Full-Scene-Animation Project

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Group ID: 05

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Task Objectives

The main target of this project is:

- Applying three different types of animations to a full-robotic body.
- Loading different external objects.
- Applying texture mapping to the floor with different options.
- Applying Lighting & Coloring concept
- Make an interaction between the robotic body and an object.

Description

Design a simulation for a full-scene animation for a robotic body. The scene consists of a robotic body standing on a floor and two different objects; a fixed table and a ball to play with. The target is to animate this body and interact with these objects with some movements to perform an animation process.

There are different types of animation applied in this project, some of them applied on the robot itself, and the other applied with the objects. In the following sections, we will explain each animation movement alone in more details.

Basic Usage (Keyboard Shortcuts)

Using the keyboard in upper or lower case, you could test the movement of the body and its animation.

1. Animations:

- Walking Forward : `'d'`
- Walking Backward : `'a'`
- Jumping : `'space'`
- Jumping Over : `'l'`
- Kick : `'k'`

2. Body Transformations:

- Rotate the whole body in the left and right direction: `'B'` and `'b'`
- Moving the left and right shoulder aside: `'y'` and `'r'`
- Moving the left and right shoulder forward: `'u'` and `'t'`
- Moving the left and right elbow: `'h'` and `'f'`
- Moving the left and right leg: `'z'` and `'g'`
- Moving the left and right knee: `'x'` and `'v'`

3. Camera Movements:

- Right: '→'
- Left: '←'
- Up: '↑'
- Down: '↓'
- Zoom In: `'+'`
- Zoom Out: `'-'`

Important Note On Using Keyboard And Animation

Performing any animation movement has to be waited till the end of it. If you click on any key that executes any type of movement i.e. if you pressed 'space' which makes the robot jumps, please wait till the robot jump to the air and return back to the ground then click on other button.

This is just to let the animation be done successfully without any delay or corruption, so please wait until the animation ends then perform the other movement.

Animations

We applied many different types of animations to the whole scene. Some of the animations are related to the body without interacting with any external object and the others by interacting with an external objects such as the ball and table.

The basic idea of the animation

The basic idea of applying an animation to a robotic body or to any object is to change its state or its position in different steps and swapping the buffer in each frame rapidly. This will make the scene looks like it's animating.

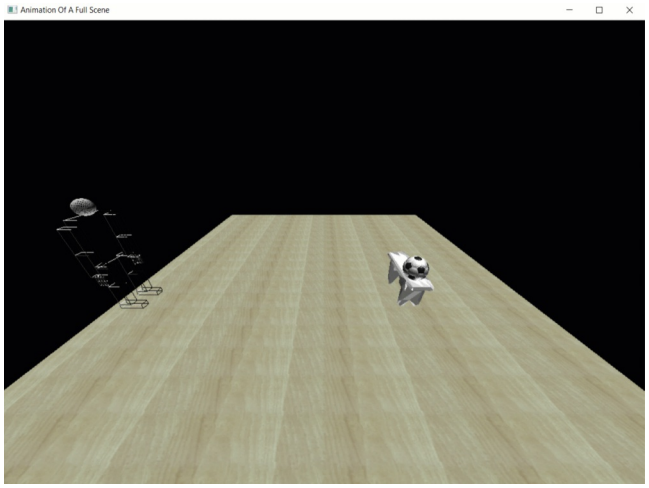
Types of animations

- Walking forward
- Walking backward
- Rotating and walking in any direction
- Jumping
- Jumping Forward
- Kicking a ball on the ground or above a table

Now lets talk about each type and see how it looks in the following GIFs.

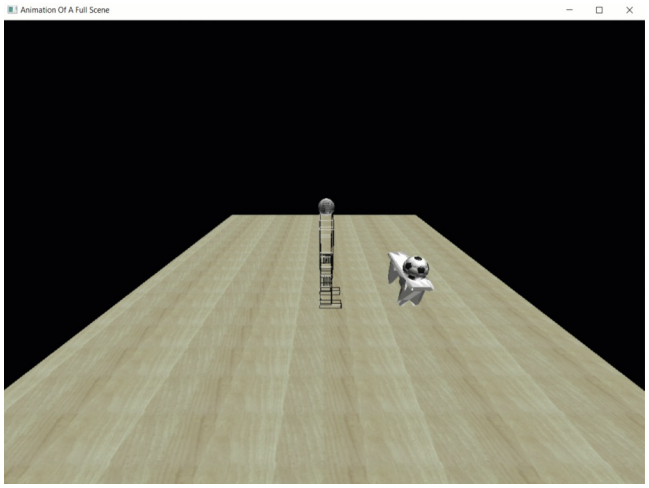
1. Walking Forward

To apply this animation, three joints is rotated (hip, knee, shoulder) with increasing the coordinates of the body in the same direction he wants to move along. Also this movement is limited by the dimensions of the ground so the robot can't walk outside the floor.



