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# ***COMPUTER GRAPHICS PROJECT REPORT***

# ***3-D RENDERING***

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# Abstract

This Project involves creating an interface based on the Computer Graphics 1 course for a 3-D object which will include features such as Modelling, Transforming the Object, Viewing, Transforming Camera/Viewer/Light Sources, Generating different projections of the Object, Creating texture/bump/environmental mappings for the object.

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# Contents

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## Introduction

This project uses HTML, CSS, JavaScript, three.js(JavaScript library and API based on WebGL) and dat.gui. HTML and CSS are used to design the webpages. JavaScript and three.js to design objects. Dat.gui to provide User Interface for controlling the created features for the object. The features implemented for this project are as follows:-

- Modeling: Create and store a 3D object
- Transform object: Apply 3D (Translate/Rotate/Scale/Shear) transformations to the created object
- Viewing: View your created object from multiple views
- Transform camera/viewer/light sources(s)
- Generate different projections of the objects
- Edit/Change perspective projection vanishing points (1, 2, 3)
- Create texture/bump/environmental mappings for the object

Link to project:
http://www.cs.uml.edu/~vmummane/427546s2018/finalProject/Project_Final/project_final.html

## Progress

- Week 1

  In Week 1, I implemented 3D Transformations i.e. Rotation, Translation, Scaling, Shearing of two objects: house and a cat. I also drew views for them such as Front View, Top View, Side View.

  I used HTML, CSS and SVG for this.

- Week 2

  In Week2, I implemented a Rotating Cube and a Rotating Triangle.

  I used HTML, CSS and WebGL for this.

- Week 3

  In Week 3, I implemented Textures on a Rotating Cube. The textures were Wooden Crate, Metal Crate, Gift Box, Chess Box, Windows Logo, YouTube Logo. I also implemented shadows such that when a face of the cube moves out of focus of the viewer, it darkens and the face which moves in focus, lightens.

  I used HTML, CSS and three.js(for WebGL rendering).

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- Week 4

  In Week 4, I implemented views for a cube such as Parallel Views and Perspective Views. In Parallel Views, I implemented Simple(Front, Top and Side) and Axonometric Views(Isometric, Dimetric, Trimetric). In Perspective Views, I implemented 1-point, 2-point and 3-point views.

  I used HTML, CSS and three.js(for WebGL rendering).

- Week 5

  In Week 5, I combined the work done in first 4 weeks and performed operations on a Cube. The operations involved 3-D Transformations(Translate, Rotate, Scale, Shear). It also included Views/Projections such as Front, Top, Side, Oblique, Isometric, Dimetric, Trimetric. Point Light sources at various locations such as Front of Cube, Top of Cube, Top Near Left, Top Near Right, Top Far Left, Top Far Right, Bottom of Stage and also a low density Ambient Light. I also implemented Vanishing point Views(1, 2 and 3). I have implemented Textures for the Cube such as Wooden Crate, Metal Crate, Gift Box, Chess Box, Windows Logo, YouTube Logo.

  I used HTML, CSS, JavaScript, three.js for Object Design and dat.gui for Object Control.

- Week 6/Final Week

  In Week 6/Final Week, I added onto work done in week 5 by adding Environmental Mapping and Ambient Light colour selections. I added textures for the stage on which the cube stands.

  I used HTML, CSS, JavaScript, three.js for Object Design and dat.gui for Object Control.

