ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A Novel Heuristics to Reconstruction of an Object from Multiple Orthogonal Projections

Soumik Maiti[1], Sanchita Ghosh[2]
[1]Department of Computer Application, Calcutta Institute of Technology, Uluberia, Howrah, India
[2]Department of Computer Science and Engineering, Birla Institute of Technology Mesra, Kolkata,India
soumik.maiti@gmail.com, bij_arn@yahoo.com

Abstract

Three directional view of an object often give a pleasure to human eye than the conventional two dimensional (directional) images. Therefore converting images from 2D to three directional are sometimes very much important in certain applications. An orthogonal view of the sides of an object is captured by uncalibrated consumer camera. The sides are then combined to make a perspective projection image so that it is look like a three dimensional object. The approach is applicable for symmetric as well as asymmetric images. In this paper we propose a new technique through which we able make three directional objects.

Keywords: Orthogonal view, Perspective projection, Shearing, Symmetric, Asymetric objects.

Introduction

We use the words three directional and three dimensional for alternative purpose. The three directional object has immense importance in the field of medical imaging, mathematical model formation, pattern formation etc. Various existing methods are there which can used to convert normal two dimensional images to three dimensional images. Stereoscopy is such a technique for creating the illusion of depth by introducing stereopsis. It is the impression of depth that is perceived when an object is viewed by two eyes and normal binocular vision. This image provide spatial information that trick a user's brain into believing and seeing depth in the images. French physicist Louis Ducos du Hauron invented the red-and-blue 3D glasses used to transform 2D images to 3D images in comics, magazines, books, and newspapers in 1891. The Stereoscopic images have been more than 150 years with us. Most popular commercially produced formats have been the stereoscopic post cards, lenticular prints or auto stereograms, luggage tags, greetings cards,3-D movies, and the View-Master reels. These formats are still widely used available formats to understand three dimensional images than 2D images. The toughest problem in 2D to 3D conversion is the depth information which is not present in the single 2D image. Several methods have been proposed to know the depth of the single view image. In [1], Feldman et al. generate the depth map which is made by manual method using some adjusting tools offered in Photoshop. As an automatic estimation method, S. Battiato et al. utilize the color information to estimate the relative depth map in a 2D image [2]. In [3], Jaeseung Koa et al. estimates the depth information of a single-view image based on degree of focus of segmented regions and then generates a stereoscopic image. Modelers can use ortho-images of different sides to make a 3D model by using existing modeling package they are trained in [4]. We are not corporating the depth information here. The image we are going to produce is two dimensional representations that appear as 3D image. No 3D devices, i.e.; glasses, lenses needed to view it.

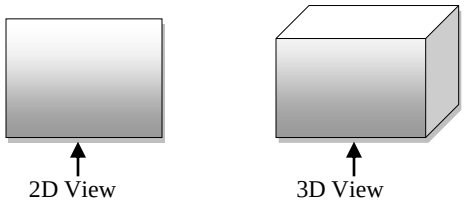


Figure 1. Difference between 2D and 3D image

The above figure explains the absolute differences between two and three directional view of objects in the human eye. The 3D view is basically a 2D representation that makes illusion as 3D. Perspective projection captures a true three-dimensional view onto a two-dimensional plane. It is a form of pictorial drawing that gives the illusion of depth onto a flat

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

surface, very similar to that of viewing of the object through the human eye.

Symmetry and Asymmetry

Symmetry is when one shape becomes exactly like another if we flip, slide or turn it. The simplest type of symmetry is reflection. Symmetry has two meanings. The first is a vague sense of harmonious and beautiful proportion and balance. The second is an exact mathematical "patterned self-similarity" that can be demonstrated with the rules of a formal system, such as geometry or physics. Although these two meanings of "symmetry" can sometimes be told apart, they are related, so they are here discussed together. Asymmetry is the absence of, or a violation of, symmetry. Symmetry is an important property of both physical and abstract systems and it may be displayed in precise terms or in more aesthetic terms. The absence of violation of symmetry that are either expected or desired can have important consequences for a system.

Problem Definition

Our approach is to obtain a 3D impression of an image from multiple sides' views of a 2D image. We have taken view of different orthogonal projection of an image of symmetric objects including top portion (a box). Then we create a perspective view of the image by combining two sides and top. We have applied horizontal and vertical shearing [5] to achieve this. The same thing is applied also for the asymmetric object (a cup) also.

Proposed Algorithm

The following algorithm is for symmetric object.

Taking images of five sides SideA, SideB, SideC, SideD and top of the box object.

