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Depth Estimation From Stereo Image Based on Texture And Sparsity

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***Abstract*—This paper presents a stereo image processing techniques for the detection of a depth information from images. Inspite of a remarkable growth in the last few years, the availability of 3D content is still diminutive by that of its 2D portion. To solve this problem, many 2D-to-3D image methods have been proposed. Here a stereo image processing technique is actually a 3D modeling technique. We analyze two types of methods. The first is a texture mapping. For a detail like surface texture and a color to extract from computer generated graphic model or 3D model, is a technique called as texture mapping . The second method is based on sparsity to obtain depth information of stereo image. Finally comparison of both methods are elaborated with parameters like PSNR and MSE. Hence at the end it shows a better algorithm for stereo image.**

***Keywords*—depth information, 3D image, stereo image, sparsity, depth estimation**

I. INTRODUCTION

Stereo image processing or 3D image processing is a technique for creating or enhancing the apparition of depth in an image[1]. 3D models represents an image using a collection of points in 3D coordinate and this are connected by several geometric entities like triangles, lines, curved surfaces, etc. By collecting of data , 3D models can be created by algorithmically or scanned. Now a days, 3D models are used in a various fields. Specially the medical industry uses detailed models of body's internal part which may be created with multiple 2-D image slices by MRI or CT scan , the movie industry uses them as characters and objects for animated and real-life motion pictures , the video game industries uses them as important content for computer and video games, the science department uses them as highly detailed models of chemical compounds, the architecture industry uses them to demonstrate proposed buildings and landscapes through models of software architecture, the engineering community uses them as designs of new devices, vehicles and structures and In recent decades the earth science community is working on construction of 3D geological models as a standard practice[2]. Thus 3D modeling is a development process of a mathematical representation of any 3 dimensional facade of an image by specially utilized software.

Nowadays there has been increased applications of 3-D image data in a variety of fields, like movies, shopping malls, on web networks, and in computer games. A 3-D image of any 2D image can be obtained by estimating 3D shape and its texture data by using 3D range scanner[3]. This 3D range scanner can acquire 3D shape data of a static object accurately, though it is not able to measure the 3-D shape for a dynamic object. So to measure the 3-D view of a dynamic object for example a person, it can easily reconstructed 3D shape from various multi-view image data which are measured by taking moving pictures of the dynamic object with several cameras.

Here depth estimation of stereo iIn this paper, the depth image estimation by texture mapping method is described in section 2, and we describe a new method for correcting the depth image based on the sparsity of depth image in section 3. Proposed work for this methods is shown in section 4, and the conclusion is in section 5

II. TEXTURE MAPPING

To obtain a detail like surface texture and color for computer generated graphic or 3D model, a mathod applied is known as texture mapping. . Its application to 3D graphics was invented by Edwin Catmull in 1974 . By a texture detail of an image we can see a 3D view of a 2D image.

A. For document processing

In document processing once the mesh has been unfolded, any 2D document image can be overlapped on the mesh with the texture mapping technique which is already supported in the library OpenGL[4]. As a result of the previous step, the triangles in the mesh have one by one correspondences in the texture vertices. Thus , to pack a document image on the mesh, image on the texture coordinates as a mask is placed as shown in Fig. 1. Then, each image pixel triangle is fitted in mesh. And an interpolation procedure is applied for vacant pixels[14]. The bi-linear interpolation is also used for images where a pixel of the input image is mapped to the output, and we can estimate the grey-level value of this pixel.

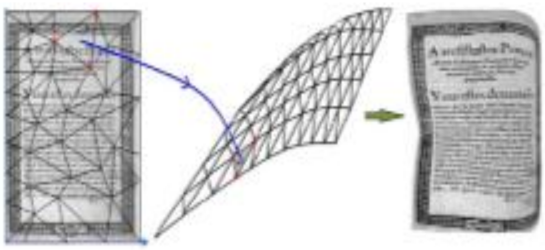

Fig 1 Packing an image on the mesh with extracted texture coordinates[4]

B. Texture mapping of 3D face

Here human face is captured with different views and then all this symmetrical images are merged to obtain a complete

