THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

UCS505: Computer Graphics

Rocket Launch using OpenGL

B.E Third Year (COE)

Name	Roll Number
Jayant Singh	102103556
Varun Thakur	102103547

Faculty:

Ms. Anupam Garg

Department of Computer Science and Engineering

Thapar Institute of Engineering and Technology

Contents

1. **Introduction to Project** **3**
2. **Computer Graphics concepts used** **4**
3. **User Defined Functions** **5**
4. **Code** **6**
5. **Output/Screenshots** **25**

1. Introduction to Project

The code exemplifies the construction of a rocket launch using OpenGL and GLUT libraries. In this virtual environment, the program seems to aim at creating a simple rocket launch animation with basic graphical elements such as stars, Mars, and a rocket. The animation is controlled by a sequence of events triggered by time intervals. Its purpose is to provide a visual representation of a rocket ascending from a launch pad into space.

Limitations and Future Improvements:

Discuss potential limitations, such as basic graphics techniques.
Suggest future improvements, such as incorporating advanced rendering and physics simulation techniques.

Usage Instructions:

Compile and execute the program within a C environment supporting graphics rendering (e.g., Turbo C).
Follow on-screen prompts to interact with and experience the simulation, if applicable.

Conclusion:

Encourage users to enjoy the immersive rocket launch simulation.

2. Computer Graphics concepts used

The code utilizes various computer graphics concepts to create a basic animation of the solar system. Some of the important concepts used in the code are as follows:

OpenGL: OpenGL is a graphics API (Application Programming Interface) that is widely used to create 2D and 3D graphics. It provides a set of functions that can be used to create and manipulates geometric shapes, textures, lighting, and other visual elements. In the code above, OpenGL is used to create the window, set up the projection and viewing matrices, and render the planets and other objects in the solar system.

Coordinate Systems: In computer graphics, different coordinate systems are used to represent objects in 3D space. The most commonly used coordinate system is the Cartesian coordinate system, which uses three perpendicular axes (X, Y, and Z) to specify the position of a point in space. In the code above, the solar system is represented using the Cartesian coordinate system.

Transformations: Transformations are used to change the position, orientation, or size of objects in 3D space. In the code above, the planets and other objects in the solar system are transformed using translation, rotation, and scaling operations. The translation is used to move objects from one position to another, rotation is used to change the orientation of objects, and scaling is used to change the size of objects.

Textures: Textures are images that are used to add detail and realism to 3D objects. In the code above, textures are used to add the surface details of the planets and other objects in the solar system. Texture mapping is used to apply the textures to the 3D objects.

Shading: Shading is used to calculate the color of the pixels in a 3D scene based on the lighting and other factors. In the code above, the planets and other objects in the solar system are shaded using the Phong shading model, which calculates the color of each pixel based on the lighting, the surface properties of the objects, and the viewing angle.

3. User Defined Functions

1. **void drawstring(int x, int y, char* s)**: This function is used to display text content on the screen at the specified coordinates (x, y). It takes three parameters: the x and y coordinates of the starting position of the text, and a pointer to a string (**char* s**) containing the text to be displayed.
2. **void semicircle(float radius, float u, float v)**: This function draws a semicircle with the specified radius centered at (u, v) on the screen. It takes three parameters: the radius of the semicircle and the coordinates (u, v) of its center.
3. **void control()**: This function determines the state of the rocket launch based on the value of the **count1** variable and sets flags accordingly.
4. **void stars()**: This function draws a collection of stars on the screen.
5. **void stars1()**: Similar to the **stars()** function, this function also draws stars, but with different coordinates.
6. **void static_rocket()**: This function draws a static scene depicting a rocket launch site, including a rocket on the launch pad and surrounding environment.
7. **void rocket_to_cam_pos()**: This function animates the rocket ascending from the launch pad to a certain camera position.
8. **void rocket_to_cam_pos1()**: Similar to **rocket_to_cam_pos()**, this function animates the rocket ascending but with different visual effects.
9. **void rocket_in_motion()**: This function is likely supposed to handle the animation of the rocket in motion after it reaches a certain height, but it seems to be cut off in the provided code.

