☺3-D Flowing Fountain ☺

Made by:-

Arunim Chakraborty 07 ***Atharva Khangar 26***

Kshitij Shidore 51 ***Rupesh Dhirwani 10***

A computer Graphics MINI-PROJECT.

Table of contents.

INTRODUCTION

The "FLOWING FOUNTAIN MODEL". It depicts a 3 Dimensional model of a fountain

through which water is continuously flowing out in its idle state. The water gets stored into a small

reservoir. The water flows out through different levels in the fountain, giving it a realistic look.

User can specify these levels as three, four or five at the beginning.

The program starts with a menu on the screen giving you the options as mention below:

1. Proceed.

2. Help.

3. Exit.

The user is provided with an option to change the colour of the fountain using the RIGHT

MOUSE BUTTON. The user can view the fountain from different angles including a Top-view

and can also zoom in or zoom out. This can be controlled using a set of specified keys on

keyboard such as ‘N’ and ‘A’ for ZOOM IN and ZOOM OUT, buttons ‘T’ and ‘F’ for TOP and

FRONT VIEW etc. Clicking on the RIGHT MOUSE BUTTON shows a sub menu -'Help' which

displays the keyboard shortcuts for various controls. The third option ‘Exit’ pops out of the

program.

The project is based on Simple window coordinates and using recursive techniques in OpenGL.

REQUIREMENT ANALYSIS

2.1 Hardware requirements:

1. i3 or higher processor.

2. 1GB or more RAM.

3. A standard keyboard, and Microsoft compatible mouse

3. Full HD\Standard monitor.

3. If the user wants to save the Created files a secondary storage medium can be

Used.

2.2 Software requirements:

1. The graphics package has been designed for OpenGL; hence the machine must

have Eclipse/Visual Studio Community Edition 2019 or later.

2. Software installed preferably 6.0 or later versions with mouse driver installed.

3. Turbo c Libraries are used and hence a TC version 3 or later is required.

2.3 Development platform:

Windows 10 & Windows 11.

IMPLEMENTATION

Movement of a drop:

The movement of a drop contains two factors.

The direction, how the drop gets out of the fountain and the gravity. The position of a drop is

pretty easy to compute if we know, how much time has passed since the drop has leaved the

fountain.

We have to multiplicate the vector of the constant moving (how the drop leaves the fountain)

with the time and then subtract the squared time multiplicated with an acceleration factor. This

acceleration factor contains the weight of a drop and the power of gravity. We now have to know

the direction, how the drop comes out of the fountain, but this is just a bit calculating with sine

and cosine.

Blending means that a pixel on the screen isn't replaced by another one, but they are "mixed".

Therefore you can use the alpha value of colors, it indicates how much of the color of the

consisting pixel is used for the new color - for antialiasing of points, OpenGL computes this alpha

value.

After calling glEnable(GL_BLEND); you have to tell OpenGL how to use the alpha values. It

isn't specified, that a higher alpha-value means more transparency or something like that. You can

use them as you want. To tell OpenGL _what_ you want, you must use glBlendFunc(). It takes

two parameters, one for the source factor and the second for the destination factor. I used

GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA as parameters. This is quite an often used

combination and affects, that the higher the alpha value, the less transparency of the incoming

fragment

Step 1: [To create a fountain]

Declare a class called CDrop.

In GetNewPosition (), we calculate the position and delay of each drop with respect to the co□ordinate axes.

Step 2: [function createlist ()]

Dynamically allocate memory for the required vertices.

Function glGenLists used to generate a contiguous set of empty display lists.

Then specify a series of ‘for ‘loops to construct the top and bottom of the stone.

Then create a qaudrilateral to represent the ground.

To create water, use the following functions:

GlTranslatef () – is to calculate water and stone height.

rand () function is used to generate random unique numbers, for each time it is executed.

Step 3: [function InitFountain ()]

Create fountain drops and vertices. Declare StepAngle, the angle which the ray gets out of the

fountain and RayAngle, the angle you see when you look down on the fountain. Use sine () and

cosine () functions inside for loops, to calculate the speed of each step in the fountain, how many

steps are required, that a drop comes out and falls down again.

Step 4: [Displaying]

[Keyboard function]

Manages operations by various keys pressed on the key board

[Display function]

Renders the program on to the screen.

Uses the following functions:

GlClear (GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)- Indicates the buffers

currently enabled for color writing and also indicates the depth buffer.

GlPushMatrix (), glPopMatrix () — to push and pop the current matrix stack.

DrawTextXY () — used to set the text of the program.

glFlush () — force execution of GL commands in finite time.

GlutSwapBuffers ()-Swap the buffers ->make the result of rendering visible.

[reshape function]

glMatrixMode (GL_PROJECTION) -applies subsequent matrix operations to the projection

matrix stack.

glMatrix

Flowing Fountain

Mode (GL_MODELVIEW)-applies subsequent matrix operations to the model view matrix

stack.

