COMPUTER GRAPHICS

FINAL PROJECT REPORT

Submitted to Prof. Haim Levkowitz

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1.Introduction

In my project, I create a “dream house”. I draw it on the canvas and implemented it by the APIs and the WebGL.

Firstly, it draw three 2D elevations (front, top, side) of my house, which are very classic graphic first term. The front elevation is just looking the house straight on the front. When rotated the house 90 degrees along with the Y axes and look the side, it is the side elevation. When rotate the house 90 degrees along with the X axes, it is the top elevation.

Secondly, it represent the house on parallel axonometric projections: isometric, dimetric and trimetric. In isometric projection, the angles between the projection of the axes are equal i.e. 120°. In dimetric projection, the angles between the projection of the axes in renders two of the three to be equal (figure 1). In trimetric projection, the angles between the projection of the axes are unequal (figure 2).

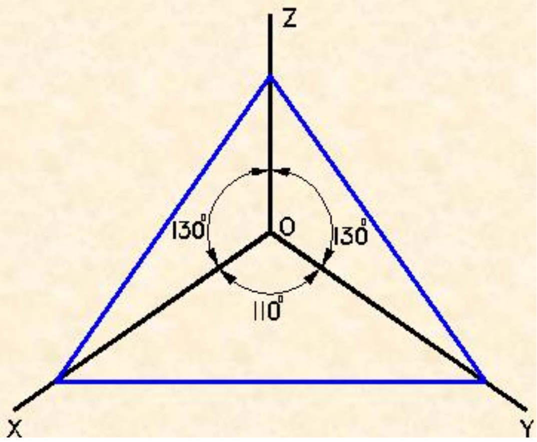


Figure 1

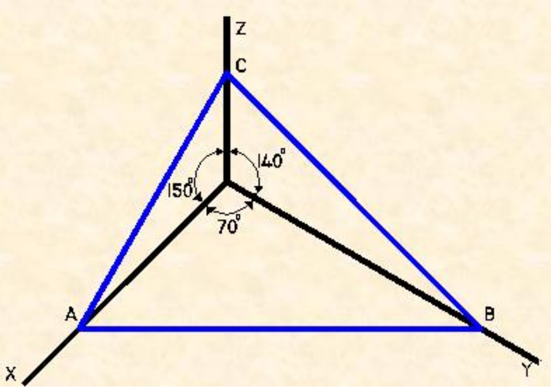


Figure 2

The width, height and depth of my house can be adjusted according to the user input. All the 2D elevations and the isometric can apply translate, rotate, scale, and shear transformations. Users can either just drag them on the canvas by choosing which elevation they like to transform or transform by inputting parameters.

Specifically, the isometric projection can be viewed from multiple views as a 3D model that I build, therefore, you can rotate it to view it.

Thirdly, as the oblique projection, I designed that users can change the side and top angle to view it. By changing the side angle, the user can see more about the side. By changing the top angle, the user can see more about the top.

Fourthly, my project has the perspective projections of my house: perspective 1 point, perspective 2 point and perspective 3 point. Perspective projections are used to produce images which look natural. When we view scenes in everyday life far away items appear small relative to nearer items. A side effect of perspective projection is that parallel lines appear to converge on a vanishing point, which can be one, two or three. An important feature of perspective projections is that it preserves straight lines.

The oblique and three perspective projections can be adjusted by change the parameters that the user enters.

Fifthly, the house model can transform camera and light sources that implemented by WebGL.

Sixthly, the last feature that my project achieved is the texture mappings. I downloaded some images of the door, windows, walls, roof and chimney from the Internet. And using texture mappings to make my house looks like a real house.

2. Week 1

In the week 1, I achieved: (1) Modeling: create and store a 3D object by draw three 2D "elevations" (front, top, side of "my dream house"). And create a 3D model (isometric) of the object from them (figure 3).

(2) Transform object: apply 3D (Translate/Rotate/Scale/SHear) transformations to the created object (isometric) (figure 4 and figure 5).

On my website:

https://www.cs.uml.edu/~wma/427546s2018/finalProject.html

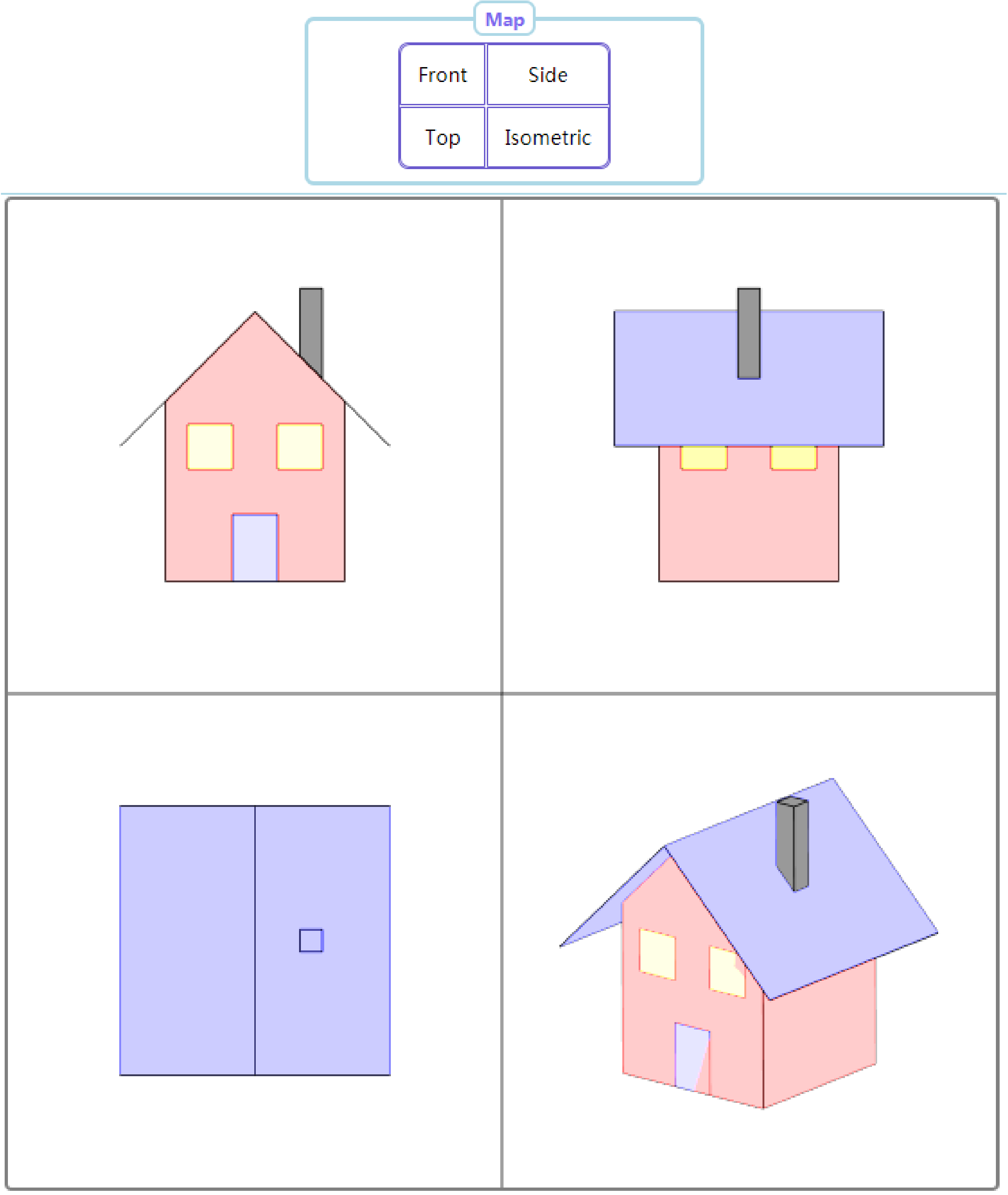
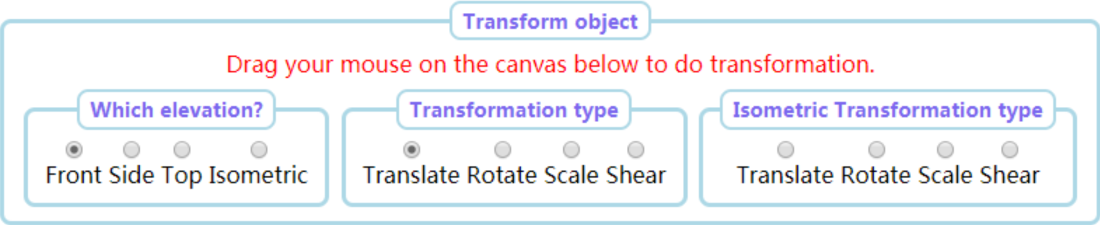


Figure 3 Three 2D "elevations" and a 3D model (in isometric projection)

In order to transform, firstly, choose from below table on my website:



Transform object

Drag your mouse on the canvas below to do transformation.

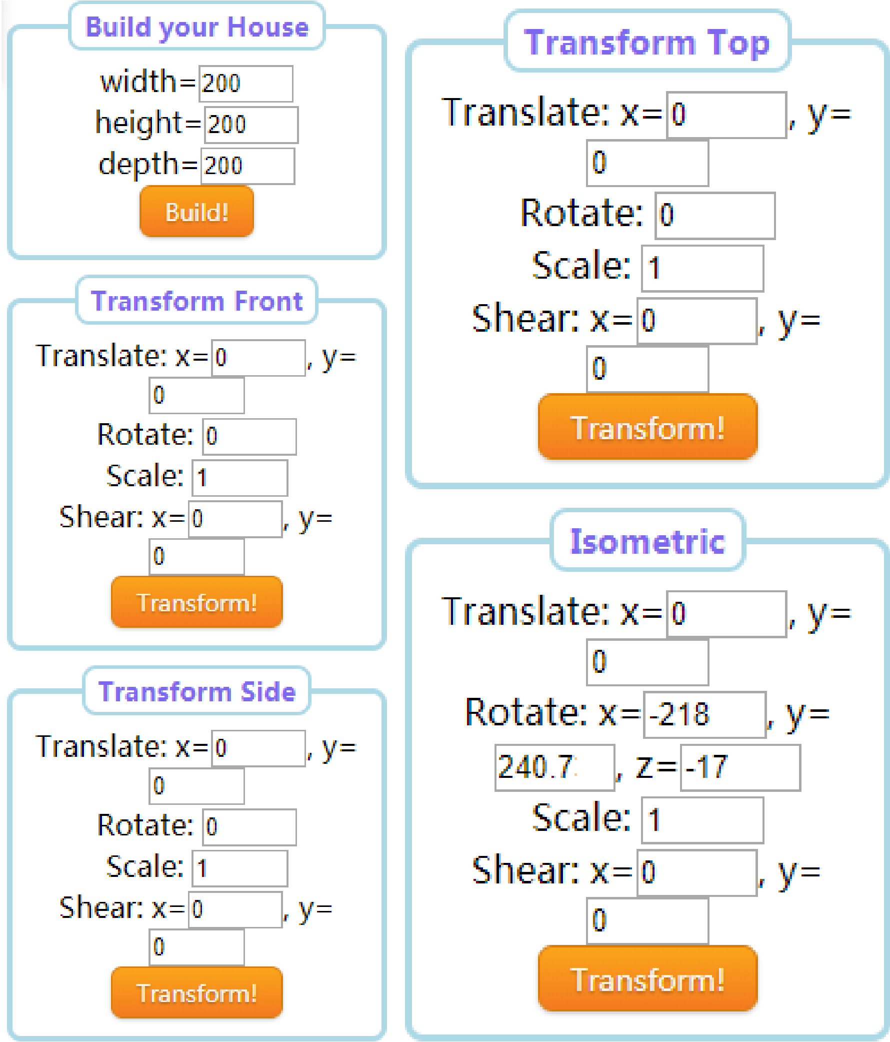
Which elevation?
● Front ○ Side ○ Top ○ Isometric