4. Code

```
#include<stdlib.h>
#include<stdio.h>
#include<math.h>
#include<string.h>
#include<glut.h>
const float DEG2RAD = 3.14159 / 180;
void stars();
int p;
void stars1();
void static_rocket();
void rocket_to_cam_pos();
void rocket_to_cam_pos1();
void rocket_in_motion();
void mars(float radius);
void mars1(float radius);

float i, j, count = 0, count1 = 0, count3 = 0, flag = 0, flag1 = 0, t = 0, f = 0, flag3 = 0;

// fucntion to display the text content of the home screen
void drawstring(int x, int y, char* s)
{
	char* c;
	glRasterPos2i(x, y);
	for (c = s; *c != '\0'; *c++)
		glutBitmapCharacter(GLUT_BITMAP_8_BY_13, *c);
}

void semicircle(float radius, float u, float v)
{


	glColor3f(1.0, 1.0, 1.0);
	glBegin(GL_POLYGON);

	for (int i = 135; i <= 315; i++)
	{
		float degInRad = i * DEG2RAD;
		glVertex2f(u + cos(degInRad) * radius, v + (sin(degInRad)) * radius);//100,100
specifies centre of the circle
	}

	glEnd();
}

//determines the state of rocket launch
void control()
{
	count1++;
	if (count1 == 250)
		flag = 1;

	else if (flag == 1 && (count1 == 600 || count1 == 601))
```

```
		rocket_to_cam_pos();

	else if (flag == 1 && (count1 == 800 || count1 == 801))
		rocket_to_cam_pos1();

	else if (flag == 1 && count1 >= 1000)
		rocket_in_motion();
}

void stars()
{
	int l;
	glColor3f(1.0, 1.0, 1.0);
	glPointSize(1.37);
	glBegin(GL_POINTS);
	glVertex2i(10, 20);
	glVertex2i(20, 100);
	glVertex2i(30, 10);
	glVertex2i(15, 150);
	glVertex2i(17, 80);
	glVertex2i(200, 200);
	glVertex2i(55, 33);
	glVertex2i(400, 300);
	glVertex2i(330, 110);
	glVertex2i(125, 63);
	glVertex2i(63, 125);
	glVertex2i(20, 10);
	glVertex2i(110, 330);
	glVertex2i(440, 430);
	glVertex2i(32, 65);
	glVertex2i(110, 440);
	glVertex2i(210, 230);
	glVertex2i(390, 490);
	glVertex2i(12, 90);
	glVertex2i(400, 322);
	glVertex2i(420, 366);
	glVertex2i(455, 400);
	glVertex2i(20, 20);
	glVertex2i(111, 120);
	glVertex2i(401, 200);
	glVertex2i(230, 30);
	glVertex2i(220, 20);
	glVertex2i(122, 378);
	glVertex2i(133, 340);
	glVertex2i(345, 420);
	glVertex2i(130, 360);
	glVertex2i(333, 120);
	glVertex2i(250, 22);
	glVertex2i(242, 11);
	glVertex2i(280, 332);
	glVertex2i(233, 40);
	glVertex2i(210, 418);
	glVertex2i(256, 12);
	glVertex2i(288, 232);
	glVertex2i(247, 36);
	glVertex2i(229, 342);
	glVertex2i(257, 47);
	glVertex2i(290, 63);
	glVertex2i(232, 72);
	glVertex2i(243, 143);
	glVertex2i(100, 200);
	glVertex2i(90, 250);
	glVertex2i(80, 225);
	glVertex2i(50, 333);
	glVertex2i(60, 350);
	glVertex2i(243, 143);
	glVertex2i(243, 143);
	glEnd();
	for (l = 0; l <= 50000; l++)
		;
}

void stars1()
{
	int l;
	glColor3f(1.0, 1.0, 1.0);
	glPointSize(1.0);
	glBegin(GL_POINTS);
	glVertex2i(50, 20);
	glVertex2i(70, 100);
	glVertex2i(80, 10);
	glVertex2i(65, 150);
	glVertex2i(67, 80);
	glVertex2i(105, 33);
	glVertex2i(450, 300);
	glVertex2i(380, 110);
	glVertex2i(175, 63);
	glVertex2i(113, 125);
	glVertex2i(70, 10);
	glVertex2i(160, 330);
	glVertex2i(490, 430);
	glVertex2i(82, 65);
	glVertex2i(160, 440);
	glVertex2i(440, 490);
	glVertex2i(62, 90);
	glVertex2i(450, 322);
	glVertex2i(420, 366);
	glVertex2i(455, 400);
	glVertex2i(60, 20);
	glVertex2i(111, 120);
	glVertex2i(451, 200);
	glVertex2i(280, 30);
	glVertex2i(220, 20);
	glVertex2i(132, 378);
	glVertex2i(173, 340);
	glVertex2i(325, 420);
	glVertex2i(180, 360);
	glVertex2i(383, 120);
```

```
		glVertex2i(200, 22);
		glVertex2i(342, 11);
		glVertex2i(330, 332);
		glVertex2i(283, 40);
		glVertex2i(210, 418);
		glVertex2i(256, 12);
		glVertex2i(288, 232);
		glVertex2i(247, 36);
		glVertex2i(229, 342);
		glVertex2i(257, 47);
		glVertex2i(290, 63);
		glVertex2i(232, 72);
		glVertex2i(243, 143);
		glVertex2i(100, 200);
		glVertex2i(90, 250);
		glVertex2i(80, 225);
		glVertex2i(50, 333);
		glVertex2i(60, 350);
		glVertex2i(243, 143);
		glVertex2i(243, 143);
		glEnd();
		for (l = 0; l <= 50000; l++)
			;
	}
	void static_rocket()
	{

		count1++;
		if (count1 == 150)
			flag = 1;
		if (flag == 0)
		{
			glClearColor(0.196078, 0.6, 0.8, 1.0);
			glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

			glColor3f(0.0, 0.25, 0.0);
			glBegin(GL_POLYGON);//green ground
			glVertex2f(0.0, 0.0);
			glVertex2f(0.0, 250.0);
			glVertex2f(270.0, 250.0);
			glVertex2f(500.0, 50.0);
			glVertex2f(500.0, 0.0);
			glEnd();
			glColor3f(0.0, 0.25, 0.0);
			glBegin(GL_POLYGON);//green ground
			glVertex2f(280.0, 250.0);
			glVertex2f(500.0, 250.0);
			glVertex2f(500.0, 60.0);
			glEnd();
			glColor3f(0.0, 0.0, 0.0);
			glBegin(GL_POLYGON);//road
			glVertex2f(260.0, 250.0);
			glVertex2f(290.0, 250.0);
			glVertex2f(500.0, 70.0);
```

```
glVertex2f(500.0, 40.0);
glEnd();
glColor3f(0.0, 0.0, 0.0);


glColor3f(0.8, 0.498039, 0.196078);
//glColor3f(0.678, 0.847, 0.902);
glBegin(GL_POLYGON);//house 1
glVertex2f(250.0, 250.0);
glVertex2f(300.0, 250.0);
glVertex2f(300.0, 350.0);
glVertex2f(250.0, 350.0);
glEnd();
glColor3f(0.678, 0.847, 0.902);
//glColor3f(1, 0, 0);
glBegin(GL_POLYGON);//HOUSE A
glVertex2f(255, 267.5);
glVertex2f(275.0, 267.5);
glVertex2f(275.0, 277.5);
glVertex2f(255.0, 277.5);
glEnd();
glBegin(GL_POLYGON);//HOUSE B
glVertex2f(255, 285.0);
glVertex2f(275.0, 285);
glVertex2f(275.0, 295);
glVertex2f(255.0, 295);
glEnd();

glColor3f(0.0, 0.0, 0.0);
glBegin(GL_POLYGON);//HOUSE C
glVertex2f(255, 302.5);
glVertex2f(275.0, 302.5);
glVertex2f(275.0, 312.5);
glVertex2f(255.0, 312.5);
glEnd();

glColor3f(0.678, 0.847, 0.902);
glBegin(GL_POLYGON);//HOUSE D
glVertex2f(255, 320.0);
glVertex2f(275.0, 320.0);
glVertex2f(275.0, 330.0);
glVertex2f(255.0, 330.0);
glEnd();

glBegin(GL_POLYGON);//HOUSE E
glVertex2f(285, 267.5);
glVertex2f(295.0, 267.5);
glVertex2f(295.0, 277.5);
glVertex2f(285.0, 277.5);
glEnd();

glBegin(GL_POLYGON);//HOUSE F
glVertex2f(285, 285.0);
glVertex2f(295.0, 285);
```

```
glVertex2f(295.0, 295);
glVertex2f(285.0, 295);
glEnd();

glBegin(GL_POLYGON);//HOUSE G
glVertex2f(285, 302.5);
glVertex2f(295.0, 302.5);
glVertex2f(295.0, 312.5);
glVertex2f(285.0, 312.5);
glEnd();

glBegin(GL_POLYGON);//HOUSE H