We adjust the viewing volume. We use the whole window for rendering and adjust point size to

window size.

Step 5: [main function]

Here we specify the initial display mode, window size and position. Create a new window

where the output is rendered. Create menus to move near, move away, move down, move up and

sub-menus for color, flow, level, and help.

Project PICTURES/SNAP SHOTS

Project code:-

```
#include <GL/glut.h>

#include <stdlib.h>

#include <math.h>

#include <stdio.h>

#include <string.h>

#include <iostream>

#define PI 3.14152653597689786

#define RandomFactor 2.0

#define ESCAPE 27

#define TEXTID 3

unsigned int i;

int flag=0,f=2;

int vflag=0;

GLfloat xt=0.0,yt=0.0,zt=0.0;

GLfloat xangle=0.0,yangle=0.0,zangle=0.0;

GLfloat X[3];
```

```
GLint ListNum;
GLfloat OuterRadius = 2.4;
GLfloat InnerRadius = 2.0;
GLint NumOfVerticesStone = 6;
GLfloat StoneHeight = 0.5;
GLfloat WaterHeight = 0.45;
struct SVertex
{
GLfloat x,y,z;
};
class CDrop
{
private:
GLfloat time;
SVertex ConstantSpeed;
GLfloat AccFactor;
public:
void SetConstantSpeed (SVertex NewSpeed);
void SetAccFactor(GLfloat NewAccFactor);
void SetTime(GLfloat NewTime);
void GetNewPosition(SVertex * PositionVertex);
};
```

```
void CDrop::SetConstantSpeed(SVertex NewSpeed)
{
ConstantSpeed = NewSpeed;
}
void CDrop::SetAccFactor (GLfloat NewAccFactor)
{
AccFactor = NewAccFactor;
}
void CDrop::SetTime(GLfloat NewTime)
{
time = NewTime;
}
void CDrop::GetNewPosition(SVertex * PositionVertex)
{
SVertex Position;
time += 0.15;
Position.x = ConstantSpeed.x * time;
Position.y = ConstantSpeed.y * time - AccFactor * time *time;
Position.z = ConstantSpeed.z * time;
PositionVertex->x = Position.x;
PositionVertex->y = Position.y + WaterHeight;
PositionVertex->z = Position.z;
```

```
if (Position.y < 0.0)
{
time = time - int(time);
if (time > 0.0) time -= 1.0;
}
}
CDrop * FountainDrops;
```



```
SVertex * FountainVertices;
GLint Steps = 4;
GLint RaysPerStep =8;
GLint DropsPerRay = 80;
GLfloat DropsComplete = Steps * RaysPerStep * DropsPerRay;
GLfloat AngleOfDeepestStep = 80;
GLfloat AccFactor = 0.011;
void CreateList(void)
{
SVertex * Vertices = new SVertex[NumOfVerticesStone*3];
ListNum = glGenLists(1);
for (GLint i = 0; i<NumOfVerticesStone; i++)
{
```

```
Vertices[i].x = cos(2.0 * PI / NumOfVerticesStone * i) * OuterRadius;
Vertices[i].y = StoneHeight;
Vertices[i].z = sin(2.0 * PI / NumOfVerticesStone * i) * OuterRadius;
}
for (i = 0; i<NumOfVerticesStone; i++)
{
Vertices[i + NumOfVerticesStone*1].x = cos(2.0 * PI /
NumOfVerticesStone *
i) * InnerRadius;
Vertices[i + NumOfVerticesStone*1].y = StoneHeight;
Vertices[i + NumOfVerticesStone*1].z = sin(2.0 * PI /
NumOfVerticesStone *
i) * InnerRadius;
}
for (i = 0; i<NumOfVerticesStone; i++)
{
Vertices[i + NumOfVerticesStone*2].x = cos(2.0 * PI /
NumOfVerticesStone *
i) * OuterRadius;
Vertices[i + NumOfVerticesStone*2].y = 0.0;
Vertices[i + NumOfVerticesStone*2].z = sin(2.0 * PI /
NumOfVerticesStone *
i) * OuterRadius;
```

```
}
glNewList(ListNum, GL_COMPILE);
glBegin(GL_QUADS);
glColor3ub(0,105,0);
glVertex3f(-OuterRadius*10.0,0.0,OuterRadius*10.0);
glVertex3f(-OuterRadius*10.0,0.0,-OuterRadius*10.0);
glVertex3f(OuterRadius*10.0,0.0,-OuterRadius*10.0);
```



