Computer Graphics I

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Project Report
Week 2

As project requires implementation of modeling of 3D objects, the first step was to implement a simple 3D box with the various environmental features (such as lighting). Fig. 1 is the screenshots of the webpage.

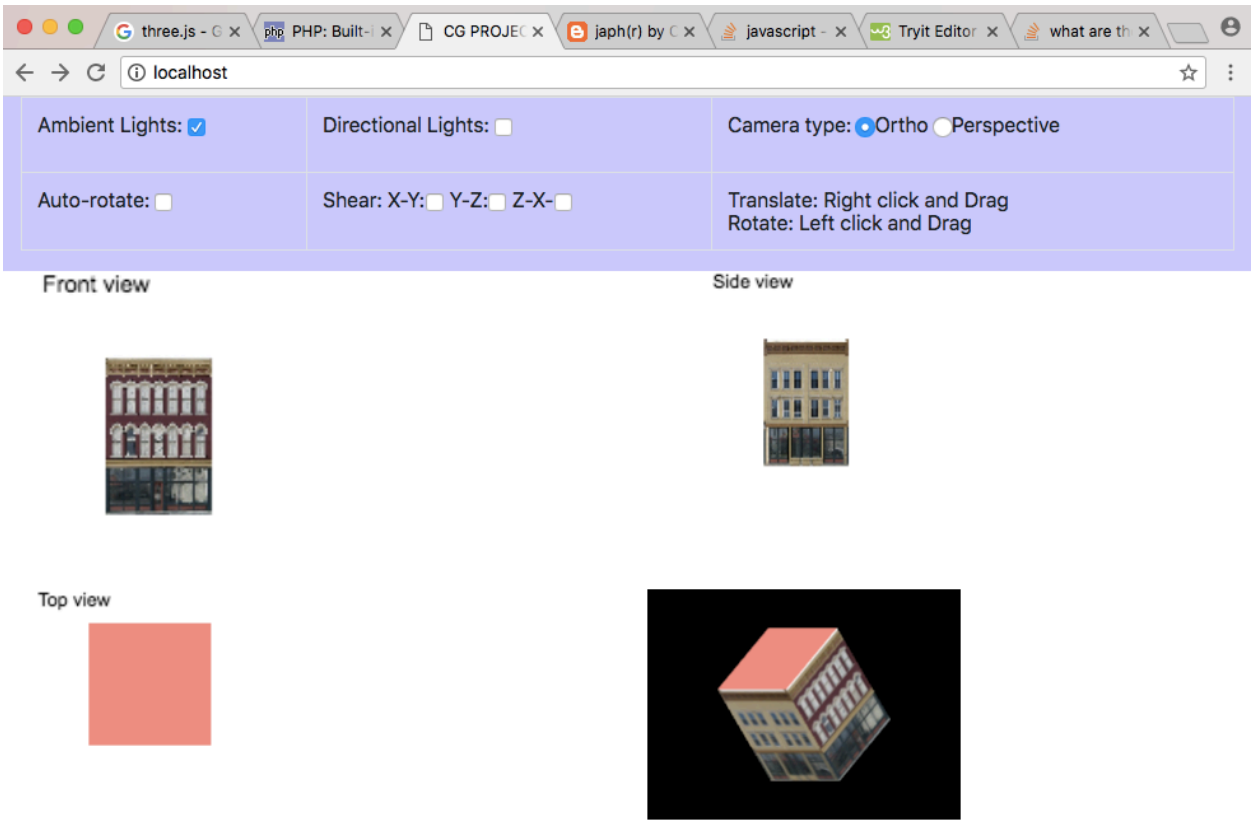

Fig. 1 Orthographic view of the camera is evident in this screenshot of the webpage.

Languages & libraries

The javascript library, THREE.js is used to define and render the objects and environment. This library is based on the WebGL open source library. THREE.js library is available under the MIT license.

Viewing, transformations & projection

The object can be viewed from multiple directions. Simple mouse movements and keyboard inputs can be used to perform basic transformations. And the camera is set for perspective projection.

