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2D to 3D Image Conversion using Trimetric Projection and Depth-map Estimation

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Abstract: The three-dimensional (3D) displays needed the axes and angle information for dimensional view which is engaged in the predictable 2D substance. This work presents a novel methodology that involuntarily converts 2D images into 3D which is easily available for users with the help of our mM desktop application. Here we are working on axonometric projection and focusing on axis of any object or image, in this methodology we are going to merge three different axonometric projections and showing this as a new technique in Tri-metric projection. Projection applies in 2D records which we have to convert in 3D. This technique is helpful in 2d to 3D conversion with a better view and it takes less time for conversion since researchers are using three different projection techniques together for an exceptional result.

Keywords: Predictable 2D substance, focusing on axis of any object or image, 2D records which we have to convert in 3D help of our mM desktop application

1. INTRODUCTION

In the 2D structure, we use only two coordinates X and Y other than in 3D an extra coordinate Z is new. 3D graphics techniques and their functions are basic to the entertainment, games, and computer-aided design industries. In addition, 3D graphics mechanisms are now a piece of almost every individual computer and, even if habitually projected for graphics-intensive software such as games, they are more and more being used by additional applications. Axes for 2D and 3D systems see in figure 1, in this paper we are going to convert 2D image to 3D image.

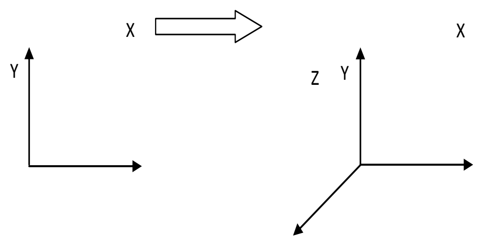

Figure 1: Axes of 2D and 3D

When we come to 3D images we must know that a simple 3D image is created by two images from an object, but from different angles, one per eye. Then brain can use this difference and create a depth map for itself. This will give it an idea of the outer world, how objects are near or how they are far. Here we are introducing axonometric projection and applying it in 2D for a most excellent view of 3D image after conversion. Three different types of axonometric projections are: Isometric, Dimetric and Trimetric projections.

1.1. Axonometric projection

Axonometric projection is a form of parallel projection in favor of creating a graphic representation of an object, where the object is orbited. "Axonometric" means "to measure along axes". Axonometric projection demonstrates an illustration of an object as analyzed from a skew direction in sort to expose more than one side in alike picture.

1) Isometric projection has equal foreshortening by the side of each of the three axis directions.
2) Dimetric projection has equal foreshortening next to two axis directions and a special amount of foreshortening along the third axis. This is since it is not tipped a same amount to all of the prime planes of projection.
3) Trimetric projection has dissimilar foreshortening along all three axis directions. This view is produced by an object that is not equally tipped to any of the planes of projection.

