

A Survey on Anaglyph Generation

Prachi V. Deshpande¹, Dr.(Mrs.)S.S.Lokhande²ME Student, Dept. of ENTC, Sinhgad College of Engineering Vadgaon (Bk.), Pune, Maharashtra, India¹Professor, Dept. of ENTC, Sinhgad College of Engineering Vadgaon (Bk.), Pune, Maharashtra, India²

ABSTRACT: In recent years, three-dimensional visualization is becoming a topic of increasing interest. As three-dimensional visualization reproduces depth information of the target, it's most popular with the sculpture arts. Anaglyph is one of the methods of three-dimensional visualization which is very economical. Anaglyphs are a way to present stereo pairs images to the appropriate eye. After creating the left and right eye image, red and blue or cyan filters are applied to the two images. Superimposing the two images into one results the anaglyph images which gives a sense of depth while seeing through the anaglyph glasses. In this paper, we discuss the different methods of anaglyph generation.

KEYWORDS:Anaglyph, Depth information, Three-dimensional visualization

I. INTRODUCTION

Nowadays, there are a lot of sources of stereo images like 3D cameras, software that produce 3D effects, technologies that can create stereo-pairs from a 2D images. Many industries (e.g. games, movies, education) have grown to a vast extent in 3D effects. As there is a limitation on the 3D content, one alternative solution is the conversion of 2D to 3D to fulfil the demand of the viewers. Another problem is that if the 3D effect is displayed on a 2D visualization medium then the 3D will look like a 2D visual. Thus there is no meaning of the 3D. The debate goes on whether the 3D effect can be brought using the 2D mediums. This is called as 3D modelling.

The 3D space consists of three parameters which includes depth of the objects. 3D image modelling is a method to create an illusion by taking in account the third parameter i.e. the depth from the 2D images. Generally, cameras are used for the 2D image acquisition. The depth parameter can be estimated by finding the distance between the camera and the object. One of the method to estimate the distance between the object and the camera is the intensity (brightness). The nearer the object the higher intensity it reflects and vice-a-versa.

Anaglyph image is one of the examples of 3D modelling. It is a well-known method for stereo viewing using coloured spectacles and the most economical also. The word anaglyph is of the greek origin where 'ana' means 'again' and 'glyph' means 'sculpture' [6]

The basic step for 3D conversion or modelling is to have a stereo pair of images and their depth values. After creating the stereo pairs images from a single image taken from the camera, the two images are superimposed on one another after applying the two filters for each eye. The two filters are red and blue or cyan (blue and green). These two images after superimposing on one another and observing through the anaglyph glasses or spectacles creates a 3D view of the image. The red filter on the left eye allows only the red part of the anaglyph image through, while the cyan filter over the right eye allows only the blue and green parts of the image through.[4] The blending of the two filters of a captured image creates an illusion for human eyes with a specific displacement. These images allows the depth sense when observed through the glasses.

There are basic 3 phases in anaglyph generation. First, the depth map is calculated which is the set of depth values for each pixel. The lighter and the darker values of the pixels assigned to the depth of the objects in the image gives us the shift-value. This shift-value suggests how many pixels of the image should be shifted to create the left and the right eye

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

images. The second step consists of application of the red and cyan or blue filters to the two images respectively. The third phase is to merge the two filter applied images into one to provide a single anaglyph image.

Anaglyph has the advantage of being simple and economical, required viewing glasses are inexpensive and easily available. Also can be cheaply reprinted in magazines or newspaper. It also has some disadvantages. It is not suitable to some kind of images. Also the image quality is not as good as other polarized methods. Anaglyph images mainly suffer from three deficiencies, i.e., color distortions, retinal rivalry, and ghosting effect. [7] Color distortion has an effect on the colors perceived through the glasses. The colors in the original image and those perceived through glasses are different from one another. Retinal rivalry is produced when a same object in both the images for the two eye have different colors. When we talk about retinal rivalry, we just mean the retinal rivalry caused by brightness differences of colored objects. Of course there is an additional form of retinal rivalry, independently of the anaglyph method used: retinal rivalry caused by the different color channels perceived by left and right eye. Ghosting occurs due to improper filtering of the light wavelengths. This causes the unwanted image to mix with the wanted one.

The goal of this paper is to discuss different methods of anaglyph generation. The next section gives the related work with respect to anaglyph. Section three gives the different methods of anaglyph generation. Section four gives the conclusion.

II. RELATED WORK

In 1853, W. Rollman was the first person who illustrated the principle of the anaglyph using blue and red lines on a black field, and was perceived with red and blue glasses for the effect. The first printed anaglyph was owed to Louis Ducas du Hauron, produced in 1891. [4] Anaglyph generation is difficult. It's not sufficient to only to have one color channel for left eye image and another for right eye. The need is to combine the two images into single image by colors for stereo effect making and to reproduce colors with their naturalness. Due to these problems it is not possible to develop an algorithm for anaglyph generation which produces good color representation and is free from the other artifacts.

