RESEARCH ARTICLE   **OPEN ACCESS**

Volume Construction Techniques to Construct 3D Image form 2D Digital Image

Kaushal Patel
Department of Matheamtics Veer Narmad South Gujarat University,Surat, Gujarat

ABSTRACT:
The 3D image gives the experience of the invisible dimension of the 2D image. Many researchers work for a display that projects 3D images in a way that makes them visible from all angles and does not require extra accessories.
In this paper, we propose a novel method for constructing 3D image form 2D image. 3D imaging provides very detailed and valuable information. The approach effectively incorporates visually prominent boundaries, prominence measure of pixels and local color & region gestures. 3D vision of image has become the area of interest of many researchers and numerous imaging and processing algorithms have been developed over the past decade. The proposed method uses the method of gradient that would be the direction of uphill. The gradient has a direction and a magnitude, it is natural to encode this information in a vector. The length of this vector provides the magnitude of the gradient. Because the gradient may be different at every location, we represent it with a different vector at every image location. Vector can be used to provide height and depth of an image, that generates 3D image of an original 2D image.
Keywords: 2D image, 3D image, segmentation, Remain Sum, gradient, Vector

----

I. INTRODUCTION

In an image, objects low or directly in front of us are perceived as closest to us and are in the foreground. They are larger, clearer, and brighter than those "behind" them. Objects at a medium distance are perceived as mid-ground; they are in the middle of the frame. Objects farthest from us, in the background, are usually higher in the picture; they seem less clear, and their colors are less intense than those in both the foreground and middle ground.

To understand an image, the first step is to identify foreground and background so that we can focus on an interested object. In computer vision application, object detection is fundamental and most important steps for video analysis [9]. Therefore, in 3D modeling, foreground and background have its own importance. 3D modeling is a technology through which three-dimensional models of any given object can be created. The product design process has become easy with 3D modeling as we can create three-dimensional models virtually for any object no matter how gigantic or micro it is. This very fact helps to create an exquisite design for any product (e.g. orthodontic diagnosis) [4].

3D means three-dimensional, that is, something that has width, height and depth (length). Our physical environment is three-dimensional and we move around in 3D every day.

Humans are able to perceive the spatial relationship between objects just by looking at them because we have 3D perception, also knownas depth perception. As we look around, the retina in each eye forms a two-dimensional image of our surroundings and our brain processes these two images into a 3D visual experience.There are high expectations for the further development of three-dimensional display technology [11].

In this work, we focus only on the foreground of an image. We use a foreground that relates and enhances the overall composition of an image. we will achieve by creating depth and a dynamic visual relationship between nearer and farther elements using gradient method that would be the direction of uphill. Having something of visual interest that is closer than your main subject adds depth and compositional power. The goal of 3D perception of a 2D image using gradient vectors. Gradient vector is to design models that are able to generate the 3D perception of 2D image and predict image accurately based on primary information. An ideal objective of this method should be able to mimic the quality predictions of 3D perception of an average human observer. Based on the availability of a reference image which is considered to be distortion-free and has a perfect quality.

II.   LITERATURE REVIEW

In the field of robotics and face recognition, foreground and background play an important role to identify the objects. Especially AI (Artificial Intelligence) is a rapidly growing field of the current century and therefore, the 3D vision has become the area of interest of many researchers.

The fundamental difference between 2D and 3D vision is the inclusion of the third coordinate – depth [3]. This information can be acquired by various means ranging from stereoscopy (use of two specifically aligned cameras) to laser scanning of the environment, while each of these techniques has their own advantages and disadvantages [1, 8].

In industry and manufacturing, 3D vision systems provide unprecedented precision and flexibility in control, measurement, and quality inspection. While these areas require different approaches to hardware construction and methods of 3D image acquisition, most of the image processing algorithms are used universally [3].

As an important part of digital image processing technology, the 3D reconstruction technology has been widely applied in medical research, remote sensing and telemetry and virtual reality, etc. [10, 12]. With the development of 3D applications, face recognition and facial animation [5] becomes an important component of 3D content production [2]. Another exploring field is 3D printing technology. 3D printing has been a great impact in many industries such as medical science, engineering, aerospace, education and many more.