```
glVertex3f(OuterRadius*10.0,0.0,OuterRadius*10.0);
for (int j = 1; j < 3; j++)
{
if (j == 1) glColor3f(1.3,0.5,1.2);
if (j == 2) glColor3f(0.4,0.2,0.1);
for (i = 0; i<NumOfVerticesStone-1; i++)
{
glVertex3fv(&Vertices[i+NumOfVerticesStone*j].x);
glVertex3fv(&Vertices[i].x);
glVertex3fv(&Vertices[i+1].x);
glVertex3fv(&Vertices[i+NumOfVerticesStone*j+1].x);
}
glVertex3fv(&Vertices[i+NumOfVerticesStone*j].x);
```

```
glVertex3fv(&Vertices[i].x);
glVertex3fv(&Vertices[0].x);
glVertex3fv(&Vertices[NumOfVerticesStone*j].x);
}
glEnd();
glTranslatef(0.0,WaterHeight - StoneHeight, 0.0);
glBegin(GL_POLYGON);
for (i = 0; i<NumOfVerticesStone; i++)
{
glVertex3fv(&Vertices[i+NumOfVerticesStone].x);
GLint m1,n1,p1;
m1=rand()%255;
n1=rand()%255;
p1=rand()%255;
glColor3ub(m1,n1,p1);
}
glEnd();
glEndList();
}
GLfloat GetRandomFloat(GLfloat range)
{
```

```
return (GLfloat)rand() / (GLfloat)RAND_MAX * range *
RandomFactor;
}
void InitFountain(void)
{
FountainDrops = new CDrop [ (int)DropsComplete ];
```



```
FountainVertices = new SVertex [ (int)DropsComplete ];
SVertex NewSpeed;
GLfloat DropAccFactor;
GLfloat TimeNeeded;
GLfloat StepAngle;
GLfloat RayAngle;
GLint i,j,k;
for (k = 0; k <Steps; k++)
{
for (j = 0; j < RaysPerStep; j++)
{
for (i = 0; i < DropsPerRay; i++)
{
DropAccFactor = AccFactor + GetRandomFloat(0.0005);
```

```
StepAngle = AngleOfDeepestStep + (90.0-AngleOfDeepestStep)
* GLfloat(k) / (Steps-1) + GetRandomFloat(0.2+0.8*(Steps-k-
1)/(Steps-1));
NewSpeed.x = cos ( StepAngle * PI / 180.0) * (0.2+0.04*k);
NewSpeed.y = sin ( StepAngle * PI / 180.0) * (0.2+0.04*k);
RayAngle = (GLfloat)j / (GLfloat)RaysPerStep * 360.0;
NewSpeed.z = NewSpeed.x * sin ( RayAngle * PI /180.0);
NewSpeed.x = NewSpeed.x * cos ( RayAngle * PI /180.0);
TimeNeeded = NewSpeed.y/ DropAccFactor;
FountainDrops[i+j*DropsPerRay+k*DropsPerRay*RaysPerStep].SetCo
nstantSpeed (
NewSpeed );
FountainDrops[i+j*DropsPerRay+k*DropsPerRay*RaysPerStep].SetAc
cFactor
(DropAccFactor);
FountainDrops[i+j*DropsPerRay+k*DropsPerRay*RaysPerStep].SetTi
me(TimeNeeded
* i / DropsPerRay);
}
}
}
glEnableClientState(GL_VERTEX_ARRAY);
glVertexPointer( 3,
```

```
GL_FLOAT,
0,
FountainVertices);
}
void randcolor()
{
GLint a,b,c;
a=rand()%101;
b=rand()%101;
c=rand()%101;
X[0]=(GLfloat)a/100.0;
X[1]=(GLfloat)b/100.0;
X[2]=(GLfloat)c/100.0;
}
void DrawFountain(void)
{
if(flag==0)
glColor3f(1,1,1);
else if(flag==1)
glColor3fv(X);
else if(flag==2)
glColor3f(0.0,1.0,0.0);
```

```
else
glColor3f(0.0,1.0,1.0);
for (int i = 0; i < DropsComplete; i++)
{
FountainDrops[i].GetNewPosition(&FountainVertices[i]);
}
glDrawArrays( GL_POINTS,
0,
DropsComplete);
glutPostRedisplay();
}
void colours(int id)
{
flag=id;
if(flag==1)
randcolor();
glutPostRedisplay();
}
void flow(int id)
{
RaysPerStep=id;
glutPostRedisplay();
```

```
}
void level(int id)
{
Steps=id;
glutPostRedisplay();
}
void help(int id)
{
glutPostRedisplay();
}
void CMain(int id)
{
}
void NormalKey(GLubyte key, GLint x, GLint y)
{
if(f==0)
{
switch ( key )
{
case 13:
case '1': f=3; break;
case '2': f=1; break;
```

```
case '3':
case '4': case 'b': f=2; break;
case ESCAPE: exit(0);
glutPostRedisplay();
}
}
else if(f==1)
{
if(key=='b'||key=='B')
f=0;
else
f=3;
glutPostRedisplay();
}
```