Different techniques of color anaglyph generation display have been described in [7]. Many papers described the techniques for production anaglyphs for viewing. In three approaches are discussed: Photoshop algorithm (PS) and its variants, the least squares algorithm (LS) proposed by Eric Dubois, that optimizes colors in the CIE space, and the midpoint algorithm (MID) that minimizes the sum of the distances between the anaglyph color and the left and right eye colors in CIE $L^*a^*b^*$. [7] The results show that the MID method produces excellent color and detail for color images but may suffer severe ghosting. [7] Several techniques for enhancement of anaglyph. These techniques remove all the unwanted artifacts and improve the quality of the image.

A new technique for anaglyph generation is proposed in a paper. This is successfully applied to the anaglyph stereo visualization of sculpture arts at variable distances from the target objects in whole three-dimensional space [1]

Another algorithm is proposed to create anaglyph images from a single 2D image and depth information. The 2D image pixels are duplicated and shifted to either left or right direction by displacement matrix. Both the images created are then blended together to form a 3D image. The proposed work has been experimented under different light conditions and is well viewed with anaglyph glasses [4]

A technique of generating anaglyph images with colors adapted according to glasses and printer colors by special colors pattern analysis. Images resulting from this have a better quality. The images contain fewer artifacts and look better in comparison to anaglyphs without adaptation, which are generated in existing software applications. [5]

Technique to develop an algorithm to generate anaglyphs using information captured in a light field image by a Lytro Illum camera. [8]

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

III. ANAGLYPH GENERATION METHODS

The process of anaglyph generation is shown with the help of block diagram in Fig1. There are five different kinds of anaglyphs which are used in the 3D visualization of an image. They are- True anaglyphs, Gray anaglyphs, Color anaglyphs, Half Color anaglyphs and Optimised anaglyphs. These are called simple anaglyphs. They are described below with their formulas and examples. The formulas are to calculate the anaglyph's RGB values r_a , g_a and b_a from the RGB values of the original left (r_1, g_1, b_1) and right images (r_2, g_2, b_2). The formulas must be applied for each pixel.

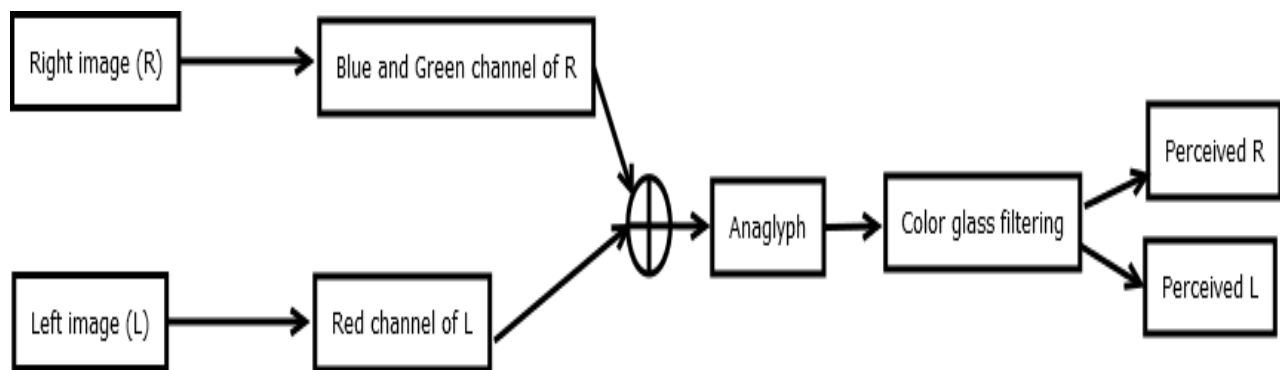


Fig1. Block Diagram of Anaglyph generation [2]

1. True Anaglyph:-

The true anaglyph gives a dark image. There is no color reproduction. There is a little ghosting in true anaglyphs. The formula is given below.

$$RGB_a = X * RGB_1 + Y * RGB_2$$

$$\text{Where, } X = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$Y = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0.299 & 0.587 & 0.114 \end{bmatrix}$$

$$RGB_a = \begin{bmatrix} r_a \\ g_a \\ b_a \end{bmatrix}, RGB_1 = \begin{bmatrix} r_1 \\ g_1 \\ b_1 \end{bmatrix}, RGB_2 = \begin{bmatrix} r_2 \\ g_2 \\ b_2 \end{bmatrix}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Fig.1 shows the example of a true anaglyph.[3]



Fig.2 True Anaglyph[3]

2. Gray Anaglyphs:-

There is no color reproduction in gray anaglyphs. There is more ghosting than the true anaglyphs. Formula is-

$$RGB_a = X * RGB_1 + Y * RGB_2$$

$$\text{Where, } X = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$Y = \begin{bmatrix} 0 & 0 & 0 \\ 0.299 & 0.587 & 0.114 \\ 0.299 & 0.587 & 0.114 \end{bmatrix}$$

$$RGB_a = \begin{bmatrix} r_a \\ g_a \\ b_a \end{bmatrix}, RGB_1 = \begin{bmatrix} r_1 \\ g_1 \\ b_1 \end{bmatrix}, RGB_2 = \begin{bmatrix} r_2 \\ g_2 \\ b_2 \end{bmatrix}$$