glVertex2f(285, 320.0);
glVertex2f(295.0, 320.0);
glVertex2f(295.0, 330.0);
glVertex2f(285.0, 330.0);
glEnd();
glColor3f(0.5, 0.5, 0.5);
glBegin(GL_POLYGON);//solid cone
glVertex2f(26, 250);
glVertex2f(52, 250);
glVertex2f(39, 290);
glEnd();
semicircle(20.0, 50, 300);

glColor3f(0.5, 0.5, 0.5);
glBegin(GL_LINES);//wires
glVertex2f(37, 313);
glVertex2f(62, 310);
glVertex2f(63, 287);
glVertex2f(62, 310);
glEnd();
glColor3f(1.0, 1.0, 1.0);

glEnd();
glPointSize(2.0);

glColor3f(0.0, 0.0, 1.0);
glBegin(GL_POINTS);//road paint
glVertex2f(497, 56);
glVertex2f(488, 65);
glVertex2f(479, 74);
glVertex2f(470, 83);
glVertex2f(460, 92);
glVertex2f(450, 101);
glVertex2f(439, 110);
glVertex2f(428, 119);
glVertex2f(418, 128);
glVertex2f(408, 137);
glVertex2f(398, 146);
glVertex2f(388, 155);
glVertex2f(378, 164);
glVertex2f(366, 173);
glVertex2f(356, 182);
```

```
glVertex2f(346, 191);
glVertex2f(336, 200);
glVertex2f(324, 209);
glVertex2f(314, 218);
glVertex2f(304, 227);
glVertex2f(294, 234);
glVertex2f(284, 243);
glVertex2f(278, 248);


glColor3f(1.0, 0, 0);
glBegin(GL_POINTS);//road paint
glVertex2f(496, 56);
glVertex2f(487, 65);
glVertex2f(478, 74);
glVertex2f(469, 83);
glVertex2f(459, 92);
glVertex2f(449, 101);
glVertex2f(438, 110);
glVertex2f(427, 119);
glVertex2f(417, 128);
glVertex2f(407, 137);
glVertex2f(397, 146);
glVertex2f(387, 155);
glVertex2f(377, 164);
glVertex2f(365, 173);
glVertex2f(355, 182);
glVertex2f(345, 191);
glVertex2f(335, 200);
glVertex2f(323, 209);
glVertex2f(313, 218);
glVertex2f(303, 227);
glVertex2f(293, 234);
glVertex2f(283, 243);
glVertex2f(277, 248);

glEnd();


glColor3f(0.0, 0.0, 0.0);//stand object
glBegin(GL_POLYGON);
glVertex2f(130, 10.0);
glVertex2f(160, 10.0);
glVertex2f(160, 180.0);
glVertex2f(130, 180.0);
glEnd();
glBegin(GL_LINES);
glVertex2f(130, 30.0);
glVertex2f(262, 30.0);

glVertex2f(130, 130.0);
glVertex2f(260, 130.0);
glEnd();
```

```
glColor3f(0.8, 0.498039, 0.196078);
glBegin(GL_POLYGON);//core
glVertex2f(237.5, 20.0);
glVertex2f(262.5, 20.0);
glVertex2f(262.5, 120.0);
glVertex2f(237.5, 120.0);
glEnd();

glColor3f(1.0, 0.0, 0.0);//bonnet
glBegin(GL_POLYGON);//front
glVertex2f(237.5, 120.0);
glVertex2f(262.5, 120.0);
glVertex2f(250, 170.0);
glEnd();
glColor3f(1.0, 0.0, 0.0);
glBegin(GL_POLYGON);//left_side_top
glVertex2f(237.5, 120.0);
glVertex2f(217.5, 95.0);
glVertex2f(237.5, 95.0);
glEnd();
glBegin(GL_POLYGON);//left_side_bottom
glVertex2f(237.5, 20.0);
glVertex2f(217.5, 20.0);
glVertex2f(237.5, 70.0);
glEnd();
glBegin(GL_POLYGON);//right_side_bottom
glVertex2f(262.5, 20.0);
glVertex2f(282.5, 20.0);
glVertex2f(262.5, 70.0);
glEnd();
glBegin(GL_POLYGON);//right_side_top
glVertex2f(262.5, 120.0);
glVertex2f(262.5, 95.0);
glVertex2f(282.5, 95.0);
glEnd();
glColor3f(0.556863, 0.137255, 0.419608);
glBegin(GL_POLYGON);//bottom_1_exhaust
glVertex2f(237.5, 20.0);
glVertex2f(244.5, 20.0);
glVertex2f(241, 0.0);
glEnd();
glBegin(GL_POLYGON);//bottom_2_exhaust
glVertex2f(246.5, 20.0);
glVertex2f(253.5, 20.0);
glVertex2f(249.5, 0.0);
glEnd();
glBegin(GL_POLYGON);//bottom_3_exhaust
glVertex2f(262.5, 20.0);
glVertex2f(255.5, 20.0);
glVertex2f(258.5, 0.0);
glEnd();

glColor3d(1.0, 1.0, 1.0);
glBegin(GL_POLYGON);//left_stand_holder
```

```
            glVertex2f(182.5, 85.0);
            glVertex2f(182.5, 0.0);
            glVertex2f(187.5, 0.0);
            glVertex2f(187.5, 80.0);
            glVertex2f(237.5, 80.0);
            glVertex2f(237.5, 85.0);
            glVertex2f(182.5, 85.0);
            glEnd();
            glBegin(GL_POLYGON);
            glVertex2f(312.5, 85.0);//right_stand_holder
            glVertex2f(312.5, 0.0);
            glVertex2f(307.5, 0.0);
            glVertex2f(307.5, 80.0);
            glVertex2f(262.5, 80.0);
            glVertex2f(262.5, 85.0);
            glVertex2f(312.5, 85.0);
            glEnd();

            for (j = 0; j <= 10000000; j++)
                ;
            glutSwapBuffers();
            glutPostRedisplay();
            glFlush();
        }

}
void rocket_to_cam_pos()
{
        count++;
        count3++;

        for (i = 0; i <= 200; i++)
        {

            glClearColor(0.196078, 0.6, 0.8, 1.0);
            glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

            glColor3f(0.8, 0.498039, 0.196078);
            glBegin(GL_POLYGON);//core
            glVertex2f(237.5, 20.0 + i);
            glVertex2f(262.5, 20.0 + i);
            glVertex2f(262.5, 120.0 + i);
            glVertex2f(237.5, 120.0 + i);


            glEnd();

            glColor3f(1.0, 0.0, 0.0);//bonnet
            glBegin(GL_POLYGON);//front
            glVertex2f(237.5, 120.0 + i);
            glVertex2f(262.5, 120.0 + i);
            glVertex2f(250, 170.0 + i);
            glEnd();
            glColor3f(1.0, 0.0, 0.0);
```

```
glBegin(GL_POLYGON);//left_side_top
glVertex2f(237.5, 120.0 + i);
glVertex2f(217.5, 95.0 + i);
glVertex2f(237.5, 95.0 + i);
glEnd();
glBegin(GL_POLYGON);//left_side_bottom
glVertex2f(237.5, 20.0 + i);
glVertex2f(217.5, 20.0 + i);
glVertex2f(237.5, 70.0 + i);
glEnd();
glBegin(GL_POLYGON);//right_side_bottom
glVertex2f(262.5, 20.0 + i);
glVertex2f(282.5, 20.0 + i);
glVertex2f(262.5, 70.0 + i);
glEnd();
glBegin(GL_POLYGON);//right_side_top
glVertex2f(262.5, 120.0 + i);
glVertex2f(262.5, 95.0 + i);
glVertex2f(282.5, 95.0 + i);
glEnd();
glColor3f(0.556863, 0.137255, 0.419608);
glBegin(GL_POLYGON);//bottom_1_exhaust
glVertex2f(237.5, 20.0 + i);
glVertex2f(244.5, 20.0 + i);
glVertex2f(241, 0.0 + i);
glEnd();
glBegin(GL_POLYGON);//bottom_2_exhaust
glVertex2f(246.5, 20.0 + i);
glVertex2f(253.5, 20.0 + i);
glVertex2f(249.5, 0.0 + i);
glEnd();
glBegin(GL_POLYGON);//bottom_3_exhaust
glVertex2f(262.5, 20.0 + i);
glVertex2f(255.5, 20.0 + i);
glVertex2f(258.5, 0.0 + i);
glEnd();

if ((p % 2) == 0)
        glColor3f(1.0, 0.25, 0.0);
else
        glColor3f(1.0, 0.816, 0.0);

glBegin(GL_POLYGON);//outer fume
glVertex2f(237.5, 20 + i);
glVertex2f(234.16, 16.66 + i);
glVertex2f(230.82, 13.32 + i);
glVertex2f(227.48, 9.98 + i);
glVertex2f(224.14, 6.64 + i);