Transformation type
● Translate ○ Rotate ○ Scale ○ Shear

Isometric Transformation type
○ Translate ○ Rotate ○ Scale ○ Shear

Figure 4

Then the user can either drag mouse to transform or input the parameters on my website:



Build your House
width=200
height=200
depth=200

Transform Front
Translate: x=0, y=0
Rotate: 0
Scale: 1
Shear: x=0, y=0

Transform Side
Translate: x=0, y=0
Rotate: 0
Scale: 1
Shear: x=0, y=0

Transform Top
Translate: x=0, y=0
Rotate: 0
Scale: 1
Shear: x=0, y=0

Isometric
Translate: x=0, y=0
Rotate: x=-218, y=240.7, z=-17
Scale: 1
Shear: x=0, y=0

Figure 5 User input part

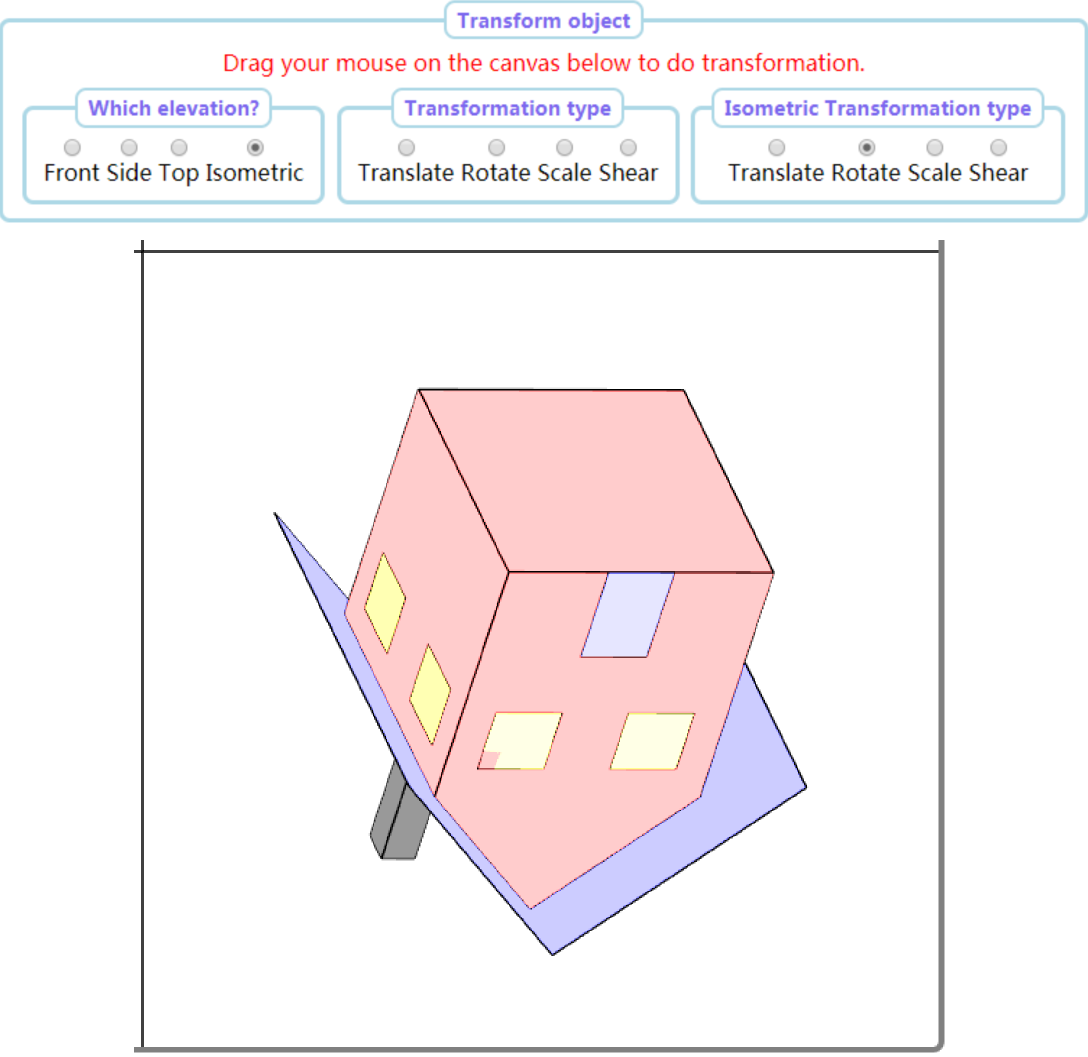
3. Week 2

In the week 2, I achieved: (3) Viewing: view your created object (Isometric) from multiple views (figure 6). (4) Transform camera (figure 7) and light sources(s) (figure 8).

