COMPUTER GRAPHICS MINIPROJECT REPORT

on

Simulation of Projectile

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COMP411

Prepared by
AbhishekBhatta(14)
DoCSE

Submitted to
DhirajShrestha
Lecturer, *DoCSE*

Kathmandu University
Dhulikhel, Kavre

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1 Introduction

Projectile motion is a form of motion in which an object or particle (called a projectile) is thrown near the earth's surface, and it moves along a curved path under the action of gravity only. The thrown body is called the Projectile.

The project is the 3-Dimensional simulation of projectile that will help us to study the motion of the body under the effect of gravity when various initial conditions like initial velocity, initial angle of projection and initial height of the body are varied.

1.1 Background:

We often experience many kinds of motions in our daily life. Projectile motion is one among them. A projectile is some object thrown in air or space. The Curved path along which the projectile travels is what is known as trajectory.

Projectile Motion is the free fall motion of any body in a horizontal path with constant velocity.

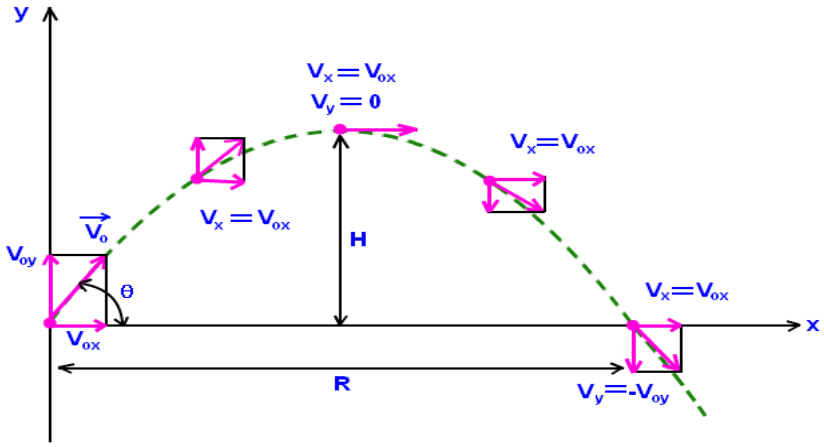

Figure 1.1: Projectile Motion

Projectile Motion Formula (trajectory formula) is given by

$$HorizontalDistance, x = V_x t$$

$$HorizontalVelocity, V_x = V_{x0}$$

$$VerticalDistance, y = V_y t - \frac{1}{2} g t^2$$

$$VerticalVelocity, y = V_{y0} - gt$$

where,
V_x is the velocity along x-axis,
V_{x0} is the initial velocity along x-axis,
V_y is the velocity along y-axis,

V_{y0} is the initial velocity along y-axis.
g is the acceleration due to gravity and
t is the time taken.

1.2 Objectives

1. To throw an object from different height and study its motion under gravity.
2. To change the initial parameters of the projectile motion and compare the output.
3. To calculate the maximum height travelled, maximum distance travelled and time of flight of the projectile.

1.3 Applications

1. Simulator can be used for research and testing.
2. It can be used for educational purpose.
3. It can be used for millitary purpose for simulation of missiles.

2 Implementation

2.1 Basic Algorithm:

1. Set initial position of object, initial velocity(V), angle of projection(θ)
2. Set initial time $t = 0$ and increment in time $dt = 0.0001s$.
3. Calculate vertical and horizontal component of initial velocity at time t.

$$V_x = V * \cos(\theta)$$

$$V_y = V * \sin(\theta)$$

4. Increment time $t = t + dt$
5. The vertical acceleration due to gravity is $g = -9.8m/s^2$.
6. Calculate vertical velocity due to gravity which is $g * t$.
7. Add the velocities of the body due to initial velocity and due to gravity in corresponding components of velocity which gives the resultant velocity.

$$V_x = V_x + 0$$

$$V_y = V_y + g * t$$

8. Calculate the position of object using

$$x\_distance = x\_velocity * t$$

$$y\_distance = y\_velocity * t$$

9. Repeat 3 until y_distance reaches to ground. i.e. $y\_distance < 0$

2.2 Platform Used:

2.2.1 Python:

The Python Programming Language is used for the development for the application. The main reason behind using this particular language is that it is easy to understand and supports various libraries that are quite easy for development of 3D enviroment.

2.2.2 VPython

Vpython is a free, open-source module for producing real-time 3D scenes with Python. The concept of vectors is used to store the 3-dimensional information of the object.

3 Output

The output of the program is the GUI based simulation software that asks the user for the initial velocity, initial angle of projection and initial height of projection of the object. The GUI contains the 3D view of Dharahara which is used as the height from where the object is projected.

Arrows are used to indicate the vertical and horizontal component of the velocity at different instant of time. The arrows length are adjusted accordingly as the component of velocity varies at different instant. This gives the idea how velocity varies at different instant of times.

