A Survey on 2D to 3D Conversion Techniques

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Abstract— The Stereoscopic images are also called Three- dimensional images (3D). The 3D image provide more information than a 2D image. The existed 2D content does not provide depth information. Therefore 2D to 3D conversion is necessary. The 3D images are widely used in 3D Televisions, 3D Projectors, and 3D Digital cameras. The medical field uses 3D scan images as a diagnostic tool for various diseases. This survey describes different techniques that are widely used for converting 2D images to 3D images.

Index Terms— 2D image, Depth, Region based grouping, Smoothening, Rendering, Cross bilateral filtering, Graph cuts and Random walks, 3D image.

I. INTRODUCTION

The Stereoscopic images are also called as 3D images. The Stereoscopic images provide information on details of each object in the image in three dimensions and help to observe the image in a better way. The 3D Digital Cameras, 3D Televisions, 3D Projectors etc. 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. 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. Fuhrman 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 the2D image.

The most important and difficult problem in 2D- to-3D conversion is how to generate or estimate the depth information using only a single-view image. Since there is no 3D information, we should estimate relative depth differences for each region in a single-view image. Several methods have been proposed to estimate the depth information from a single- view image. The figure explains the difference of the 2D and 3D vision.

II. DEPTH

The world of 3D incorporates the third dimension of depth, which can be perceived by the human vision in the form of binocular disparity. Human eyes are located at slightly different positions, and these perceive different views of the real world. The brain is then able to reconstruct the depth information from these different views. A 3D display takes advantage of this phenomenon, creating two slightly different images of every scene and then presenting them to the individual eyes. With an appropriate disparity and calibration of parameters, a correct 3D perception can be realized. The current and past media data is in 2D format and should be possible to be viewed with a stereoscopic effect.

III. AUTOMATIC AND SEMI-AUTOMATIC METHOD

The following two methods are mainly used for determining the depth.

a) Automatic Method

b) Semi-Automatic Method

In semi-automatic method a skilled operator assigns depth to various parts of an image or video. Based on this sparse depth assignment, algorithm estimates dense depth over the entire image or video sequence. In an automatic method human intervention is not required, a computer algorithm automatically do whole estimation of the depth from a single image or video. Semi-automatic method is much successful but it is time consuming and costly [6].

Depth estimation method for a single image

Define abbreviations and acronyms the first time they are the problem of depth estimation from a single 2D image, which is the main step in 2D to 3D conversion, can be formulated in various ways. As image or video is having different attributes, those have considered by different authors and everyone has developed their own algorithm for conversion [6]. Including depth from defocus, depth from perspective geometry, depth from models, and depth from motion [6] and so on.

1) Defocus: It is used to extract the blur information from a single image by measuring the amount of blur and then remaps the blur Measures to depth map. In [6], the number of high value wavelet transform coefficients is taken as a measure of blur.

2) Perspective geometry: It refers to the property that parallel lines in real world tend to converge at a point (vanishing point) in the picture. Generally, the vanishing point has the farthest distance, so we can derive a suitable assignment of depth based on the position of the lines and the vanishing points [6].

3) Depth from models: The approach of depth models constructs several basic depth models of typical scenes and then blends them together to estimate the depth of real scenarios[6].

4) Depth from motion: It is based on the law that near objects move faster across the retina than far objects for a moving observer, so relative Motion provides an important depth cue. However, when the objects are also moving, the law does not apply in many cases, which Constraints the utilization of this depth cue in 2D to 3D conversion. In many papers described here machine-learning techniques have been Used to automatically estimate the depth map from a single monocular image.

IV. 2D TO 3D CONVERSION METHOD

The described methods are proposed for image conversion.

Depth control using image fusion

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 right eye view image and left eye view images are produced from the input 2D image using the depth value given by the user. 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 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 gray scale images as well as color images. The quality of the 3D image is normal.

Depth evaluation using edge information in the given 2d image

A novel algorithm that uses a simple depth hypothesis to assign the depth of each group rather than retrieving the depth value directly from the depth cue. Firstly, an effective grouping method is chosen which involves grouping pixels that have similar colours and spatial locality. Now the depth values are assigned according to the hypothesis depth value. To enhance the visual comfort, apply a cross bilateral filter.

