Projectile Motion

Steps to follow-

1. After selecting this option, the camera of the device will open.
2. Place the camera on top of the image target given for projectile motion.
3. User will find a ball and a target plan for observing the projectile motion (Fig.1 (a)).
4. There are two options that can be varied by the user. One is the "Angle of Throw" and another one is "Target Distance". By choosing specific values for these parameters', user can define initial velocity, horizontal velocity, vertical velocity and time of flight (Fig. 1 (b)).

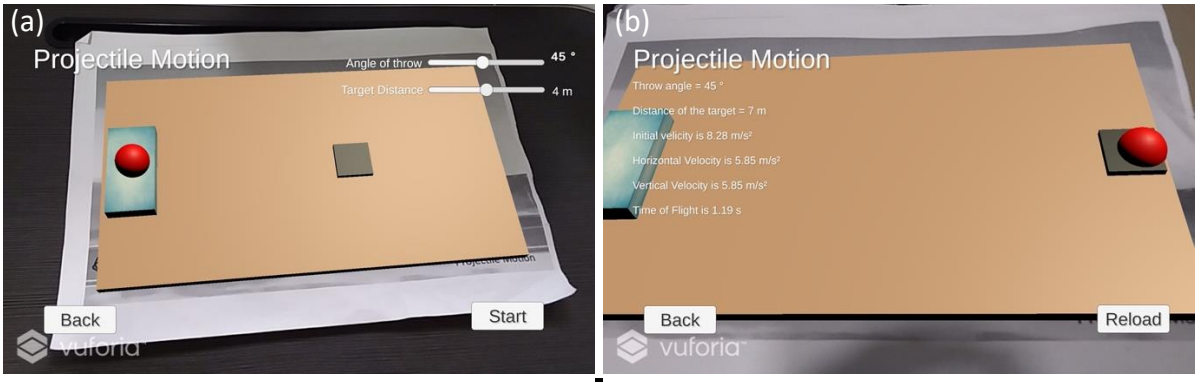

Fig.1 Projectile Motion Module (a) before pressing the "start" button and (b) after pressing "start" button.

Theory

Projectile motion is a form of motion where an object moves in a bilaterally symmetrical, parabolic path. The path that the object follows is called its trajectory. Projectile motion only occurs when there is one force applied at the beginning on the trajectory, after which the only interference is from gravity ($g=9.8ms^{-2}$).

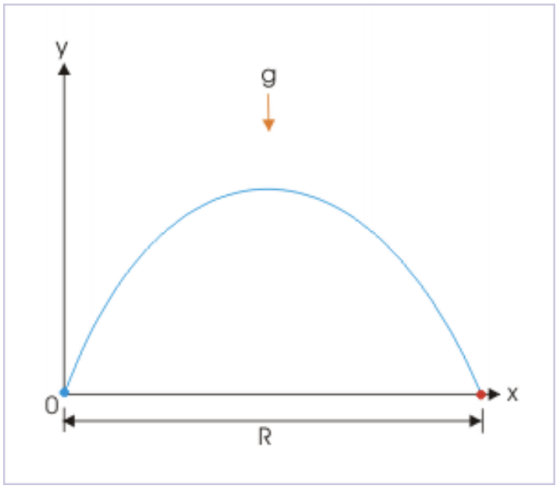

Fig. 2 Projectile motion

Initial Velocity

The distance of the target (R) is fixed by the condition y = 0 (fig. 2). From this, the initial velocity equation can be found:

$$u = \sqrt{\frac{R \times g}{sin2\theta}}$$

where, R = distance of the target, g = gravity (9.8 ms^{-2}) and θ refers to projectile angle

The initial velocity can be expressed as horizontal (u_x) and vertical (u_y) components-

$$u_x = u \times cos\theta$$

$$u_y = u \times sin\theta$$

Time of Flight

The time of flight of a projectile motion is the time from when the object is projected to the time it reaches the surface. T depends on the initial velocity magnitude and the angle of the projectile:

$$T = \frac{2 \times u \times sin\theta}{g}$$