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Research Article

An Efficient Stereo Vision Technique for Detecting Obstacles for Visually Impaired

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Abstract

World Health Organization (WHO) has estimated that there are about 45 million visually handicapped people worldwide. These visually impaired people experience serious difficulties in leading an independent life due to reduced perception of the environment. Most of them confront serious difficulties in mobility and navigation, when they find themselves in new, unknown environment. In this paper, we have developed a technique that automatically detects obstacles and help the blind user in navigation. In this paper, we have discussed in detail all the design issues involved in the development of stereo vision based navigation technique for the blind people. The results of the technique are presented and they show that the technique can detect obstacles with sufficient accuracy and can easily help a blind user in navigation.

Keywords: *Automatically detects obstacles, Disparity map, Stereo vision, segmentation*

1. Introduction

World Health Organization (WHO) has estimated that there are about 45 million visually handicapped people worldwide. These visually impaired people experience serious difficulties in leading an independent life due to reduced perception of the environment. Most of them confront serious difficulties in mobility and navigation, when they find themselves in new, unknown environment. The shopping malls have building maps, which are stationary displays and are useful only when one can locate and read the display. Many academic and medical buildings lack even this kind of navigation assistance. The visually impaired people greatly rely on vision aids to perform their daily activities.

In the second section of paper, we have developed a technique that automatically detects obstacles and help the blind user in navigation. The developed technique makes use of calibrated stereo cameras to acquire stereo images of an object from nearby viewpoints. The acquired stereo images are rectified to ease the stereo correspondence problem, which is computationally hard. The rectified pair of images is searched for correspondences to develop dense disparity maps. The area based techniques are applied for the creation of disparity maps. The disparity maps are refined to solve problems like depth discontinuities. The Normal Cut method is used to segment the image. The dense disparity maps and segmented image are used to detect obstacles. In the third section of paper, the results of the technique are presented and they show that the technique can detect obstacles with sufficient accuracy and can easily help a blind user in navigation.

2. System Design

In this Section, the major components of the system along with the interaction between them are discussed. The section also deals with the description of the implemented techniques.

2.1 Outline of the system

The system consists of following components:-

1. Rectification
2. Disparity map
3. 3-D Map
4. Segmentation
5. Obstacle detection

2.2 Overview of System

Explanation of each part is given below and system model is shown in the figure 1.

1. In the first step, two cameras at a different view reference points see an object in 3-D world at different position. Rectification is fundamentally required to ease the stereo correspondence problem. The stereo correspondence problem involves the search in two dimensions and is computationally

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expensive. The computational requirement of stereo correspondence algorithm makes its use suitable in real time application. Rectification reduces the complexity of stereo correspondence algorithm by rectifying the search to one dimensional only.

2. To calculate disparity we have used region based stereo matching algorithm which applies global error energy minimization by smoothing functions method. The used stereo color image pair is loaded into an array. The disparity range i.e. the maximum value of disparity is set. This range is then applied to the array. The region based algorithm is searched in one dimension, which is further restricted by the disparity range to compute a disparity map.
3. The computed disparity map is further used for 3-D construction.

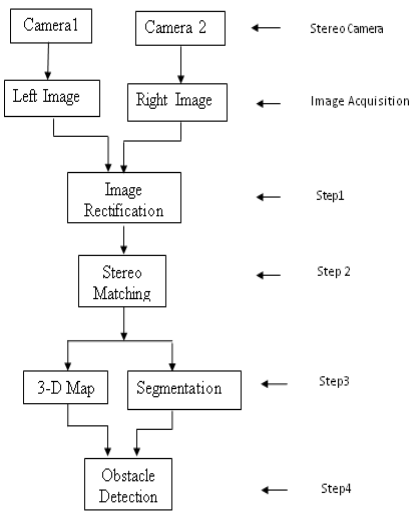


Figure 1: Flow chart of proposed approach

4. For the segmentation of the image, we have used two techniques: the first technique is based on normal cut method and the other one is on median filtering method. The goal in segmentation is to decompose the sequence into a small number of homogeneous pieces, segments, such that the data in each segment can be described accurately by a simple model.
5. By the result of 3-D map and segmentation, we have easily detected the obstacle.