On my website:

https://www.cs.uml.edu/~wma/427546s2018/finalProject.html

In order to have multiple views, firstly choose the isometric and the transformation type is rotate.



Transform object

Drag your mouse on the canvas below to do transformation.

Which elevation?

○ Front ○ Side ○ Top ● Isometric

Transformation type

○ Translate ○ Rotate ○ Scale ○ Shear

Isometric Transformation type

○ Translate ● Rotate ○ Scale ○ Shear

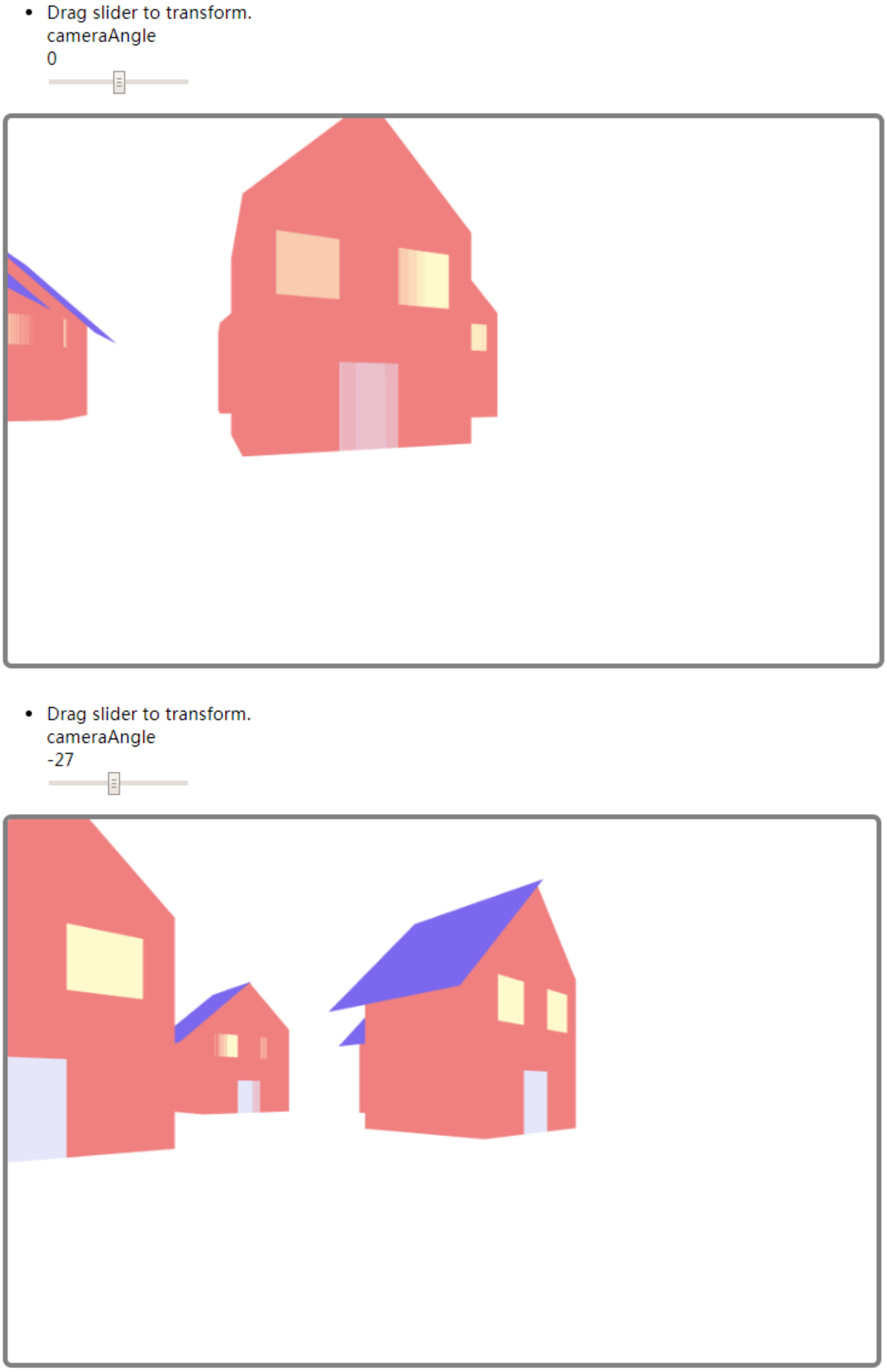
Figure 6 Isometric multiple views

For the camera transform (figure 7), I got help from the website:

https://webglfundamentals.org/webgl/lessons/webgl-3d-camera.html

On my website: you can change the view angle of the camera. The camera is moving around the houses.