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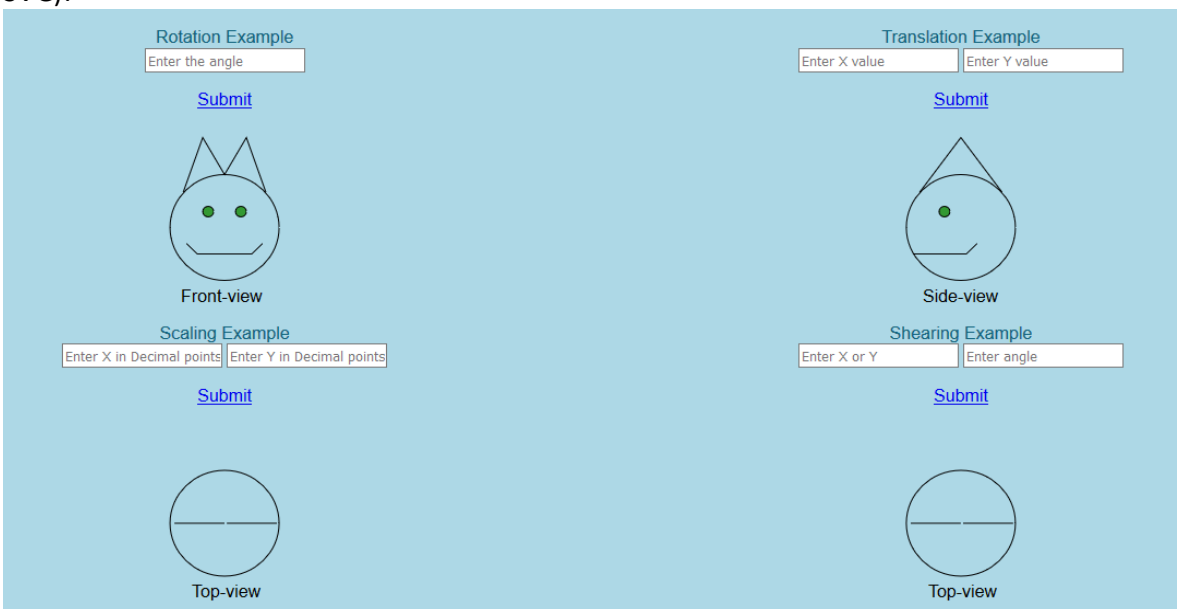
# Results

