Real time Object Distance Measurement System with tracking based on Stereo Vision

Bhagyashree N Govindiya, Nabila Shaikh
Department of Electronics and Communication
L J Institute of Technology, Ahmedabad

ABSTRACT-There are many approach of measuring the distance of the object the most commonly used approaches are LASER range finder, Ultrasonic measurement etc. These approaches provide good accuracy but it needs human assistance and many times it is not possible in application like industrial automation. By using the stereo vision approach for the distance measurement we can make it automatic and determine the object distance as well as object geometry. The model of stereo camera imaging is established using traditional camera calibration method. The internal and external distortion parameters of cameras are calculated and optimized. Then the suitable algorithm for matching the left and right image is developed to calculate the disparity on MATLAB. After that the desired object from the disparity map is extracted and the distance of the object is calculated using the epipolar- triangulation method.

Key words-Binocular stereo vision, tracking.

I.STEREO VISION

As we can observe in image from the single camera that all the point into the same projection line are same image point. In fig 1.2.2(a) Both real points (P and Q) project into the same image point (p ≡q) This occurs for each point along the same line of sight and useful for creating optical illusion. With two (or more) cameras we can infer depth, by means of triangulation, if we are able to find corresponding (homologous) points in the two images shown in fig

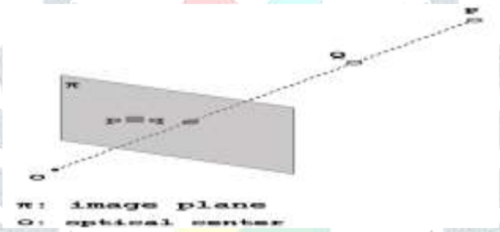

Fig 1 (a) single camera

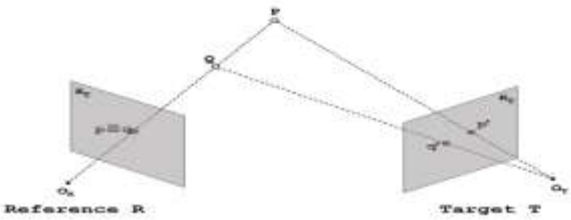

Fig 1 (b) stereo camera

Binocular stereo vision determines the position of a point in space by finding the intersection of the two lines passing through the Centre of projection and the projection of the point in each image. The recovery of the 3D structure of a scene using two or more images of the scene, each acquired from a different view point in space. The images can be obtained by using multiple cameras or one moving camera. The term binocular vision is used when two cameras are employed.

Modified approach

Till now the object for which distance to be measured considered as fixed color. But now we will measure the distance of the object of any color or shape and size. The algorithm is modified as below.

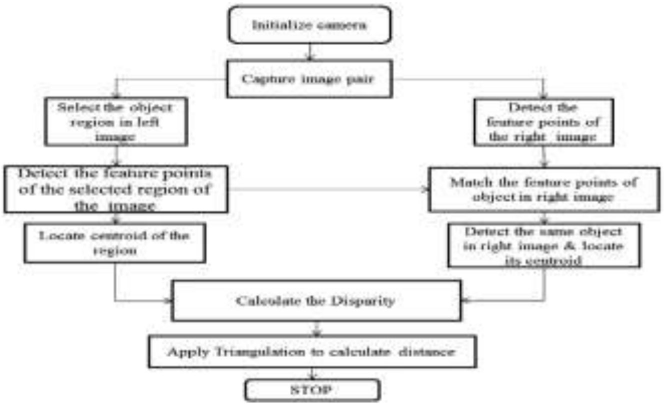

Figure 5.1.1 Algorithm for general object

- Initialize the stereo camera model
- Capture the image pair with the both cameras at same time.
- Select the region containing the object from the left image for which we want to measure distance.
- Find the feature points of the selected region of the left image & whole right image. For this purpose many feature point detection methods like gradient based feature detection, Harris corner detection, SURF point detection etc.
- Next step is to match the feature point from the left to right image. It can be done through the methods like SSD (Sum of squared differences), SAD (Sum of absolute differences) and Normalized cross-correlation.
- Locate the same region in the right image.
- Calculate the centroid of the located object in both left & right image.
- Take subtraction of x coordinate of centroid in both images to calculate disparity.
- Using triangulation measure the object distance.