3D face textured image. So , we need to classify reference feature line of 3D faces like hairline, eyebrow, canthus, mouth, and chin by using different views of an image. We can merge these two images according to the matched reference line to generate the texture image. To eliminate boundaries and to make an image even Multi-resolution image pyramid decomposition method is used for stereo image . So we can acquire the Gaussian image and Laplacian image, where 1 shows a level number. In that pyramid image size and resolution are decreased from level to level[5]. An image of each level on the pyramid is obtained from its previous level.

$$G_{l+1}(i,j)=\sum\sum_{m,n=-2}^{2} w(m,n)\cdot G_l(2i+m,2j+n) \qquad (1)$$
$$l=0,1,2\ldots,N-1$$

Here w(m,n) is a weighting Gaussian-like function [6,7]. After the image pyramid is created as in Fig.2, the combination of three LI images on each level is acquired and so we can obtain the PIimages[13]. Where PI image is augmented with SI1, and we t get SIimage ,which is the result of each level, and is constructed from its topper level by using (3). We obtained a final texture image.

$$L_l(i,j)=G_l(i,j)-\sum\sum_{m,n=-2}^{2} w(m,n)\cdot G_{l+1}\left(\frac{i+m}{2},\frac{j+n}{2}\right) \qquad (2)$$
$$l=0,1,2\ldots,N-1$$
$$S_l(i,j)=L_l(i,j)+\sum\sum_{m,n=-2}^{2} w(m,n)\cdot S_{l+1}\left(\frac{i+m}{2},\frac{j+n}{2}\right) \qquad (3)$$
$$S_N=G_N, l=0,1,2\ldots,N-1$$

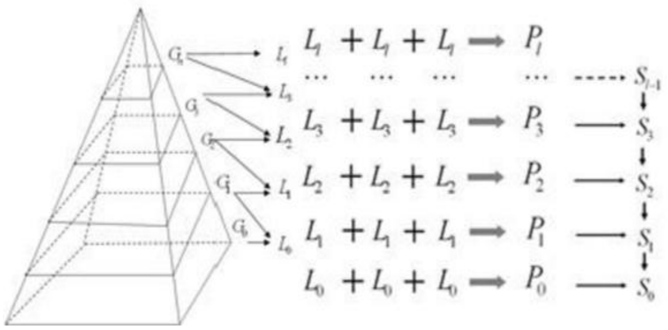

Fig 2. Gaussian and Laplacian pyramid

1) Simulation results and Discussions

Here specific texture mapping algorithm is explained for 3D face and document . texture is extracted with a reference of Gaussian and laplacian pyramid.

For a depth generation in stereo image as shown in figure 3 texture is extracted with the image pyramid. In which the result of each level is constructed from its topper level by using 3rd equation therefore we obtain a final texture image as shown in fig 3.

Here quality can also be measured by using quality parameters like PSNR and MSE.

Image texture depth here is extracted with is location variation as shown in fig 3.

PSNR: PSNR is referred as Peak signal-to-noise ratio, which is used for an engineering term for the proportion between the maximum possible power of a signal and the power of corrupting noise which affects the fidelity for its representation .As many signals have a very wide dynamic range PSNR is usually expressed as logarithmic, decibel scale[15].

$$\begin{aligned} PSNR &= 10\cdot\log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\ &= 20\cdot\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\ &= 20\cdot\log_{10}(MAX_I) - 10\cdot\log_{10}(MSE) \end{aligned}$$

MSE: MSE is referred as mean squared error. It measures the average of the squares of the errors[16]. MSE is the second moment which calculates variance of the estimator and its bias.

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j)-K(i,j)]^2$$

This both the parameters shows a quality of an image. High PSNR shows a better quality of an image and low MSE also shows a better quality of an image.

TABLE 1
COMPARISON OF IMAGES

Image	PSNR	MSE
mouse	4.25	2446.42
mandrill	5.46	1502.68
cube	6.47	1338.02

As shown in table quality of an image increases with increasing values of PSNR and decreasing values of MSE.