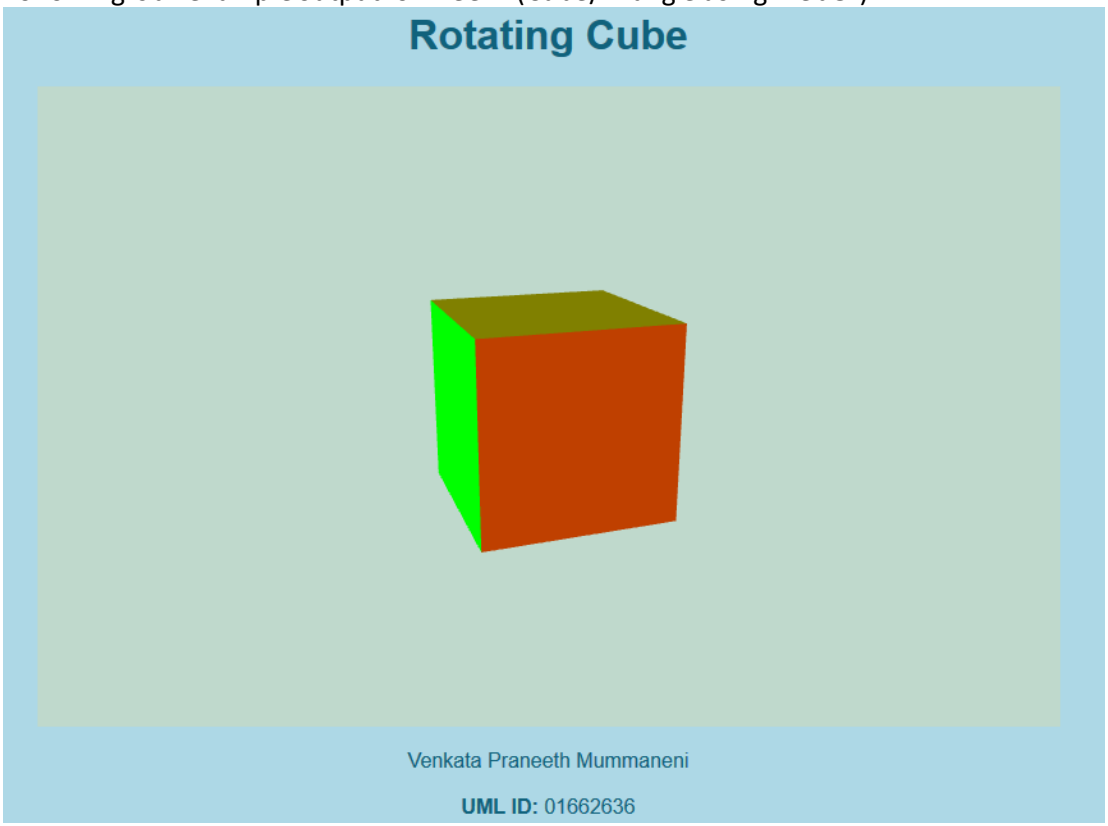
- Week 1 Results

  Following is an example output for Week 1(Rotation/Translation/Scaling/Shearing using SVG):-




- Week 2 Results

  Following is an example output for Week 2(Cube/Triangle using WebGL):-



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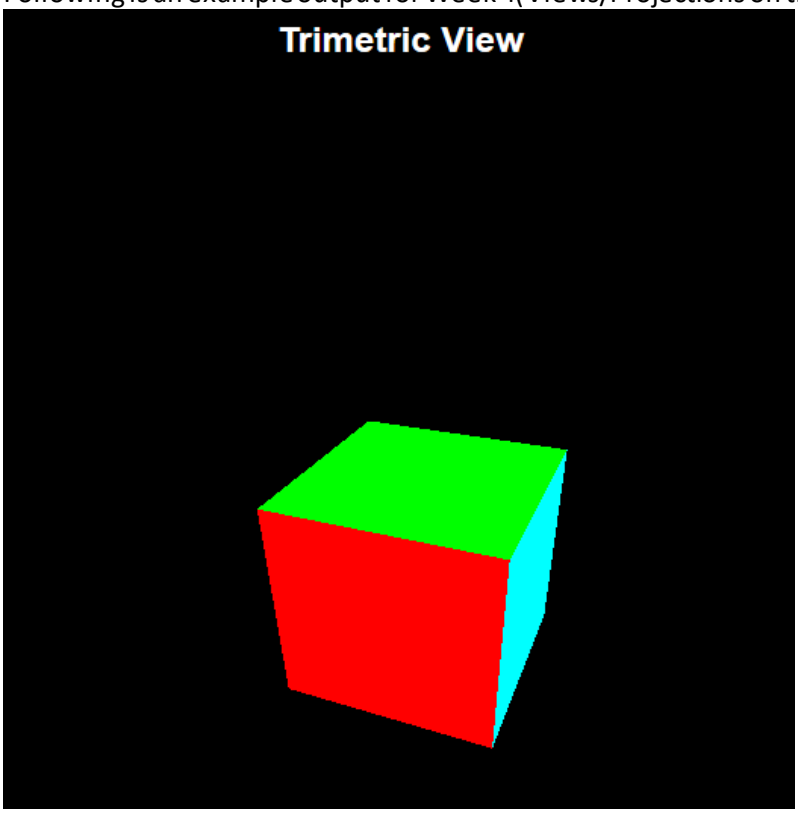
- Week 3 Results

Following is an example output for Week 3(Textures and Lighting on Cube using three.js)


- Week 4 Results

Following is an example output for Week 4(Views/Projections on the Cube using three.js):-



