Novel Algorithm for Converting 2D Image to Stereoscopic Image with Depth Control using Image Fusion

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***Abstract*—The Stereoscopic image provide information on details of each object in the image in three dimension and helps to observe the image in a better way. The Stereoscopic images are also called as 3D images. The 3D Digital Cameras, 3D Televisions, 3D Projectors etc. are commonly available in the electronic stores in a reasonable price. The people prefer 3D images than the 2D image. The 3D image provides more information than the 2D image. The 3D image makes the people to experience real time world in a 2D device. The medical field uses 3D Scan image as a diagnostic tool for various diseases. There are many scientists working in the area of 3D images and movies. A faster 2D to 3D conversion algorithm is developed using Image Fusion technique. The algorithm creates two images one as left eye view and another one as right eye view with reference to the user defined depth. These left view image and right view image are fused with mean value. The left view image and fused image are stored in the 3D image format MPO and shall be viewed in 3D capable device.**

***Index Terms*— 3D image, stereoscopic image, conversion of 2D to 3D image, image fusion.**

I. Introduction

The Stereoscopic images evolved early in the 1860s with a nature scene taken at Boston using side by side. Stereoscopic photographs were painted by Jacob Spoel, before 1868. In the 1890, A. Fuhrmann developed a multi-station viewing apparatus with sets of stereo slides [1]. French physicist Louis Ducos du Hauron invented the red-and-blue 3D glasses used to transform 2D images to 3D images in comics, magazines, books, and newspapers in 1891. The Stereo images have been more than 150 years with us. Most popular commercially produced formats have been the stereo view cards, lenticular prints, 3-D movies, and the View-Master reels. Still, these formats are available to for better understanding of a situation in 3D image than the 2D image. The Stereo Realist system was introduced in 1947 which helped to develop millions of 3D images [2]. Frederic Eugene Ives patented his stereo camera rig having two lenses coupled together 4.45 centimeters apart in 1900. The camera had. 1915, Edwin S. Porter and William E. Waddell presented tests in red green anaglyph to an audience at the Astor Theatre in New York City [3]. Displaying 3D films shall be made with any one of the techniques such as Anaglyph, Polarization systems, Eclipse method, Interference filter technology, and Auto-stereoscopy.

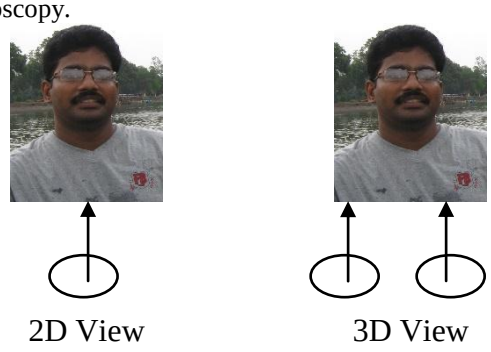

Figure 1. Difference between 2D and 3D image

The above Fig. 1 explains the difference of the 2D and 3D vision. The 2D picture is taken using single view lenses. The human vision system is a natural made perfect system of 3D with two eyes is apart in a fixed distance. The 3D pictures are taken using two lenses kept apart at a fixed distance. The distance between the lenses are calculated using

$$\text{Stereo} = 1/30 \times \text{distance of object} \quad (1)$$

Stereoscopy develops an illusion of three dimensional depths from given two dimensional images.

There is several research works are progressing on 2D to 3D conversion of images which shall be used in the motion pictures [4] and [5]. 3D imaging system has been incorporated in the televisions, cameras etc. In the health system the 3D body scanners help surgeons to determine the accurate status of various diseases. The 3D hardware is expensive compared with 2D hardware system. Therefore, it is necessary to develop a fast and accurate algorithm for converting 2D images to 3D images. In this research article, a new simple algorithm is proposed for converting 2D image to 3D image using image fusion.

II. Stereoscopy Imaging

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Xiaoyang Mao, lbsiyasu L. Kunii, Hierarchical was proposed G-octree as an extension of G-quadtree to 3D grey-scale images. They did the program in C on VAX 11/750. Application to the color coding of macro-auto-radiography images of rat brains demonstrated the advantages of the approach [6]. Chin-Tung Lin, Chiun-Li Chin, Kan-Wei Fan, and Chun-Yeon Lin was presented a 2D to 3D effect image conversion architecture integrated image segmentation system and depth estimation. They tested many 640*480 RGB format color images. They generated left view and right view image and displayed the 3D stereo image [7].

H. Murata, X Mori, S. Yamashita, A. Maenaka, S. Okada, K. Oyamada, and S. Kishimoto, proposed a system for converting all kinds of 2D images into 3D images. The method is used adaptively by computing the depth of each separated area of the 2D images with their contrast, sharpness, and chrominance [8]. Wa James Tam and Liang Zhang provided an overview of the fundamental principle of 2D to 3D conversion techniques, short note on approaches for depth extraction using a single image, and depth image based rendering [9].

Chao-Chung Cheng, Chung-Te Li, and Liang-Gee Chen presented an automatic system for converting 2D videos to 3D videos. They grouped the regions into blocks using the edge information and applied bilateral filter to generate depth map [10]. Zhebin Zhang, Yizhou Wang, Tingting Jiang, and Wen Gao described an approach which estimated a 2.5D depth map by leveraging motion cues and photometric cues in video frames [11].

