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2D to 3D Conversion of Stereo Pair Images

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***Abstract*—A 3D display takes benefit of the phenomenon of creating two slightly diverse images of every scene and then presenting them to the individual eyes. With an appropriate disparity and calibration of parameters, different layers of image can be known as closer objects will have elevated disparities whereas objects at background will have comparatively poorer disparities. Based upon disparity map, diverse techniques can be used for extrication of foreground from backgroundand a correct 3D perception can be realized.The main challenge in 3D imaging is the noise content of the input image and degraded quality of the reconstructed image. In this paper a bright technique is introduced to get resourceful conversion of 2D images to 3D. In this technique after the standardization, the image it is filtered todiminish the noise content.**

***Index Terms*—3D image, Disparity map, max flow,median filter,Scan line algorithm, stereoscopic image, s-t minimum cut graph.**

I. INTRODUCTION

Producing three dimensional images with proper brightness and contrast is a tough constraint in several areas like computer vision, biomedical image analysis, radar imaging, scene reconstruction, human computer interaction systems and robotics [7]. 3D adds the third dimension of depth, which can be perceived by human vision. Human eyes are positioned at vaguely different positions, and these can distinguish dissimilar views of the real world scene. The brain can now renovate the depth information from these different views. A 3D display takes benefit of this phenomenon, creating two slightly different images of scenes and then resenting them to the individual eyes. By an appropriate disparity and calibration of parameters, a correct 3D perception can be realized.

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 involving the lenses are calculated by [Stereo=1/30 x distance of object]. Stereo vision therefore tries to imitate the ability of the human brain to infer depth from a scene and consequently uses the same principle.Stereo pair is set of images taken from different viewpoints (cameras). Figure 1 shows a set of stereo images.

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Fig. 1 Pair of stereo images

Stereo vision is the course of extracting 3D information from several 2D views of a scene. Stereoscopy develops a false impression of three dimensional depths from given two dimensional images. The 3D information can be obtained from a pair of images, also acknowledged as a stereo pair, by estimating the relative depth of points in the scene. These estimates are represented in a stereo disparity map, which is constructed by matching corresponding points in the stereo pair [6].

There are a number of research works are continuing on 2D to 3D conversion of images which shall be used in the motion pictures. 3D imaging system has been incorporated in the televisions, cameras etc. In the health system the 3D body scanners facilitate surgeons to resolve the accurate status of a variety of diseases. The 3D hardware is high-priced compared with 2D hardware system. Therefore, it is obligatory to develop a swift and precise algorithm for converting 2D images to 3D images.

A depth map is a 2D function that gives the depth (with respect to the viewpoint) of an object point as a function of the image coordinates. Usually, it is represented as a gray level image with the intensity of each pixel registering its depth. The laser element emits a light wall towards the real world scene, which hits the objects in the scene and reflected back. This is subsequently registered and used for the construction of a depth map. Fig.2 shows the depth map of a 2D image.

The length of the horizontal displacement vector is generally referred to as disparity, and a pixel's disparity is inversely proportional to the pixel's distance from the cameras. By means of this principle, the human brain converts the disparity information into a three-dimensional impression of the world.

Fig.2 A 2D image and its depth map

Even though the process seems to be very simple and the stereo task is undyingly solved by the human visual system without us even noticing the effort, the same problem turns

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out to become very tricky when it needs to be solved by a computer. The foremost challenge that one faces when using a shape-from-stereo approach is that of solving the correspondence problem. The correspondence problem denotes the task of automatically computing the correct disparity value at each pixel. This is one of the oldest, but still most challenging problems in low-level computer vision two images are obtained from different viewpoints. Due to the different perspectives, corresponding image points are displaced in horizontal direction as indicated by the arrows. The amount of displacement is inversely proportional to the depth of a point.

The stereo matching methods can be generally divided into two categories, local and global ones. There are several local correspondence algorithms; we can compare these algorithms in terms of both performance and efficiency. The global algorithms first make explicit smoothness assumptions of the disparity map and then calculate globally optimized matching by minimizing energy function. Graph Cuts algorithm have attracted much attention due to their good performance. Recently, global methods are carried out with Mean-Shift color segmentation algorithm.

II. RELATED WORK

There is a considerable amount of literature on the stereo correspondence problem and giving an all-embracing review is hardly possible. We therefore focus our summary on a few techniques that we consider as important.