View direction can be set by clicking and dragging the left mouse button. Translation can either be performed by using the keyboard arrows, or bu right clicking and dragging. The zoom operation can be performed by scrolling in and out.

Lighting, Texture and Material

Several light sources have been used to illustrate how lighting affects a scene. The webpage has option to turn on or off *ambient light* and two sources of directions light. Fig. 2 shows different types of lights which can be used.

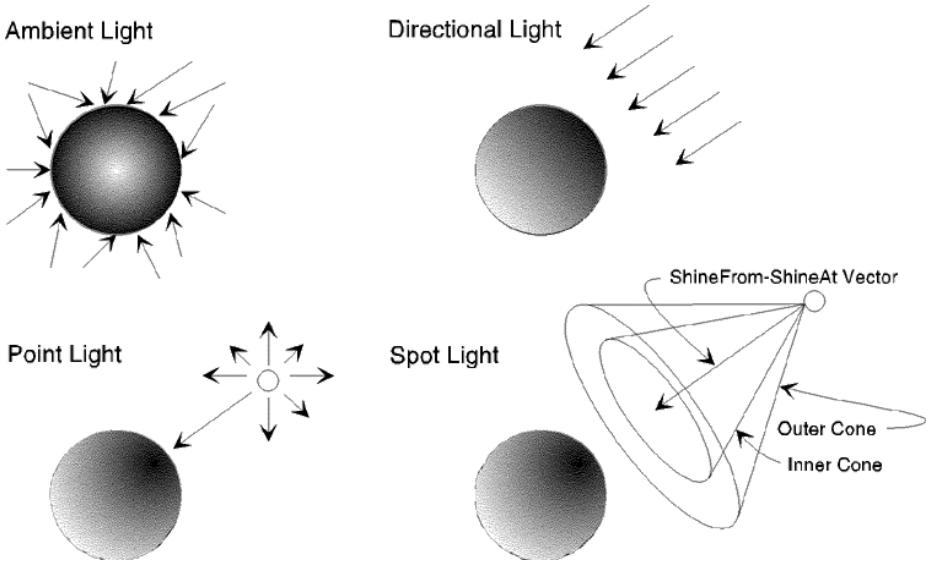

Fig. 2 Types of common light sources. The darker shades indicate higher intensity of light.

The type of material plays a crucial role in determining how the final objects are rendered. In this project, the two materials used are *basic material* and *Phong materials* on the surface of the building. Fig 3 lists common material types.

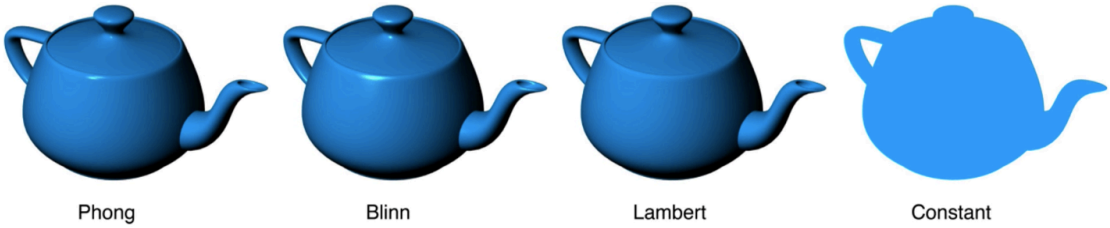

Fig 3 Common material types.

WEEK 2 updates

1. Option to choose camera types has been added (**Orthographic and perspective**).The scene is rendered with a new camera every time the radio button selection is changed.
2. Skew option along 3 axes.
    1. Skewing can be done individually for each axis.
3. Front, side and top view canvases are added.
4. The webpage has been made responsive with ***bootstrap grid***.

