ORIGINAL RESEARCH PAPER

Volume-8 | Issue-7 | July - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CONTOUR TRACING TECHNIQUES TO CONSTRUCT 3D IMAGE FORM 2D DIGITAL IMAGE

Computer Science

Kaushal Patel Department of Mathematics, 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.
Contour tracing is one of many pre-processing techniques performed on digital images in order to extract information about their general shape. Contour lines may be traced on a visible three-dimensional model of the surface. 3D models are very meticulous and provide immense details about each element, which can help in communicating the information with ease and allow viewers to understand design in lot better way. This work gives a novel methodology to construct 3D contour image from 2D image.

KEYWORDS

2D image, 3D image, Contour, Reconstruction

INTRODUCTION

A contour line of a function of two variables is a curve along which the function has a constant value, so that the curve joins points of equal value [3]. It is a cross-section of the three-dimensional graph of the function *f(x,y)* parallel to the x-y plane. In cartography, a contour line (often just called a "contour") joins points of equal elevation (height) above a given level, such as mean sea level.

Contour tracing is one of many pre-processing techniques performed on digital images in order to extract information about their general shape. Once the contour of a given pattern is extracted, it's different characteristics will be examined and used as features which will later on be used in pattern classification. Contour lines may be traced on a visible three-dimensional model of the surface. 3D modelling is a technology through which three dimensional models of any given object can be created. 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 creating 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 [7]. Humans are able to perceive the spatial relationship between objects just by looking at them because we have 3D perception, also known as 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 [10].

The accuracy which 3D models contain is unparalleled and no other conventional modeling or visualizing approach can be as accurate as 3D modeling.

Literature Review

In the engineering field, contour has an important role to extract details and to understand characteristics of an object. Contour lines are closed with themselves or the edges of the map, by definition of being a contour and they may be traced on a visible three-dimensional model of the surface. 3D contour gives more details to understand the data and therefore, and for various fields, 3D modelling becomes more important.

The fundamental difference between 2D and 3D model 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 have 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 construction technology has been widely applied in medical research, remote sensing and telemetry and virtual reality etc. [9, 11]. 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 great impact in many industries such as medical science, engineering, aerospace, education and many more.

This work enables us to visualized and understand the three-dimensional world behind a two-dimensional image.

Proposed Work:

Algorithm

This method includes three main steps:
(1) Image Pre-Processing
(2) Contouring the image
(3) Construct 3D surface

These steps are constructed in MATLAB using image processing algorithms [7]. MATLAB is an excellent tool to accomplish these tasks.

Image Pre-processing

Pre-processing is applied on images at the lowest level of abstraction and its aim is to reduce undesired distortions and enhance the image data which is useful and important for further processing. It is usually necessary and required for improving the performance of image processing methods like image transform, segmentation, feature extraction and fault detection. This Step is focused on filtering and intensity adjustment as pre-processing methods [6].

Contour

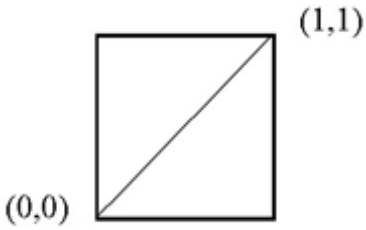
Contour maps are a way to depict functions with a two-dimensional input and a three-dimensional output. The input (x,y) with the output $f(x,y)$ is to combine both into a triplet $(x,y,f(x,y))$ and plot that triplet as a point in three-dimensional space. The graph itself consists of all possible three-dimensional points of the form $(x,y,f(x,y))$, which collectively form a surface.

On this stage, rather than tracing contour line, an algorithm analyse the picture for dark or shadowy areas depends on intensity of the image and creates a flat object with negative space where any of those areas occur.

Construct 3D surface

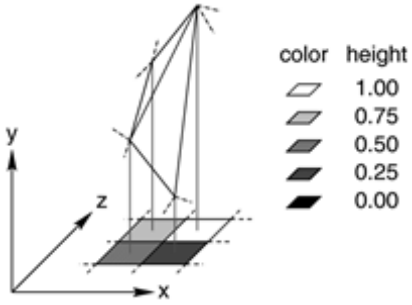
Basic idea behind this concept is to construct a polygonal "mesh" based on the intensity values of pixels in an image. That is, read an image and use the brightness of each pixel to generate and place triangles.