Flowing Fountain


```
else if(f==2)
{ f=0;
}
else
{
switch ( key )
```

```
{
case ESCAPE :
printf("Thank You\nAny Suggestions??????\n\n\n");
exit(0);
break;
case 't': case 'T':
vflag=3;
glutPostRedisplay();
break;
case 'f': case 'F':
vflag=33;
glutPostRedisplay();
break;
case 'd': case 'D':
vflag=2;
glutPostRedisplay();
break;
case 'u': case 'U':
vflag=22;
glutPostRedisplay();
break;
case 'a': case 'A':
```

```
vflag=1;
glutPostRedisplay();
break;
case 'n': case 'N':
vflag=11;
```



```
glutPostRedisplay();
break;
case 'b': case 'B':
f=0;
glutPostRedisplay();
break;
case 'h': case 'H':
f=1;
glutPostRedisplay();
break;
default:
break;
}
}
}
```

```
void DrawTextXY(double x,double y,double z,double scale,char *s)
{
int i;
glPushMatrix();
glTranslatef(x,y,z);
glScalef(scale,scale,scale);
for (i=0;i < strlen(s);i++)
glutStrokeCharacter(GLUT_STROKE_MONO_ROMAN,s[i]);
glPopMatrix();
}
void Display(void)
{
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
glLoadIdentity();
glClearColor(0,0,100,1.0);
glTranslatef(0.0,0.0,-6.0);
glTranslatef(0.0,-1.3,0.0);
if(vflag==1)
{
```



```
zt-=0.06;
```

```
}
glTranslatef(xt,yt,zt);
if(vflag==11)
{
zt+=0.06;
}
glTranslatef(xt,yt,zt);
if(vflag==2)
{
yt -= 0.05;
}
glTranslatef(xt,yt,zt);
if(vflag==22)
{
yt += 0.05;
}
glTranslatef(xt,yt,zt);
if(vflag==3)
{
if(xangle<=80.0)
xangle += 5.0;
}
```

```
if(vflag==33)
{
if(xangle>=-5)
xangle -= 5.0;
}
glColor3f(1.0,0.0,0.0);
glRotatef(xangle,1.0,0.0,0.0);
vflag=0;
glRotatef(45.0,0.0,1.0,0.0);
glPushMatrix();
glCallList(ListNum);
glPopMatrix();
```

```
DrawFountain();
glFlush();
glutSwapBuffers();
}
void menu1()
{
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
glLoadIdentity();
```

```
glClearColor(0,0,0,0.0);
glTranslatef(0.0,0.0,-6.0);
glTranslatef(0.0,-1.3,0.0);
glColor3f(1.00,0.20,0.10);
glLoadName(TEXTID);
DrawTextXY(-2.7,3.5,0.0,0.003," FOUNTAIN ");
glColor3f(0.6,0.8,0.7);
DrawTextXY(-1.25,2.4,0.0,0.0014," MENU ");
glColor3f(1.0,0.8,0.4);
DrawTextXY(-1.25,2.1,0.0,0.001," 1 : PROCEED ");
DrawTextXY(-1.25,1.9,0.0,0.001," 2 : HELP ");
DrawTextXY(-1.25,1.7,0.0,0.001," 3 : EXIT ");
DrawTextXY(-1.25,1.5,0.0,0.001," 4 : BACK");
glFlush();
glutSwapBuffers();
}
void menu2()
{
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
glLoadIdentity();
glClearColor(0,0,0,1.0);
glTranslatef(0.0,0.0,-6.0);
```

```
glTranslatef(0.0,-1.3,0.0);
glColor3f(0.6,0.8,0.7);
DrawTextXY(-2.7,3.5,0.0,0.003," HELP ");
glColor3f(1.0,0.8,0.4);
DrawTextXY(-1.75,2.4,0.0,0.0014," Keyboard Controls : ");
glColor3f(0.9,0.8,0.9);
DrawTextXY(-1.25,2.1,0.0,0.001," Move Near -> N ");
DrawTextXY(-1.25,1.9,0.0,0.001," Move Away -> A ");
DrawTextXY(-1.25,1.5,0.0,0.001," Move Up -> U ");
```



```
DrawTextXY(-1.25,1.3,0.0,0.001," Move Down -> D ");
DrawTextXY(-1.25,0.9,0.0,0.001," Top View -> T ");
DrawTextXY(-1.25,0.7,0.0,0.001," Front View -> F ");
DrawTextXY(-1.25,0.3,0.0,0.001," Open HELP -> H ");
DrawTextXY(-1.25,0.1,0.0,0.001," Open MENU -> B ");
glColor3f(0.9,0.9,0.8);
DrawTextXY(1,-0.4,0.0,0.001," Press any KEY ... ");
glFlush();
glutSwapBuffers();
}
void cover()
```

```
{
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
glLoadIdentity();
glClearColor(0,0,0,0.0);
glTranslatef(0.0,0.0,-6.0);
glTranslatef(0.0,-1.3,0.0);
glColor3f(1.00,0.20,0.10);
glLoadName(TEXTID);
DrawTextXY(-1.7,3.5,0.0,0.001," GRAPHICAL IMPLEMENTATION OF
");
glColor3f(0.6,0.8,0.7);
DrawTextXY(-1.75,3,0.0,0.0014," FLOWING FOUNTAIN ");
glColor3f(0.7,0.6,0.1);
DrawTextXY(-3.25,1.5,0.0,0.0007," Submitted by :- ");
glColor3f(1.0,0.5,0.0);
DrawTextXY(-2.5,1.2,0.0,0.001," ARUNIM CHAKRABORTY");
DrawTextXY(1,1.2,0.0,0.001," ATHARVA KHANGAR ");
DrawTextXY(1,1.2,0.0,0.001," KSHITIJ SHIDORE");
DrawTextXY(1,1.2,0.0,0.001," RUPESH DHIRWANI");
glColor3f(0.7,0.8,0.6);
glColor3f(0.7,0.6,0.1);
glColor3f(1.0,0.8,0.4);
```

```
glColor3f(0.3,0.3,0.3);
DrawTextXY(-1,-1,0.0,0.0008," Press any key... ");
glFlush();
glutSwapBuffers();
}
void Dis()
{
if(f==0)
menu1();
else if(f==1)
menu2();
else if(f==2)
cover();
else
Display();
}
void Reshape(int x, int y)
{
if (y == 0 || x == 0) return;
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
gluPerspective(50.0,(GLdouble)x/(GLdouble)y,0.10,20.0);
```

