Computer Graphics- 3D rendering

Submitted by
Chirag Bhardwaj, 01702805

Date Submitted

3/29/2018

ABSTRACT

This project will try to implement the following features but will be completed at the end of the semester. The aim is to create a 3D object by drawing three 2D "elevations". Upon drawing, storing the coordinates of the elevations in a way that will allow the user to create a 3D model of the object from them. The user can also transform the object i.e. apply 3D (Translate/Rotate/Scale/Shear) transformations to the created object. The user also has the ability to view the object from multiple viewing angles and also transform camera/viewer or light sources. The project also provides the ability to generate different projections of the objects, edit/change perspective projection vanishing points and create texture/bump/environmental mappings for the object.

Table of Contents

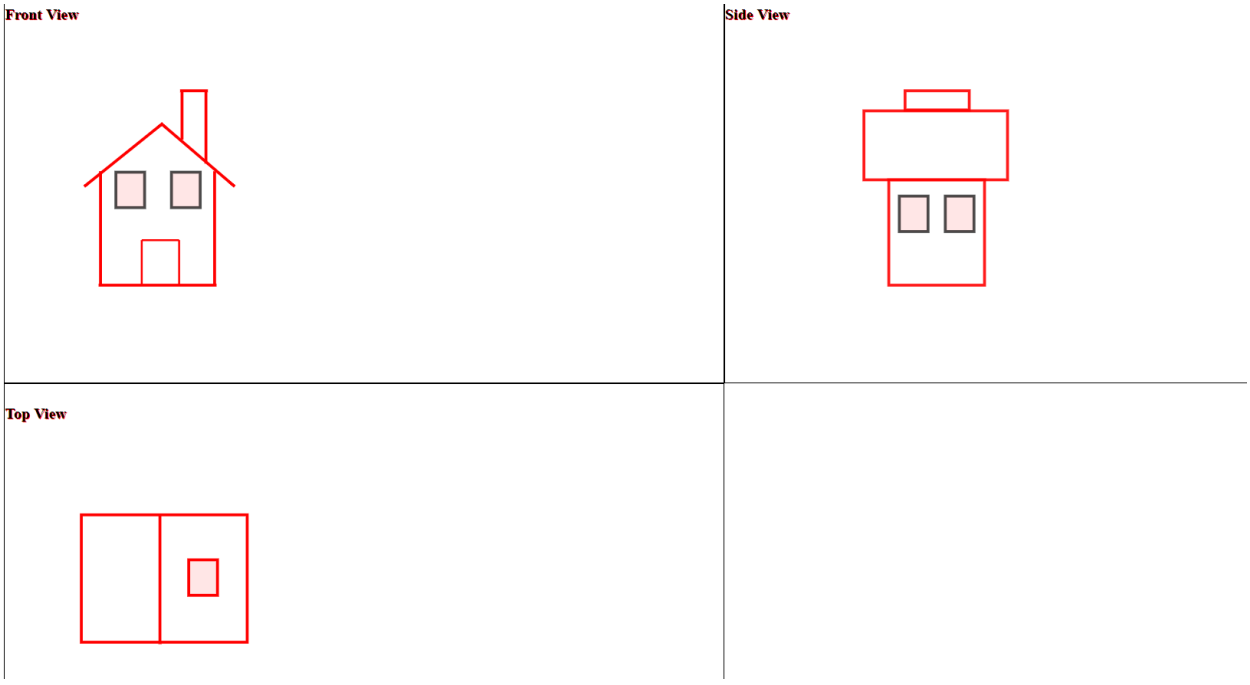
1. Introduction

The project will employ the use of WebGL which is a JavaScript API for rendering interactive 2D and 3D graphics within any compatible web browser without the use of plug-ins. WebGL is integrated completely into all the web standards of the browser, allowing GPU-accelerated usage of physics and image processing and effects as part of the web page canvas. WebGL elements can be mixed with other HTML elements and composited with other parts of the page or page background. Due to this reason I am choosing to work with it. The project will be able to render user defined images in 3D and also provide the ability to