III.   METHODOLOGY

There are two methods that widely used in 3D reconstruction field

➤ Stereo triangulation
➤ Structure frommotion

These areas require different approaches to hardware construction and methods of 3Dimageacquisition, most of the image processing algorithms are used universally.

Theimplementationcontainssomebasicimageproces singoperationnamelysegmentation,smoothingandco nstruct volume using gradient vector.

Segmentation

An image is not just a random collection of pixels, it is a meaningful arrangement of regions and objects. Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels. Actually, partitions are different objects in image which have the same texture or colour. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image.

Histogram-based methods are very efficient compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. Colour or intensity can be used as the measure.

Insegmentationprocess,followingstepsareperformed :

Step 1: Partition Image into Blocks
For better result, we partition image into blocks rather processing on whole image. So that we efficiently separate foreground and background.

Step 2: Choose Threshold Value
The key parameter in the thresholding process is the choice of the threshold value (T). create a histogram of the image pixel intensities and use the valley point as the threshold.

Step 3: Segment the Image
A threshold value (T) separates Object and background. Any point of the image for which that point value is greater than T is called an object point, otherwise, the point is called a background point.

Let $I(x, y)$ be the intensity value at pixel location (x, y) and T is the threshold value. If $I(x, y) \geq T$ then it is labeled 1 in the output image otherwise it is labeled as 0. The pixel value corresponding to 1 and 0 depends on the application

Step 4: Restore Blocks into Full Image
Restore image blocks that we partitioned in Step 1 into whole image.

Step 5: Remove the unwanted Gaps
Segmented image has holes and gaps. We need to fill holes/gaps up so that image looks proper.

Smoothening

In image processing, to smooth a data set is to create an approximating function that attempts to capture important patterns in the data, while leaving out noise or other fine-scale structures/rapid phenomena. In smoothing, the data points of a signal are modified so individual points (presumably because of noise) are reduced, and points that are lower than the adjacent points are increased leading to a smoother signal using Gussianfilter or mean filter

Construct Volume from Surface

In this process, we use Riemann sum concept to generate surface of an image which construct 3d image from 2d image.

The integral $\int_a^b f(x)\, dx$ for positive $f(x)$ can be interpreted as the area under the curve $f(x)$ over the interval $[a, b]$. The integral is the area between the curve $f(x)$and the x-axis.

In the same way, the double integral $\iint_D f(x, y)\, dA$

of positive $f(x, y)$ can be interpreted as the volume under the surface $z = f(x, y)$ over the region D. Imagine that the object is the surface $z = f(x, y)$ floating over the xy-plane. The double integral $\iint_D f(x, y) \, dA$ can be interpreted as the volume of the object.

We can see this from the Riemann sum approximating the integral

$$\sum_{i,j} f(x_{ij}, y_{ij}) \, \Delta x \Delta y$$

$$(1)$$

Each term in the Riemann sum is the volume of the thin box with the base $\Delta x \times \Delta y$ and height $f(x_{ij}, y_{ij})$.
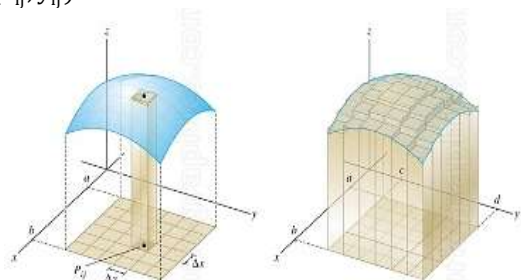
Hence, the total Riemann sum approximates the volume under the surface by the volume of these thin boxes. In the limit as $\Delta x, \Delta y \to 0$, we obtain total volume under the surface over the region D. That is,

$$\iint_D f(x, y) \, dA$$

$$(2)$$

In Image Processing, a digital image may be defined as a two-dimensional function $f(x, y)$, where x and y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. We can considered a digital image which is, obviously, in xy-plane as a surface $z = f(x, y)$. Now to find the volume of an image, i.e. height (or depth), we can apply The Riemann Sum by means of intensity of a digital image.

We can use equation-(2) in which $f(x_i, y_j)$ is considered as an intensity value of a pixel at (x_i, y_j) position on the image, Where $i, j = 1(1)n$. Which provide height at (x_i, y_j) pixels where $i, j = i(1)n$ and all pixels together give volume of a digital image.