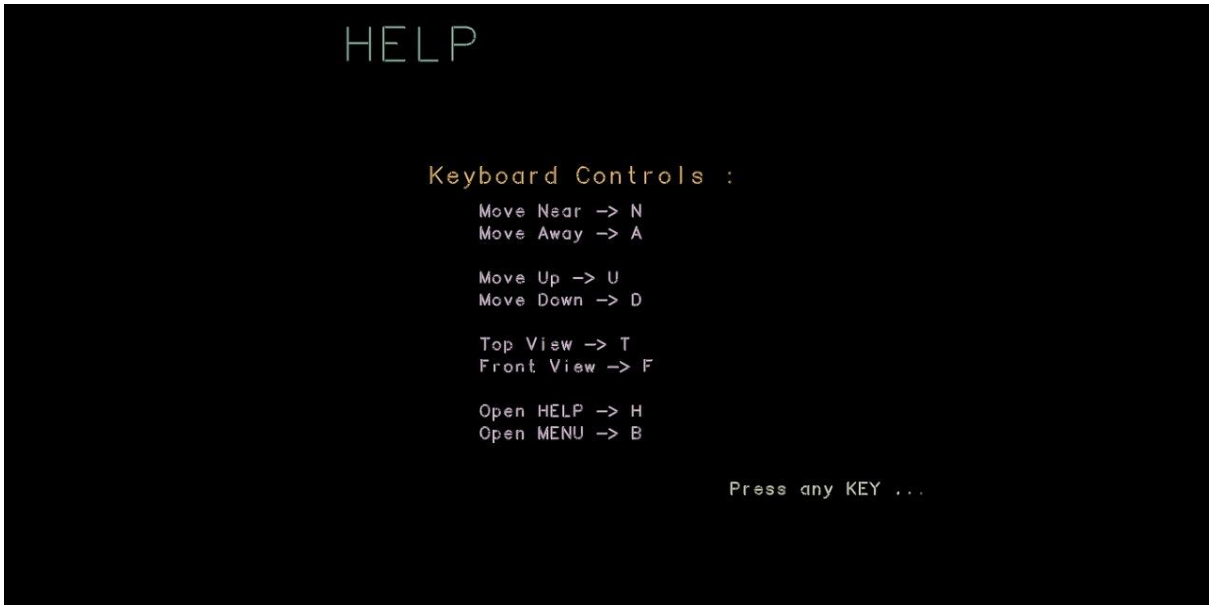
```
glMatrixMode(GL_MODELVIEW);
glViewport(0,0,x,y);
glPointSize(GLfloat(x)/600.0);
}
int main(int argc, char **argv)
{
glutInit(&argc, argv);
printf("KeyboardControls\n");
printf("'x'-topview\n");
printf("'d'-movedown\n");
printf("'u'-moveup\n");
printf("'a'-moveaway\n");
printf("'n'-movenear\n");
glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
glutInitWindowSize(1024,768);
glutInitWindowPosition(0,0);
glutCreateWindow("Fountain");
glEnable(GL_DEPTH_TEST);
glBlendFunc(GL_SRC_ALPHA,GL_ONE_MINUS_SRC_ALPHA);
```



