NITTE EDUCATION TRUST | N.M.A.M. INSTITUTE OF TECHNOLOGY
(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi)
Nitte – 574 110, Karnataka, India
(ISO 9001:2015 Certified)
Accredited with 'A' Grade by NAAC

SUMMER RESEARCH INTERNSHIP

ON

"OCCLUSION DETECTION AND HANDLING IN STEREO IMAGES"

By

MALVINA VIANNA DSOUZA -4NM17IS054

NIDHI S – 4NM17IS066

PRATHIBHA M S -4NM17IS073

RAKSHITHA B R -4NM17IS077

Under the guidance of

Ms. DEEPA
Assistant Professor

Department of Information Science and Engineering

OCCLUSION DETECTION AND HANDLING IN STEREO IMAGES

Malvina Vianna Dsouza*[1], Nidhi S*[2],Prathibha M S*[3], Rakshitha B R*[4], Deepa[#5]

Third year

[1]malvinaviannadsouza@gmail.com

[2]nidhisrao29@gmail.com

[3]prathims027@gmail.com

[4]rakshithabr2@gmail.com

Department of Information Science and Engineering,

NMAM Institute of Technology, Nitte

[#5]deepashetty17@nitte.edu.in

Abstract-- This paper presents a framework to generate a stereo matching algorithm using the Semi Global Block Matching algorithm (SGBM). After finding the stereo images corresponding to the left and right images, we determine the disparity map. The disparity map is nothing but the depth information related to those two images. Some sets of measurements are used in ground truth which is accurate when compared to the testing system. And the images which decide the accuracy of an algorithm is nothing but the ground truth images. Ground truth images are widely used in the fields of ML, Remote sensing, Image segmentation, Edge detection, etc.

After obtaining the disparity map we have calculated the number of occluded pixels in the obtained disparity map. Then the disparity map is refined using the post-processing technique which involves filling the occluded pixels with the help of the inpainting technique. Standard images are taken by the Middlebury dataset. Experiment results conducted on the Middlebury benchmark show that the proposed algorithm achieves high performance among the existing algorithms.

The experiment result demonstrates that the proposed technique provides high-quality disparity maps.

Keywords: Stereo imaging, Disparity map estimation, Occlusion detection, Occlusion removal, Inpainting

I. INTRODUCTION

Images detected by the two-dimensional camera do not contain any depth information. But in many systems, we need depth information. There are many algorithms present to find the disparity information of stereo images. The challenge is to determine the best approach to find the correspondence between these images. In stereo imaging is the usage of two spatially separated cameras to image a three-dimensional object. Two or more spatially separated cameras to form images from different directions are used in stereo imaging. This difference between these images gives the disparity.

The problem in this technique arrives in the occluded regions. The interpolation of the mismatched and occluded pixels must be handled separately. In this paper, we mainly focus on the reduction of errors in the occluded region with the help of an inpainting technique.

II. LITERATURE SURVEY

The literature survey is based on the existing stereo imaging algorithm. There are many methods available for solving this problem.

The apparent pixel difference or motion between a pair of stereo images is nothing but the disparity. We can measure the apparent motion in pixels at every point and make an intensity image out of the measurements from a pair of images derived from stereo cameras.

Many methods for solving this problem have been developed. The combination of the efficiency of local methods with the accuracy of global methods by approximating a 2D MRF optimization problem with several 1D scan line optimizations, which can be solved efficiently via dynamic programming gives the Semi-Global Block Matching algorithm.

The applications of disparity map estimation will be in the stereoscopic vision for depth calculation, aerial photography, satellite stereo, Stereoscopic microscope, Stereoscopic endoscope, and other medical applications. And also it is used for image registration.

III. THEORY AND FRAMEWORK

A. Disparity Map Estimation

A way of locating matching macro blocks in digital stereo images for the purpose of disparity estimation is called a Semi Global Block Matching Algorithm.

This algorithm is a widely used stereo matching technique, which is the combination of the local and global methods with high efficiency and accuracy. It is based on the principle of pixel-wise matching which uses fast approximation from all directions.

fig1:Applied SGBM technique on teddy

The idea behind SGBM includes line optimization along with multiple directions and computing an aggregated cost by summing the costs to reach pixels with disparity from each direction affects the run time of the algorithm, and while 16 directions usually ensure good quality, a lower number can be used to achieve faster execution. A typical 8-direction implementation of the algorithm can compute the cost in two passes, a forward pass accumulating the cost from the left, top-left, top, and top-right, and a backward pass accumulating the cost from right, bottom-right, bottom, and bottom-left. A single-pass algorithm implementation takes only five directions. [1]

Searching in multiple directions to enforce a global smoothness constraint on our solution is given by the cost aggregation in SGBM. Without any constraints, the disparity for each pixel is computed. Therefore the result will typically contain a lot of 'noise' as the matching process will return many false positives.