The program begins with a keystroke by the user. The motion of the body is paused when it reaches the maximum height. It requires a further keystroke to continue. When the body finally reaches the floor, various output parameters like range, time of flight and maximum height reached by the object are displayed in the screen.

The various screenshots of the output are shown below:

3.1 Screenshots:

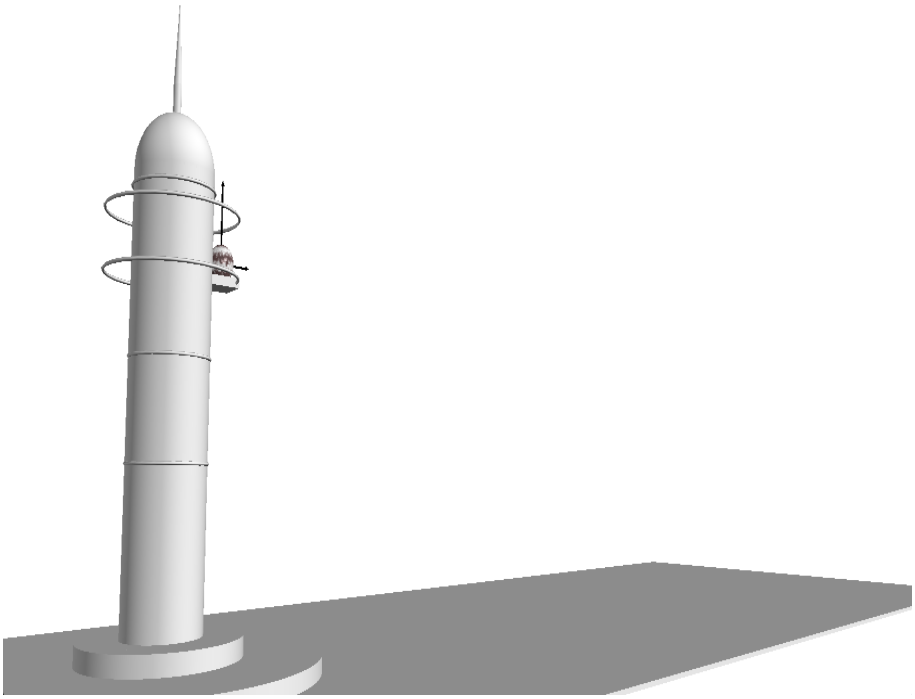

Figure 3.1: Initial State before motion starts

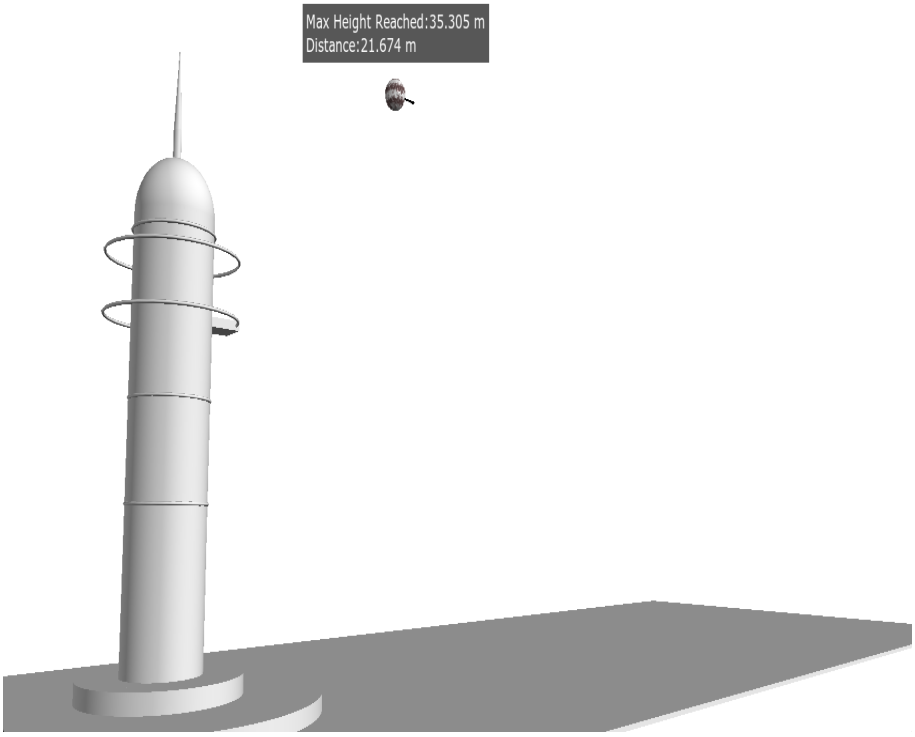

Figure 3.2: Ball reached the maximum height

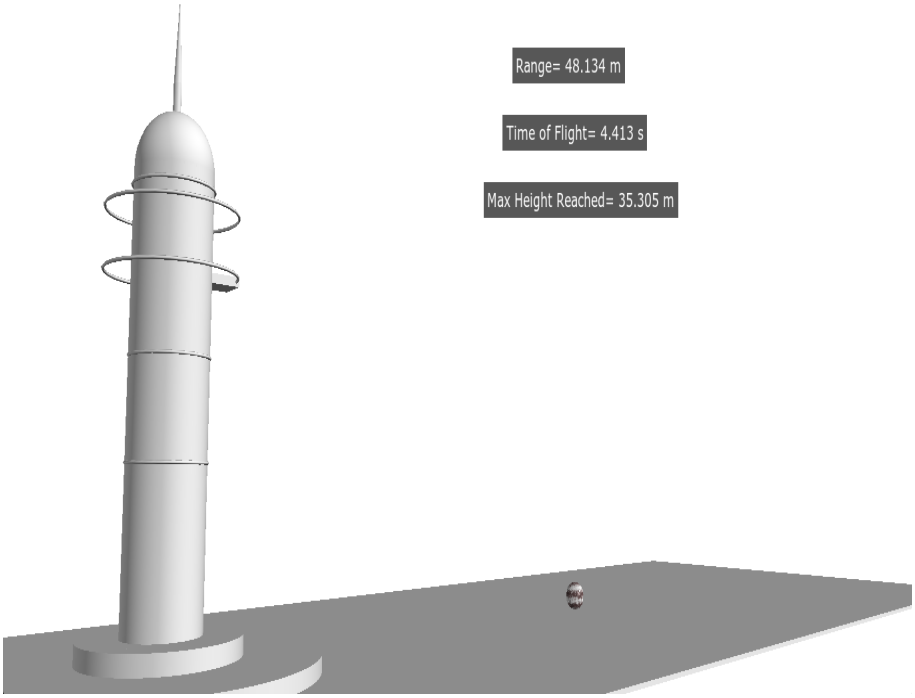

