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**A Report
On
3D DARTS**

Submitted To:
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We must acknowledge Mr. Donald Hearn & Mr. M. Pauline Baker for their book "COMPUTER GRAPHICS" which has been the most helpful for our project.

Lastly, we thank you all friends and teachers.

ABSTRACT

Darts is a form of throwing sport where the narrow pointed missiles are thrown at a circular target hung on a wall. The pointed pins are called darts and the circular target board is called dart board. Player is provided with a set dart and is targeted at dartboard. Each of the circular regions on the dartboard has its own score. The score is calculated for the player on the basis of the targeted point on the board.

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INTRODUCTION:

Anything we see through our eyes is 3D object. In contrast, anything represented on papers, pictures and monitors is a 2D drawing. A 3D object can be picturized on such 2D media upon mathematical transformations, which is, practically, perspective or parallel projection of a kind.

Our graphics project title is "Darts". Here, we perform transformation of simple 3D-object in three dimensions.

OBJECTIVES:

On the completion of this project, we have been able to-

- i) Increase our knowledge in 2D & 3D computer graphics.
- ii) Understand the each and every motion of simple 3D object.
- iii) Implementation of Computer Graphics to model real world objects.

METHODOLOGY AND ALGORITHMS

Modeling Co-ordinates:

The simple 3D object we used here are cuboid, pyramid and triangles. So, they are drawn with the help of different algorithms. The information about them is stored in vertex table and surface table for further processing.

Transformation to world Co-ordinates:

After modeling the object, the object was transformed to the exact location in the world co-ordinate system.

3-D transformation:

We have used the mathematics to translate and rotate the object according to the requirement as follows:

$$\text{Translation:}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & tx \\ 0 & 1 & 0 & ty \\ 0 & 0 & 1 & tz \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$\text{Z axis rotation:}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$\text{X axis rotation:}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$\text{Y axis rotation:}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

2-D Viewing:

If (x, y, z) be world co-ordinate and (u, v, n) be the viewing co-ordinates, then a point in world co-ordinate is transformed to viewing co-ordinate by using the following matrix relation:

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} u1 & u2 & u3 & 0 \\ v1 & v2 & v3 & 0 \\ n1 & n2 & n3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$n = N / |N| = (n1, n2, n3)$$

$$u = V \times N / |V \times N| = (u1, u2, u3)$$

$$v = n \times u = (v1, v2, v3)$$

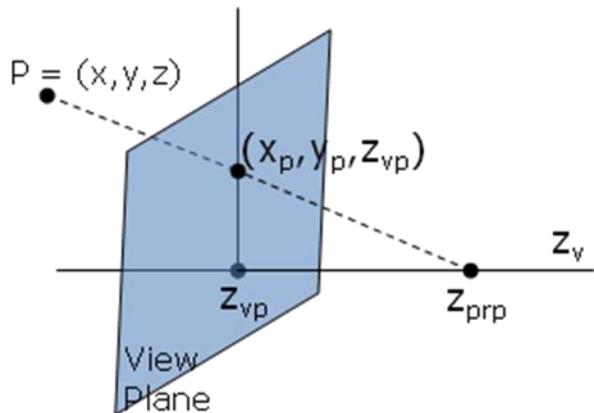
where, N= View plane normal vector

V= View up vector

U= vector perpendicular to both N and V

Projection:

We have used the perspective projection method to give our model a realistic 3-D view.



$$x_p = x \left(\frac{z_{prp} - z_{vp}}{z_{prp} - z} \right) = x \left(\frac{d_p}{z_{prp} - z} \right)$$
$$y_p = y \left(\frac{z_{prp} - z_{vp}}{z_{prp} - z} \right) = y \left(\frac{d_p}{z_{prp} - z} \right)$$

Visible surface detection:

We have used the simple and commonly used method for the detection of visible surfaces i.e. back face detection method. If N is the normal vector to the surface such that $N = (A, B, C)$ where A, B and C are the coefficients of the equation of the plane. Then for hidden surface, $C \leq 0$. Else, it is a visible surface.

We might further use the Z-Buffer algorithm to draw the visible surface.

Surface rendering

Constant Intensity Shading or flat shading was used to simulate 3D illumination and ambient lighting effect. It is a simple and fast method for rendering.

Program Flow Diagram

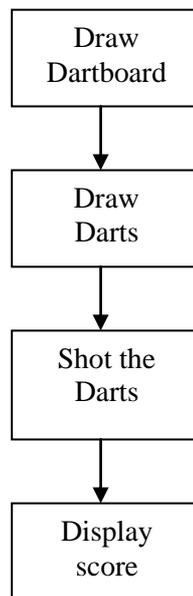


Fig: Program Flow Diagram

The geometric components used in developing the game include cube, pyramid, plane and so on.

All the team members had extensively used Visual C++ as a programming language. The tasks were divided among several members of the team on the basis of their interest and continuous meetings and discussions were held at the time of working on their respective tasks so as to maintain proper coordination.

USER INTERACTIVITY:

We have tried to make our model user interactive. We have included keyboard as our only medium of user interactivity. The various keys which might be used for user interactivity will be arrow keys.

OUTCOME:

After the completion of the project, we have created a simple dart game in 3D view with the implementation of our knowledge of computer graphics.

LIMITATIONS

- We applied back-face detection due to time limitation.

FUTURE ENHANCEMENTS

- Use of fast phong shading method for appropriate rendering and shading
- Use of advanced tools and techniques to develop a realistic 3D game.

CONCLUSION:

With the help of discussions with friends and seniors we have concluded our graphics project on "3-D Dart game". This project was very helpful for us to become familiar with the series of steps used to model a real world object in a 2-D computer screen. This project was very much helpful for us to gain the core knowledge of graphics and we might use these concepts in the various fields in future.

REFERENCES

1. Computer Graphics C Version by Donald Hearn and M. Pauline Baker
2. Computer Graphics Principles and Practices by Foley, Von Dam, Feiner and Hughes