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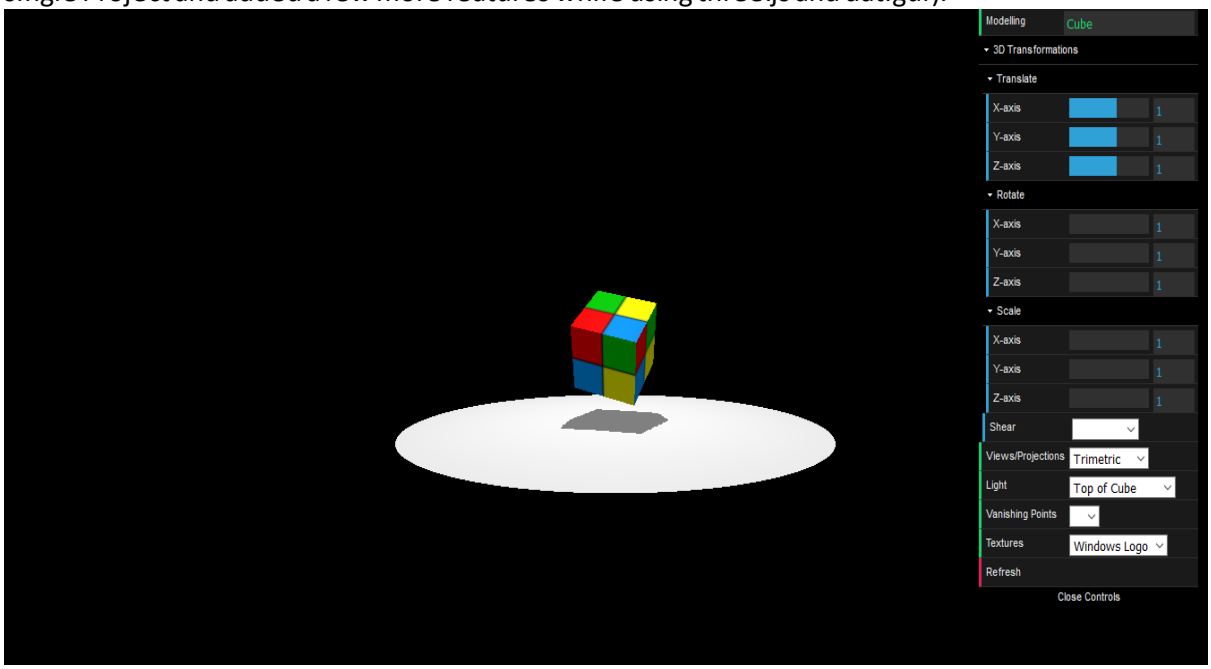
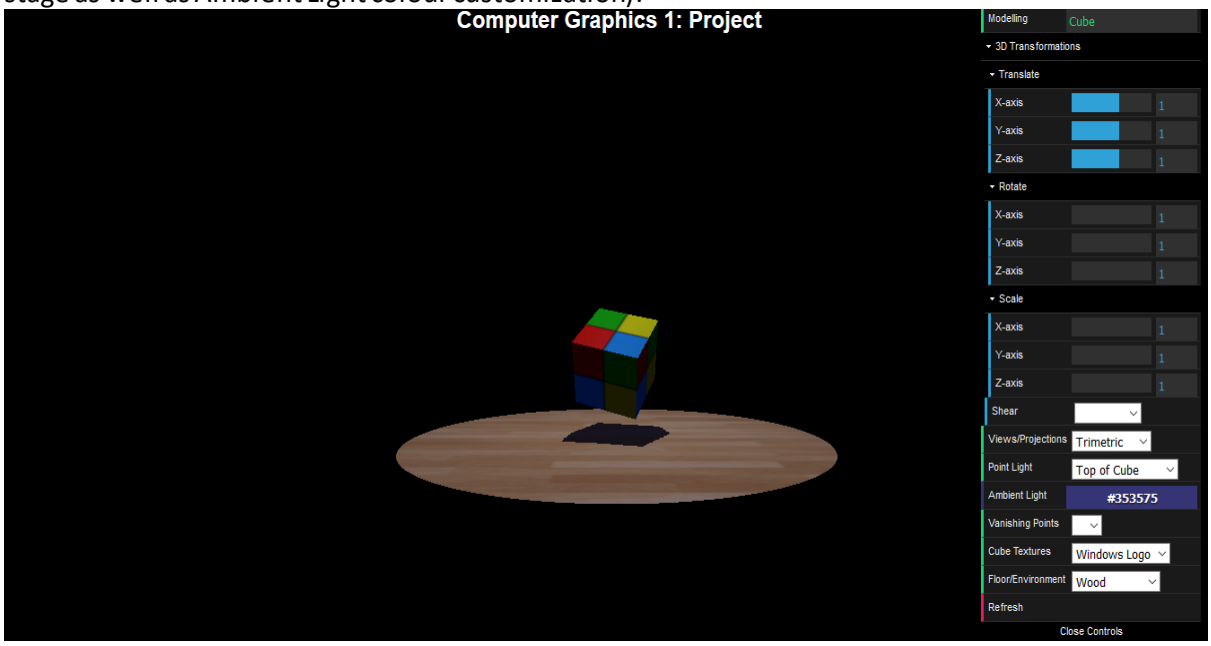
- Week 5 Results