Viral H. Borisagar et al. (2011) proposed a new algorithm [1] and evaluate disparity map results for Mean shift, Hill climbing, Otsu and Graph-based color segmentation techniques. He also presents a novel segment-based stereo matching algorithm for disparity map generation which is computationally inexpensive. Daniel Scharstein et al. [2] presented taxonomy of dense, two-frame stereo methods designed to assess the different components and design decisions made in individual stereo algorithms. This algorithm particularly emphasis on stereo methods that (1) operate on two frames under known camera geometry, and (2) produce a dense disparity map, i.e., a disparity estimate at each pixel. Any vision algorithm, explicitly or implicitly, makes assumptions about the physical world and the image formation process. Common assumptions are Lambertian surfaces, i.e., surfaces whose appearance does not vary with viewpoint. Some algorithms also model specific kinds of camera noise, or differences in gain or bias. In this some limitation related to local and global methods have been discussed.

Yichen WEI et al. [3] proposed region based progressive stereo matching algorithm in which reliable regions are firstly identified and matched using GCPs. Remaining regions are matched progressively in a growing-like process using a global best first strategy based on a cost function that integrates disparity smoothness and visibility constraints and an ambiguity measure that is defined to be the ratio of the best and second best costs. Dong Yang et al. [4] described a new segment-based dense stereo matching algorithm. Firstly, the reference view and matching view are over segmented using mean-shift segmentation method. A new region-based approach [4] is proposed to obtain the initial disparity maps of the two views. Then, the unreliable matching points are filtered out by left-right consistency checking technique. An improved greedy search algorithm [4] is applied to propagate the reliable disparity to the segments which don't have reliable disparity. Finally, the disparity map in coarse regions is refined. Skbastien Roy et al. [5] describes a new algorithm for solving the IC'-camera stereo correspondence problem by transforming it into a maximum-flow problem. Once solved, the minimum-cut associated to the maximum-flow yields a disparity surface for the whole image at once. This global approach to stereo analysis provides .a more accurate and coherent depth map than the traditional line-by-line stereo. Moreover, the optimality of the depth surface is guaranteed and can be shown to be a generalization of the dynamic programming approach that is widely used in standard stereo. Results showimproved depth estimation as well as better handling of depth discontinuities.

III. PROPOSED WORK

If The intention is to execute tool to practice Foreground object segmentation(i.e. to separate foreground from background) from stereo pair images using s-t minimum graph cut algorithm and also using scan line algorithm. The results obtained from these two techniques will be analyzed. The following hierarchy shows the proposed procedure for implementing the conversion. First of all the stereo pair is loaded and correspondence of left and right image is obtained. According to the correspondence obtained, the disparity map is formed. Median filtering is applied to even the disparity map. Foreground is separated from the background using the disparity map and 3D illusion is formed. Figure 3 shows the hierarchy of the proposed algorithm.

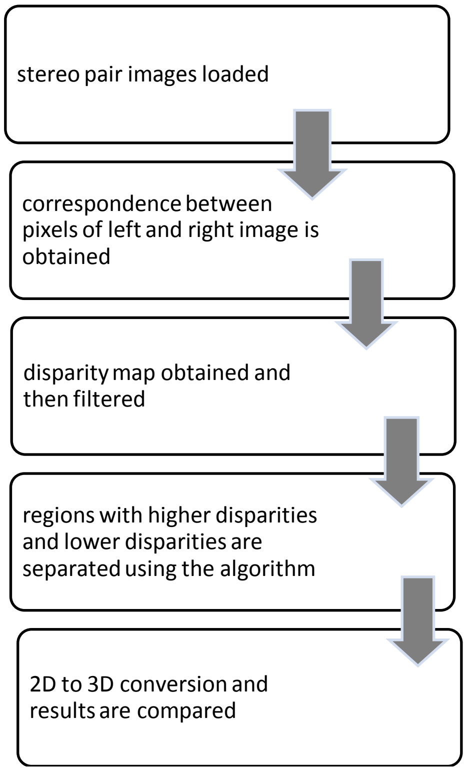

Fig.3 Proposed procedure

The approach followed is a hybrid approach based on line scanning.

To enforce two-dimensional smoothness, those approaches convert the stereo correspondence task into a maximum

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flow/minimum cut problem. The maximum flow problem is explained in figure 4.