STEP 1: Take an orthogonal view picture of top side from the object.
STEP 2: RESIZE top to width and height.
STEP 3: ROTATE top by specified angle; i.e.; any angle θ depending on the view wanted.
STEP 4: Convert top to gray.
STEP 5: Horizontally shear to fit with specified angle.
[Sh_x determines amount of shearing]

X-direction shear matrix

$$\begin{pmatrix} 1 & 0 & 0 \\ Shx & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

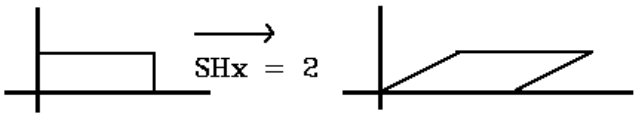


Figure 2. X direction shear

STEP 6: Take an orthogonal view picture of sideA from the object.
STEP 7: RESIZE sideA to width and height.
STEP 8: Convert sideA to gray.
STEP 9: I1 ← Vertically concatenate top with sideA.

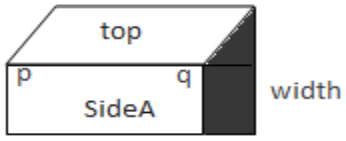


Figure 3. Merging top with sideA and padding zeros

STEP 10: Resize SideA and pad (from point q up to width) to zeros.
STEP 11: Take an orthogonal view picture of sideB from the object.
STEP 12: RESIZE sideB to width and height.
STEP 13: Convert sideB to gray.
STEP 14: Vertically shear to fit with specified angle.
Y-direction shear matrix

$$\begin{pmatrix} 1 & Shy & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

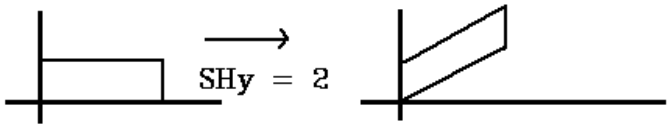


Figure 4. Y direction shear

STEP 15: Horizontally concatenate I1 with SideB.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Figure 5. Shape with the black portion

STEP 16: Removal of black portion to come up with the final shape.

Figure 6. The final shape

And the following algorithm is for asymmetric object. By taking two sides, top and one view of the side of cup with handle we developed it.
STEP 1: Take an orthogonal view picture of top side from the object.
STEP 2: Convert top to gray.
STEP 3: Determine width and height of top.
STEP 4: Scale top to x and y direction using scaling factors up to width and height.
STEP 5: Perform AVERAGE filter on top to smooth glossy effects.
STEP 6: Take an orthogonal view picture of a side from the object.
STEP 7: Convert side to gray.
STEP 8: Vertically concatenate side and top.
STEP 9: Smooth the joined portion.

Results and discussion

Lets take the symmetric object. Taken images of four sides of square shaped box including top portion. Then formed a three directional shaped image by combining two sides and top.Applied horizontal and vertical shearing to achieve this. It is needed total four images to show every sides while combining two sides with top portion. It needs to maintain approximately same distance while taking the images in camera.
The following are the five sides of the box-

(a)Frontal view(Side A)

(b)Right side view(Side B)

(c)Back view (Side C)

(d) Left view (Side D)

(e)Top view

Figure. 7. (a)(b)(c)(d)(e)All the sides of the box

The images are converted into grayscale after reading them. Then combined Side A with top.

Figure.8. Side A with Top

But to give a meaning to the image it is necessary to pad black area to the above figure. That means side A will needs to be shrinked where the bottom right corner of the top portion ends.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Figure. 9. Merged shape with the padded region

After that Side B is sheared vertically and attached to the previous image.

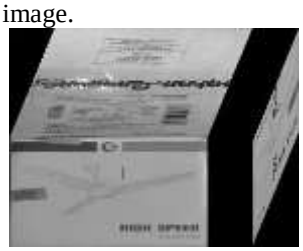


Figure. 10. Shape with side B

Then all pixel information (intensity values) of Side B are copied and merged programmatically with the joined picture.

Figure. 11. The final shape

After completing this procedure repeat all the necessary steps to get other three views of the box.

(a)Second view (b)Third view (c) Fourth view

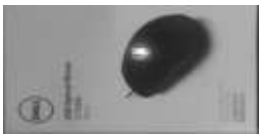
Figure. 12. (a)(b)(c)All possible views

All these views need to be displayed one by one after providing a milliseconds gap. And the whole thing will make illusion of the box object.

Taking other symmetric objects like a mouse cover and a book we do the same thing:

By taking three sides of a mouse cover we are making the final shape. Here from three sides we get one goal shape.

(a)Front view



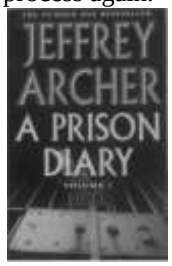
(b)Top view

(c)Left view

(d)Final shape

Figure. 13. (a)(b)(c)Ortho-images(d)final shape

Now by taking different sides of a book we run the process again.



