

## Assignment 2

### Problem Statement

Write an OpenGL program that incorporates the following.

1. Create a robot made of cubes using the given object hierarchy.
2. Color the robot with any color of your choice. Add eyes, mouth, nose using any GLUT or GLU primitives. Place the robot in a 3D environment consisting of at least a floor where the robot could walk.
3. Use `gluLookAt()` and `gluPerspective()` to set up the 3D viewing and projection matrices. Place the camera such a way you can see all the objects in the scene.
4. Finally, allow the robot to walk forward and backward using key presses 'f' and 'b' respectively. Ensure that the arms and legs swing appropriately as the robot walks.
5. Use GLUT keyboard functions for user interaction. As the user presses 'w', the robot should toggle between filled and wireframe mode. Use appropriate functions for wireframe.

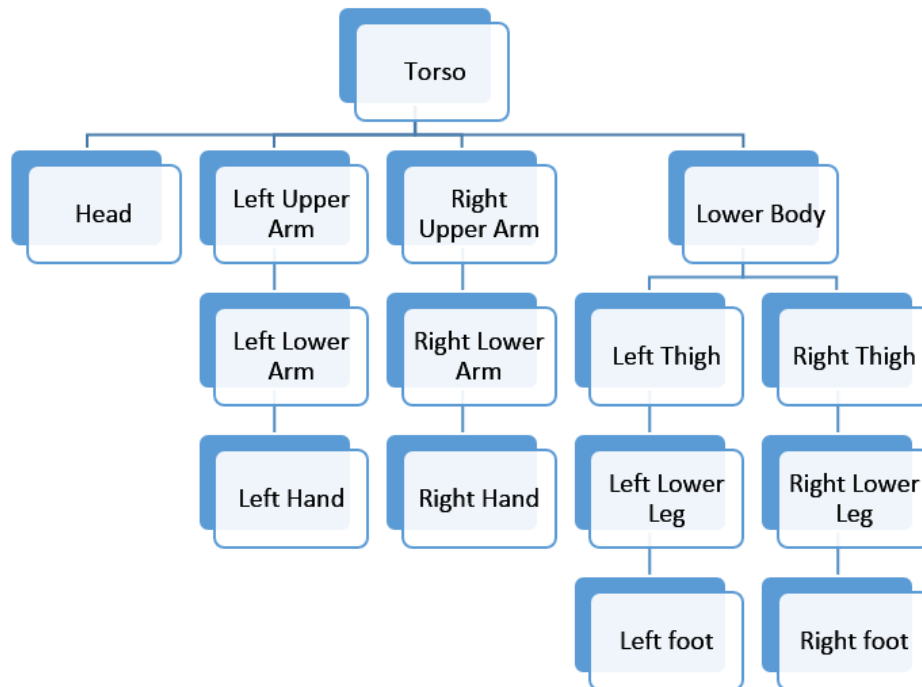
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## Scene Graph



The scene consists of 2 identical bots on a plane separated by a line of cubes as separators.

The sizes of all the components of the bot have been defined as constants at the start of the .cpp file.

All the parts of the body have been implemented as cubes by rotating and scaling.

Some Extra elements like torso and spheres have also been added to the scene.

## Commands

The program uses keyboard to trigger robot movements:

- "F": Moving robot forward
- "B": Moving robot backward
- "T": Toggle between bots
- "W": Toggle Wireframe mode
- "Q": Exit

## Motion of the Bot

We have implemented the motion of the bot in four steps.

Step 1 – Left hand ahead, Right leg ahead

Step 2 – Both Legs and hands straight

Step 3 – Right hand ahead, Left leg ahead

Step 4 – Both Legs and hands straight

These four steps keep cycling in the order 1 → 2 → 3 → 4 → 1 as we press the 'f' key and in the order 4 → 3 → 2 → 1 → 4 when we press the 'b' key.

## Brief Explanation of Code

All the functions take an integer argument to choose between filled or wireframe mode.

### 1. torso ()

The function is used to draw the torso of the robot.

### 2. head()

The function is used to draw the head of the robot. It also adds eyes, mouth and nose appropriately.

### 3. arms() and lowers()

These functions draw the various modes of arms and legs. We have created 4 states to ensure that the arms and legs swing appropriately as the robot walks. The arms are divided into 3 parts, lower arm, upper arm and wrists and same is for legs.

### 4. keyboard()

This function handles the events triggered by keyboard.

### 5. solid bit

This bit is used to toggle the robot from solid mode to wire frame mode and vice versa.

## Race Mode

- We have added a race feature. The two robots present can be raced against each other.
- To move the robot, the user can press the keys "f" or "b". To toggle between the two bots, the user can press "t" key.
- Once, the key is pressed, the other bot is triggered to move. Now, if the user presses the "f" or "b" key, the other bot is moved.

The active bot is indicated by red color on the nearby torus.

## Output

The figure below shows the final Robot.