Ching-Lung Su, Kang-Ning Pang, Tse-Min Chen, Guo-Syuan Wu, Chia-Ling Chiang, Hang-Rnei Wen, Lung-Sheng Huang, Ya-Hsin Hsueh, and Shau-Yin Tseng, presented an algorithm for conversion of 2D to 3D in real time. The 2D video accompanied with a depth image was stored to create 3D video [12].

Yeong-Kang Lai, Yu-Fan Lai, and Ying-Chang Chen proposed a hybrid algorithm for 2D to 3D conversion. They used motion information, linear perspective, and texture characteristic for depth estimation. They used bilateral filter for depth map smoothing and noise removal [13].

III. Proposed Algorithm

The latest Televisions and Digital Cameras are having provision for 3D imaging and vision. Few televisions having provision for converting 2D motion picture to 3D motion picture. But, the converted 3D motion picture from 2D motion picture is not in a good quality. The 3D motion pictures are collection of 2D pictures or frames. Thus, converting of 2D images to 3D images shall be used in converting 2D motion pictures to 3D motion pictures. The conversion process should be faster and accurate so that the technique shall be used as adaptive conversion procedure. There is a need of faster 2D to 3D conversion algorithm to convert 2D videos into 3D videos.

Considering time as the main factor, a simple algorithm is proposed to convert 2D images to 3D images. The steps involved in the 2D to 3D conversion as shown in the following Fig. 2.

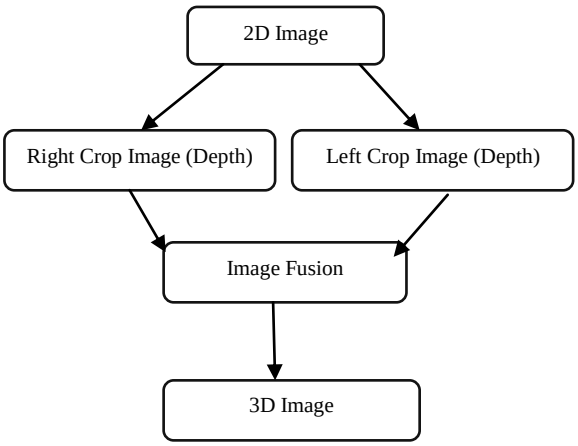


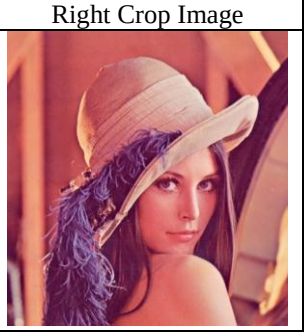
Figure 2. Proposed 2D to 3D conversion algorithm

The 2D image and depth are taken as input from the user. The 2D sample image taken for the experiment is shown in the below Fig. 3.

Figure 3. Input 2D sample image

The right eye view image and left eye view images are produced from the input 2D image using the depth value given by the user. The following Table I show the left crop image and right crop image.

TABLE I. Left Crop Image and Right Crop Image.

Left Crop Image	Right Crop Image
	

Further, image fusion is applied on the right eye image and left eye image using mean value. The depth of the 3D image shall be specified by the user. Finally, the left view image and right view image is stored in the MPO or PNS or JPS format. The following images shown in Table II are 3D images developed from 2D images using the new proposed algorithm.

TABLE II. INPUT 2D IMAGES AND OUTPUT 3D IMAGES.

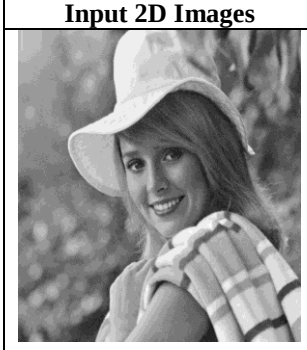
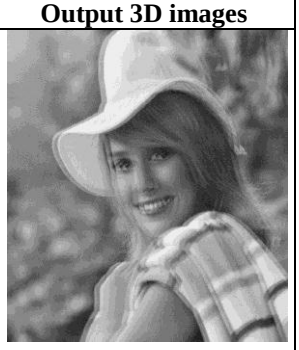
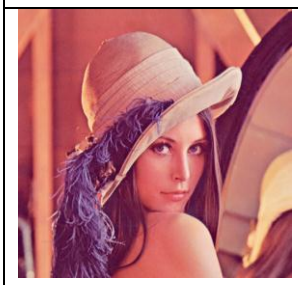
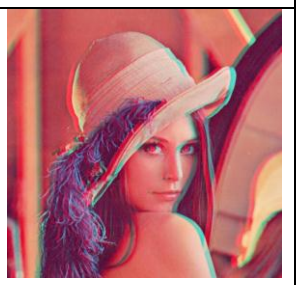
Input 2D Images	Output 3D images
	
	
	

TABLE III. 3D IMAGES WITH DIFFERENT DEPTH

	
Depth = 5	Depth = 10
	
Depth = 15	Depth = 20

The following Table III shows images with different depth 5, 10, 15 and 20. The user shall fix depth according to the requirement of image and basic feature of the image.

IV. CONCLUSION

The proposed algorithm takes 2D image and converts into 3D image using left view image and right view image. The left view image and right view image are prepared using the depth value provided by the user. The proposed algorithm uses image fusion. The image fusion uses the mean value to fuse the left eye image and right eye image. The proposed algorithm is simple and faster. The new algorithm works with grayscale images as well as color images. The quality of the 3D image is normal.

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