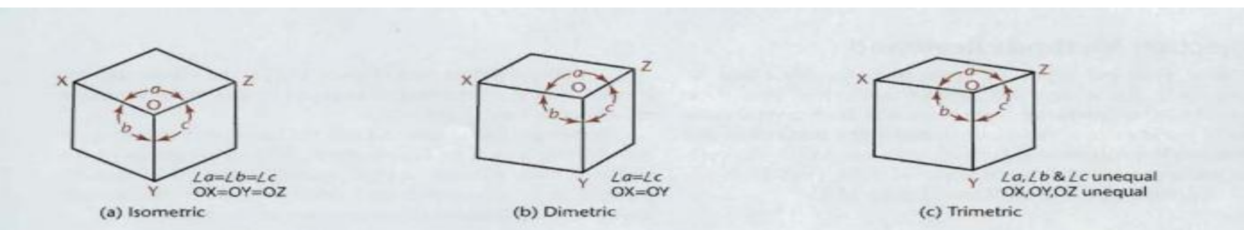

Figure 2: Axonometric projection types

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2. RELATED WORK

Three-dimensional (3D) imaging has been developed in the early of 1990's. Webber RL et al. [1] Theory and application for three-dimensional dento-alveolar imaging, the goals of these techniques are to replicate or describe the anatomic and physiological facts exactly and to display the three-dimensional (3D) anatomy precisely. Ucar FIet et al. [2] Standardization of records in orthodontics, Imaging is one of the most important tools for orthodontists to evaluate and record size and form of craniofacial structures. Hajeer MY et al. [3] Applications of 3D imaging in orthodontics: Part 1, part 1 of this paper describes the background, general concepts, available techniques and the clinical applications of recording external craniofacial morphology in three dimensions. Plooij JM et al. [4] Digital three-dimensional image fusion processes for planning and evaluating orthodontics and orthognathic surgery, in this paper imaging of these structures is one of useful diagnostic tools for clinicians to make decision treatment modality. Herman GT. [5] Fundamentals of computerized tomography: Image reconstruction from projection, Describes how projection data are obtained and used in science and medicine, focusing on x-ray data but also covering other fields such as electron microscopy, nuclear medicine, ultrasound, materials science and nondestructive testing. Scarfe WC et al. [6] Clinical applications of cone-beam computed tomography in dental practice; In this paper authors design CBCT system, cone-beam computed tomography systems have been designed for imaging hard tissues of the maxillofacial region. Ritman EL. [7] Micro-computed tomography-current status and developments, in this paper authors discussed about biomedical applications, micro-computed tomography (CT) scanners can function as scaled-down (i.e., mini) clinical CT scanners that provide a three-dimensional (3-D) image of most, if not the entire, torso of a mouse at image resolution (50-100 microm) scaled proportional to that of a human CT image. Paddock SW et al. [8]

Laser scanning confocal microscopy: History, applications, and related optical sectioning techniques, here protocols of specimen preparation, to the analysis, the display, the reproduction, sharing and management of confocal images using bioinformatics techniques. Fechteler P. et al. [9] Fast and high resolution 3D face scanning, in this work, authors present a framework to capture 3D models of faces in high resolutions with low computational load, the system captures only two pictures of the face, one illuminated with a colored stripe pattern and one with regular white light. The results are shown in different views: simple surface, wire grid respective polygon mesh or textured 3D surface. Fan Guo et al. [10] Automatic 2D-to-3D Image Conversion based on Depth Map Estimation, in this paper, authors propose a novel algorithm to estimate the map by simulating haze as a global image feature. Besides, the visual artifacts of the synthesized left- and right-views can also be effectively eliminated by recovering the separation and loss of foreground objects in the algorithm.

3. PROPOSED WORK

In this methodology we are working on axonometric projection and combined all 3 axonometric techniques for a new axonometric projection technique for a complete 3D image projection, viewing and for conversion of 2d to 3d imaging. Here we are applying axonometric projection in 2D objects or images for Tri-metric technique. With the help of proposed methodology we will use all axonometric projection together at same time. It will be beneficial for 2D to 3D object conversion which works under our desktop application.

In Axonometric projection all tree projection works individually with different projection features like, Isometric projection shows all axis direction are equal from initial object point, Dimetric projection confirms two axes are equal and third are different, Trimetric projection having all different axes directions.

Trimetric is sufficient for the projection of images but this technique applied in a single image, 2D to 3D image conversion is not possible by a single image for this problem first we have to calculate depth and later we have to use haar-wavelet for distribution of image.

3.1. Depth-map Estimation

2D to 3D conversion is not possible by a single image that's why we are calculating depth for a single image and converting it to other shaded images for multiple images and for this purpose later we are applying Haar-Wavelet method for distributing image. We can adopt the transmission estimation method that widely used in haze removal to obtain depth information. For this purpose, the dark channel prior and a guided filter are used to estimate the depth map.

Specifically, we first estimate the atmospheric light A for the image I. Most algorithms estimate A from the pixels with highest intensities, which is fast but not accurate.