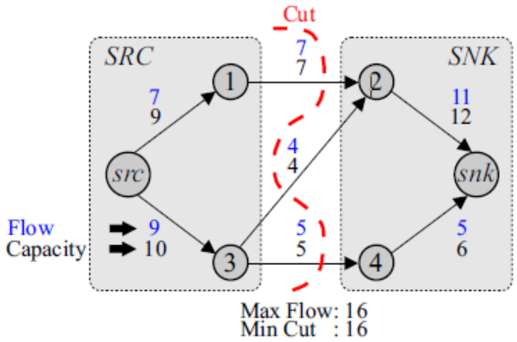

Fig. 4Maximum flow/minimum cut approach

One of the fundamental results in combinatorial optimization is that the minimum s − t cut problem can be solved by finding a maximum flow from the source s to the sink t. Loosely speaking, maximum flow is the maximum "amount of water" that can be sent from the source to the sink by interpreting graph edges as directed "pipes" with capacities equal to edge weights. The theorem of Ford and Fulkerson states that a maximum flow from s to t saturates a set of edges in the graph dividing the nodes into two disjoint parts{S,T}, corresponding to a minimum cut.

3.1 Stereo MatchingAlgorithm- Segmentation based matching algorithm is used that divide one or sometimes both images into non-overlapping regions of homogeneous colour. Instead of computing a disparity for each individual pixel, those techniques assign a single disparity value (or model) to a complete segment.

3.2 Color segmentation -In principle, any algorithm that divides the reference image into regions of homogeneous colour can be used for the proposed stereo algorithm. The current implementation uses a mean-shift-based segmentation algorithm that incorporates edge information. [8]Pixels belonging to the same segment are assigned the same colour. To derive the desired plane models, we first compute an initial disparity map and use the computed disparity values to fit the plane for each segment.

3.3 Median filtering-Median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. In median filtering, a window slides along the image and median intensity of pixels within the window becomes output intensity of pixel being processed. Figure 4 shows the result of Median filtering on an image.

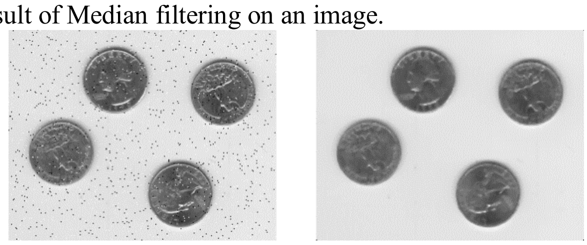

Fig. 5 Median filtering of an image

3.4 Calculate Disparity Map- We compute an initial disparity map using a local window-based method that exploits the results of the image segmentation and operates on different window sizes. We benefit from the image segmentation by exploiting the assumption of smoothly varying disparities inside a segment.Stereo correspondence or disparity is conventionally determined based on matching windows of pixels. Every time disparity have some value, if disparityis zero it means a depth is zero because disparity is inversely propositional to depth.

IV. EXPERIMENTAL SETUP AND RESULTS

For implementation MATLAB, a high-performance language for technical computing is used.

First, the reference image is segmented using a technique called Mean Shift Segmentation. This is a clustering algorithm that "over-segments" the image. The result is a very 'blocky' version of the original image. Then, for each segment, we look at the associated pixel disparities. In this implementation, we assign each segment to have the median disparity of all the pixels within that segment.

As bright colors represent closer objects(foreground), a range of bright colors is selected for foreground. I chose red color so i computed red objects, all objects which are not green, and all objects which are not blue as shown in figure 6. Smaller objects which are less than 100 pixels are removed.For computed red mask, combine red, green and blue components to obtain foreground objects.

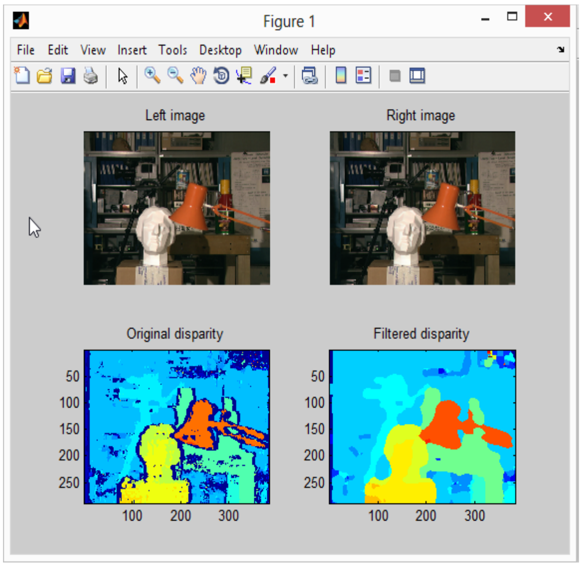

Fig.6 Original and filtered disparity maps of stereo pair images.

V. CONCLUSION

MATLAB simulation results with the min-cut/maxflow algorithm provide better segmentation outputs comparing with the normalized cut methods. The approach is hybrid approach that aims at accuracy of the results as well as minimum time consumption that most of the existing approaches are not able to fabricate. The proposed algorithm is hypothetical to give a clearer 3D view of 2D stereo pair of images

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