https://www.cs.uml.edu/~wma/427546s2018/finalProject/finalProject_Camera.html



- Drag slider to transform.
cameraAngle
0

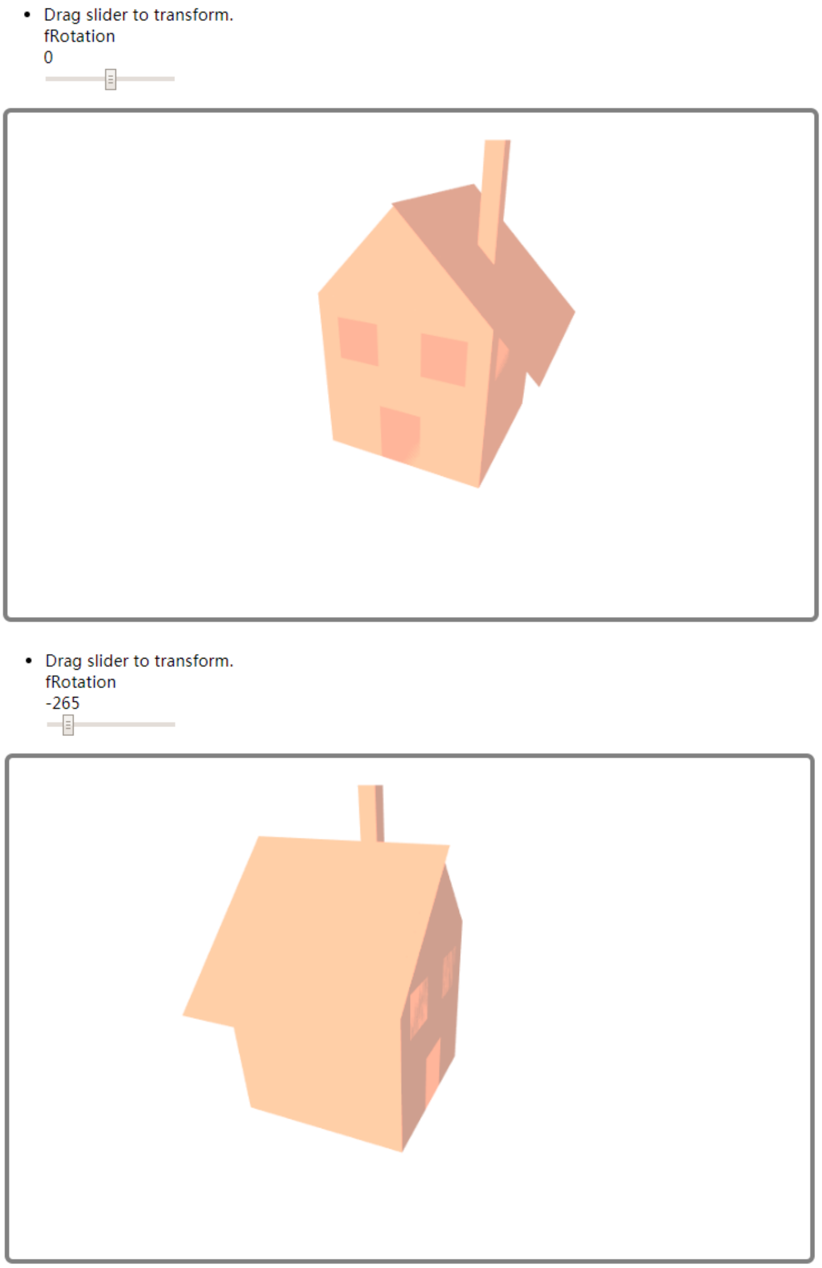
- Drag slider to transform.
cameraAngle
-27

Figure 7 Camera Transform

For the directional light sources, I got help from the website: https://webglfundamentals.org/webgl/lessons/webgl-3d-lighting-directional.html

On my website (figure 8): you can change the lighting angle to see how the light effect the view of the house. The surface of the house that is facing the light will be brighter. And the surface far from the light will be darker.

https://www.cs.uml.edu/~wma/427546s2018/finalProject/finalProject_light.html



- Drag slider to transform.
  fRotation
  0

- Drag slider to transform.
  fRotation
  -265

Figure 8 Directional Lighting

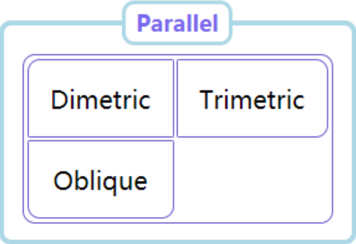
4. Week 3

In the week 3, I achieved: (5) Generate different projections of the objects (dimetric, trimetric, oblique, perspective 1 point, perspective 2 point, perspective 3 point). (6) Edit/Change perspective projection vanishing points (1, 2, 3). (7) Create texture mappings for the object.

On my website:

https://www.cs.uml.edu/~wma/427546s2018/finalProject/finalProject_D_T_O.html

There are the dimetric, trimetric and oblique projections (figure 9).