The depth map is calculated based on the image degradation model, for the haze image, we first estimate the initial depth map m(x, y), this process can be written as

$$m(x,y) = 1-\omega_2 \min_{c\epsilon\{R,G,B\}} \left[\min_{(x',y')\epsilon\Omega(x,y)} \frac{I^c_{haze}(x',y')}{A^c} \right] \quad (1)$$

Where I_{haze}^c is a color channel of I_{haze}, $\Omega(x, y)$ is a local patch centered at (x, y), and (x ', y ') is the pixel location that belong to Ω (x, y). ω_2 is a constant parameter for adjusting the amount of haze for distant objects.

It should be noticed that there are obvious block effects and redundant details in the initial depth map. In order to handle these deficiencies, we thus use the guided filter and bilateral filter to refine the initial depth map. The detailed estimation process of the final depth-map is described in the following steps.

Step 1. For the initial depth map, we first compute the linear coefficients a_k and b_k for the guided filter:

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$$a_k = \frac{\frac{1}{|\omega|}\sum_{(x,y)\in\omega_k} I_{haze}(x,y)m(x,y) - u_k m_k}{\sigma_k^2 + \varepsilon}$$

$$b_k = m_k - a_k u_k \qquad \ldots\ldots\ldots\ldots\ (2)$$

Where the guidance image and m is is the input image of the guided filter since the filter is a general linear translation-variant filtering process, which involves a guidance image and an input image. In Eq. (2), $\mathcal{E}$ is a regularization parameter preserving from being too large. & are the mean and variance of in a window that centered at the pixel k. |ω| is the number of pixels in , and is the mean of m in.

Step 2. Once the linear coefficients (a_k, b_k) are obtained, we can compute the filter output by

$$m'(x,y) = a_k m(x,y) + b_k \qquad \ldots\ldots\ldots\ldots\ldots\ (3)$$

Where $a_k = (1/|\omega|)\Sigma_{i\varepsilon\omega_k} a_i$ and $b_k = (1/|\omega|)\Sigma_{i\varepsilon\omega_k} b_i$.m is the initial depth map, and the filter output m' is the refined depth map.

Step 3. A bilateral filter is used here to remove the redundant details for the refined depth map m' since the bilateral filter can smooth images while preserving edges. Thus, the redundant details of the refined depth map m' estimated by the algorithm presented above can be effectively removed. This process can be written as:

$$m(u) = \frac{\Sigma_{p\varepsilon N(u)} W_c(||p-u||W_s(|m'(u)-m'(p)|m'(p)}{\Sigma_{p\varepsilon N(u)} W_c(||p-u||W_s(|m'(u)-m'(p)|)} \qquad ..\ (4)$$

Where m'(u) is the refined depth map corresponding to the pixel u=(x, y), N (u) is the neighbors of u.

The spatial domain similarity function $W_c(x)$ is a Gaussian filter with the standard deviation is σ_c: $W_c(x)$ =, and the intensity similarity function $W_s(x)$ is a Gaussian filter with the standard deviation is σ_s, it can be defined as: $W_s(x)$ =, In our experiments, the value of σ_c and σ_s is set as 3 and 0.4, respectively. Thus, we can obtain the final depth map m(x, y).

3.2. All-metric Projection

In this technique axonometric projection's types are merged and all axonometric projection features works together. So Isometric, Dimetric and Trimetric projections perform together, convert axes of 2D object and provide new axis for conversion of 3D object.