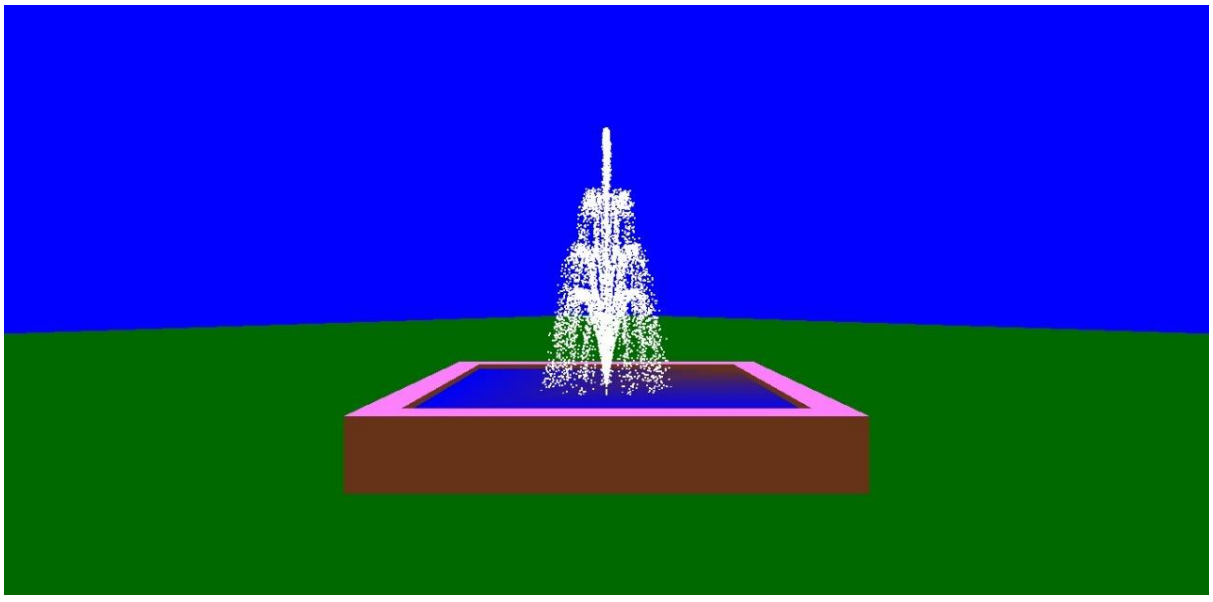
```
glEnable(GL_LINE_SMOOTH);
```

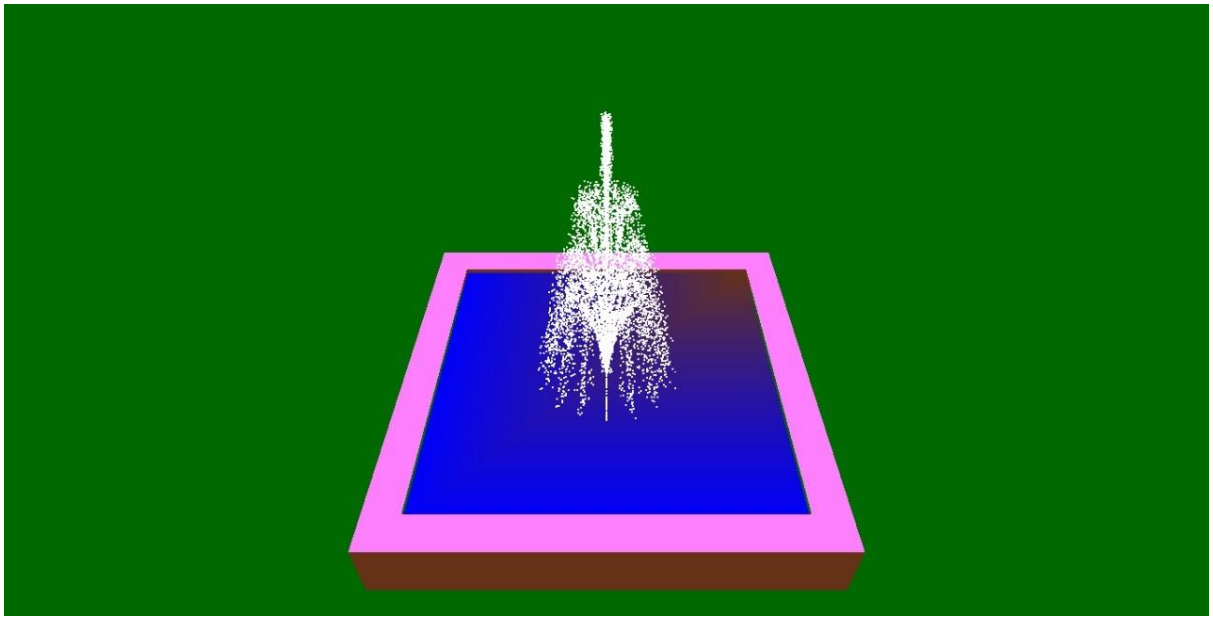
```
glEnable(GL_BLEND);
glLineWidth(2.0);
glPolygonMode(GL_FRONT_AND_BACK, GL_FILL);
InitFountain();
CreateList();
glutDisplayFunc(Dis);
glutReshapeFunc(Reshape);
glutKeyboardFunc(NormalKey);
int sub_menu=glutCreateMenu(colours);
glutAddMenuEntry("RANDOM",1);
glutAddMenuEntry("GREEN",2);
glutAddMenuEntry("BLUE",3);
int sub_menu2=glutCreateMenu(flow);
glutAddMenuEntry("LOW",8);
glutAddMenuEntry("MEDIUM",10);
glutAddMenuEntry("HIGH",20);
int sub_menu3=glutCreateMenu(level);
glutAddMenuEntry("3 LEVELS",3);
glutAddMenuEntry("4 LEVELS",4);
glutAddMenuEntry("5 LEVELS",5);
int sub_menu4=glutCreateMenu(help);
glutAddMenuEntry("KEYBOARD CONTROLS:",0);
```