glVertex2f(220.8, 3.3 + i);
glVertex2f(217.5, 0 + i);
glVertex2f(221.56, -5 + i);
glVertex2f(225.62, -10 + i);
glVertex2f(229.68, -15 + i);
glVertex2f(233.74, -20 + i);
```

```
glVertex2f(237.8, -25 + i);
glVertex2f(241.86, -30 + i);
glVertex2f(245.92, -35 + i);
glVertex2f(250, -40 + i);
glVertex2f(254.06, -35 + i);
glVertex2f(258.12, -30 + i);
glVertex2f(262.18, -25 + i);
glVertex2f(266.24, -20 + i);
glVertex2f(270.3, -15 + i);
glVertex2f(274.36, -10 + i);
glVertex2f(278.42, -5 + i);
glVertex2f(282.5, 0 + i);
glVertex2f(278.5, 4 + i);
glVertex2f(274.5, 8 + i);
glVertex2f(270.5, 12 + i);
glVertex2f(266.5, 16 + i);
glVertex2f(262.5, 20 + i);//28 points
glEnd();

if ((p % 2) == 0)
        glColor3f(1.0, 0.816, 0.0);
else
        glColor3f(1.0, 0.25, 0.0);

glBegin(GL_POLYGON);//inner fume
glVertex2f(237.5, 20 + i);
glVertex2f(236.5, 17.5 + i);
glVertex2f(235.5, 15 + i);
glVertex2f(234.5, 12.5 + i);
glVertex2f(233.5, 10 + i);
glVertex2f(232.5, 7.5 + i);
glVertex2f(236, 5 + i);
glVertex2f(239.5, 2.5 + i);
glVertex2f(243, 0 + i);
glVertex2f(246.5, -2.5 + i);
glVertex2f(250, -5 + i);
glVertex2f(253.5, -2.5 + i);
glVertex2f(257, 0 + i);
glVertex2f(260.5, 2.5 + i);
glVertex2f(264, 5 + i);
glVertex2f(267.5, 7.5 + i);
glVertex2f(266.5, 10 + i);
glVertex2f(265.5, 12.5 + i);
glVertex2f(264.5, 15 + i);
glVertex2f(263.5, 17.5 + i);
glVertex2f(262.5, 20 + i);//21 points

glEnd();
p = p + 1;
for (j = 0; j <= 1500000; j++)
        ;
glutSwapBuffers();
glutPostRedisplay();
glFlush();
```

```
		}
	}

	void rocket_to_cam_pos1()
	{
		count++;
		count3++;

		for (i = 0; i <= 200; i++)
		{

			glClearColor(0.196078, 0.6, 0.8, 1.0);
			glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

			glColor3f(0.8, 0.498039, 0.196078);
			glBegin(GL_POLYGON);//core
			glVertex2f(237.5, 20.0 + i);
			glVertex2f(262.5, 20.0 + i);
			glVertex2f(262.5, 120.0 + i);
			glVertex2f(237.5, 120.0 + i);


			glEnd();

			glColor3f(1.0, 1.0, 0.0);//bonnet
			glBegin(GL_POLYGON);//front
			glVertex2f(237.5, 120.0 + i);
			glVertex2f(262.5, 120.0 + i);
			glVertex2f(250, 170.0 + i);
			glEnd();
			glColor3f(1.0, 1.0, 0.0);
			glBegin(GL_POLYGON);//left_side_top
			glVertex2f(237.5, 120.0 + i);
			glVertex2f(217.5, 95.0 + i);
			glVertex2f(237.5, 95.0 + i);
			glEnd();
			glBegin(GL_POLYGON);//left_side_bottom
			glVertex2f(237.5, 20.0 + i);
			glVertex2f(217.5, 20.0 + i);
			glVertex2f(237.5, 70.0 + i);
			glEnd();
			glBegin(GL_POLYGON);//right_side_bottom
			glVertex2f(262.5, 20.0 + i);
			glVertex2f(282.5, 20.0 + i);
			glVertex2f(262.5, 70.0 + i);
			glEnd();
			glBegin(GL_POLYGON);//right_side_top
			glVertex2f(262.5, 120.0 + i);
			glVertex2f(262.5, 95.0 + i);
			glVertex2f(282.5, 95.0 + i);
			glEnd();
			glColor3f(0.556863, 0.137255, 0.419608);
			glBegin(GL_POLYGON);//bottom_1_exhaust
			glVertex2f(237.5, 20.0 + i);
```

```
glVertex2f(244.5, 20.0 + i);
glVertex2f(241, 0.0 + i);
glEnd();
glBegin(GL_POLYGON);//bottom_2_exhaust
glVertex2f(246.5, 20.0 + i);
glVertex2f(253.5, 20.0 + i);
glVertex2f(249.5, 0.0 + i);
glEnd();
glBegin(GL_POLYGON);//bottom_3_exhaust
glVertex2f(262.5, 20.0 + i);
glVertex2f(255.5, 20.0 + i);
glVertex2f(258.5, 0.0 + i);
glEnd();

if ((p % 2) == 0)
        glColor3f(1.0, 0.25, 0.0);
else
        glColor3f(1.0, 0.816, 0.0);

glBegin(GL_POLYGON);//outer fume
glVertex2f(237.5, 20 + i);
glVertex2f(234.16, 16.66 + i);
glVertex2f(230.82, 13.32 + i);
glVertex2f(227.48, 9.98 + i);
glVertex2f(224.14, 6.64 + i);
glVertex2f(220.8, 3.3 + i);
glVertex2f(217.5, 0 + i);
glVertex2f(221.56, -5 + i);
glVertex2f(225.62, -10 + i);
glVertex2f(229.68, -15 + i);
glVertex2f(233.74, -20 + i);
glVertex2f(237.8, -25 + i);
glVertex2f(241.86, -30 + i);
glVertex2f(245.92, -35 + i);
glVertex2f(250, -40 + i);
glVertex2f(254.06, -35 + i);
glVertex2f(258.12, -30 + i);
glVertex2f(262.18, -25 + i);
glVertex2f(266.24, -20 + i);
glVertex2f(270.3, -15 + i);
glVertex2f(274.36, -10 + i);
glVertex2f(278.42, -5 + i);
glVertex2f(282.5, 0 + i);
glVertex2f(278.5, 4 + i);
glVertex2f(274.5, 8 + i);
glVertex2f(270.5, 12 + i);
glVertex2f(266.5, 16 + i);
glVertex2f(262.5, 20 + i);//28 points
glEnd();

if ((p % 2) == 0)
        glColor3f(1.0, 0.816, 0.0);
else
        glColor3f(1.0, 0.25, 0.0);
```

```
                glBegin(GL_POLYGON);//inner fume
                glVertex2f(237.5, 20 + i);
                glVertex2f(236.5, 17.5 + i);
                glVertex2f(235.5, 15 + i);
                glVertex2f(234.5, 12.5 + i);
                glVertex2f(233.5, 10 + i);
                glVertex2f(232.5, 7.5 + i);
                glVertex2f(236, 5 + i);
                glVertex2f(239.5, 2.5 + i);
                glVertex2f(243, 0 + i);
                glVertex2f(246.5, -2.5 + i);
                glVertex2f(250, -5 + i);
                glVertex2f(253.5, -2.5 + i);
                glVertex2f(257, 0 + i);
                glVertex2f(260.5, 2.5 + i);
                glVertex2f(264, 5 + i);
                glVertex2f(267.5, 7.5 + i);
                glVertex2f(266.5, 10 + i);
                glVertex2f(265.5, 12.5 + i);
                glVertex2f(264.5, 15 + i);
                glVertex2f(263.5, 17.5 + i);
                glVertex2f(262.5, 20 + i);//21 points

                glEnd();
                p = p + 1;
                for (j = 0; j <= 1000000; j++);
                glutSwapBuffers();
                glutPostRedisplay();
                glFlush();
        }
}

void rocket_in_motion()
{
        count++;


        for (i = 195; i <= 200; i++)
        {
                if (count >= 5)
                {
                        glClearColor(0.0, 0.0, 0.0, 1.0);
                        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
                        if (flag1 == 0)
                        {
                                stars();
                                flag1 = 1;
                        }
                        else
                        {
                                stars1();

                                flag1 = 0;
```