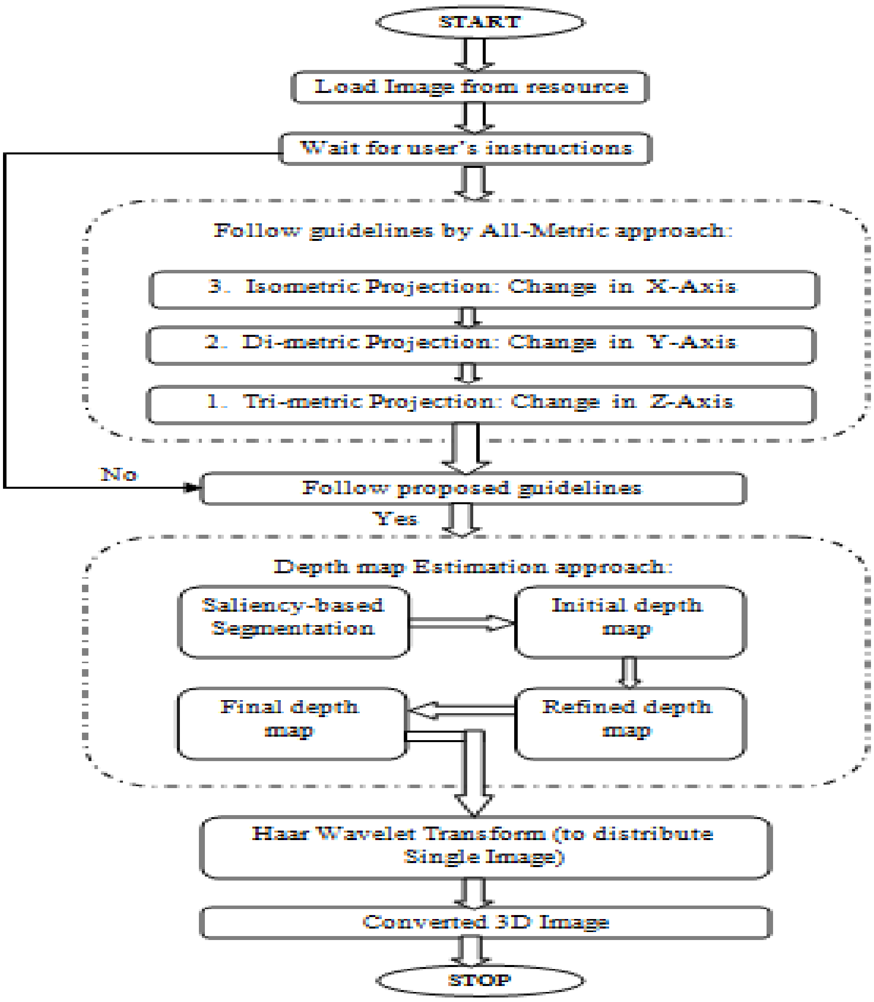

Figure 3: Flow chart for 2D to 3D conversion using proposed methodology

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In proposed technique, we are merging these different projection techniques for 2d to 3D conversion and showing its feature at same time, before in axonometric we have to work individually for all projection techniques. In proposed technique these projection techniques we will use together and it will show a better 3D converted image with our application.

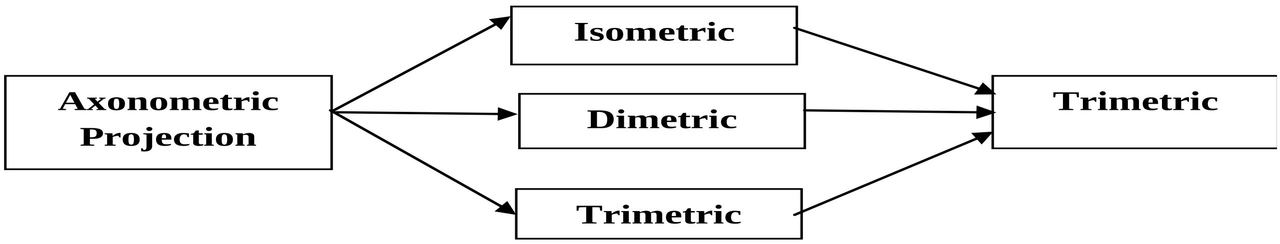

Figure 4: Merging of Axonometric projection for Trimetric.