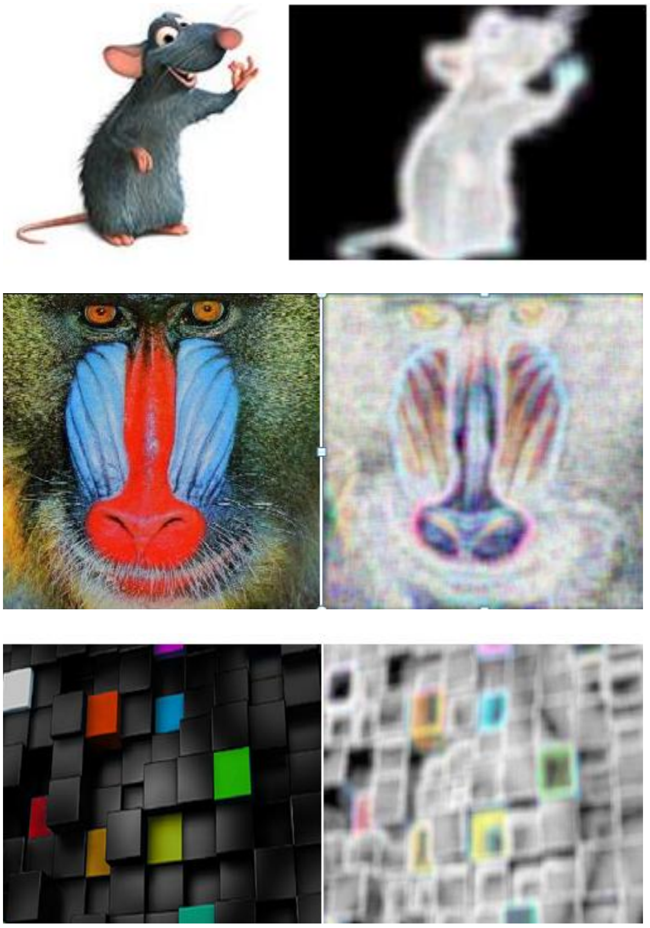

Fig 3 simulated result, 3D images of (a) mouse (b) mandrill (c) cube

III. SPARSITY TECHNIQUE

Sparsity of a signal means a signal with a some large components whereas various other components have a values which are close to zero[3]. Sparsity is generally used for the modification of depth image which is generated by stereo matching or any 2D to 3D conversion technique. Signal is said to be sparse when most of the converted image's components have values close to zero[8].

In this section we discuss a number of popular sparsity measures. These measures are used to calculate a number which describes the sparsity of a vector. This measurement can used after simulating image and we can extract sparsity variables[12]. By this a particular increase or decrease in sparsity is ensured with this measurements. The most commonly used and studied sparsity measures are the norm-like measures[9]

$$\|\vec{c}\|_p = \left(\sum_j c_j^p\right)^{1/p} \quad \text{for } 0 \le p \le 1.$$

The measure simply calculates the number of non-zero coefficients

$$\|\vec{c}\|_0 = \#\{c_j \neq 0, j = 1, \ldots, N\}.$$

A Sparse Local Stereo Matching

By using search maps, a local stereo matching can be obtained only for the labeled essential pixels and the selected disparity candidates. In this paper, the adaptive support-weight with mini-census [10] algorithm is used for local stereo matching, and the winner-take-all method is used to select the final disparities. By using this the generated sparse disparity maps can be generated for 3D image.

1) Dense Recovery : This sparse disparity maps, the dense recovery process fills the holes without disparity values row by row. In the recovery process, we consider the proximal endpoint disparities of neighbouring segments, including the left, right, bottom, and top ones, to preserve the disparity consistency in vertical direction and avoid the stripe artifact in the disparity map. Then, we refine the dense disparity maps by the left-right consistency check and the regional voting method [11] in the post-processing. The final dense disparity maps for two-view images can be obtained.

IV ADVANCEMENT IN PROPOSED ALGORITHM

By using above algorithms depth estimation of stereo image can be obtained with software development tools for simulation of stereo image. In texture mapping depth calculation can be acquired and in the same way sparsity based disparity estimation can also be obtained for depth generation. Comparison and hybridization is also possible for above mentioned techniques.

V CONCLUSION

Hence a deep approach of depth estimation algorithm is elaborated here. In that texture mapping method defines specific texture of 3D images for depth estimation. Simulation results for mouse and mandrill of texture mapping is also shown for its depth in form of a texture. In sparsity estimation depth generation for stereo matching is acquired and an error for relative view can be modified. To smooth an image filters can also be used to remove errors.

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