3D-Physics Animation on Kepler Motion between Sun and Earth

REPORT

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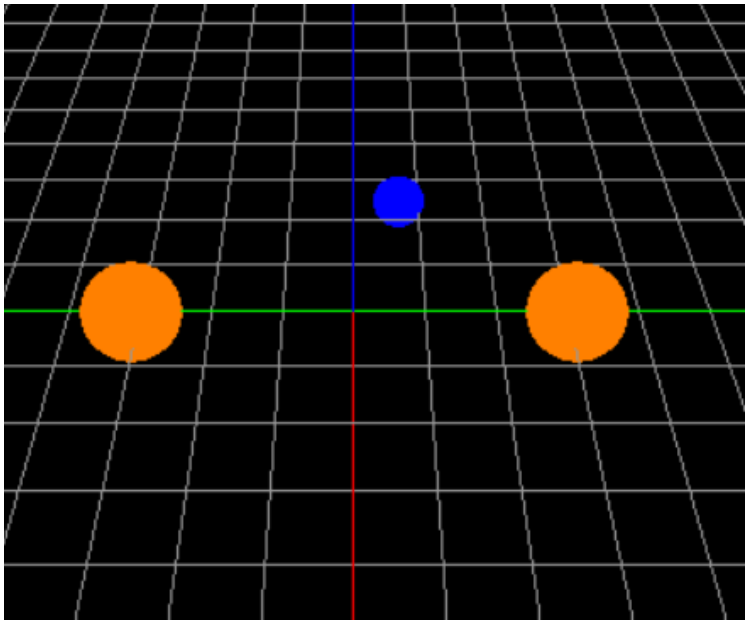
ANIMATION DESCRIPTION

This report is on 3D-Physics Animation on Kepler Motion between Sun and Earth. There is a Sun (orange color) and an Earth (blue color). The position of the Sun is fixed, the center of the sun or the Foci of the sun is located at +ae and -ae. $Foci = (\pm ae, 0) = Center\ of\ sun$

Where we calculated the **"e"** by the given formula, $e = \sqrt{1 - \frac{b^2}{a^2}}$ where **e<1 and a>b**.

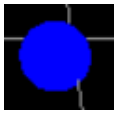
On the other hand, the Earth rotates around the sun continuously changing its "X" and "Y" coordinate value which is calculated by the following functions **X=a Cos(t)** and **Y=b Sin(t)** and as time passes by the value of the **"t"** increases as well at a constant speed making the Earth's "X" and "Y" coordinate to change causing the Kepler Motion between Sun and Earth.

Kepler Motion between Sun and Earth



Entities

Sun



Earth

Display and Animate Code Explanation

Global Variables

All the global Variables are shown in Fig-1. Where variable “t” is the time and variable “x” and “y” is the Center(x,y)coordinate value of the Earth.

```
float t = 0;
float a=40.0;
float b=25.0;
float x=80;
float y=-150;
float a_square,b_square;
float result,center_of_sun;
float e;
```

Fig-1

Display Code Explanation

In **Display function** we only call the **draw ()** function which is responsible for the drawing of Sun and Earth. At first, we calculated the square value of b and store it into a variable name b_square and then we calculated the square of a and the stored it into a_square variable. Then we calculated result of 1-(b_square/a_square) into result variable and then we square root the result variable in order to get the value of “e”, then we take center_of_sun variable in which we store the value of “a*e”.

At first we draw the Sun by calling the **drawSphere()** function having a radius of 7 and then we color the sun orange and then we translate the Sun by calling the **glTranslated(center_of_sun,0,0)** which is translated only along “x” axis. Then we create another sun having same radius just only **glTranslated(-center_of_sun,0,0)** translated negative of “x” axis as center of the sun is (+ae and -ae).

```
void draw()
{
  /// e= root over (1-(b_square/a_square))
    b_square=b*b;
    a_square=a*a;
    result= 1-(b_square/a_square);
    e= sqrt(result);
    center_of_sun= a*e;

    ///Sun1
    glPushMatrix();

        glTranslated(center_of_sun,0,0);
        glColor3f(1,0.5,0);
        drawSphere(7, 40, 40);
    glPopMatrix();

    ///Sun2
    glPushMatrix();
        glTranslated(-center_of_sun,0,0);
        glColor3f(1,0.5,0);
        drawSphere(7, 40, 40);
    glPopMatrix();

    ///earth
     glPushMatrix();
        glTranslated(x,y,0);
        glColor3f(0,0,1);
        drawSphere(4, 40, 40);
    glPopMatrix();
}
```

Fig-2

Then we draw the Earth by calling the **drawSphere()** function having a radius of 4 and color it with blue and then translated it by **calling glTranslated(x,y,0)** which only translates along “x” and “y” axis only.

Animate Code Explanation

```
void animate(){
    t += 0.002;

    x= a*cos(t);
    y= b*sin(t);

    //codes for any changes in Models, Camera
    glutPostRedisplay(); // marks the current window as needing to be redisplayed
}
```

Fig-3

Animate () function is responsible for the animation. In Animation function we increase the value of the "t" which is the time at a constant rate as time passes by, then we calculated the value of "x" and "y" which is the center(x,y) of the Earth which is being translated depending on the function of x and y due to these functions of "x" and "y" the Earth rotates around the sun as it is being translated depending on the x and y and as time passes by the x and y changes of the earth causing Kepler motion between Sun and Earth.

CONCLUSION

The Sun's location is fixed, and its focal points (+ae and -ae) are at these coordinates. On the other hand, as the Earth rotates around the sun, its "X" and "Y" coordinate values change continuously. These values are determined by the following equations: X=a Cos(t) and Y=b Sin(t), and as time passes, the value of "t" increases as well at a constant speed, causing the Earth's "X" and "Y" coordinate to change and resulting in the Kepler Motion between the Sun and Earth.