4. IMPLEMENTATION

For proposed work, we are working on axonometric projection, the methodology of the program is very simple, and there is no complexity. If we want to show it in a flowchart, it'd be something like figure 3. In this methodology we are using Microsoft visual studio .net 2012 toolkit for manufacture a desktop application in 2D to 3D image conversion.

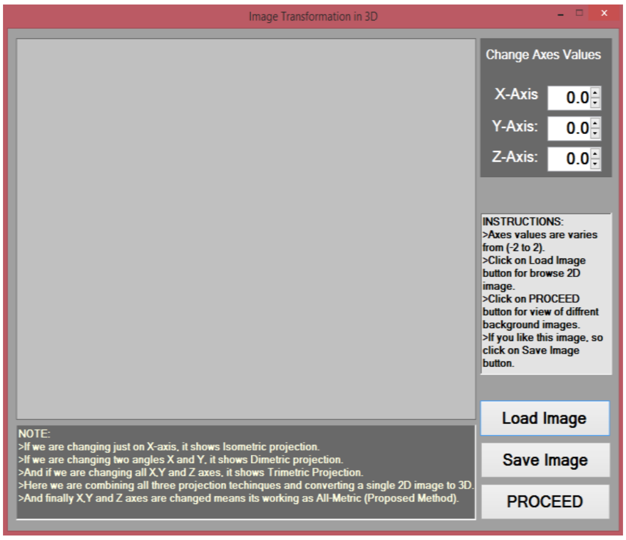

Figure 5: Click on load image

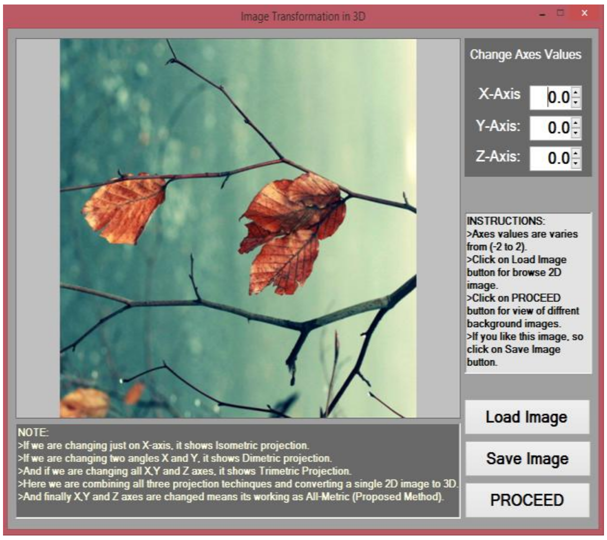

Figure 6: After image loaded change axes and click on PROCEED

Figure 7: 3D and projected view of image, click on PROCEED for view of distribution

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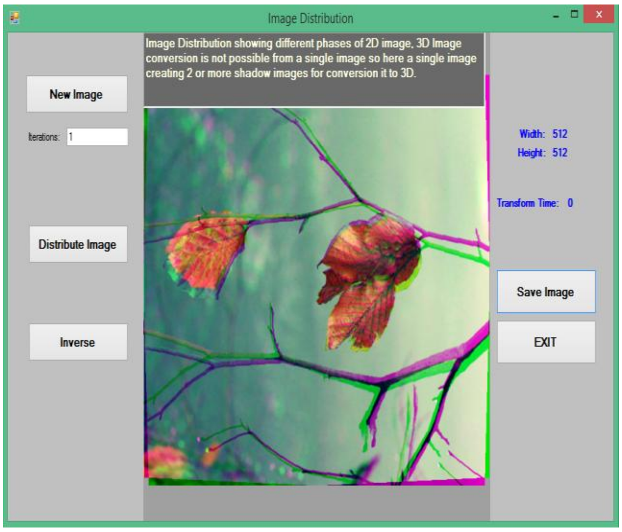