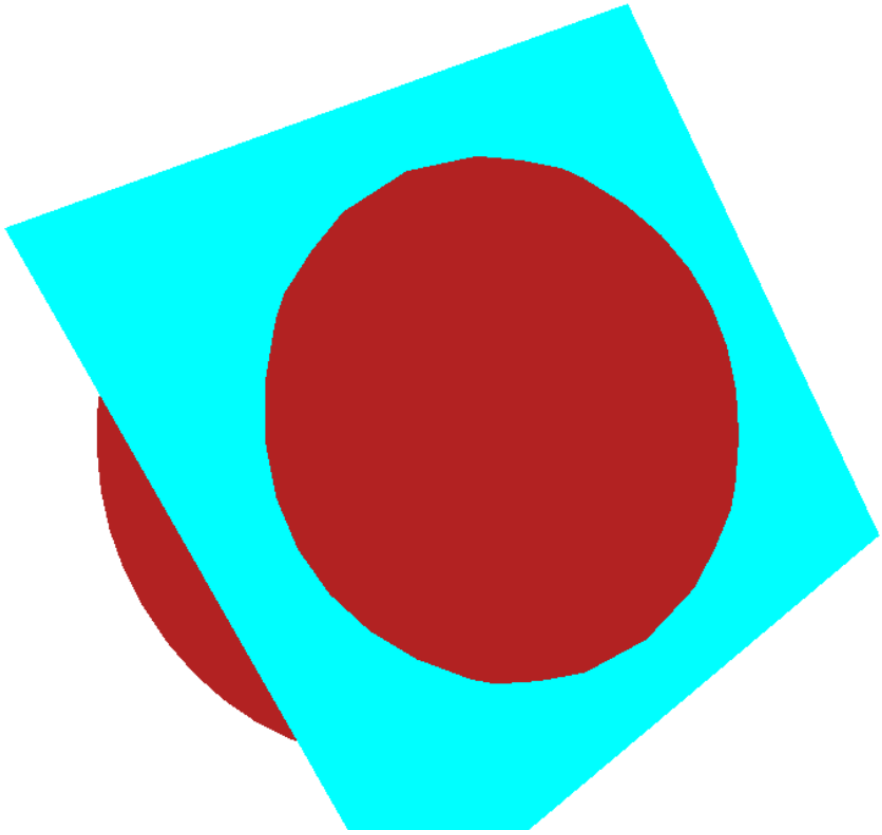
- Transform the object
- View the object from multiple views
- Transform the lighting of the object
- Generate different projection of the object
- Change the perspective projection vanishing points
- Create texture/bump/environmental mappings of the object

2. Analysis and Design

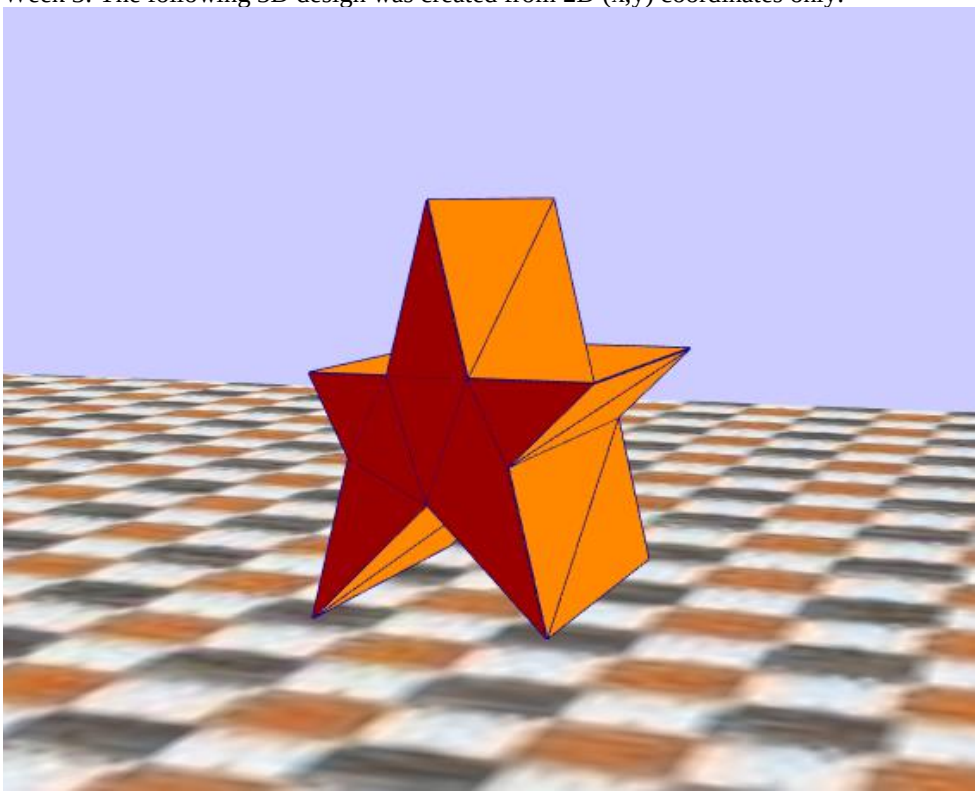
- **Week 1**: The following design includes the Front View, the Side View and the Top View of an object (in this case a house).



