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# SPACE BALL 2D GAME

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***ABSTRACT:*** *This paper describes a 2D game named as "SPACE BALL" which is a mini game implemented using Java Language and Real Life Physics. This game involves a space scenario and a ball bouncing on surface with fire. The game has been designed to be played on Internet. The game appears as a Java Applet on the Web Page. An Applet is a small Internet-based program written in Java. The paper also describes the basic concepts of Physics used in implementing this game. The game is based on the Principle of Collision of a ball with a surface.*

***Keywords:-*** *Collision, Bouncing Ball, Jumping Ball, Gaming Physics.*

## I. INTRODUCTION

Almost everybody, at some point in their lives, has bounced a rubber ball against the wall or floor and observed its motion. Normally we don't think about the physics of bouncing balls too much as it's fairly obvious what is happening — the ball basically rebounds off a surface at a speed proportional to how fast it is thrown. But what isn't known to most is that what is specifically happening to the ball before, during, and after its brief impact with the surface.

The idea came from the concept of "Surface Collision" in Physics and decided why not to implement it using programming. Keeping Collision as a base concept the game has been implemented. The game is based on principle of bouncing ball.

## II. USING REAL LIFE PHYSICS

To begin this explanation let's first consider what happens to a typical rubber ball that is dropped vertically onto a flat horizontal surface, and which falls under the influence of gravity.

In this explanation, the bouncing ball physics will be broken down into seven distinct stages, in which the ball motion (before, during, and after impact) is analyzed. To simplify the discussion let's assume that the bounce surface is hard (rigid), and that air resistance is negligible.

Let's define geometric center of ball as point C, velocity of point C as V and the acceleration of point C as 'a'. Let's further assume that the ball has uniform density, which means that point C of the ball coincides with its center of mass.

### Stage 1

In this stage, the ball falls vertically downward under the influence of gravity ($g$). The velocity $V$ points downward. The acceleration $a$ also points downward. The magnitude of $a$ is equal to $g$, in the absence of air resistance. (Note that the acceleration due to gravity is $g = 9.8$ m/s$^2$, on earth).

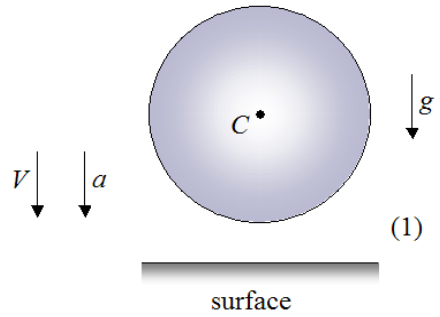



Fig (1).Ball falling fast under influence of Gravity.

**Stage 2**

In this stage, the ball begins to make contact with the surface. It continues to fall vertically downward under the influence of gravity. The velocity *V* and acceleration *a* (equal to *g*) both continue to point downward**.**

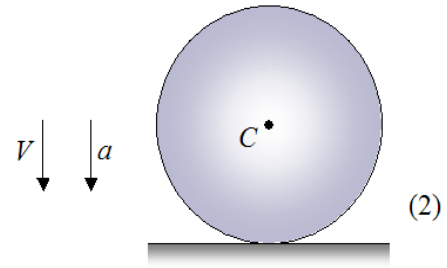



Fig (2). Ball making contact with the surface.

**Stage 3**

In this stage, the ball has slowed down. The velocity *V* is still pointing downward. However, the ball has deformed sufficiently such that the acceleration *a* is now pointing upward. This means that the ball has deformed enough such that it's pushing against the surface with a force greater than its own weight. As a result, the acceleration *a* is pointing upward**.**

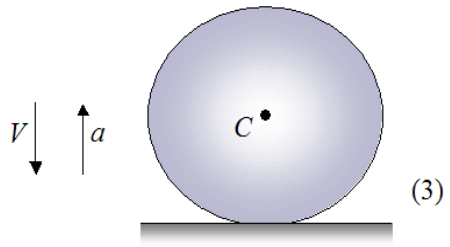



Fig (3).Ball started Deforming.

**Stage 4**

In this stage, the ball has reached its maximum deformation. As a result, the acceleration *a* is still pointing upward, and the velocity *V* is zero. This means that point *C* is at its lowest point.

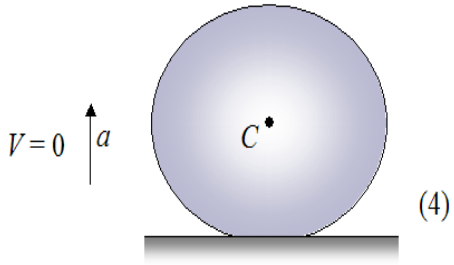



Fig (4),Ball reaching maximum deformation.