Experiment result for Harris detector

Here object is placed at distance = 5.5 m

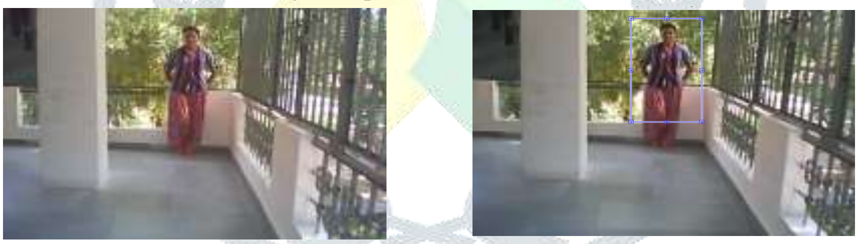

Figure 5.3.3 Stereo image pair

Figure 5.3.4 Cropped Selected Object

Figure 5.3.5 Feature points of object

Figure 5.3.6 Feature points of the right image

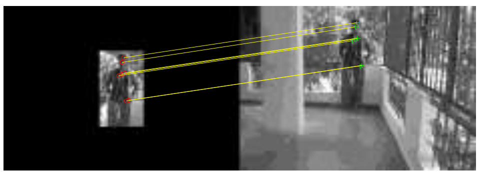

Figure 5.3.7 Feature points matching

Figure 5.3.8 Detected Object in right image

Figure 5.3.9 Measured Distance

Experimental result for Surf detector

Here object is placed at distance = 3.1 m

Figure 5.4.4 Stereo image pair

Figure 5.4.5 Cropped Selected Object

Figure 5.4.6 Feature points of object

Figure 5.4.7 Feature points of the right image

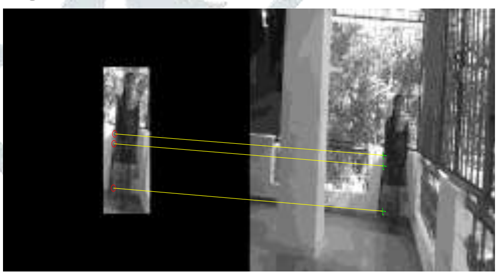

Figure 5.4.8 Matched feature points

Figure 5.4.9 Detected Object in right image

Figure 5.4.10 Result message box

CONCLUSION

- Through this I have measured distance for fixed coloured as well as general object. Construct the stereo camera model and obtain the necessary parameter for triangulation.
- Study the relation between disparity & distance of object from the experimental observation.

References

1. Manaf A. Mahammed, Amera I. Melhum, Faris A. Kochery"Object Distance Measurement by Stereo VISION"International Journal of Science and Applied Information Technology (IJSAIT), Vol.2 , No.2, Pages : 05-08 (2013) Special Issue of ICCTE 2013 - Held during 11-12 March, 2013 in Hotel Crowne Plaza, Dubai
2. Zhengzhen Liu,Tianding Chen"Distance Measurement System Based on Binocular Stereo Vision" 978-0-7695-3615-6/09 2009 IEEE DOI 10.1109/JCAI.2009.77
3. Manasi Pathade, Prachi Kadam, Renuka Kulkarni, Tejas Teredesai "FPGA based Relative Distance Measurement using Stereo Vision Technology" World Academy of Science, Engineering and Technology 55 2011
4. Grigorios Tsagkatakis, Student Member, IEEE, and Andreas Savakis, Senior Member, IEEE" Online Distance Metric Learning for Object Tracking" IEEE transactions on circuits and systems for video technology, vol. 21, no. 12, December 2011
5. Chris Harris & Mike Step hens "A COMBINED CORNER AND EDGE DETECTOR" Plessey Research Roke Manor, United Kingdom 1998
6. D. G. Lowe, "Distinctive image features from scale invariant keypoints," International Journal of Computer Vision, 2004.
7. SurachaiPanich "Comparison of Distance Measurement Between Stereo Vision and Ultrasonic Sensor" Journal of Computer Science 6 (10): 1108-1110, 2010ISSN 1549-3636
8. Ke, Y., Sukthankar, R.: PCA-SIFT: A more distinctive representation for local image descriptors. In: CVPR (2). (2004) 506 – 513
9. Jernej Mrovlje and Damir Vrancic" Distance measuring based on stereoscopic pictures" 9th International PhD Workshop on Systems and Control: Young Generation Viewpoint, Izola, Slovenia October 2008.
10. Bhowmick, B. Bhadra, Sinharay A. "Stereo Vision Based Pedestrians Detection and Distance Measurement for Automotive Application" 978-0-7695-4336-9/11 2011 IEEE DOI 10.1109/ISMS.2011.14
11. Herbert, B., A. Ess, T. Tuytelaars, and L. Van Gool, "SURF: Speeded Up Robust Features", Computer Vision and Image Understanding (CVIU), Vol. 110, No. 3, pp. 346--359, 2008.

Websites

12. "http://vision.middlebury.edu/stereo/data/ "image database
13. http://www.vision.caltech.edu/bouguetj/calib_doc/htmls/example.html