Step 1: Block-Based Region grouping The computational complexity is reduced by using a block- based algorithm. This algorithm considers that each pixel in the same block has the same depth value. For example, consider a 4x4 graph. Each node is a 4-by-4 pixel block, and each node is four-connected. The value of each link connecting thee nodes is the absolute difference of the mean of neighboring blocks: Diff (a, b) = | Mean (a) Mean (b) |.Where a and b denote two neighboring blocks, respectively, and Mean (a) and Mean (b) represents the mean colors of a and b respectively. This value gives measure of the similarity strength of neighboring blocks. A smaller value implies a higher similarity between the two blocks [2].

Step 2: Depth from Prior Hypothesis After generated the blocked groups; the corresponding depth for each block is assigned by the hypothesized depth gradient. The depth value of a given block group R is assigned by [2]. A larger value of the assigned depth implies that the pixel represents a part closer to the user. The above equation suggests that the assigned depth value indicates the gravity centre of the block group, thus explaining why each block group belongs to the same depth.

c) Step 3: 3D Image Visualization using Bilateral Filtering and Depth Image-Based Rendering The depth map generated by block-based region grouping contains undesirable blocky artifacts. The blocky artifacts are removed by using the cross bilateral filter. The cross bilateral filter smoothens the depth map properly while preserving the object boundaries.

2d-To-3d Image Conversion By Learning Depth From Examples

The proposed method is automatic conversion for images. In this method, they have proposed a simplified algorithm that learns the scene depth from a large database which is having image and depth pairs. Their proposed method is based on observation that among millions of image + depth pairs available on-line, there likely exist many pairs whose 3D content matches that of a 2D input. Also they have made two assumptions that two images that are photo metrically similar are likely to have similar 3D structure depth [3]. Since photo-metric properties are often correlated with 3D content as depth, disparity. For example, edges in a depth map almost always coincide with photo-metric edges. They have used machine learning technique in their method. Figure shows block diagram of proposed algorithm. From the database containing image and depth pairs using k nearest- neighbor (kNN) search algorithm k image + depth pairs that are matched with 2D query left image are searched. For selecting a useful subset of depth relevant images from a large dictionary is to select only the k images that are closest to the input. For this they have used distance function the Euclidean norm of the difference between histograms of oriented gradients.

Next using median filtering depth fusion of k images is generated. So this method is a simplified and computational efficient data- driven 2D to 3D conversion method and has insured its performance against state-of-the-art Make 3D algorithm. The proposed algorithm compares in terms of both estimated depth quality and computational complexity. This is valid for indoor and outdoor database. The generated anaglyph images produce a comfortable 3D perception but are not completely void of distortions. With the continuously increasing amount of 3D data on-line and with the rapidly growing computing power in the cloud, the proposed algorithm seems a promising alternative to operator assisted 2D to 3D conversion.

Image conversion using scale-space random walks and a graph cuts based depth prior

Semi-automatic user defined strokes corresponding to a rough estimate of the depth values in the scene are defined for the image of interest. This proposed system determines the depth values for the rest of the image, producing a depth map that can be used to create stereoscopic 3D image pairs. This method works in a two stage process using the smooth- ing properties of Random Walks, and the hard segmentation returned by Graph Cuts. Random Walks is the solution to a linear system and has problems preserving strong edges, but Graph Cuts does this well. However, the hard segmentation with Graph Cuts does not respect smooth gradients or fine detail. By combining the two, they have retained strong object boundaries while also allowing for smooth gradients. So the steps followed are; initially depth map using Graph Cuts is generated first with user defined depth strokes, in order to generate a depth prior. The depths prior, and the same depth strokes, are integrated into Random Walks as an additional feature when determining the edge weights. The merits of Random Walks are combined with Graph Cuts, in order to produce good quality depth map. Depth map generation is a kind of multi-label classification problem, but used formulation only provides a binary segmentation. Therefore, each unique user defined depth value was assigned an integer label.

V. CONCLUSION

These are the most recent conversion methods of 2D to 3D image. Each conversion techniques have merits and demerits. The image fusion technique is simple so complex problems cannot be solved using this technique. Edge detection using block based grouping technique need more time for deter- mining the depth. Learning based method is more complex method and time consuming. Using semi random walks and

graph cuts improve image structure. The learning based depth from examples is an accurate method. Using this method it will improve the visual quality. So modifying this method it may be useful for the future conversion process.

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