2. Walking Backward

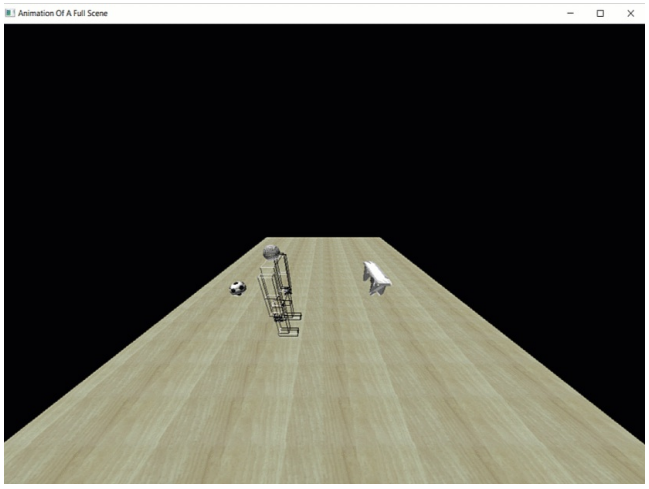
The same concept as walking forward but the joints rotates in the opposite direction as well as the coordinates of the body decreases in the opposite direction.



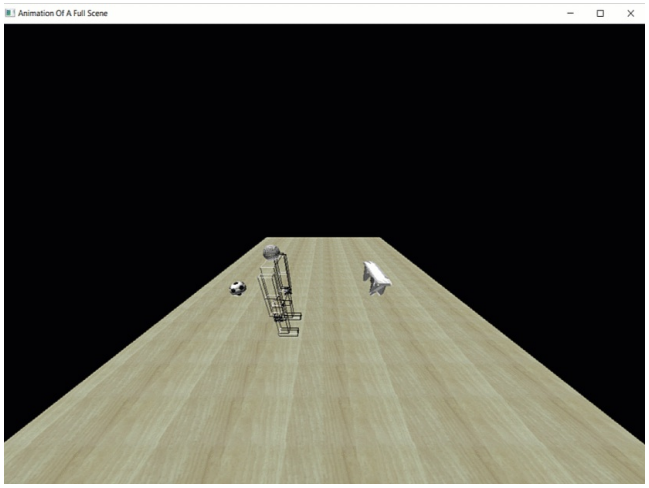
3. Rotating and walking in any direction

The previous movement was in one direction only, we added more features to make the robot move in any direction. To do this, first you should rotate the body by 90 degrees then use the same function of walking forward.

As you see in the following GIF.

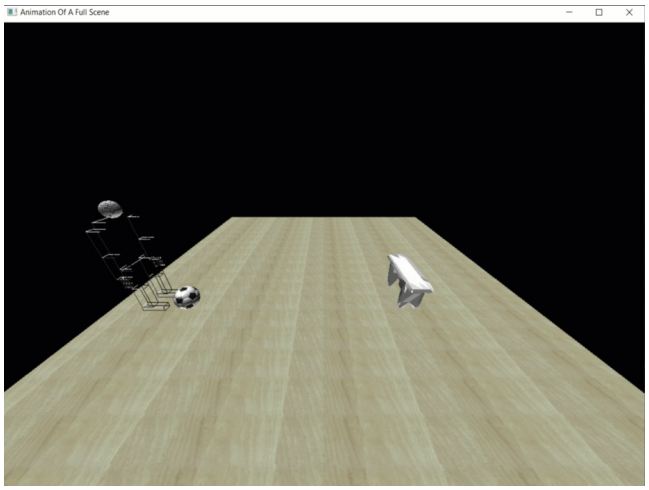


This is another explanation of this type of movement.



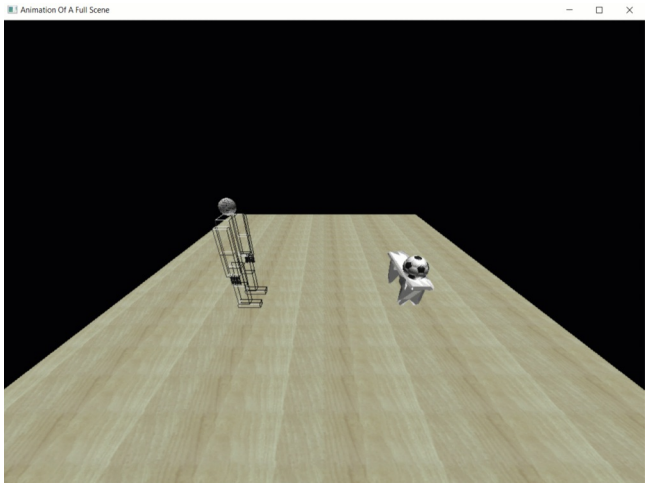
4. Jumping

As shown on the gif three joints (knee, elbow and shoulder) are rotated while jumping and the coordinates of the body is changing and return to the original state.



5. Jump Forward

This animation is made by mixing between the jumping and moving forward animations.