3. Result

There are so many way to detect the obstacle for visually impaired. We have implemented an efficient technique to detect obstacle that fulfil our target in Matlab.In this Section, firstly we have presented the results of the system components using the proposed system that had been described in the last section. Then we compare the result of our system with detection system generated by Nadia Baha Touzene .

3.1 Outcome of our System

First of all, an image is captured by two cameras which are placed at different locations but on the same level. After this rectification of images are done. To rectify both the images, eight corresponding points are found. Then by adjoining these eight points, have parallelized these two images. The left and the right image obtained after the rectification step is shown in figure 2 given below.

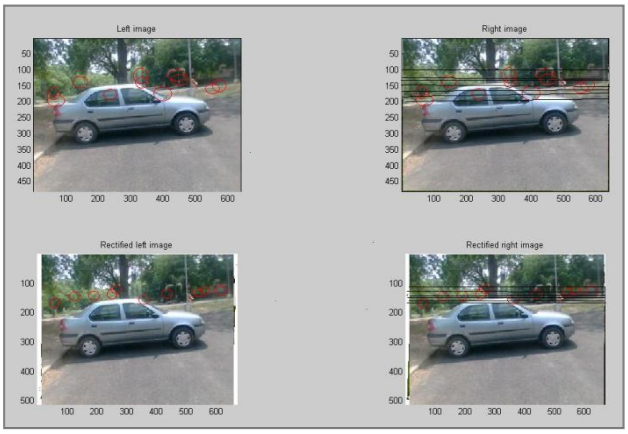


Figure 2: Rectified the images

After rectification, disparity map is calculated by the region based technique. Disparity map of images taken is shown in the figure 3 given below and disparity with error energy is shown in the figure 4 given below.

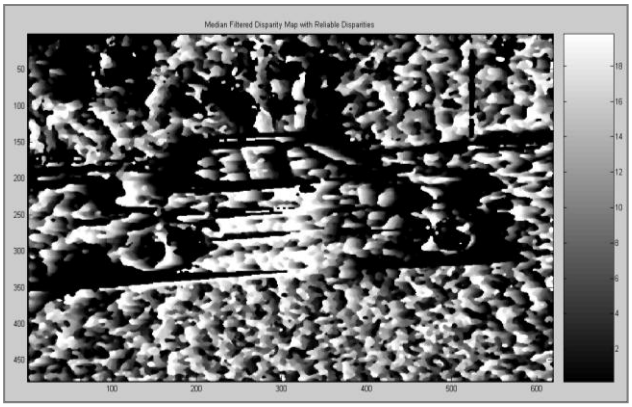


Figure 3: Disparity map of image that has been taken

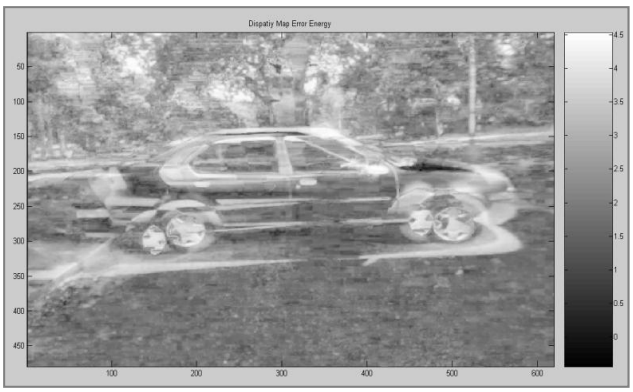


Figure 4: Disparity map with error energy

With the help of computed disparity map, we constructed 3-D map. 3-D map of computed disparity is shown in figure 5.4 given below.