Fig.2 shows the gray anaglyph example.[3]



Fig.3 Gray Anaglyph [3]

3. Color Anaglyphs:-

Color anaglyphs have partial color reproduction at the cost of retinal rivalry.

$$RGB_a = X * RGB_1 + Y * RGB_2$$

$$\text{Where, } X = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

$$Y = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$RGB_a = \begin{bmatrix} r_a \\ g_a \\ b_a \end{bmatrix}, RGB_1 = \begin{bmatrix} r_1 \\ g_1 \\ b_1 \end{bmatrix}, RGB_2 = \begin{bmatrix} r_2 \\ g_2 \\ b_2 \end{bmatrix}$$

Fig.3 shows the example of color anaglyph.[3]



Fig.4 ColorAnaglyph [3]

1. Half Color Anaglyphs:-

Half Color anaglyphs have partial color reproduction but not as good as color anaglyphs. Retinal rivalry is less than color anaglyphs.

$$RGB_a = X * RGB_1 + Y * RGB_2$$

Where, $X = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

$$Y = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$RGB_a = \begin{bmatrix} r_a \\ g_a \\ b_a \end{bmatrix}, RGB_1 = \begin{bmatrix} r_1 \\ g_1 \\ b_1 \end{bmatrix}, RGB_2 = \begin{bmatrix} r_2 \\ g_2 \\ b_2 \end{bmatrix}$$

Fig.4 shows the example of half color anaglyph.[3]



Fig.5 Half Color Anaglyph [3]

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

1. Optimised Anaglyphs:-

Optimised anaglyphs have partial color reproduction. There is no retinal rivalry in optimised anaglyphs.

$$RGB_a = X * RGB_1 + Y * RGB_2$$

$$\text{Where, } X = \begin{bmatrix} 0 & 0.7 & 0.3 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$Y = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$RGB_a = \begin{bmatrix} r_a \\ g_a \\ b_a \end{bmatrix}, RGB_1 = \begin{bmatrix} r_1 \\ g_1 \\ b_1 \end{bmatrix}, RGB_2 = \begin{bmatrix} r_2 \\ g_2 \\ b_2 \end{bmatrix}$$

Fig.5 shows the optimised anaglyph example [3]



Fig.6 Optimised Anaglyph [3]

By using these methods the anaglyphs of images can be generated according to the purpose and need.

IV. CONCLUSIONS

The different techniques of anaglyph generation are discussed in this paper. The true anaglyph gives a dark image with no color reproduction while gray anaglyph also has no color production and has ghosting phenomenon more than true anaglyph. Color anaglyphs demonstrates least color distortion, on the other hand has retinal rivalry. Half color anaglyph has less retinal rivalry at the expense of color reproduction. Instead optimised anaglyph has no retinal rivalry occurring but produces no red shades. Therefore we can say that optimised anaglyph is better choice followed by half color and then color anaglyphs.

These simple anaglyph techniques are easy to implement and may perform well in most of the cases. These methods do not have the flexibility to change according to the properties of display and colored glasses to achieve a superior display.

REFERENCES

- [1] Fuminori Matsuura, Nobuyuki Fujisawa, "A new Experimental technique for generating anaglyph stereo images for sculpture arts", The Visualization Society of Japan 2010, J Vis (2010) 13:257-261 DOI:10.1007/s12650-009-0022-5,
- [2] Songnan Lin, LinMa, KingNgi Ngan, "Anaglyph image generation by matching color appearance attributes" Department of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong, China, Signal Processing: Image Communication 28 (2013)597-607
- [3] 3d.tv.at - Anaglyph Method Comparison, www.3d.tv.at/knowhow/anaglyph_comparison_en.aspx



ISSN(Online): 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

- [4] Makhzani Niloufar , Kok-Why Ng , Babaei Mahdi, “Depth-based 3d Anaglyph image modelling”, International Journal of Scientific Knowledge Computing and Information Technology, March 2014. Vol. 4, No.7
- [5] Elena Patana, Iliia Safonov, Michael Rychagov, “Adaptive 3D Color Anaglyph Generation for Printing”, The 22nd International Conference on Computer Graphics and Vision, October 01{05, 2012.}
- [6] Dubois Eric “A projection method to generate anaglyph stereoisimages”, Proc. of ICASSP, IEEE International Conference Acoustic, Speech, and Signal Processing, vol.3, pp. 1661-1664,2001.
- [7] Ideses Ianir, Yaroslavsky Leonid “Three methods that improve the visual quality of colour anaglyphs”, J.Opt. A: Pure Appl. Opt.7, 755–762, 2005.
- [8] Sanders William, McAllister David F. “Producing Anaglyphs from Synthetic Images”, Proc. of Electronic Imaging, pp. 348–358, 2003.