Stereoscopic images are used to find the corresponding matching region in the neighboring image. After computing the disparity space distribution for global and local segments respectively, we refine the disparities of homogeneous regions by comparing matching functions between global and local disparity for local regions. Finally, the refined disparity value will be assigned to each local segment.

If we consider each pixel as ‘p’, then the disparity corresponds to the minimum cost of that particular pixel is S[p,d]. To estimate the sub-pixel a quadratic curve is lifted through all the neighboring costs i.e. next higher and lower disparity and the position of the minimum are calculated.

B. Disparity Refinement

The obtained disparity map contains some invalid errors and they must be recovered. So we use some post-processing techniques for the removal of noises. And it also removes those disparities which have been wrongly estimated. They usually show up as small patches of small disparity which is called occlusions.

The estimated occluded pixels must be filled with the non-occluded ones in order to avoid the incorrect smoothing of the image. We have used the inpainting technique for occlusion filling.

The technique of filling in the missing regions of an image using information from the surrounding area is called digital inpainting. There are two-stage processes in image inpainting. A structure completion step is the first step to complete the boundaries of regions in the hole area, followed by the texture completion process using advanced texture synthesis methods.

The way of filling the gap is decided based on the images; inpainting is used to restore the unity of the work, so it is very important to know how the inpainted pixels will function within the image among all other neighboring pixels. The region surrounding the gap tends to be continued into the gap. Contour lines that end at the gap boundary are

to be carried on into the gap. The contour lines define the different regions inside the gap. So these gaps are filled with colors or information matching those of its boundary. [2]

We have to consider a region which has to be inpainted in the disparity map. The algorithm starts filling the regions from the boundary and goes inside the region gradually filling everything in the boundary first. The pixel which is to be inpainted is replaced by the normalized weighted sum of all the known pixels in the neighborhood. Selection of the weights is an important matter. More weight is given to those pixels lying near to the point, near to the normal of the boundary and those lying on the boundary contours. After inpainting a particular pixel, that won't be considered as an occluded one and the boundary around that will be shifted to the next pixel. And the procedure continues until all the occluded pixels are repaired. [3]

IV. RESULTS

We implement the proposed framework by considering the image pairs in the Middlebury benchmark. We took the image of a teddy as input.

fig2: Left and Right view of teddy.

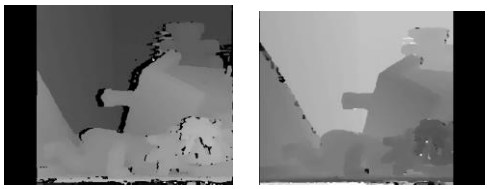

fig3: Estimated left and right disparity maps.

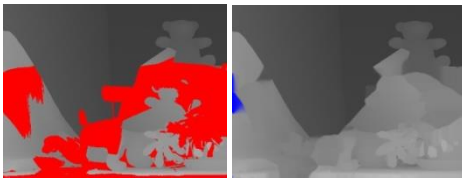

fig4: Highlighted occluded pixels of the left Image and filling the occluded part using the inpainting technique.

V. CONCLUSION

In this paper, we proposed the semi-global matching technique to obtain the disparity map of the stereo images. The proposed algorithm gives the disparity map which will contain some occluded pixels. And the occlusion handling is done using the inpainting technique, which gives the disparity map with the reduced number of occluded pixels.

REFERENCES

[1]H. Hirschmuller,"Stereo Processing by Semiglobal Matching and Mutual Information," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 30, no. 2, pp. 328-341, Feb. 2008

[2]Bertalmio,Marcelo,Andrea L.BertozziAndGuillermpSapiro,"Navier-stokes,fluiddynamics, and image and video inpainting." In Computer Vision and Pattern Recognition, 2001. CVPR 2001. Procedings of the 2001IEEE Computer Society Conference on, vol. 1, pp. I-355.IEEE,2001.

[3]A. Criminisi, P. Pérez, and K. Toyama, ―Region filling and object removal by examplar-based inpainting,‖ IEEE Trans. Image Processing, vol. 13, no. 9, pp. 1200–1212, Sept. 2004.