(a)Top view

(b)The lengthy side view (right side)

(c)The short view (front side)

(d)The short view (back side)

(e)The lengthy side view (left side)

(f)First view

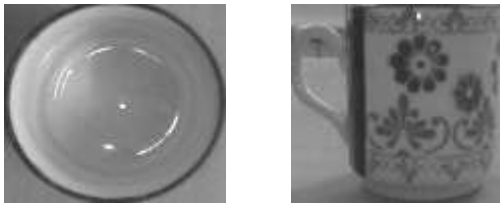
(g)Second view

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

(h) Third view *(i) Fourth view*

Figure. 14.(a)(b)(c)(d)(e)Orthogonal views (f)(g)(h)(i)Final shape

Then by considering the asymmetric object (a cup) doing the following tasks-
Taken two views of the cup namely the top portion and one side including the handle of the cup. Applied scaling on the top portion to give it to the elliptical shape. And the vertically concatenate the side with the elliptical shape we get the final result. The images are as follows-



(a) Top view *(b) Side view*

Figure. 15. (a)(b) Two sides of a cup

Let S_x,S_y be the scale[6] in the positive **x** and **y** directions respectively. Then the scaled vertex is given by x'=x. S_x and y'=y.S_y. If S_x=S_y=S, then it is said to be *homogenous* or *uniform* scaling transformation that mainatains relative propoortions of the scaled objects. The magnification factor is **|s|**. All points move **s** times away from the origin. If **|s| < 1**, all the points move towards the origin, or demagnified.

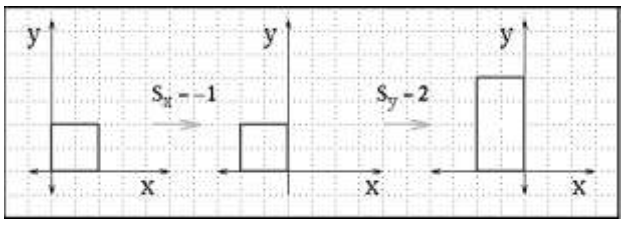


Figure. 16. Scaling in x and y direction

After converting the top portion to gray we performed the scaling operation to bring an elliptical shape.

Figure. 17. The scaled view with top

The top has the glittering effect while taking on camera. To smooth the glossy effect the Average filter is applied. Then the side is converted to gray and resized it. As the top portion is smaller in size in comparison with the side, zero padded portion is added to it. It is necessary to concatenate with the side.

Figure. 18. Scaled top with padding

Then this padded top portion is vertically concatenated with the side to get the shape of cup.

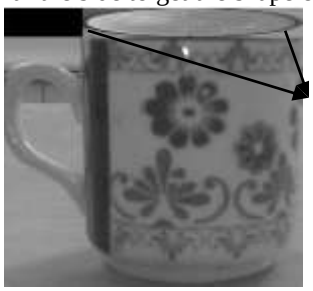


Figure. 19. Merged shape with unwanted region

From the above figure we see that some unwanted portions are present after joining. This comes from the original view of the top side. So to remove it smoothing is necessary.

Figure.20. Figure after smoothing

We can get the other side view where the cups handle will present in the right side.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Figure. 21. Another view

Treating another example and rerunning the algorithm for asymmetric object again on another cup:

Figure. 22. Orthogonal views of sides with scaled top

Figure. 23. Final shape

Conclusion

In this work we have proposed an easy and fast method to generate a perspective projection image from a group of orthogonal image. This process contains some basic image processing and computer graphics approach to generate the perspective projection of wide variety of images. It can generate all of one point, two point and three point perspective projections. This yield an illusion of depth in the two dimensional image and gives it a look of three dimensional images which is more understandable to us.

Acknowledgements

We would like to express our sincere gratitude to our institutions where from we belong. Secondly we would also like to thank our family who helped us a lot in finalizing this work within the limited time frame.

References

[1] M. H. Feldman and L. Lipton, "Interactive 2D to 3D Stereoscopic Image Synthesis", in Proc. of the SPIE, Vol. 5664, pp. 186-197 (2005).

[2] Battiato, S.; Capra, A.; Curti, S.; and La Cascia, M, "3D Stereoscopic Image Pairs by Depth-Map Generation", in Proc. of 2nd International Symposium on 3D Data Processing Visualization and Transmission, 3DPVT (2004).

[3] Jaeseung Koa;Manbae Kimb and Changick Kim; Munji-dong; Yuseong-gu, "2D-To-3D Stereoscopic Conversion: Depth-Map Estimation in a 2D Single-View Image".

[4] Thorsten Thormahlen, Hans-Peter Seidel, "3D-Modeling by Ortho-Image Generation from Image Sequences.", ACM Transactions on Graphics (TOG) - Proceedings of ACM SIGGRAPH 2008, Volume 27 Issue 3, Article No.: 86, August 2008

[5] Donald Hearn, M. Pauline Baker; Computer Graphics, 2nd Edition, Prentice Hall of India, 2002

[6]http://cs.fit.edu/~wds/classes/cse5255/thesis/scale/scale.html

Author Biblography

He works as Assistant Professor in Calcutta Institute of Technology, Uluberia, Howrah.

She works as Assistant professor in BIT Mesra, Kolkata Campus.