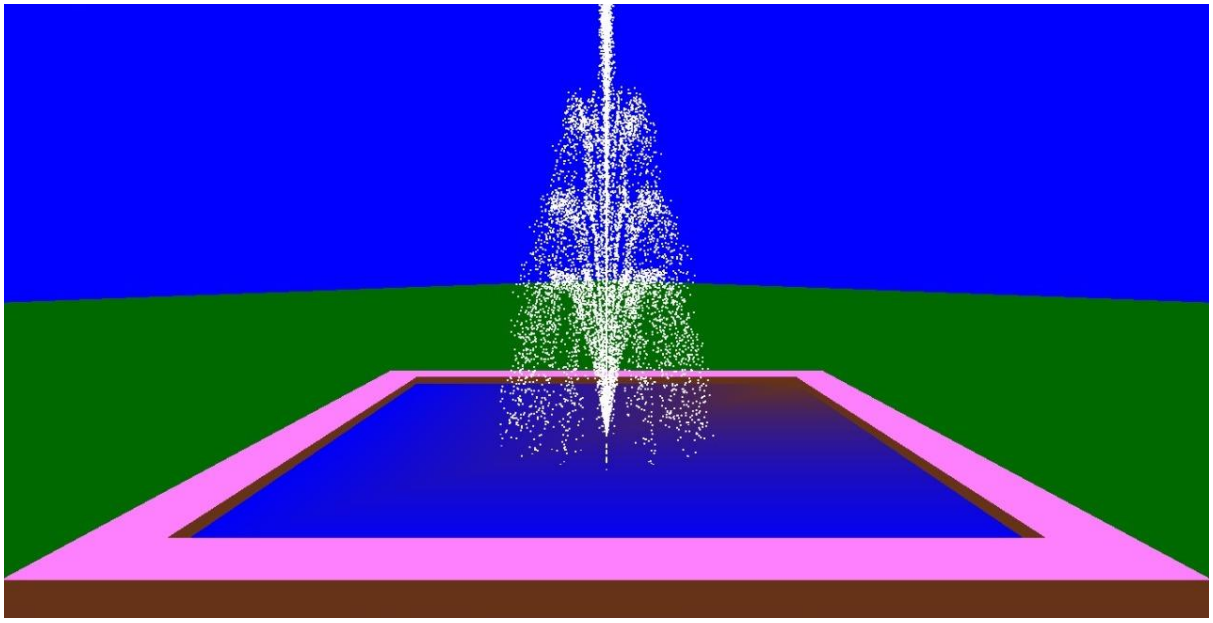
```
glutAddMenuEntry("Move Near: n",1);
glutAddMenuEntry("Move Away: a",2);
glutAddMenuEntry("Move Down: d",3);
glutAddMenuEntry("Move Up: u",4);
glutAddMenuEntry("Vertical 360: x",5);
glutAddMenuEntry("EXIT",6);
glutCreateMenu(CMain);
glutAddSubMenu("Colors",sub_menu);
glutAddSubMenu("Help",sub_menu4);
glutAttachMenu(GLUT_RIGHT_BUTTON);
glutIdleFunc(Dis);
glutMainLoop();
return 0;
}
```