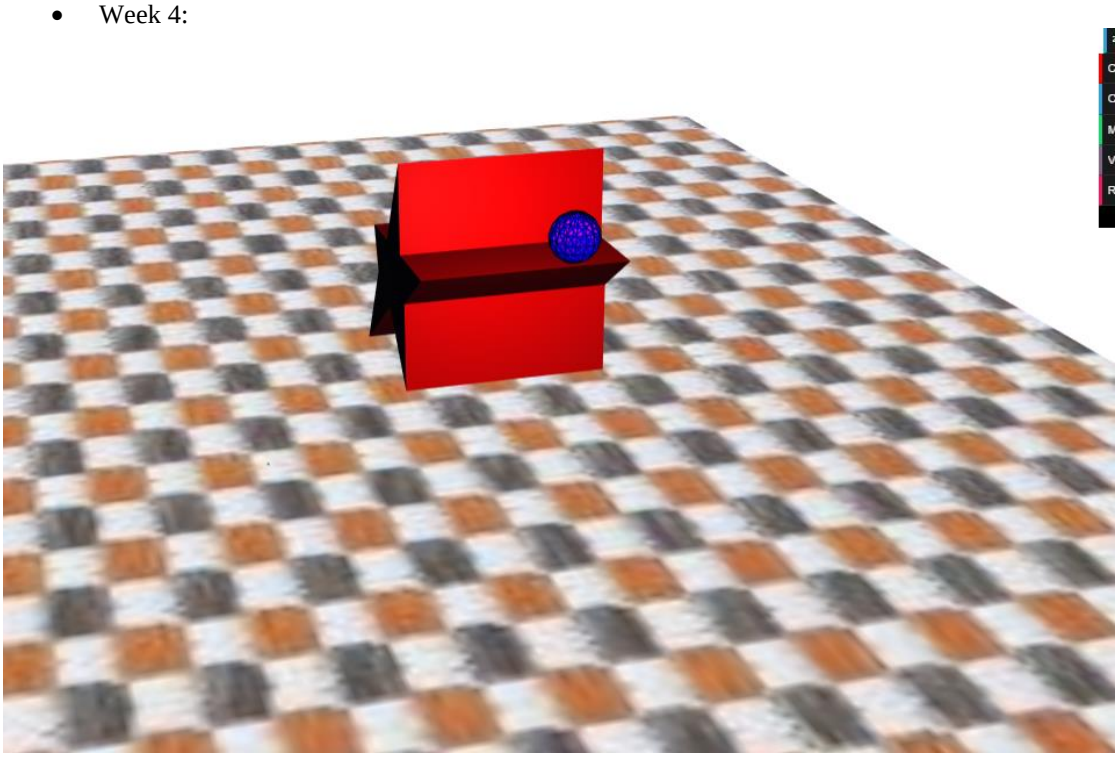
- **Week 2:** The following design was made to demonstrate the 3D effects which were established using WebGL.



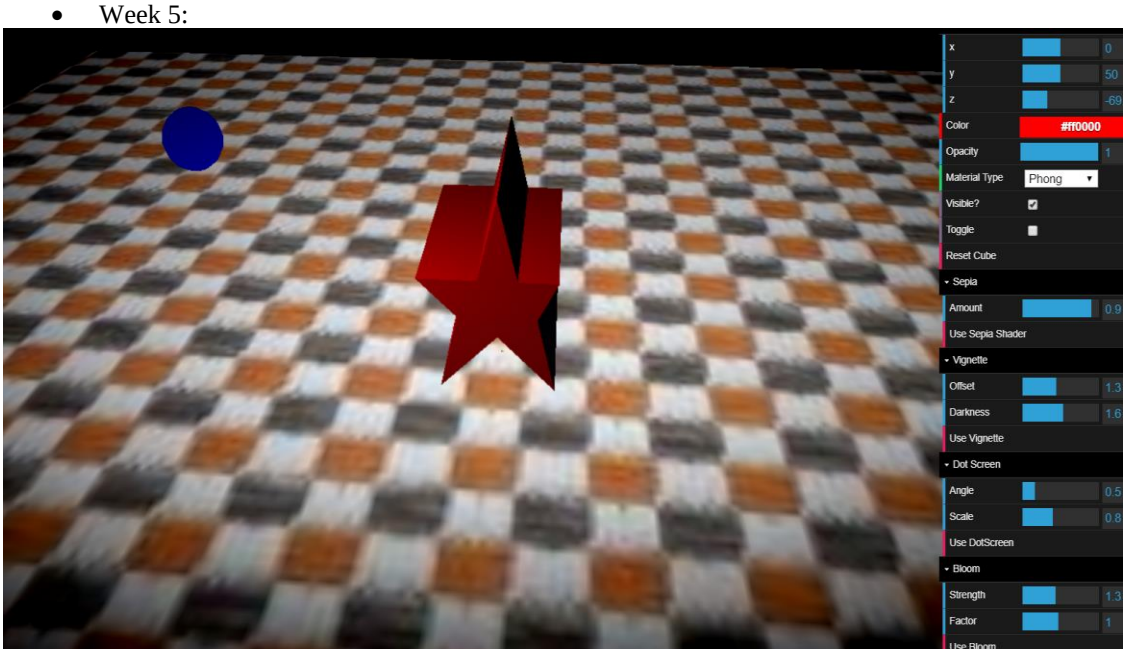
- Week 3: The following 3D design was created from 2D (x,y) coordinates only.