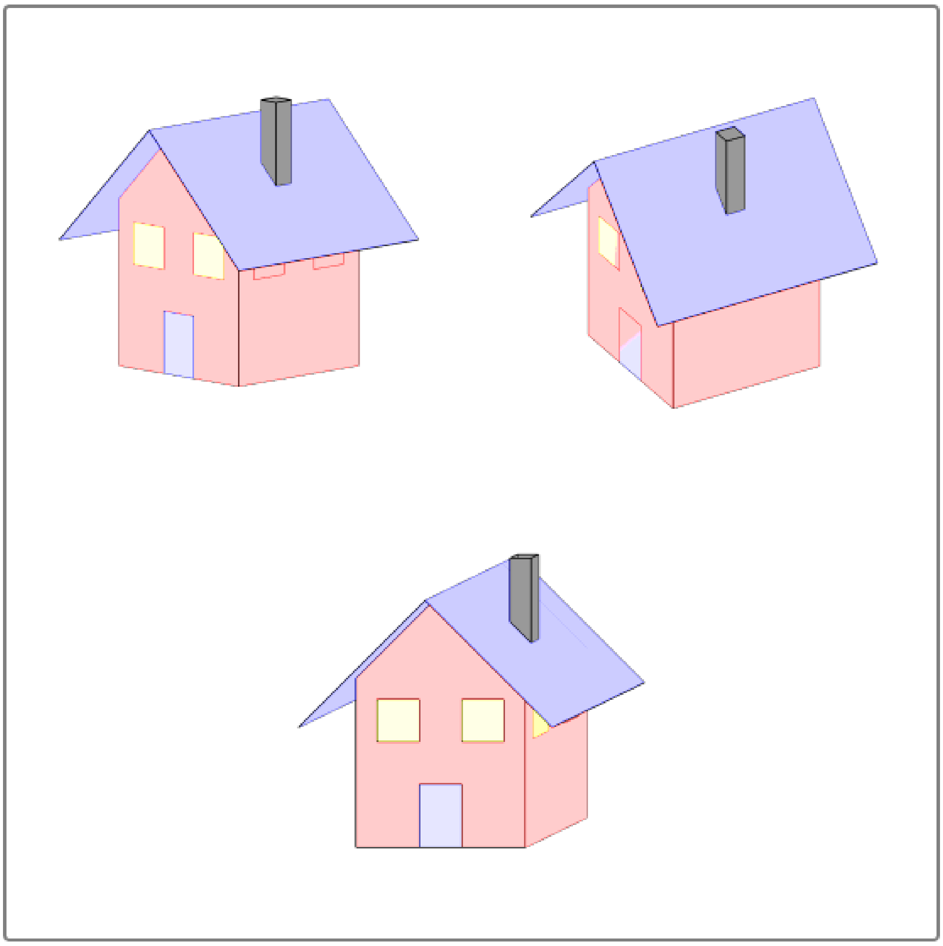
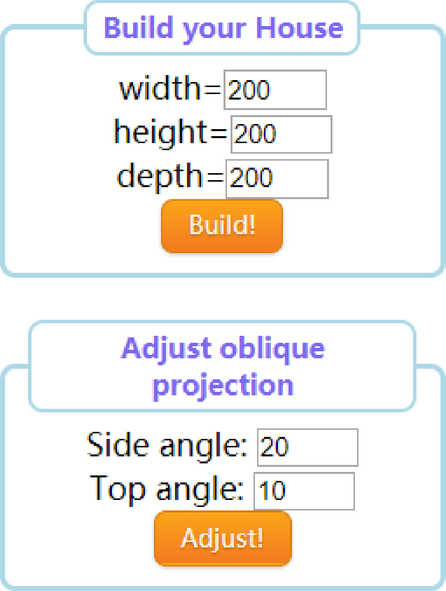


Figure 9 The dimetric, trimetric and oblique projections

For the oblique projection(figure 10), you can change the side angle to view more about the side (figure 11) or change the top angle to view more about the top (figure 12).



