspects of the 3DTV. And there is no clear evidence for the cause discomfort. The ultimate remedy for the discomfort in watching the 3D content can be the Autostereocopy (Glasses free). Still there should be more research conducted on 3DTV to have a better ergonomics and to have the best 3D viewing experience and wholesome entertainment.

References:

1. Wheatstone, C. (1838). Contributions to the Physiology of vision – Part the first: On some remarkable, and hitherto unobserved, Phenomena of binocular vision, Philosophical Transactions of the Royal Society, 128, 371-394.
2. Karajeh, H., Maqableh, M., & Masa'deh, R. E. (2014). A Review on Stereoscopic 3D: Home Entertainment for the Twenty First Century. 3D Research, 5(4), 26.
3. Novak, . M (2012). 3DTV: The future that never. Retrieved from <http://www.bbc.com/future/story/20120209-paleofuturist-3dtv>
4. Velu, . K (2010) The History of 3D TV. Callow, .R (eds) Retrieved from <http://www.brighthub.com/electronics/home-theater/articles/84377.aspx>
5. Understanding the different 3D TV Formats. (2013) Retrieved from <http://www.practical-home-theater-guide.com/3d-tv-formats.html>
6. Tai, .C.Y & Gongware, . L (2012). Viewer Symptoms And Preferences: Comparing 3d Tv Displays .Paper presented at the 6th Annual VPI Research Conference, Pacific University Oregon. Retrieved from commons.pacific.edu/vpir6/present/6pm/6/
7. Bromley, . M (n.d) 3D TV Technology. Retrieved from <http://www.3dtelevision.org.uk>
8. .Yano, . S and Yuyama, . I, "Stereoscopic HDTV: Experimental System and Psychological Effects," in SMPTE Journal, vol. 100, no. 1, pp. 14-18, Jan. 1991. doi: 10.5594/J02092
9. Fehn, .C (2005). 3D TV Broadcasting. In O. Scheer, P. Kauff & T.Sikora (eds), 3D Videocommunication – Algorithms, concepts and real-time systems in human-centred communication (pp. 23-37). Chichester, England: John Wiley & Sons.
10. Franko, J (2006) India's first 3D TV serial, 'Mayavi' debuts on Jaya TV - http://www.exchange4media.com/tv/india-s-first-3d-tv-serial-'mayavi'-debuts-on-jaya-tv_23037.html.
11. 3D television. (2017, May 24). In Wikipedia, The Free Encyclopedia. Retrieved 18:31, May 29, 2017, from https://en.wikipedia.org/w/index.php?title=3D_television&oldid=781951914
12. Lambouij, M. T. M., IJsselsteijn, W. A., et al. (2007). Visual discomfort in stereoscopic displays: A review. In Stereoscopic displays and Virtual reality systems XIV. Proceedings of the SPIE, (Vol. 6490). Presented at the society of photo-optical instrumentation engineers conference.
13. Read, J.C.A & Bohr, . I (2014). User experience while viewing stereoscopic 3D television., In Journal Ergonomics, Vol 57. No.8, 1140-1153, May 2014. <http://dx.doi.org/10.1080/00140139.2014.914581>
14. Yang, S.N., T.Schlieski, B.Selmins, S.C.Cooper, R.A.Doherty, P.J Corrriveau, and J.E Sheedy, 2012, Stereoscopic Viewing and Reported Perceived Immersion and Symptom," Optometry and Vision Science 89 (7): 1068-1080. doi:10.1097/OPX.0b013e31825da430.
15. Patel, R. (2010) Global 3-D TV shipments set to soar to 78 million units in 2015, IHS isuppli Market Research. Retrived from <http://isuppli.com/display-materials-and-systems/news/pages/global-3-D-TV-Shipment-set-to-soar-to-78-million-units-in-2015.aspx>.
16. Yano, . S, Emoto, . M and Mitsuhashi, . T. " Two factors in visual fatigue caused by stereoscopic HDTV images", Displays 25:141-150 (2004).
17. Emoto, .M, Niida, .T and Okana, . F. (2005) Repeated Vergence Adaptation causes the decline of visual functions in watching Stereoscopic Television, Journal of Display Technology 1: 328-340.
18. Woods, . A, Docherty, .T and Koch, .R (1993) Image distortions in stereoscopic video systems, proceedings of the SPIE 1915: 36-49.