Depth Perception using A Parallel-Axis Stereoscopic Camera Rig

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ABSTRACT

Recently, advancement in the visual technology has lead to the further development of the three dimensional (3D) imaging systems. The visual perception to view a pair of images simultaneously, is a crucial factor to build a stereoscopic 3D image.

In this paper, we present the depth cues between the intensities of the two images when viewing with both eyes. Due to this stereoscopic effect, objects at different distances from the eyes differ in their horizontal positions, giving the depth cue of horizontal disparity. By simple image processing technique, we also present the binocular disparity map between the two images. A median filter has been used to filter out all the noises occurring in the disparity map image.

Keywords

Visual perception, Stereoscopic 3D image, Depth cue, Binocular disparity, Median filter

Ⅰ. Introduction

The stereo visualization approach to extract 3D information from 2D images mainly depends on the alignment of the two cameras. When two digital cameras are placed on a horizontal platform then a "parallel-axis stereoscopic camera rig" is formed. The conceptual background of forming a 3D image originates by looking two images at different projections placed at some distances apart.

In this paper, relative depth information is obtained on comparing two images to each other. In the process of making a 3D image or a 3D movie, vergence and focus control of images using parallel-axis stereoscopic camera rig plays an important role. The vergence angle between two optical axes of left and right eyes changes in order to specify the different object distances [1]. Also, there is change in the focus of the lens of human eyes in order to obtain clear image of the object.

In addition, the comparative horizontal disparity map between two images is obtained taking the consideration of some unavoidable environmental conditions like noise factor.

Ⅱ. Depth Estimation

Depth perception is basically a visual ability to view the depth between the two images which is being formed by imbricating the left and right images.

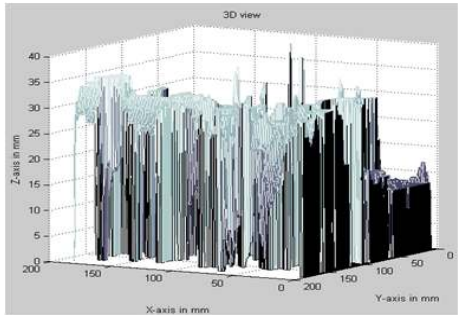

Fig. 1. Depth Estimation between Two Images.

The stereo vision approximation replicate the ability of the human visual system to generalize depth from the surrounding environment via the use of two eyes. In correspondence to human depth perception, two slightly displaced digital cameras record the same scene at different positions. The aim of our research in the field of stereoscopic imaging is to visualize the depth information between the two images. We have succeeded to obtain the three dimensional (3D) view of the depth which is shown in fig. 1. Z-axis estimates the depth between two images in fig. 1.

Ⅲ. Horizontal Disparity

The horizontal shift between the left and right images taken from stereoscopic cameras creates horizontal disparity. With the two views of stereoscopic binocular cues, a dense disparity map can be generated as an image. In the model of camera rig system, there is no vertical disparity between left and right camera images as the cameras can only move in horizontal directions.

For getting 3D image from stereoscopic camera, it is essential to control the vergence. This is done by using horizontal disparity information between left and right images followed by the position of the objects in the image [2].

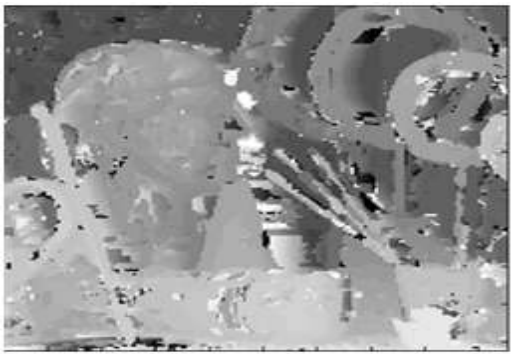

Fig. 2. Horizontal Disparity Map.

The horizontal disparity map between the two images is obtained by simple image processing in MATLAB 7.4.0 and the corresponding result is presented in fig. 2.

The distorted image as shown in fig. 2 is obtained due to presence of noise which in general not possible to avoid completely. Therefore, a median filter is used in order to reduce noise at best possible extent and to get a clear disparity map. The median filtered disparity map is shown in fig. 3.

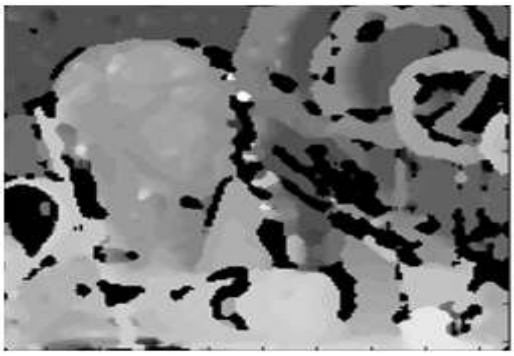

Fig. 3. Median Filtered Disparity Map.

Ⅳ. Conclusion

In this paper, we introduce the depth cues of a 3D image obtained from 2D images. The binocular disparity map between the two images is presented with and without filteration techniques.

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References

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