**Stage 5**

In this stage, the ball velocity *V* is increasing and pointing upward since the ball is now in the rebounding stage. As a result, the ball is less deformed than in the previous stage, but is still deformed enough such that it's pushing against the surface with a force greater than its own weight. This means that the acceleration *a* is still pointing upward.

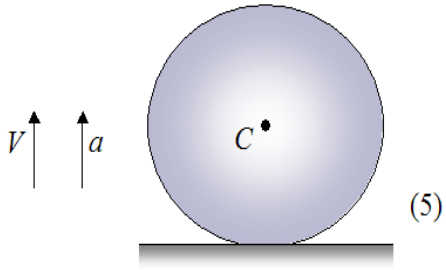



Fig (5).Deforming of ball decreases.

**Stage 6**

In this stage, the ball is barely touching the surface. The velocity *V* is still pointing upward since the ball is still in the rebounding stage. However, since the ball is no longer deformed it has essentially zero contact force with the surface. This means that the only force acting on the ball is gravity. As a result, the acceleration *a* is now pointing downward, and the upward velocity *V* is now decreasing.

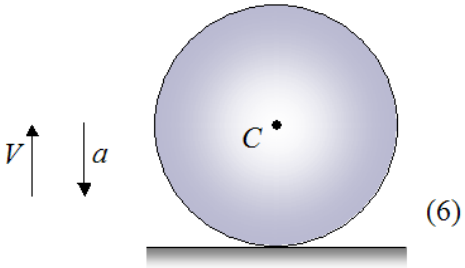
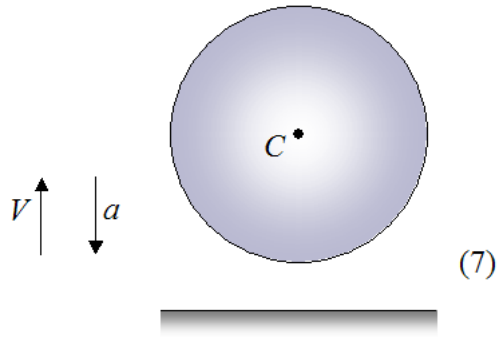



Fig (6). Ball barely touching the surface.

**Stage 7**

In this stage, the ball has fully rebounded and has lifted off from the surface. The velocity *V* is still pointing upward, and the acceleration *a* is still pointing downward since the only force acting on the ball in this stage is gravity.




Fig(7).Ball has lifted from the surface.

## III. IMPLEMENTATION

The game consists of a ball and moving surfaces and a ball bouncing on them. For bouncing of the ball on surface the concept of Surface Collision is used. When a ball is dropped from a specific height and strikes the surface, it rebounds back.

The below Figure (Fig 8) shows the mechanism of collision of a ball to a surface.

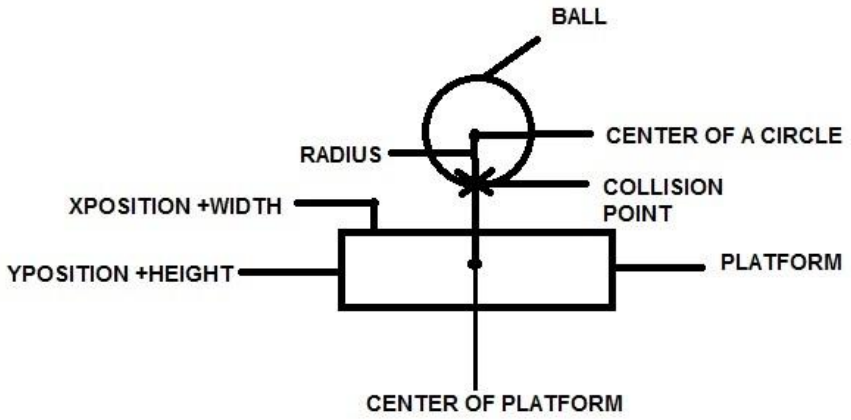



**Fig (8). Ball falling on a surface.**

The above logic can be used in Programming by considering X and Y coordinates of both ball and surface and implementing the logic of collision according to the width and height of rectangle as ball can bounce anywhere on the rectangular surface.

### 2.1 KINEMATICS

**"The branch of mechanics concerned with the motion of objects without reference to the forces which cause the motion"**. Each of these equations appropriately describes the mathematical relationship between the parameters of an object's motion. The equations can be utilized for any motion that can be described as being either a constant velocity motion (an acceleration of 0 m/s/s) or a constant acceleration motion. They can never be used over any time period during which the acceleration is changing. Following are Kinematic Equations used in game.

### 2.1.1 EQUATION FOR DISPLACEMENT

When something moves from a point to the other we call it as displacement. Suppose the golf ball moves from position $x_1$ to position $x_2$.
The position change Δx (position formula) is given as,

$$\square\ x=x2-x1$$

Where,

- x1 is the first position of the body,
- x2 is the second position after undergoing displacement,
- Δx is the rate of change of displacement when change in position takes place.