Figure 8: View of image distribution phase

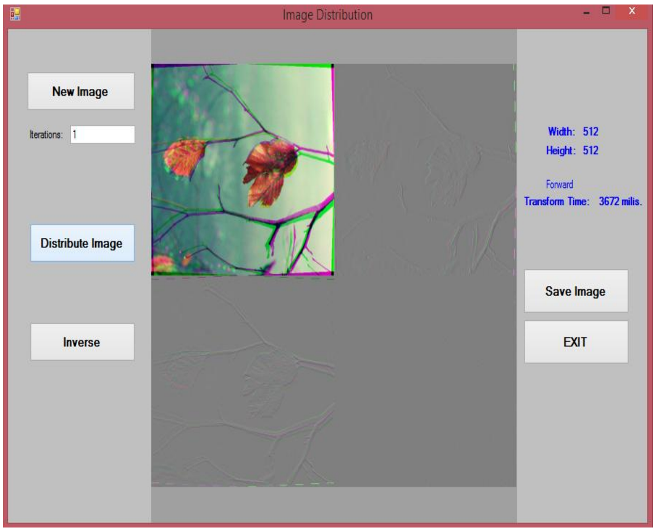

Figure 9:Image distribution and view of other shadow images

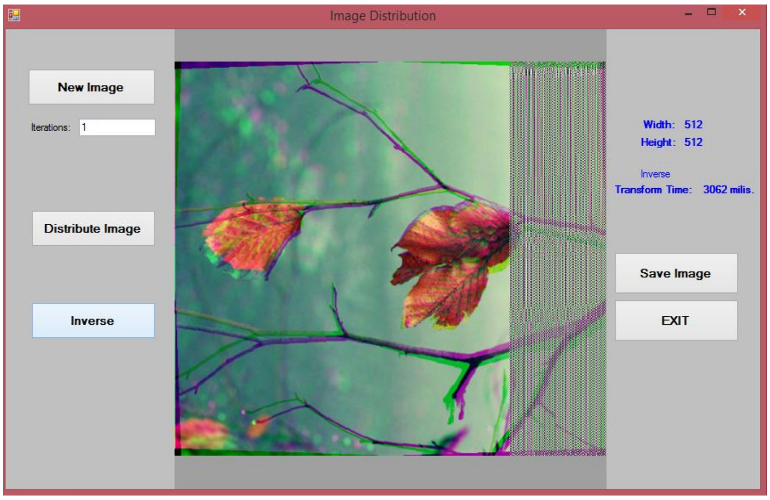

Figure 10: Different depth of a single image

5. RESULT

Figure 11: 2D image

Figure 12: 3D image after proposed methodology

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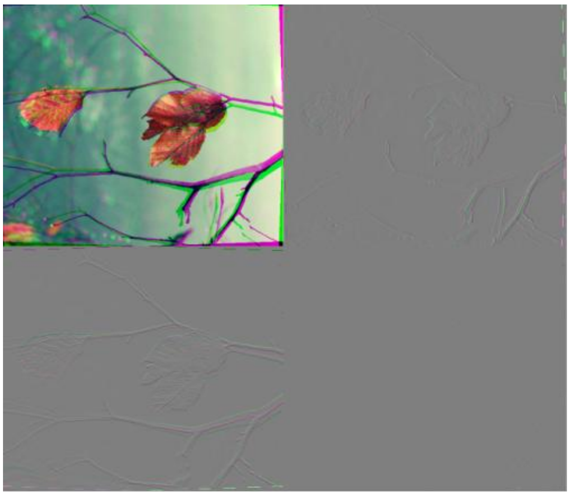

Figure 13: Image distribution by haar-wavelet

Figure 14: Different depth in a single image

6. CONCLUSION

A combination of haar-wavelet, depth-map estimation and trimetric projection is a novel method was proposed to generate a merge of axonometric projection which is a proposed methodology for conversion of 2D to 3D imaging using function of axonometric projection and our desktop application. The projection applies in 2D records for conversion of its axis, later which we have to convert in 3D object. This technique is helpful in 2d to 3D conversion with an improved view and it takes less time for conversion because we are using three different projection techniques together for an exceptional result.

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