Shearing

Shearing is the transformation which slants the shape of an object. In 2-D it can be defined using the matrix X_{sh}:

$$X_{sh} = \begin{bmatrix} 1 & 0 & 0 \\ shx & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$X' = X + Sh_x \cdot Y$$

$$Y' = Y$$

```
var matrix = new THREE.Matrix4();

matrix.set(   1,   Syx,  Szx,  0,
            Sxy,     1,  Szy,  0,
            Sxz,   Syz,   1,   0,
              0,     0,   0,   1  );

// apply shear matrix to geometry
cube.geometry.applyMatrix( matrix );
scene.add( cube );
```

Fig. 3 shows the code snippet which is used to skew cube shapes in THREE.js.

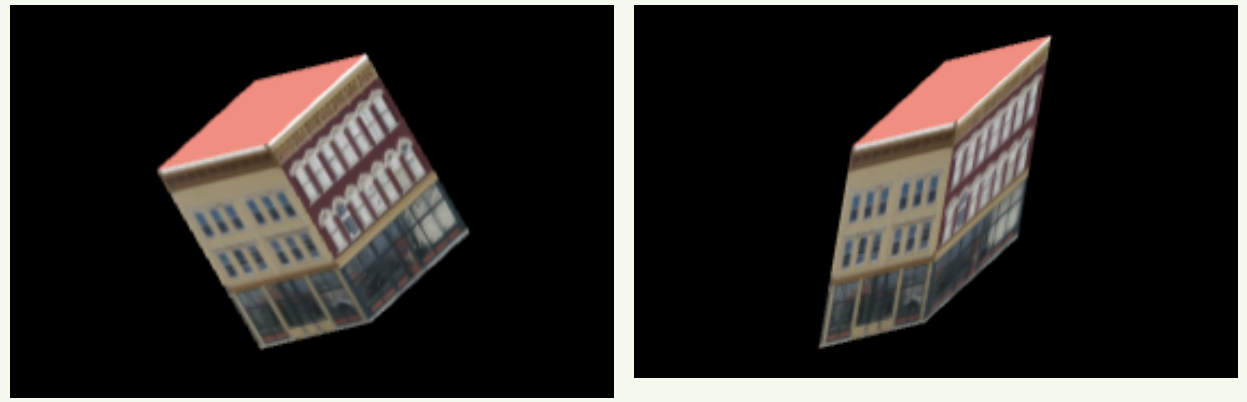

Fig 4. Normal image and a Skewed image (Orthographic)

Orthographic vs Perspective

The following images show the difference between the perspective and orthographic cameras.

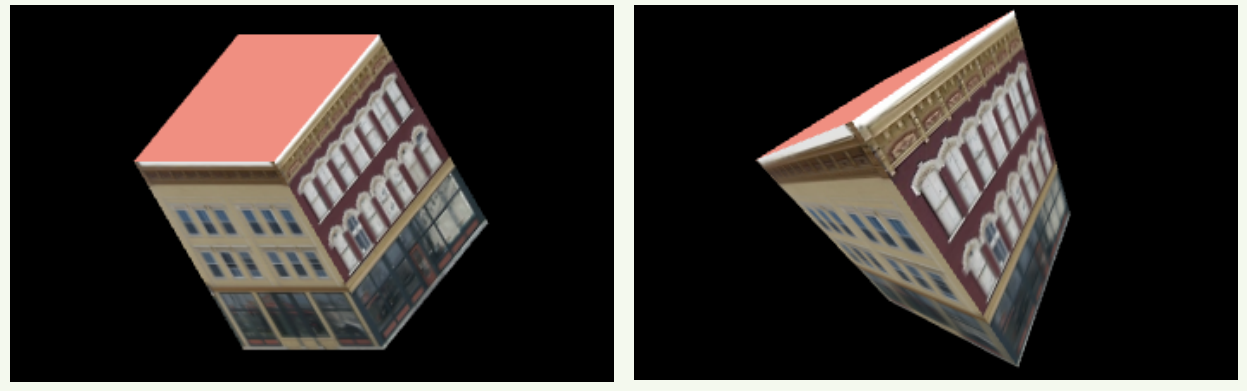

Fig 5 a, b. Orthographic and Perspective camera for the same object.