Figure 3.3: Final state when the ball reaches ground

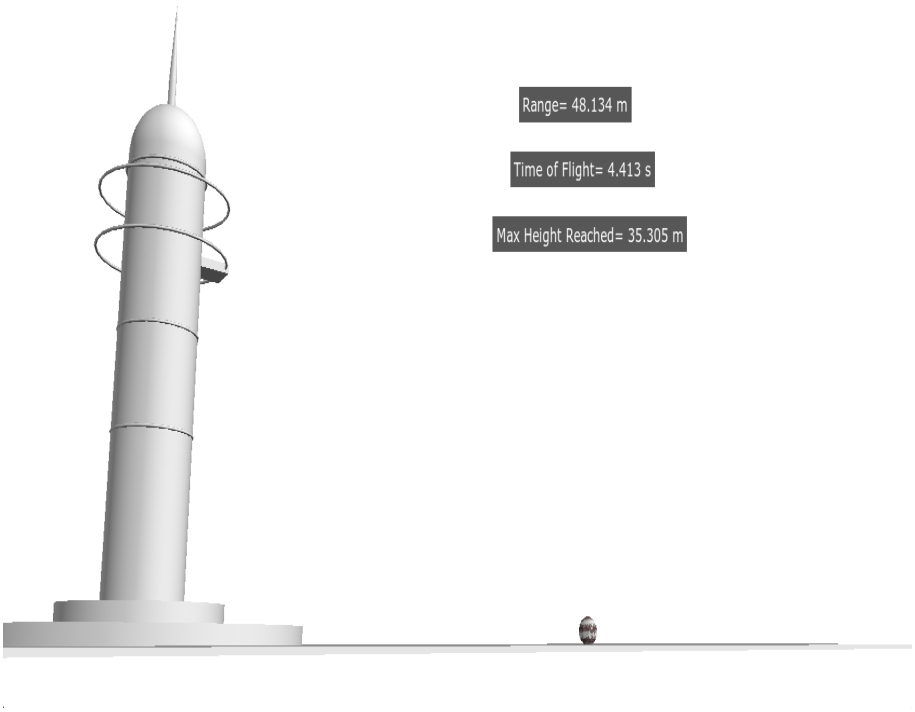

Figure 3.4: Final State

4 Conclusion

The simulator can be used for various academic and reseach purposes. The simulator however is incomplete. The various factors like wind, air friction and rotation of the ball can be incorporated to make the motion more realistic and accurate. Also the interface can be enhanced with adding widgets like buttons, textboxes and sliders to set the intitial parameters of the program.

However the simulator gives you the basic and essential concept of the projectile. It can be used in the real life applications.