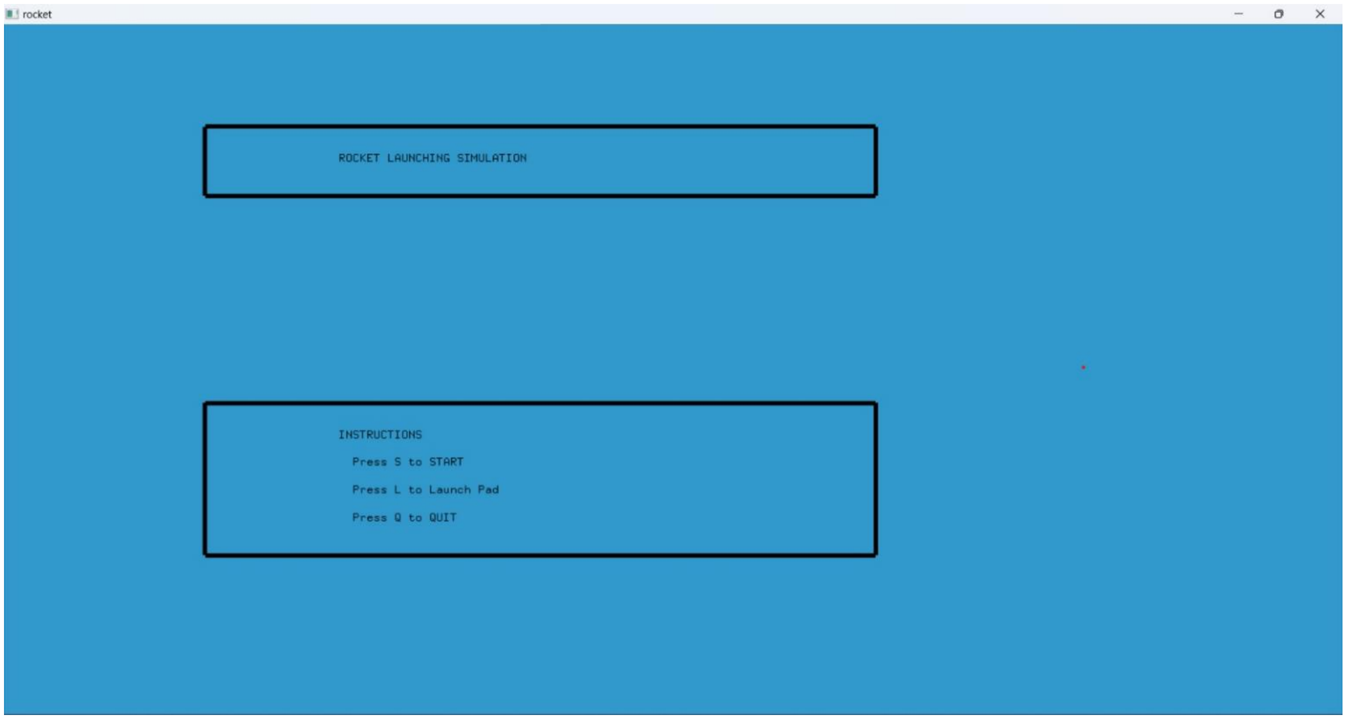
```
		}

	}
	else
	{
		glClearColor(0.196078, 0.6, 0.8, 1.0);
		glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
	}
	if (count >= 360)
		mars(60.0);

	if (count >= 240)
		mars1(10.0);


	if (count <= 180) {
		glColor3f(0.8, 0.498039, 0.196078);
		glBegin(GL_POLYGON);//core
		glVertex2f(237.5, 20.0 + i);
		glVertex2f(262.5, 20.0 + i);
		glVertex2f(262.5, 120.0 + i);
		glVertex2f(237.5, 120.0 + i);
		glEnd();
	}

	if (count >= 220) {
		static int k = i;
		glColor3f(0.6, 0.8, 1);//satellite
		glBegin(GL_POLYGON);//core
		glVertex2f(237.5, 150.0 + k);
		glVertex2f(252.5, 150.0 + k);
		glVertex2f(252.5, 120.0 + k);
		glVertex2f(237.5, 120.0 + k);
		glEnd();

		glColor3f(0, 0, 1);
		glBegin(GL_POLYGON);//side-panels
		glVertex2f(237.5, 140.0 + k);
		glVertex2f(230, 140.0 + k);
		glVertex2f(230, 130.0 + k);
		glVertex2f(237.5, 130.0 + k);

		glVertex2f(262.5, 140.0 + k);
		glVertex2f(227.5, 140.0 + k);
		glVertex2f(227.5, 130.0 + k);
		glVertex2f(262.5, 130.0 + k);
		glEnd();
	}

	else {
		glColor3f(1.0, 0.0, 0.0);//bonnet
		glBegin(GL_POLYGON);//front
		glVertex2f(237.5, 120.0 + i);
		glVertex2f(262.5, 120.0 + i);
```

```
        glVertex2f(250, 170.0 + i);
        glEnd();
}

if (count <= 150) {
        glColor3f(1.0, 0.0, 0.0);
        glBegin(GL_POLYGON);//left_side_top
        glVertex2f(237.5, 120.0 + i);
        glVertex2f(217.5, 95.0 + i);
        glVertex2f(237.5, 95.0 + i);
        glEnd();

        glBegin(GL_POLYGON);//right_side_top
        glVertex2f(262.5, 120.0 + i);
        glVertex2f(262.5, 95.0 + i);
        glVertex2f(282.5, 95.0 + i);
        glEnd();
}

if (count <= 130) {
        glColor3f(1.0, 0.0, 0.0);
        glBegin(GL_POLYGON);//left_side_top
        glVertex2f(237.5, 120.0 + i);
        glVertex2f(217.5, 95.0 + i);
        glVertex2f(237.5, 95.0 + i);
        glEnd();
        glBegin(GL_POLYGON);//left_side_bottom
        glVertex2f(237.5, 20.0 + i);
        glVertex2f(217.5, 20.0 + i);
        glVertex2f(237.5, 70.0 + i);
        glEnd();
        glBegin(GL_POLYGON);//right_side_bottom
        glVertex2f(262.5, 20.0 + i);
        glVertex2f(282.5, 20.0 + i);
        glVertex2f(262.5, 70.0 + i);
        glEnd();
        glBegin(GL_POLYGON);//right_side_top
        glVertex2f(262.5, 120.0 + i);
        glVertex2f(262.5, 95.0 + i);
        glVertex2f(282.5, 95.0 + i);
        glEnd();
}

if (count <= 100) {
        glColor3f(0.556863, 0.137255, 0.419608);
        glBegin(GL_POLYGON);//bottom_1_exhaust
        glVertex2f(237.5, 20.0 + i);
        glVertex2f(244.5, 20.0 + i);
        glVertex2f(241, 0.0 + i);
        glEnd();
        glBegin(GL_POLYGON);//bottom_2_exhaust
        glVertex2f(246.5, 20.0 + i);
        glVertex2f(253.5, 20.0 + i);
        glVertex2f(249.5, 0.0 + i);
```

```
				glEnd();
				glBegin(GL_POLYGON);//bottom_3_exhaust
				glVertex2f(262.5, 20.0 + i);
				glVertex2f(255.5, 20.0 + i);
				glVertex2f(258.5, 0.0 + i);
				glEnd();
			}

			for (j = 0; j <= 2000000; j++);
			glutSwapBuffers();
			glutPostRedisplay();
			glFlush();
		}
}

void mars(float radius)
{


		glBegin(GL_POLYGON);
		glColor3f(0.556863, 0.137255, 0.419608);
		for (int i = 0; i <= 359; i++)
		{
			float degInRad = i * DEG2RAD;
			glVertex2f(300 + f + cos(degInRad) * radius, 500 - t + (sin(degInRad))

				* radius);//100,100 specifies centre of the circle
		}

		glEnd();
		t = t + 0.1;
		f = f + 0.1;
}
void mars1(float radius)
{


		glBegin(GL_POLYGON);
		glColor3f(1, 1.0, 1.0);
		for (int i = 0; i <= 359; i++)
		{
			float degInRad = i * DEG2RAD;
			glVertex2f(10 + f + cos(degInRad) * radius, 100 - t + (sin(degInRad))

				* radius);//100,100 specifies centre of the circle
		}

		glEnd();
		t = t + 0.1;
		f = f + 0.1;
}

//keys that trigger manual Lanch
void keyboard(unsigned char key, int x, int y)
```

```
{
	if (key == 'S' || key == 's') {
		for (int i = 0; i < 100; i++)
			static_rocket();
		flag = 1;

	}

	if (key == 'L' || key == 'l')
	{
		for (int i = 0; i < 100; i++)
			static_rocket();
	}

	if (key == 'Q' || key == 'q')
		exit(0);

}

//design of homescreen
void page()
{
	glColor3f(0, 0, 0);
	glLineWidth(5);
	glBegin(GL_LINE_LOOP);
	glVertex2d(75, 375);
	glVertex2d(325, 375);
	glVertex2d(325, 425);
	glVertex2d(75, 425);
	glEnd();


	//const_cast<char*>("ROCKET LAUNCHING SIMULATION")
	drawstring(125, 400, const_cast<char*>("ROCKET LAUNCHING SIMULATION"));

	glBegin(GL_LINE_LOOP);
	glVertex2d(75, 115);
	glVertex2d(325, 115);
	glVertex2d(325, 225);
	glVertex2d(75, 225);
	glEnd();

	drawstring(125, 200, const_cast <char*>("INSTRUCTIONS"));
	drawstring(130, 180, const_cast <char*>("Press S to START"));
	drawstring(130, 140, const_cast <char*>("Press Q to QUIT"));
	drawstring(130, 160, const_cast <char*>("Press L to Launch Pad"));
	//drawstring(100, 100, const_cast <char*>("Press Q to quit"));
	glFlush();
}

//display all components
void display()
{
	if (flag == 0)
	{
		glClear(GL_COLOR_BUFFER_BIT);
		page();
		glutSwapBuffers();
	}
	else
		control();
	glFlush();
}


void myinit()
{
	//int i;
	glClearColor(0.196078, 0.6, 0.8, 1.0);


	glPointSize(1.0);
	gluOrtho2D(0.0, 499.0, 0.0, 499.0);
}


int main(int argc, char* argv[])
{
	glutInit(&argc, argv);
	glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB);
	glutInitWindowSize(600, 600);
	glutCreateWindow("rocket");
	myinit();
	glutKeyboardFunc(keyboard);
	glutDisplayFunc(display);
	glutIdleFunc(display);



	glutMainLoop();
	return 0;
}
```