Build your House

width=200

height=200

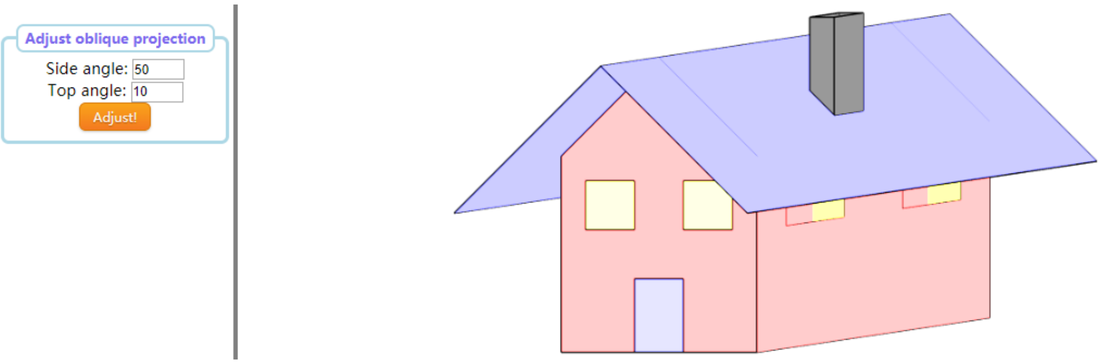
depth=200

Adjust oblique projection

Side angle: 20

Top angle: 10

Figure 10 Oblique projection adjustment

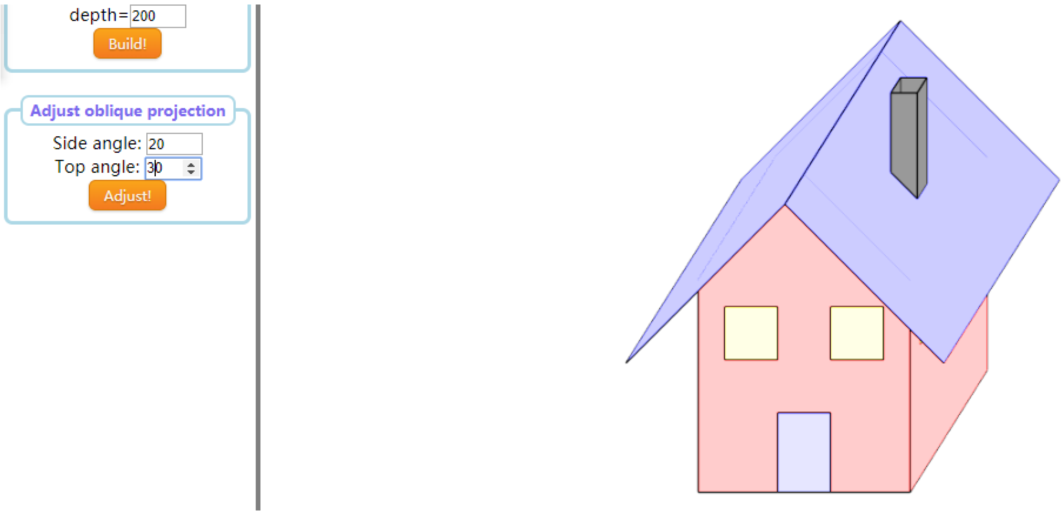


Adjust oblique projection

Side angle: 50

Top angle: 10

Figure 11 Change the side angle



depth=200

Adjust oblique projection

Side angle: 20

Top angle: 30

Figure 12 Change the top angle

On my website:

https://www.cs.uml.edu/~wma/427546s2018/finalProject/finalProject_Perspective.html

There are the perspective 1 point, perspective 2 point and perspective 3 point projections (figure 13).

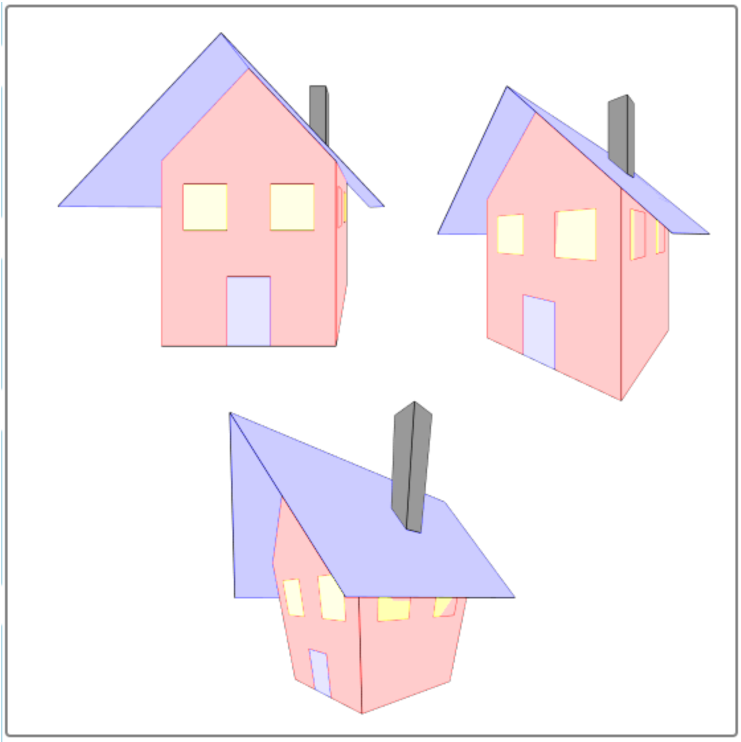
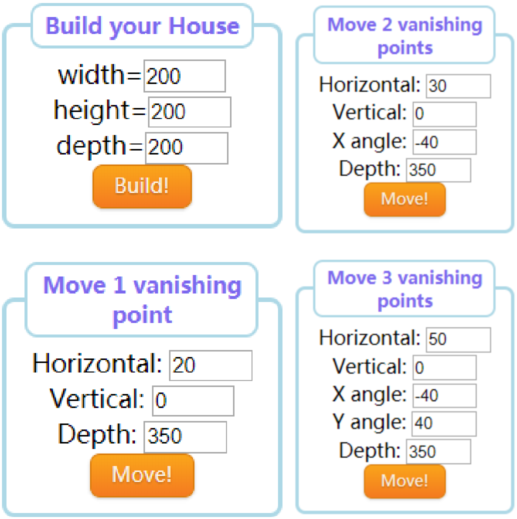


Figure 13 perspective projections

The user can edit perspective projection vanishing points (1, 2, 3) by inputting the parameters (figure 14).



Build your House

width=200

height=200

depth=200

Build!

Move 2 vanishing points

Horizontal: 30

Vertical: 0

X angle: -40

Depth: 350

Move!

Move 1 vanishing point

Horizontal: 20

Vertical: 0

Depth: 350

Move!