- Week 4:



- Week 5:



3. Description

- **Week 1:** I made the above views to understand how the 3 different 2D projections will look like and this will help me in understanding how finally 3 different projections will come together to form a single 3D object which is one of the objectives of the whole project. All the objects made here have been made 3D ready for future work. Further I will try to apply transformations to this

object in order to learn how transformations work.

- **Week 2:** I made the above-mentioned view after learning to work with WebGL which for now is going to be my choice of library for the final project. I learned how WebGL works and how to render 3D objects from it. I also ventured into learning about camera and how different views work. Transformation such as rotate have been applied to the above. I shall further learn about WebGL and how to use it to get to the final product.
- **Week 3:** I made the above-mentioned drawing using only 2D coordinates. This week I learned how to draw 3D from 2D coordinates i.e. by taking only x and y coordinates how to make a 3D object. I applied the extrusion property of WebGL to achieve the same. I also made progress in applying transformations such as scaling, rotation etc. to the 3D object. Now the object can be viewed from various views as was desired from the final project. The camera too can be transformed. Light source for now is fixed and will be transformable by next week. Textures too have been implemented and can be seen in the drawing itself. I shall further look into generating different projections of the objects and also try to change perspective vanishing points.
- **Week 4:** I rendered the above made drawing to display the Environmental Mappings which in this case is the shadow that is being cast on the various surfaces of the object which can be seen when translating the object. I made progress in Texturing as 4 different types of Textures can be applied to the object dynamically. The user can also change the Opacity of the object. The color of the textures and the visibility of the object can also be changed using the same. The blue sun like drawing represents the Light source which is also transformable as you move the object. All the things from the past weeks can also still be applied to the object. If you use the scrollbar Vanishing Points also have been implemented and can be seen when using the mouse or scrollbar on the keypad. Like last week you can still view the object from multiple views. I shall further display various projections of the object and also try to get user to input the coordinates to display the created object and try to finish the project.
- **Week 5:** As can be seen from the image above I did manage to use shaders to give the scene various filters. The user can also see the various projections that were asked. The User has now the freedom to not only translate and apply other transformations to the given object but can also apply various shadings to the given object. Various projections can also be seen of a cube object. The visibility and transparency can be controlled using the GUI on the right. All the controls are on the right side are work well on the scene and will also be well defined by the end of submission.
- **Final Submssion:** So for my last submission the following things have been implemented in this project:
  - Applying 3D Transformations to the object
  - Converting 2D object to 3D objects
  - Viewing the object from multiple views.
  - Zooming in and out of the object.
  - Vanishing points.
  - All the projections mentioned in the tree by the professor.
  - Transforming camera
  - Transforming Viewer
  - Transforming Light Source
  - Creating Textures
  - Creating bumps
  - Creating Environmental Mappings
  - Creating Shaders of various types(Impress Me Feature)
  - Toggling Visibility and Opacity. (Impress Me Feature)
  - Toggling Transparency. (Impress Me Feature)
  - Changing Colors of the given object(Impress Me Feature)

4. Testing :

Please go through the Manual on how to work with the system.

5. Deployment of the System

The System has been deployed on my cs.uml.edu page and also can be found on the submiited github page.

Ideal Deployment Specifications include the following:

1. 3js 5.1.0
2. Chrome Version 66.0.3359.139 (Official Build) (64-bit)
3. Nvidia GE Force GTX 1070- 8GB Graphics Card
4. Visual Studio Code (Latest)

6. Limitation of the System

3D object could not be created from given 2D drawings although 2D coordinates can be used to create 3D objects.

7. Conclusion

The process of creating objects using various libraries and generic methods have given me a deeper insight into how Computer Graphics work and render mathematical data into beautiful graphics. The knowledge of WebGL and how it can be used for various things such as game design to website design has been really beneficial.

8. Reference

- Dr. Haim Levkowitz Video Classes
- Threejs.org
- WebGL: https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API
- Stackoverflow.com
- Javascript.com