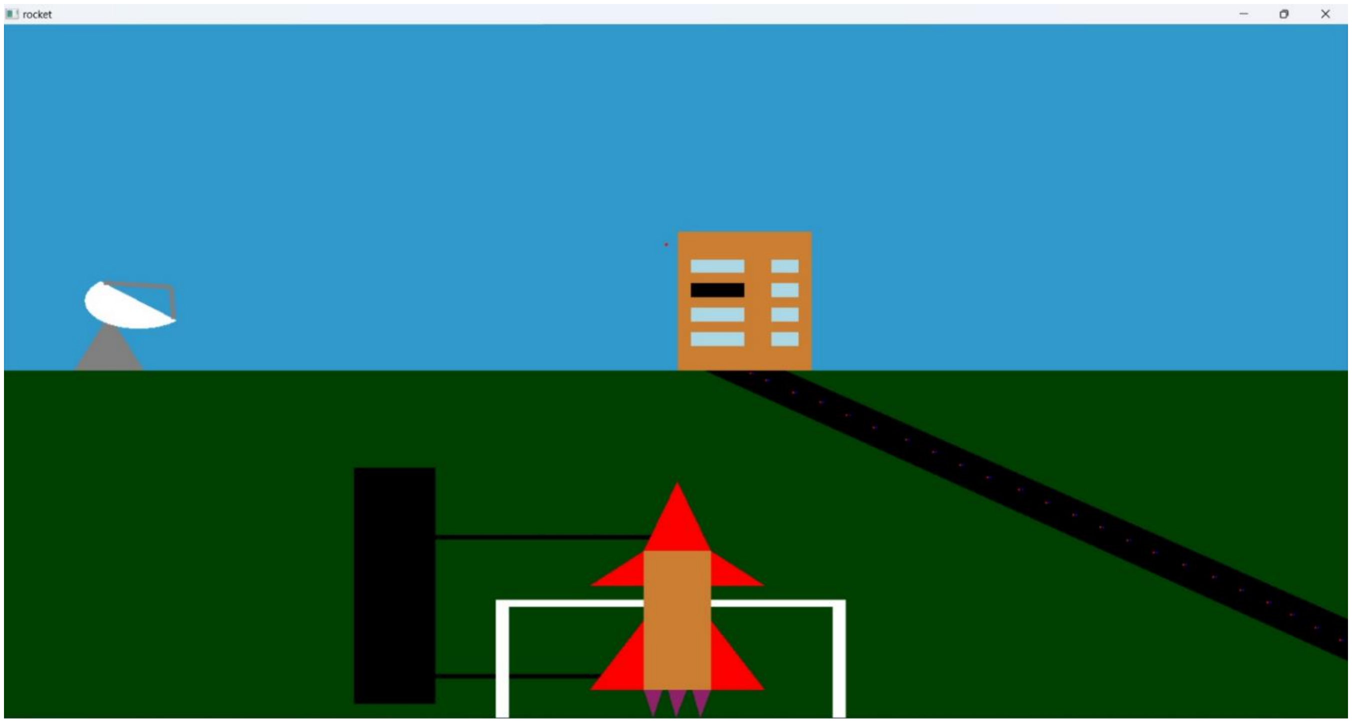
5. Output/Screenshots

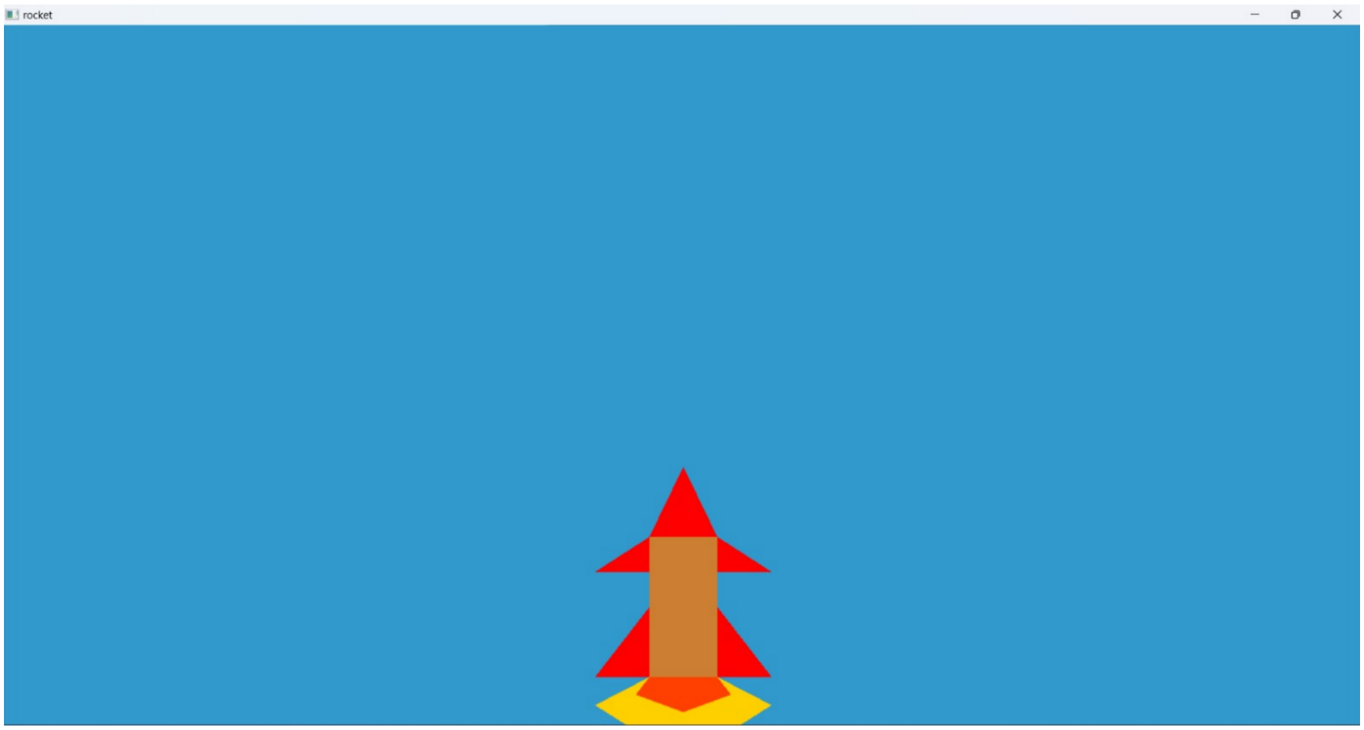


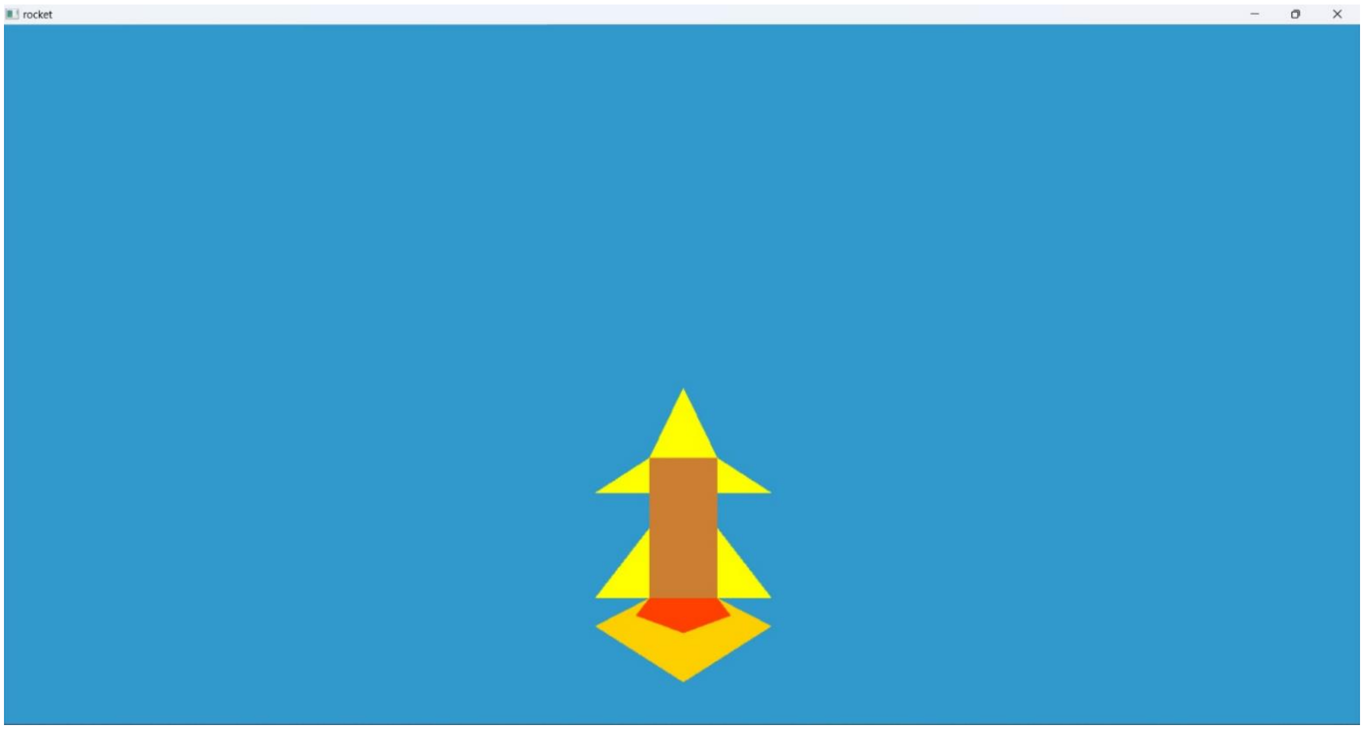