Experimental Results
In image processing, there are different software available in the market. In this work, we use image processing tools available in MATLAB for implementation of an algorithm.
Segmentation
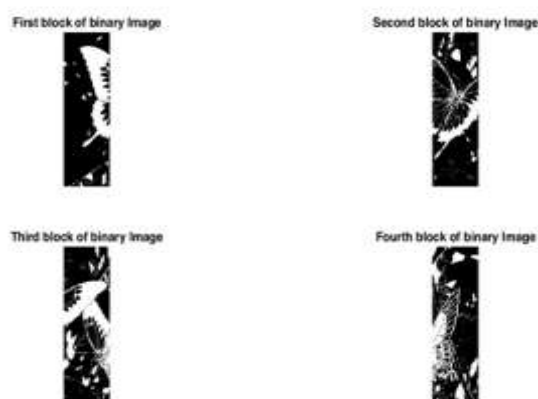**Step 1**

Figure 1: Partition Image into Blocks
Step 2

Figure 2: Segmented Binary Image of Blocks

Step 3

Figure 3: Restored Blocks into Full Image

Step 4

Figure 4: Total Segmented Image

Step 5

Figure 5: 3D image of 2D Image

IV.   CONCLUSION

We are unable to include 3D perception in every photograph that we take. We find that foregrounds add considerable depth to composition image. When we use a foreground, it helps to establish a visual relationship between the bottom of the photograph and the top, which is important for leading the viewer's eye into the scene. Proposed method provides very detailed and valuable information about the environment or examined objects. Vector construction technique is useful to understand the characteristics of an object from a single 2D image. In an image, this technique produces image quality measurements which are more relevant to the volume spatial content of an integral image than conventional reliability on optically encoded spatial distribution. This technique enables us to visualized and understand the three-dimensional object behind a two-dimensional image. The vast application of the algorithm can be explored further, which large potential to be used in a lot more areas than just for an aesthetic purpose.

REFERENCES

[1]. Pirjan A. and Petroşanu D., "The Impact of 3D Printing Technology on The Society and Economy"
[2]. Bisoyi A., A. Das M., "A Survey and Comparative Analysis of Various 3D Reconstruction Methods", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 3, March 2015.
[3]. Varga M. and Jadlovský J., "3D imaging and image processing – literature Review", Scientific Conference of Young Researchers – FEI TU of Košice, May 2016.
[4]. Karatas O. H. and Toy E., "Three‑dimensional imaging techniques: A literature review", European Journal of Dentistry, Vol 8, Issue 1, Jan-Mar 2014.
[5]. Gnanamuthu P. and Balasubramanian S., "Literature Review of Facial Modeling and Animation Techniques", International Journal of Graphics and Multimedia Volume 1, Issue 1, May 2010, pp. 1 – 14.
[6]. Gonzalez R. C. and Woods R. E.: Digital Image Processing. Prentice-Hall, Englewood Cliffs (2007).
[7]. Vyas S. D., Patelia R. M., "A Review on the Role of 3D Technology in the Field of Industry and Entertainment", International Journal of Advance Research in Computer Science and Management Studies Volume 3, Issue 2, February 2015, pg. 109-115.
[8]. Rulania T., "Impact & Applications of 3D Printing Technology", SSRG International Journal of Computer Science and Engineering (SSRG-IJCSE) – volume 3, Issue 8, August 2016.
[9]. Ukinkar V. G., Samvatsar M., "Object Detection in Dynamic Background Using Image Segmentation: A Review", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 3, May-Jun 2012, pp.232-236"
[10]. Luan X., Xie Y., Ying L. and Wu L., "Research and Development of 3D Modeling", International Journal of Computer Science and Network Security, VOL.8 No.1, January 2008.
[11]. Kenji Y., Tomoyuki M., Takanori S., Ryutaro O., and Taiichiro K., "3D-Image Technology - Electronic Holography System Using 4K Video System", Journal of the National Institute of Information and Communications Technology, Vol.57 Nos.1-2 2010.
[12]. Zhang Y. and Zhang L., "The Research of 3D Reconstruction Based on Single Image", International Symposium on Computer, Communication, Control and Automation (3CA 2013).