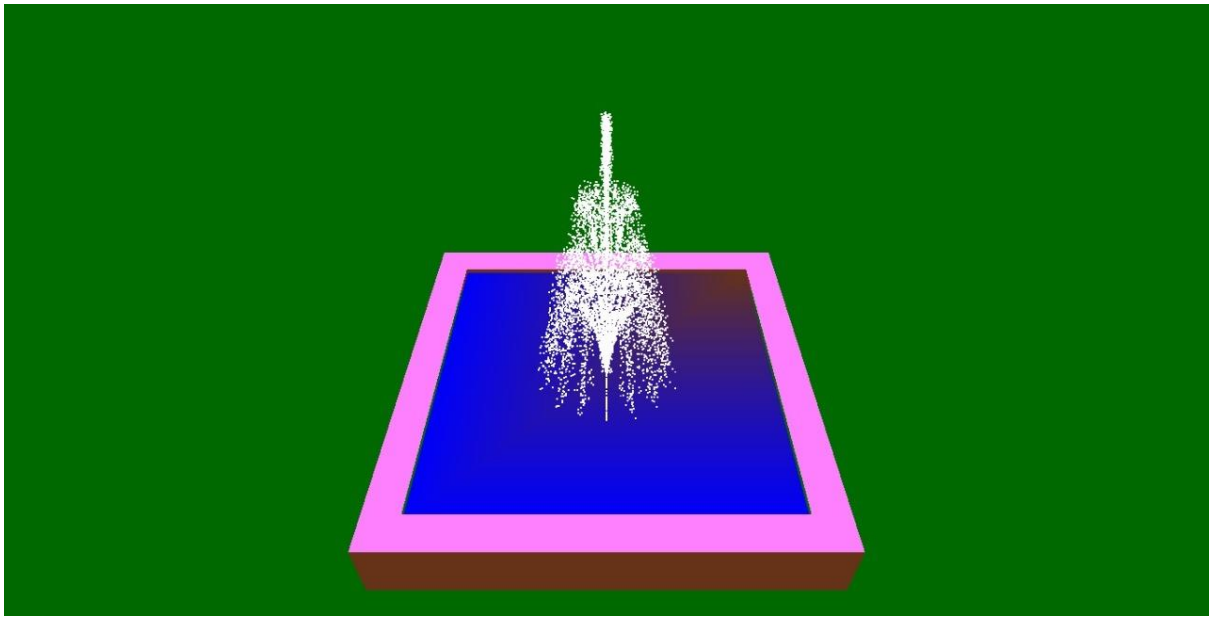

HELP
Keyboard Controls :
Move Near -> N
Move Away -> A
Move Up -> U
Move Down -> D
Top View -> T
Front View -> F
Open HELP -> H
Open MENU -> B
Press any KEY ...

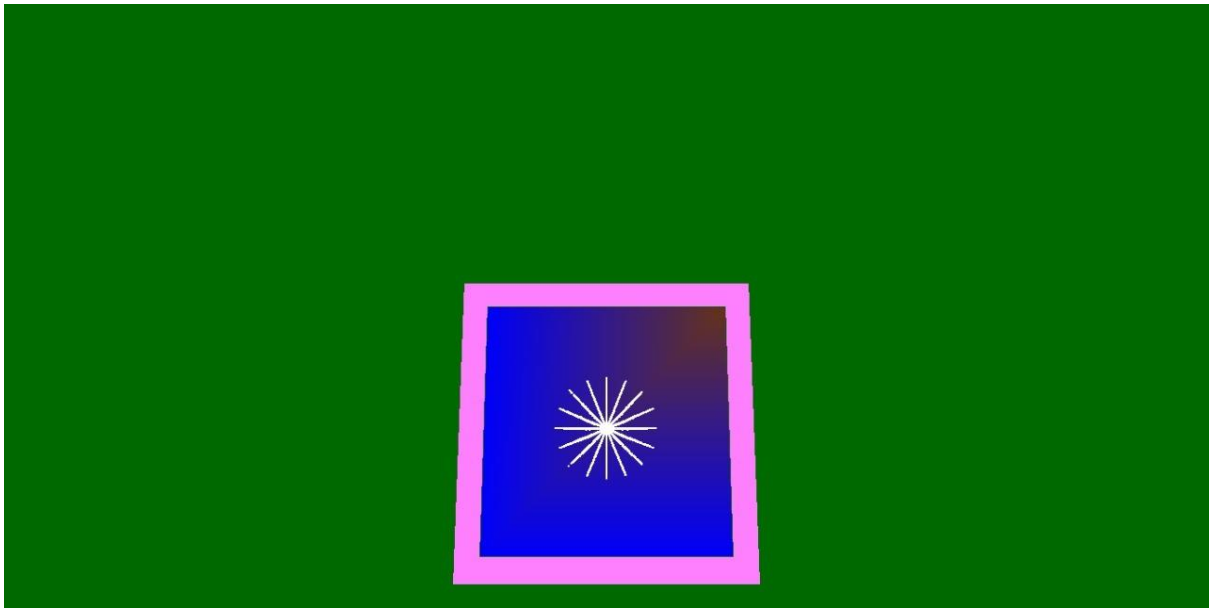

FOUNTAIN
MENU
1 : PROCEED
2 : HELP
3 : EXIT
4 : BACK











Conclusion

An attempt has been made to develop an OpenGL package which meets necessary requirements of the user successfully. Since it is user friendly, it enables the user to interact efficiently and easily.

The development of the mini project has given us a good exposure to OpenGL by which we

have learnt some of the technique which help in development of animated pictures, gaming.

Hence it is helpful for us even to take up this field as our career too and develop some other

features in OpenGL and provide as a token of contribution to the graphics world.