Following is an example output for Week 5(Combined components from weeks 1-4 into a single Project and added a few more features while using three.js and dat.gui):-




- Week 6/Final Week Results

Following is an example output for Week 6(Added environment mapping/textures to cube stage as well as Ambient Light colour customization):-



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## Discussion

Through this project, I was able to understand the concepts of Computer Graphics a lot better. I learnt new technologies such as OpenGL and WebGL. I learnt a lot of new things too such as lighting(PointLight and AmbientLight) of the objects. It felt pretty challenging to combine all the features(Modelling, Transformations, Views, Transforming Camera/Viewer/Light sources, Perspective Views, Texture/Environment Mapping) into one simple interface. Synchronizing all these features was also very challenging.

## Conclusion and Future Work

I was able to learn and implement a lot of features related to Computer Graphics throughout the course of this project. I was able to get a sense of how objects are seen by a computer. I thoroughly enjoyed doing this project.
As for future work, I would like to make this interface universal for any object that is put in.

## Acknowledgements

The work described in this paper was conducted as part of a Spring 18 Computer Graphics 1 course, taught in the Computer Science department of the University of Massachusetts Lowell by Prof. Haim Levkowitz.

## References

1. *SVG References(Only used in Week 1)*

   - https://www.safaribooksonline.com/library/view/svg-animations/9781491939697/
   - https://www.w3schools.com/graphics/svg_intro.asp
   - http://tutorials.jenkov.com/svg/index.html

2. *WebGL References*

   - https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API/Tutorial
   - https://www.youtube.com/playlist?list=PLjcVFFANLS5zH_PeKC6I8p0Pt1hzph_rt
   - glMatrix library used for math: http://glmatrix.net/

3. *three.js References*

   - https://medium.com/@necsoft/three-js-101-hello-world-part-1-443207b1ebe1
   - https://webdesign.tutsplus.com/tutorials/a-noobs-guide-to-threejs--cms-28639
   - https://www.youtube.com/watch?v=YKzyhcyAijo&list=PLRtjMdoYXLf6mvjCmrltvsD0j12ZQDMfE
   - https://www.youtube.com/watch?v=ABV1mK1CGOY&list=PL08jItIqOb2qyMOhtEUoLh100KpccQiRf
   - http://davidscottlyons.com/threejs-intro/#slide-0
   - https://threejs.org

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4. *dat.gui References*


- https://github.com/dataarts/dat.gui/
- http://workshop.chromeexperiments.com/examples/gui/#1--Basic-Usage
- https://www.youtube.com/watch?v=YMJzjjOumbw&t=601s