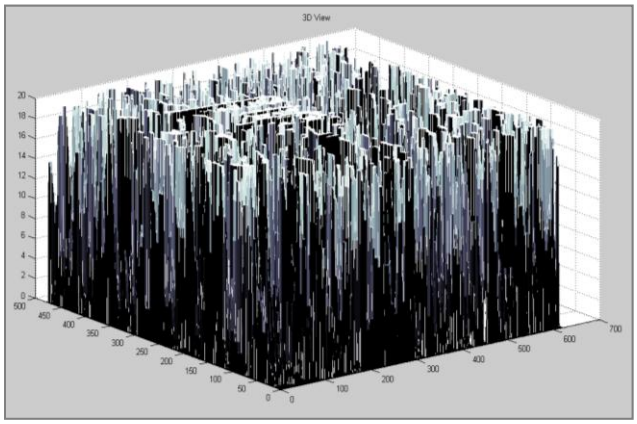
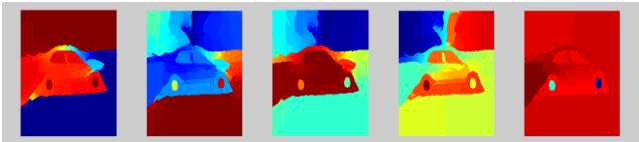


Figure 5: 3-D Map of computed disparity

Detection of segment of an image reduces significantly the quantity of data and help to judge the images. We have implemented three method of segmentation. In the first method, we have implemented a technique which is based on Normal Cut method. Result of this segmentation techniques are shown in figure 6 given below:-

Figure 6: Segmented Image



(a) (b) (c) (d) (e)

Figure 7: Eigen Vector Segmentation

In the second method of segmentation, median filtering is used to remove noise. The edges are then detected and lastly the connected components are calculated. Result of this method is shown figure 8 given below.

In last two decades, obstacles detection has been a major research topic in computer vision. By using the disparity map, 3-D map and the segmentation of the image, we can detect the present obstacles in the scene. In the above segment result (as shown in figure 7), a clear image of obstacles is formed. In this, boundaries are making a shape of car and behind this there are many other obstacles. So, we can reject the background obstacles and consider the back ground as a plane white color in and black color is consider as ground plane in figure 7(a).

Figure 8: Segmentation by median filtering method

3.2 Comparisons of results

In this section we have compared the result generated by our system with system proposed by NADIA BAHA TOUZENE. Result of this method is shown in figure 8 given below.

Figure 9: Obstacle detection by system proposed by Nadia Baha Touzene

The result of our system and system proposed by NADIA BAHA TOUZENE are shown in figure 6,7 and 8 respectively. System proposed by NADIA BAHA TOUZENE requires less clear result and it takes high time to compute the result than our system.

Conclusion

Most blind and visually impaired people confront serious

difficulties when finding themselves in new, unknown environments. A cane or a guidance dog won't be enough to enable them to find their way through an unknown city, not even in a less complex environment, like an airport terminal or a university building. So, proper attention is required in this area. Therefore there is a keen interest in developing a new method of obstacle detection.

In this dissertation, an efficient technique for visually impaired has been presented. The area based techniques is used to generate the disparity map from which 3-D map is constructed. Further, Normal Cut method is used to segment the image. The result shown clearly indicates that the developed technique is successful in detecting the obstacles. Obstacles are detected in real time and hence the developed technique can be used for detecting obstacles in real time. .

Future Work

In this paper we have described an efficient technique to rectify the problem of the visually impaired. Our purposed system meets the goals of this paper. In the future we can append more features in this system like:

- System will work in hard real time.
- System will calculate the distance of obstacle from position of visually impaired.
- System will represent the obstacle shape.

References

World Health Organization (Web). World Health Organization (2006). Retrieved on December 16, 2006.

Nadia Baha Touzene, Slimane Larabi Lria(2008),*Obstacle* Detection from Uncalibrated Cameras, Panhellenic *Conference on Informatics-IEEE*, DOI 10.1109/PCI.2008.34.