Image can be defined as f(x,y). We consider a small square of four pixels from this image. Each one has an x and y coordinate, taken straight off the image. The lower left pixel is (0,0) and the upper right is (1,1). We generate two triangles in 3D space from these four pixels. In the diagram below, each of our four pixels is marked as an 'x' and we can draw two triangles.



Each pixel has an *x* and *y* already. So, we can write the vertices for two 2D triangles:
Triangle 1: (0,0) (0,1) (1,1)
Triangle 2: (0,0) (1,1) (1,0)

Now, to turn these 2D coordinates into 3D coordinates, we take each of our four pixels and calculate its brightness. We use this brightness, scaled into some appropriate range, as the Z coordinates.



A square of four pixels and calculate the intensity of each pixel. Then, use these four intensity values as the four Z coordinates. We have two triangles in 3D space generated from four pixels. We do over the whole image and finally get 3D image.

Experimental Results

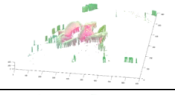
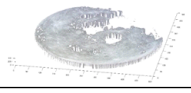
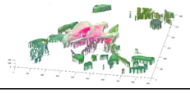
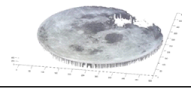
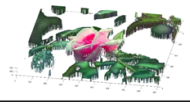
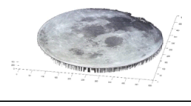
Intensity Level	Sample Image-1	Sample Image-2
Greater than 150		
Greater than 100		
Greater than 50		

Table 1.1 3D Contour Image based on Intensity Level

CONCLUSION

We are unable to include 3D perception in every photograph that we take. Once the contour of a given pattern is extracted, it's different characteristics will be examined and used as features which will later on be used in pattern classification. Therefore, correct extraction of the contour will produce more accurate features which will increase the chances of correctly classifying a given pattern. This method is very useful to understand the characteristics of an object from a 2D image. Contour tracing is often a major contributor to the efficiency of the feature extraction process - an essential process in the field of pattern recognition. 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] A. Pirjan and D. Petroşanu, "The Impact of 3D Printing Technology on The Society and Economy"
[2] A.K. Bisoyi, A. Mahapatra, S. Das, "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] D. N. Kailasrao, "Elevation Contours Generation, Analysis and Water Scarcity Regions Extraction using DEM," International Journal of Advanced Research in Computer Science, Volume 3, No. 3, May-June 2012"
[4] M. Varga and J. Jadlovský, "3D imaging and image processing – literature Review", Scientific Conference of Young Researchers – FEI TU of Košice, May 2016.
[5] O. H. Karatas and E. Toy , "Three-dimensional imaging techniques: A literature review", European Journal of Dentistry, Vol 8 / Issue 1 / Jan-Mar 2014.
[6] P. Gnanamuthu and S. Balasubramanian, "Literature Review of Facial Modeling and Animation Techniques", International Journal of Graphics and Multimedia Volume 1, Issue 1, May 2010, pp. 1 – 14.
[7] R. C. Gonzalez and R. E. Woods: Digital Image Processing. Prentice-Hall, Englewood Cliffs (2007).
[8] S. D. Vyas, R. M. Patelia, "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.
[9] T. Rulania, "Impact & Applications of 3D Printing Technology", SSRG International Journal of Computer Science and Engineering (SSRG-IJCSE) – volume 3, Issue 8, August 2016.
[10] X. Luan, Y. Xie, L. Ying and L. Wu, "Research and Development of 3D Modeling", International Journal of Computer Science and Network Security, VOL.8 No.1, January 2008.
[11] Y. Kenji, M. Tomoyuki, S. Takanori, O. Ryutaro, and K. Taiichiro, "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] Y. Zhang and L. Zhang, "The Research of 3D Reconstruction Based on Single Image", International Symposium on Computer, Communication, Control and Automation (3CA 2013).