

EXERCISE - 4

AIM : To implement 3D transformation operations (translation, scaling, and rotation) on an object and display the transformed object using graphical techniques.

PROCEDURE:

1. Input:

- o The 3D coordinates of the object.
- o Transformation parameters (e.g., translation distances, scaling factors, or rotation angles).

2. Apply Transformation Matrix:

- o For each transformation, multiply the object's 3D coordinates with the appropriate transformation matrix:

- Translation matrix:

$$\begin{bmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- Scaling matrix:

$$\begin{bmatrix} s_x & 0 & 0 & 0 \\ 0 & s_y & 0 & 0 \\ 0 & 0 & s_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- Rotation matrices (e.g., rotation about the z-axis):

$$\begin{bmatrix} \cos \theta & -\sin \theta & 0 & 0 \\ \sin \theta & \cos \theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

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3 Transform the Object:

- Multiply the transformation matrix with each point of the object to compute the transformed coordinates.

4 Output:

- Display the original and transformed object using a graphical interface.

SAMPLE CODE:

3D Translation:

```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>
int maxx,maxy,midx,midy;
void axis()
{
    getch();
    cleardevice();
    line(midx,0,midx,maxy);
    line(0,midy,maxx,midy);
}
void main()
{
    int x,y,z,o,x1,x2,y1,y2;
    int gd=DETECT,gm;
    detectgraph(&gd,&gm);
    initgraph(&gd,&gm,"c:\\tc\\bgi");
    //setfillstyle(0,getmaxcolor());
    maxx=getmaxx();
    maxy=getmaxy();
    midx=maxx/2;
    midy=maxy/2;

    axis();

    bar3d(midx+50,midy-100,midx+60,midy-90,10,1);

    printf("Enter translation factor");
    scanf("%d%d",&x,&y);
    //axis();
    printf("After translation:");
    bar3d(midx+x+50,midy-(y+100),midx+x+60,midy-(y+90),10,1);
    getch();
    closegraph();
}
```

3D Scaling:

```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>
int maxx,maxy,midx,midy;
void axis()
{
    getch();
    cleardevice();
    line(midx,0,midx,maxy);
    line(0,midy,maxx,midy);
}
void main()
{
    int x,y,z,o,x1,x2,y1,y2;
    int gd=DETECT,gm;
    detectgraph(&gd,&gm);
    initgraph(&gd,&gm,"c:\\tc\\bgi");
    //setfillstyle(0,getmaxcolor());
    maxx=getmaxx();
    maxy=getmaxy();
    midx=maxx/2;
    midy=maxy/2;

    axis();

    bar3d(midx+50,midy-100,midx+60,midy-90,5,1);
    printf("Enter scaling factors");
    scanf("%d%d%d", &x,&y,&z);
    //axis();
    printf("After scaling");
    bar3d(midx+(x*50),midy-(y*100),midx+(x*60),midy-(y*90),5*z,1);
    //axis();
    getch();
    closegraph();
}
```

3D Rotation:

```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>
int maxx,maxy,midx,midy;
void axis()
{
    getch();
    cleardevice();
    line(midx,0,midx,maxy);
    line(0,midy,maxx,midy);
}
void main()
{
    int x,y,z,o,x1,x2,y1,y2;
    int gd=DETECT,gm;
    detectgraph(&gd,&gm);
    initgraph(&gd,&gm,"c:\\tc\\bgi");
    //setfillstyle(0,getmaxcolor());
    maxx=getmaxx();
    maxy=getmaxy();
    midx=maxx/2;
    midy=maxy/2;
    axis();
    bar3d(midx+50,midy-100,midx+60,midy-90,5,1);
    printf("Enter rotating angle");
    scanf("%d",&o);
    x1=50*cos(o*3.14/180)-100*sin(o*3.14/180);
    y1=50*sin(o*3.14/180)+100*cos(o*3.14/180);
    x2=60*cos(o*3.14/180)-90*sin(o*3.14/180);
    y2=60*sin(o*3.14/180)+90*cos(o*3.14/180);
    axis();
    printf("After rotation about z axis");
    bar3d(midx+x1,midy-y1,midx+x2,midy-y2,5,1);
    axis();
    printf("After rotation about x axis");
    bar3d(midx+50,midy-x1,midx+60,midy-x2,5,1);
    axis();
    printf("After rotation about yaxis");
    bar3d(midx+x1,midy-100,midx+x2,midy-90,5,1);
    getch();
    closegraph();
}
```