Move 3 vanishing points

Horizontal: 50

Vertical: 0

X angle: -40

Y angle: 40

Depth: 350

Move!

Figure 14 Vanishing points adjustment

For texture mappings, I got help from the website: https://webglfundamentals.org/webgl/lessons/webgl-3d-textures.html On my website (figure 15): it rotates automatically. https://www.cs.uml.edu/~wma/427546s2018/finalProject/finalProject_Mapping.html

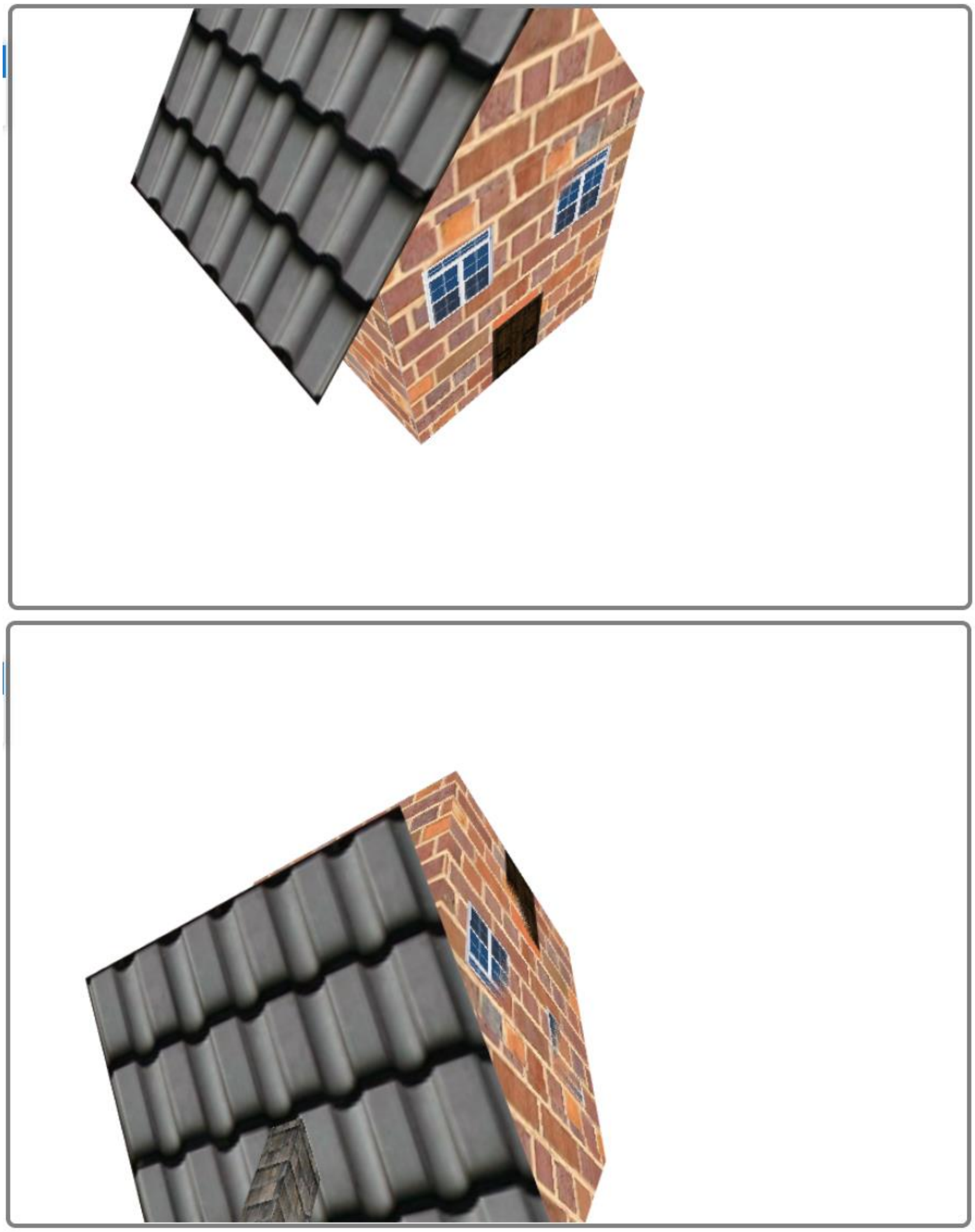


Figure 15 Texture mapping

5. Week 4

In week 4, I optimize the user interface of my project that is my house and the view of different features that I achieved.

6. Week 5

In week 5, I optimize the user interface of my project that is my house and the view of different features that I achieved.

7. Conclusion

In this project, I use the APIs and WebGL to implement all the features that professor required:

1. Modeling: create and store a 3D object by draw three 2D "elevations" (front, top, side of "my dream house"). And create a 3D model (isometric) of the object from them.
2. Transform object: apply 3D (Translate/Rotate/Scale/SHear) transformations to the created object (isometric).
3. Viewing: view your created object (Isometric) from multiple views.
4. Transform camera and light sources(s).
5. Generate different projections of the objects (dimetric, trimetric, oblique, perspective 1 point, perspective 2 point, perspective 3 point).
6. Edit/Change perspective projection vanishing points (1, 2, 3).
7. Create texture mappings for the object.

I also learnt a lots about the principles and concepts of the basic computer graphics. In the future, I will study further in computer graphics.