

## **Ten Pin Bowling – Documentation**

Ten Pin bowling is a single player game showcasing interesting and realistic physics that were created with the Cyclone Physics Engine. The game is a little different from the traditional ten pin bowling games because there is no concept of a strike. The player will only accumulate points if the bowling ball touches the pin. Each shot is reset after 10 seconds automatically and the game is reset once all 10 frames have been bowled.

The bowling ball is controlled by the user using the keyboard. The key map is as follows:

Left arrow key	-	Throw the ball to the left
Right arrow key	-	Throw the ball to the right
Up arrow key	-	Increase shot power
Down arrow key	-	Decrease shot Power
'Z' button	-	Give Left spin to the ball
'X' button	-	Give Right Spin to the ball
'G' button	-	Change the material of the bowling floor
'R' button	-	Restart the game

The physics features implemented in the game include: gravitational forces and angular forces on the rigid bodies (bowling ball and pins); inertia; and friction force between the bowling ball and the floor.

The bowling ball is released from a height above the ground and gravitation force is applied to the ball to make it roll along the surface. Once the ball hits the pins, gravitation force is applied to the pins to ensure they fall back on the ground.

Before the bowling ball is rolled, the bowling pins have zero inertia. As the ball collides with the pins and the pins subsequently collide with other pins, inertia tensor is applied to the bowling pins.

The game allows the player to choose from a variety of floors to bowl on: wood, grass and ice. Each of these floors has a different friction force, which is applied to the ball as it rolls on the bowling surface. The grass has the highest friction value while the ice floor has the lowest. The friction force applied on the ball slows it down depending on the magnitude of this force.

Along with the features mentioned above, collision detection and resolution has been implemented in the game. Collision is detected between the pins and the bowling ball, the bowling ball and the side gutter walls, the bowling ball and the back wall, and the pins and the back wall. Collision detection and resolution ensures that the bodies do not pass through each other but rebound off each other.

There are certain physics features that have not been incorporated in the game. These features include air resistance and wind factors. Since the bowling game takes place in an indoor setting, presence of air resistance and wind movements seemed un-realistic and were thus not implemented.

As mentioned earlier, Cyclone Physics Engine was used in the development of this game. The engine was used to apply the angular forces and forces of gravity to the rigid bodies and to apply inertia to the bowling pins once the bowling ball collided with them.

Cyclone was also used to detect collision between the wall, gutters, pins and the ball to display realistic collision resolution.