If the body change its position after time t the rate of change in position at any instant of time t, x(t) is given by

$$x(t)=1/2\ \square t\text{^}2+v0t+x0$$

Where,

- x(t) is the position of the body with respect to time t,
- v0 is the initial velocity of the body,
- α is the acceleration the body possesses,
- x0 is the initial position of the body.

### 2.1.2 GRAVITY EQUATION FOR VELOCITY

The general gravity equation for velocity with respect to time is:
$v = gt + v_i$
Since the initial velocity $v_i = 0$ for an object that is simply falling, the equation reduces to:
$v = gt$
Where

- v is the vertical velocity of the object in meters/second (m/s) or feet/second (ft/s)
- g is the acceleration due to gravity (9.8 $m/s^2$ or 32 $ft/s^2$)
- t is the time in seconds (s) that the object has fallen.

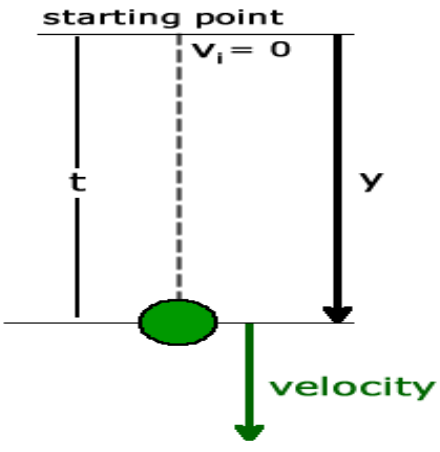



**Fig (9).Initial Velocity of a ball while dropping is zero.**

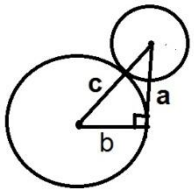
## 2.2 COLLISION WITH OTHER OBJECTS

Some more objects have been added to game to increase the score in form of circles. These objects appear at a certain interval of time and boost the score according to level of game.
For Collision of the item with the ball Pythagoras Theorem which states

(Hypotenuse)^2= (Base) ^2+ (Height) ^2

Where,
c is the hypotenuse
b is the base
a is the perpendicular

i.e. (c) ^2= (a) ^2+ (b) ^2




**Fig(10).Collision of a ball with other Objects.**

The value of c (distance between centers of two balls denoted by c) should always be less than radius of ball plus radius of an Item. The items keeps on appearing after different intervals as soon as ball hits these items a score is boosted by certain amount depending on the level of game. Through the concepts of Java Graphics Programming and Real World Physics the game is implemented.

## IV. SCREENSHOTS

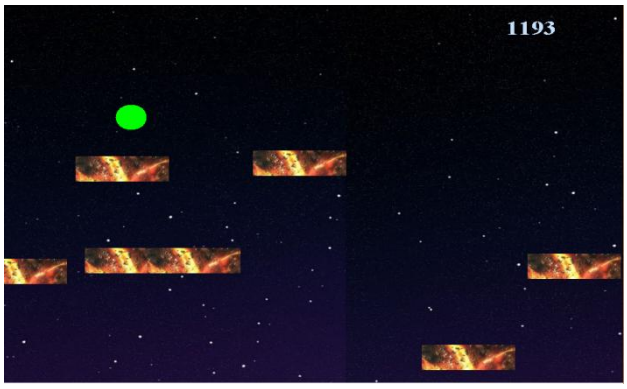



**Fig (10).View of ball bouncing.**

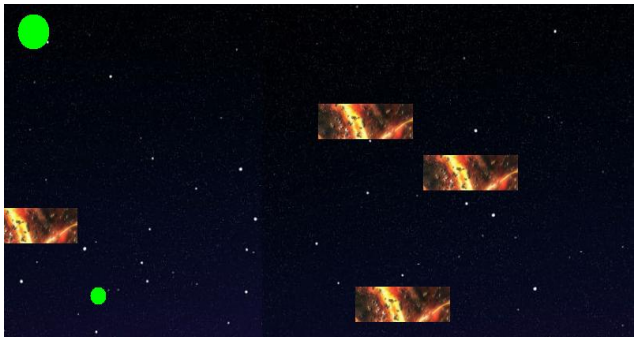


**Fig (11).View of Items appearing in a Game**

## V. CONCLUSION

The Game is tested and played a number of times. It worked accordingly but it can be taken to a higher level by adding some difficulties to the game and making it more user interactive. The game is meant to be played during free time while downloading something from the Internet or while it takes some time for loading any resource on the Web. Further the concepts used in this game can be applied for implementing similar games.
At last I would like to conclude"

**The first thing to realize about physics ... is its extraordinary indirectness.... For physics is not about the real world, it is about "abstractions" from the real world, and this is what makes it so scientific.... Theoretical physics runs merrily along with these unreal abstractions, but its conclusions are checked, at every possible point, by experiments. "**

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