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Three Dimensional Rotation Technique

HamzaContractor , ShoaibInamdar, RohitKandul, Anand Magar

***Abstract*—A rotation is a rigid body movement which, unlike a translation, keeps a point fixed. In 3D computer graphics, 3D modeling is the process of developing a mathematical representation of any three-dimensional surface of object (either inanimate or living) via specialized software. This definition applies to rotations within both two and three dimensions. Three dimensional rotation techniques, name itself gives idea of rotation of object through the center axis. This paper gives the new idea for three dimensional rotation of object through center axis by converting it to two dimensional. First the three dimensional object is converted to all the six views i.e. front view, top view, side views, etc. and rotated individually and then combining all the view to three dimensional.**

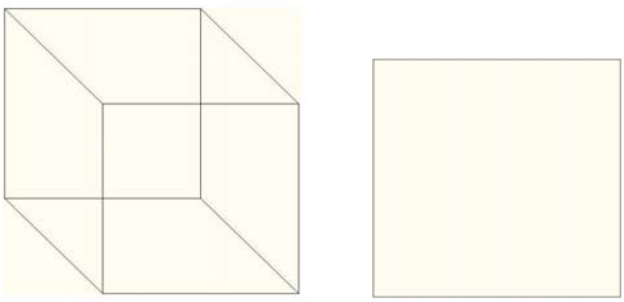
***Index Terms*—Three Dimensional; 3D; object rotation.**

I. Introduction

As the rotation of two dimensional objects is easy, so we convert the three dimensional object to two dimensional and rotate each six two dimensional object by the rotation of degree required and merge all the views to make it one three dimensional object which is been rotated by the required degree. This method is easy for the rotation of the plane objects like cube, cuboid, circle, etc. and for the rotation of the curved and flexible objects method called NURBS (Non-uniform rational basis spline),is a mathematical model commonly used in computer graphics for generating and representing curves and surfaces which offers great flexibility and precision for handling both analytic (surfaces defined by common mathematical formulae) and modeled shapes.

Let us take an example to understand this technique. First of all consider one cube which is three dimensional. Now this cube will have at least three views possible from the present vision. Now rotate all the three views to required degree. This will give us the new three views which are rotated from the previous threeviews. Now we prepare the three dimensional object from the new three views available by rotation and the required object is rotated in required fashion.

Now we will understand this by the diagrams. The below shown diagram is of three dimensional cuboid the six possible view of this diagram are top view, front view, side view etc. this can be show as a plane square as shown below.



II. Procedure

A. Three dimensional modeling

3D models represent a 3D object using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. Being a collection of data (points and other information), 3D models can be created by hand, algorithmically (procedural modeling), or scanned.

3D models are widely used anywhere in 3D graphics. Actually, their use predates the widespread use of 3D graphics on personal computers. Many computer games used pre-rendered images of 3D models as sprites before computers could render them in real-time.

Today, 3D models are used in a wide variety of fields. The medical industry uses detailed models of organs. The movie industry uses them as characters and objects for animated and real-life motion pictures. The video game industry uses them as assets for computer and video games. The science sector uses them as highly detailed models of chemical compounds. The architecture industry uses them to demonstrate proposed buildings and landscapes through Software Architectural Models. The engineering community uses them as designs of new devices, vehicles and structures as well as a host of other uses. In recent decades the earth science community has started to construct 3D geological models as a standard practice.

B. Converting to two dimensional

Now the first thing is to convert the three dimensional object to two dimensional views i.e. orthographic projection. Now these projections are in two dimensional planes.

C. Rotation of planes

Now the most important part is the rotation of plane. These planes are now rotated by the angle of degree required. But the main point to be remembered is to the axis of rotation. The axis of rotation of the plane is not inside the plane but it is outside the plane i.e. the rotation of the two dimensional plane will make the plane and figure three dimensional. The main care to be taken is the axis of rotation. This three dimensional rotated figure is converted to two dimensional photographic image which will be the new orthographic view for the rotated image. This process is similar to three dimensional rendering. By the technique of rotation invariant the planes are rotated.