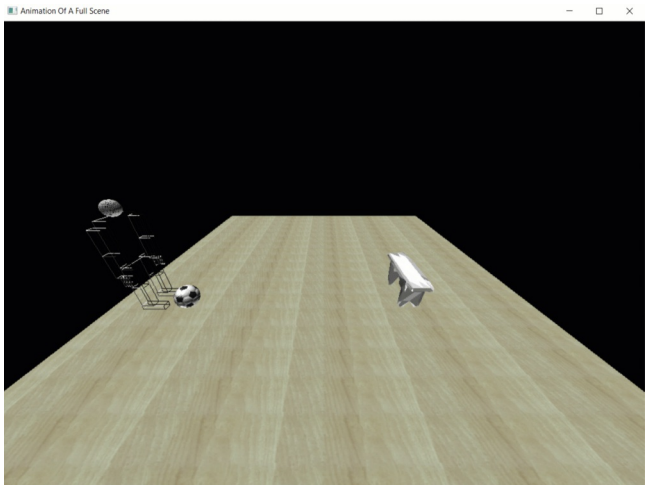


6. Kicking a ball

This type of animation has 2 cases, one without interacting with the table and the other by interacting with it.

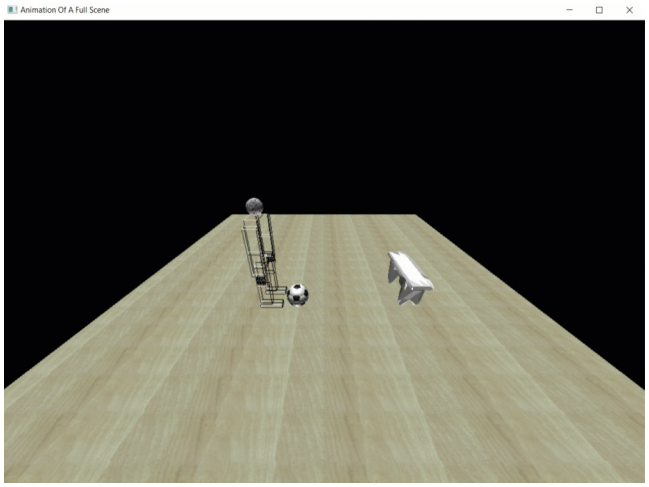
Case #1: Kicking the ball on the ground

This is applied by moving the right leg backward then forward and after it reaches the ball, the ball is kicked as shown in the GIF. As you see the distance between the ball and the table is too large, so the ball will fall on the ground.



Case #2: Kicking the ball on the table

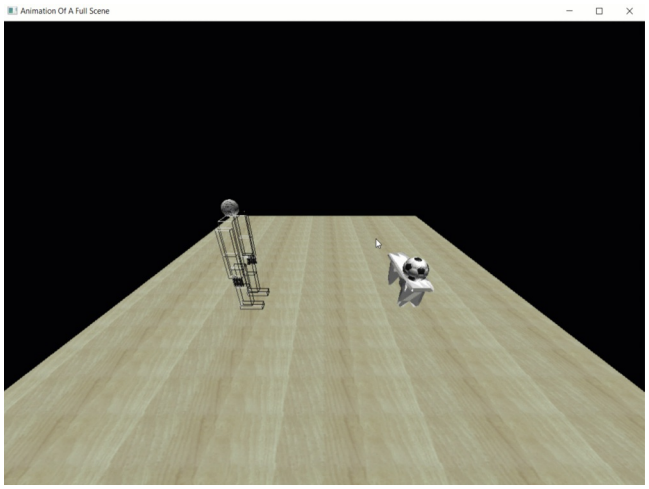
This is the same animation as above exactly but here the ball is close to the table, so after kicking it, the ball will fall on the table.



Texture Mapping

We applied three different types of texture with the ability of changing between them using a drop menu pinned to the right mouse button.

Images are saved in a BMP format with dimensions of `128*128` pixels. Then it's loaded and pinned to it's texture ID, which is then rendered to fit the vertices of the floor square. Repeat Mode is activated allowing the compiler to repeat the `128*128` pixels along the whole floor.



Loading External Objects

As shown from the previous GIFs we uploaded two different objects. Using glm library allows us to load external object files of extension `.obj` which uses `.mtl` files to color the object.

Lighting & Color

Two Light sources are applied with a diffuse mode and a white light, turning the scene from complete darkness to light.

Issues

Issue	Solution
Reflection of the view when moving the camera under the floor	Applying the lighting and coloring
Some textures were not showing as they should be as the real JPEG image	Converting the bit depth of the .bmp image from 32 to 24
Linking the animation of the body with the object	Calculation of the difference distances between them and some conditions

Conclusion

Briefly, the idea of this project is to apply the animation concept on a full-scene with a robotic body standing on a floor using `C++` with `openGL` API, `GLUT` and `GLM` libraries. We applied some features such as animating the robotic body and interacting with a ball. Also the ball interact with the table object. Three textures were added to the scene with an option to choose between anyone of them.

Extra Video

We recorded this video to represent the animation process and explain all the movements in a good way, hope you find it well.

Click on the image below to open the video