rocket

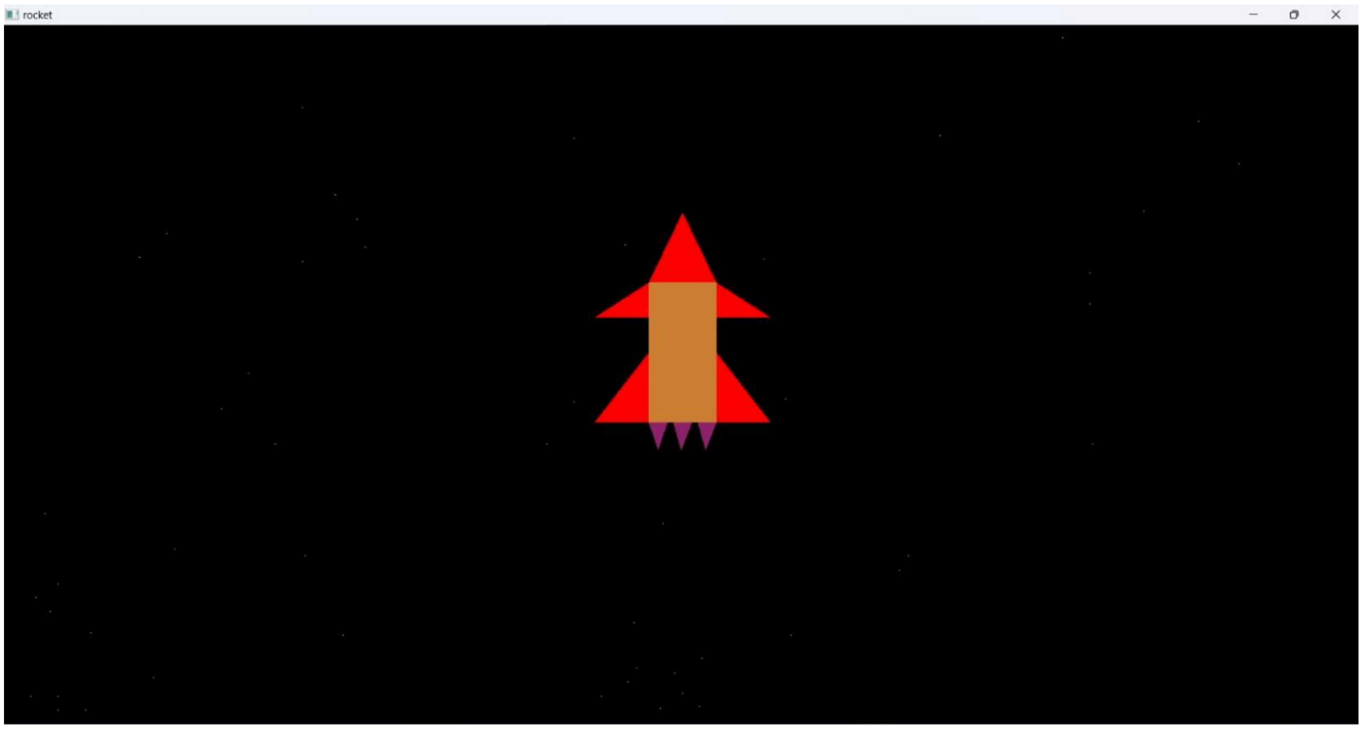
ROCKET LAUNCHING SIMULATION

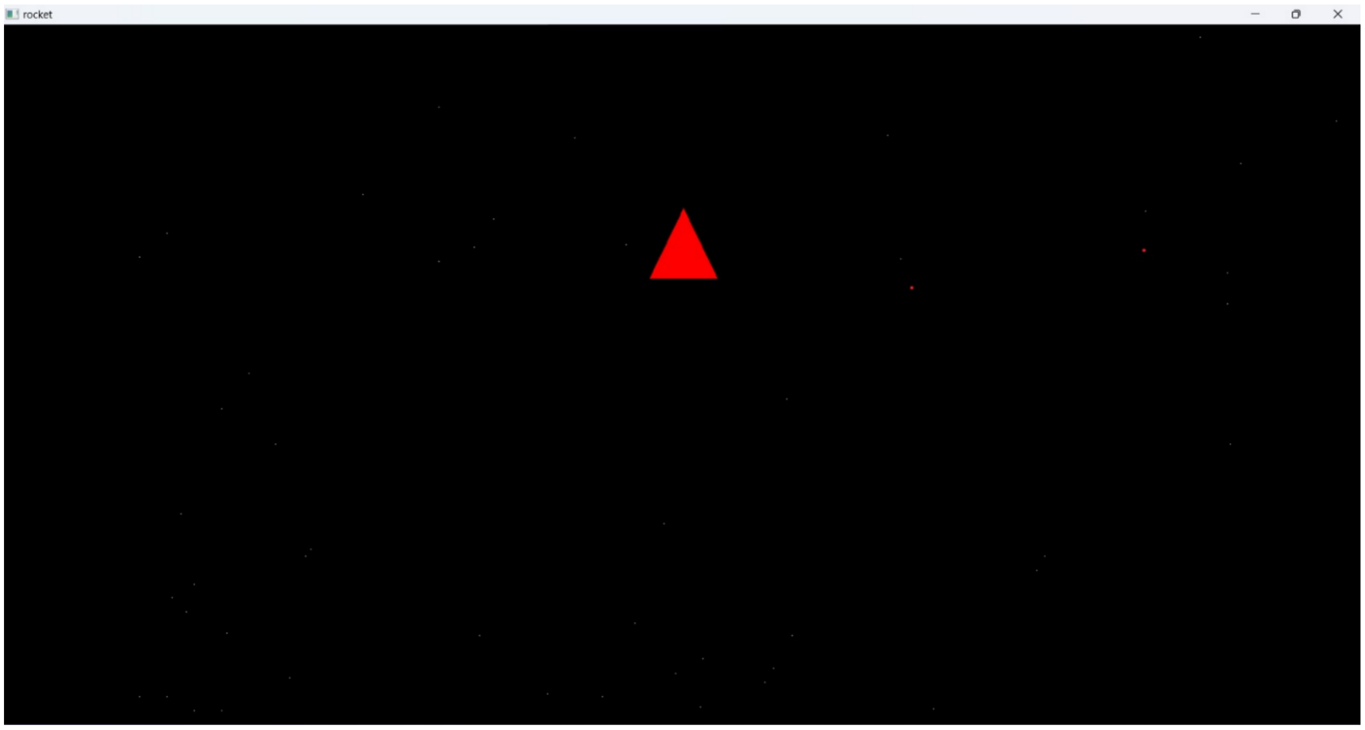
INSTRUCTIONS