D. Rotation invariant technique

Micro lens array is composed of a series of periodic self-focusing lens. Every lens projects a different angleθ to the 3-D object, so every lens can provide a different perspective of 3-D object, related withθ, and all perspective are synthesized the perspective array. Each perspective contains the different informant of 3-D object, such as the depth r , so the depth information of 3-D object is converted into the angular information of the 2-D perspective array, namely, $r - \theta$ conversion.

Every micro lens projects perspectives of the 3-D object from different angles α_n, where subscript n denotes the different micro lens. Lens n subtends an angle α_n
α_n' is given by

$$\tan \alpha_n = \frac{nD}{a} \tan \alpha_n' = \frac{nD}{a+dz} \quad (1)$$

Because of, $dz << a$, so
$\tan \alpha_n \approx \alpha_n$ $\quad$ $\tan \alpha_n' \approx \alpha_n'$,

We obtain the following results,

$$d\alpha_n = \alpha_n - \alpha n' = \frac{nD}{a} - \frac{nD}{a+dz} \approx n\frac{D}{a^2}dz \quad (2)$$

We can find that $d\alpha_n$ only depend on both the depth dzofthe 3-D object and the position of the micro lens$n$ in the array.This means that the conversion has been accomplished. The intention of seeking SDF is to find a filter function whocan obtain the same result when aberrational objects areinputted, such as rotation, translation. Firstly, a series ofperspective images of 3-D aberrational object who havedifferent parameter is employed to make a training set, and thelinear integrated is carried on to obtain a filter function. Andthen, the recognition of perspective images of 3-D aberrationalobjects in the training set is performed by using the filterfunction.Filter function h is the linear integrated of the training set$\{f_n\}$,$h$is given by

$$h = \sum_{m=1}^{N} a_m f_m \quad (3)$$

Where a is the weight factor.
The value of correlation peak is certain, which is obtainedby h and either image in$\{f_n\}$, we assumed 1.

$$f_n \otimes h = 1 \quad (4)$$

Because we only want to the value of correlation peak, butnot the spatial relationship of$f_n$and h, so equation (4) iswritten as

$$f_n \otimes h = f_n h = f_n \sum_{m=1}^{N} a_m f_m = \sum_{m=1}^{N} a_m r_{nm} = 1 \quad (5)$$

Where $r_{nm} = f_n f_m$is denotes the element in R, R is theintersecting matrix of $\{f_n\}$.
Equation (5) is given by matrix form

$$Ra = (1,1,\cdots,1)^T = \mu \quad (6)$$

Whereμ denotes the unit vector
Left multiplication is carried on the Equation (6)

$$a = R^{-1}\mu \quad (7)$$

Where R^{-1} denotes the inverse matrix of R
We can obtain the filter function h after get R^{-1}.

E. Converting back to isometric view (Three Dimensional)

Now the views obtain from the Rotation invariant technique are collected to form the three dimensional Diagram (Isometric view). This will give us the required rotated diagram in three dimensional.

III. CONCLUSION

Thus, this is the technique to rotate the three dimensional object graphically by converting the isometric view to orthographic projection and for curved surfaces we used NURBS and using the mathematical calculation from the IEEE paper "Three-dimensional object rotation-invariant recognition with Synthetic Discriminant Function" and converting the rotated orthographic projection back to isometric projection.

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AUTHORS

Hamza Contractor. The author Hamza is a final year engineering student from Information Technology field. He is from Pune and date of birth is 3rd January 1990.Education background is BEIT from sinhgad Academy of engineering, Pune university, pune, Maharashtra, India.

ShoaibInamdar. The author Shoaib is a final year engineering student from Information Technology field.He am from Pune and date of birth is 10th march 1990.Education background is BEIT from sinhgad Academy of engineering, Pune H, pune, Maharashtra, India.

RohitKandul. The author Rohit is a final year engineering student from Information Technology field.He am from Pune and date of birth is 17thnovember 1990.Education background is BEIT from sinhgad Academy of engineering, Pune university, pune, Maharashtra, India.

Prof A.M.Magar. The author A. Magar is a senior professor in Sinhgad Academy of engineering, Pune university, pune, Maharashtra, India.