**Introduction**

For our project we chose to construct a city scene composed primarily of six individual objects: a city scene, car, tree, traffic light, and two buildings. The idea of the scene came about as we were thinking of settings where we could possibly extend the project to include some nice animation(s).

Below we break down the city objects into the primitive OpenGL objects we used to construct them and some insight into the rationale used when deciding which primitives to use.

**City Scene**

The CityScene.java implements the main scene of the animation. This scene is made of the following elements:

1. Streets (intersection),
2. Green Fields,
3. Sidewalks,
4. Sky,
5. Zebra crossing (pedestrian crossing) and
6. Double yellow lines

With the exception of the sky, all these elements are drawn on a single plane, using GL\_LINE\_LOOP, GL\_QUADS and GL\_LINE\_STRIP. In other words, they are all two-dimensional. They have no depth. Moreover, with the exception of the sidewalks, these elements consist of simple lines, squares and rectangles. Each sidewalk consists of two rectangular pieces, with one piece longer than the other, joined to form the shape of an “L” around the internal corners of the different squared green fields.

We added diffuse lighting to the City Scene to give it some sunlight. The sunlight method in the CityScene class sets up this lighting. We enable the light, set the lighting properties and set which material parameters track the current color. We also gave the user the ability to control the brightness of the sunlight. The user can press ‘D’ to decrease the brightness of the sunlight and ‘B’ to increase the brightness of the sunlight to mimic a sunset and/or sunrise.

**Building**

The tall building object simply started off as a 3D cube that has its eight vertices defined.  The dark brown color was considered and chosen to give the appearance of a brick-made apartment-style building typically seen in a city.  The windows were created from a quadrilateral similar to the shape of a square or a rectangle.  The window color of blue was selected to simulate and give the realistic appearance that the material was made out of glass.  The windows are placed on the front and both the right and left side of the apartment building.  The building door was designed and created in the same fashion as the windows by simply being rectangles.  The color of the black and white door was selected to give the appearance that the door itself was opened and that there was lighting coming from inside of the building.

Another object in the city scene is a simple-styled store.  The store was design in a similar way as the tall building reusing the same code to create the cubed structure.  The building was designed to be a convenience store in the neighborhood of the city scene.

**Car**

The car is made of polygons, circles and cylinders. The wheels of the car are made of up cylinders rotated on its side. The rims of the wheels are made up of overlapping circles and triangles. By rotating the wheels around the Z-axis with a negative value, this allows the wheels to rotate in a counter-clockwise direction. The sides, roof, windows, and headlights are made of polygons and quad strips.

By using quad strips, this allowed several polygons to be made next to each other without having to duplicate multiple vertices. By creating the doors and windows together as an object, we were able to rotate this object around the Y-axis, by first translating this object to (0, 0, 0) then rotating it around the

Y-axis and then translating it back to the original position. By doing this we can create the animation of the car door opening and closing.

**Trees**

The trees are made up of cylinders with different radii as their branches and spheres as their leaves. To draw the tree, start with a cylinder as its trunk. Then draw a branch and rotate/translate it into place. Do the same with the other branch. Lastly, draw spheres at the end of each branch and the trunk. The idea for how to draw the trees came from the project 2 code that was given to us.

**Traffic Light**

The traffic light is made up of cylinders, a cube, and half spheres. Each object of the traffic light gets created at (0,0,0) and then moved to its correct location. Drawing each section as a cylinder and translating/rotating each piece created the traffic light pole. The pole is made up of 3 cylinders of different lengths. The traffic signal box is built using 6 different squares to form a cube. Each side is drawn using points from another side. The lights on the signal box are created using half spheres. One set of lights are drawn, then we apply a rotation of 180 degrees and draw the next set. Next we rotate 90 degrees and do the same drawing of the lights as before. To be able to control the lights in a way that acts like a real traffic light, the lights had to be drawn as 2 sets. This allows setting up the color of the light, draw the set of lights (north/south), set up the color for the other lights, and then draws the other set of lights (east/west). The drawing of the traffic light was set up in its own class. This way it allows the ability to drop the traffic light into any project and be easily created. Just create an instance and then apply rotation/translation/scaling to put it where you want it.

**Conclusion**

We decided to construct a city scene based on the variety of objects we were able to choose from to include in the rendered scene. We would have liked to extend the scene a bit further to include other components such as an animated dog walking on the sidewalk, a person crossing the street and an M4 Sherman tank rolling down the street. Due to time constraints we were not able to implement these features but are happy with the experience gained implementing the objects and features currently rendered in the City Scene.

**User Manual**

|  |  |
| --- | --- |
| Controls | Effect |
| Ctrl + UP | Up |
| Ctrl + DOWN | Down |
| Ctrl + LEFT | Rotate world left |
| Ctrl + RIGHT | Rotate world right |
|  |  |
| UP | Forward |
| DOWN | Backwards |
| LEFT | Side Step left |
| RIGHT | Side Step right |
|  |  |
| Shift + < | Rotate Camera left |
| Shift + > | Rotate Camera right |
|  |  |
| s | Stop animation |
| r | Reset animation |
|  |  |
| 6 | Closes door (red car) |
| 7 | Opens door (red car) |
| 8 | Closes door (yellow car) |
| 9 | Opens door (yellow car) |
|  |  |
| B | Increase sunlight brightness |
| D | Decrease (dim) sunlight brightness |