  Press S to START
  Press L to Launch Pad
  Press Q to QUIT

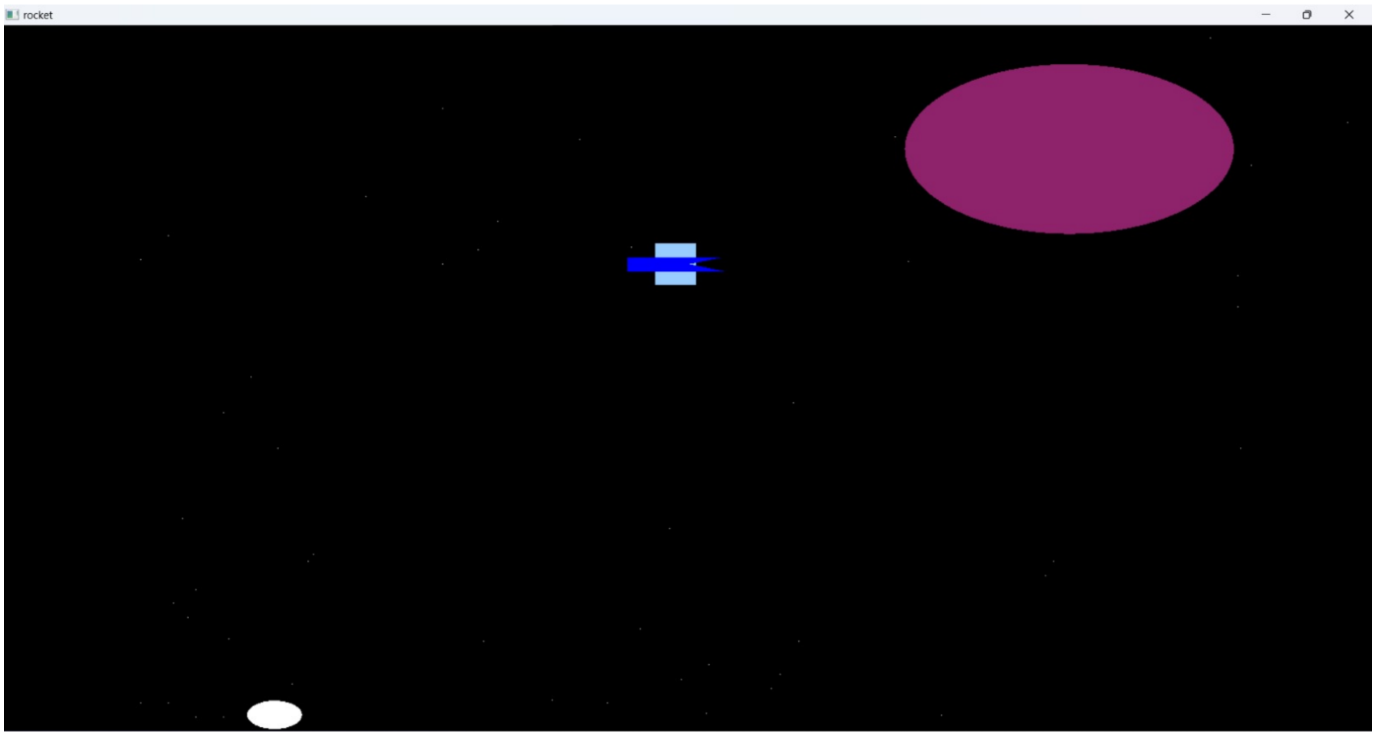



rocket


rocket


rocket


rocket


rocket