Computer Graphics Final Project – Readme file

3-Dimensional City Model

Introduction:

A 3-Dimensional Architectural view of a City model has been created as a part of Computer Graphics final project. Sig Library is used for implementation of the model. Different classes and functions of the library have been used. For a good Landscape view, key concepts such as moving objects, Building of different shapes and sizes, Sign boarding and trees were built.

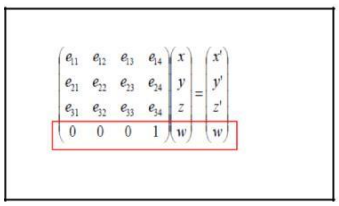
Main objects that are built in the City Model:

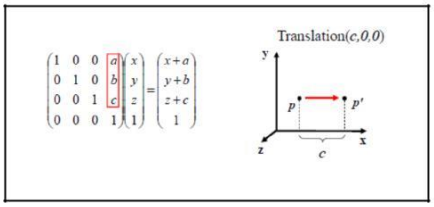
- Megaplex – large group of building
- A Self-driven Bicycle
- Sign boarding on Road
- Trees of different shapes and sizes

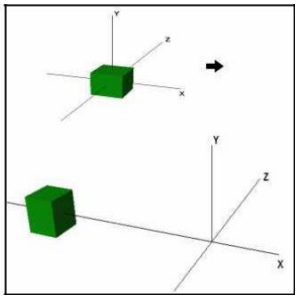
How are these objects made?

Megaplex: To design all the above mentioned things, several functions from SIG Library have been used such 'set()' function that is used to assign values to vertices, 'Push()' function has been called to create triangle's between assigned vertices. For designing an array of building, functions from SnPrimitve and GsPrimitive have been used. After defining a particular shape and color for each building, add_model function is used to add model to the scene graph. As a parameter of add_model function, Vector value has been passed to define the coordinates of the object. Refer Figure 1.

A Self-driven Bicycle: (For making the bicycle to move, Transform button in the left-up corner has to be clicked). The Bicycle that is made has been kept self-driven. The auto-driven bicycle is made up of a collection of Cylinders and shapes from GsPrimitive class. For making the wheels, basic concept of triangles is used. Firstly, the values are assigned to the vertices and then triangle is generated between the assigned vertices. V Array of GsArray class is used to store the value of vertices. As a main concept of this project, Transformation is used to rotate the wheels and translate the other parts of the bi-cycle with respect to X-axis. Research paper on transformation was found and studied to implement concept in a correct manner. The research paper described how a 4x4 matrix can be used to translate and rotate the primitives. After going through the research paper, translation matrix was used to translate the cycle on the road along the X axis. The wheels are being rotated and are also being translated. For making wheels to rotate, 'getrans' and 'setrans' functions of the GsMat class are used. A particular value is being added to the vector till a particular point. Refer figure 2.







Why was function Over-Riding needed: The add_model() function have been overridden. This is done because there are both static and dynamic models in the model. So, in the code there are 2 add_model() function and both have different parameters. The static objects such as building and sign boarding are using one function. And the Second function is for objects that are transformed such as different parts of bicycle which are using an additional parameter that is a pointer to SnManipulator class.

Trees of different shapes and sizes: For designing the trees, concept of Fractals have been used. A Research paper on fractals was also studied to understand the concept and make a new design for the tree. In the applied concept, a recursive function is made and called at every new point. Firstly, a line is made between 2 points. Secondly, a new end-point for the new line is calculated by incrementing the Y-Coordinate and rotating that point in the Z-direction by a particular angle. Lastly, the recursive function is called at every new point. Refer Figure 3.

Sign Boarding: Sign Boarding have been created by using triangles. The letter 'Y' on the board is indicating the self-driven bicycle about the Yield Sign. Refer Figure 3.

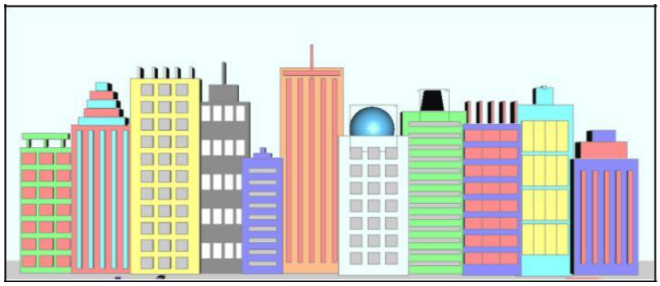


Fig 1: Megaplex – Collection of building

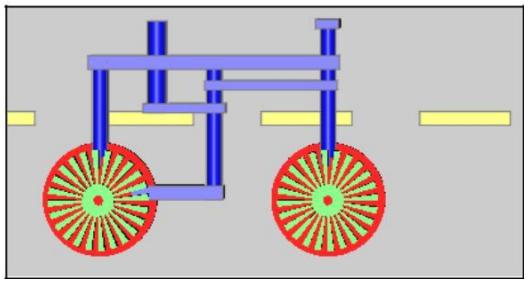


Fig 2: Self-Drive Bicycle

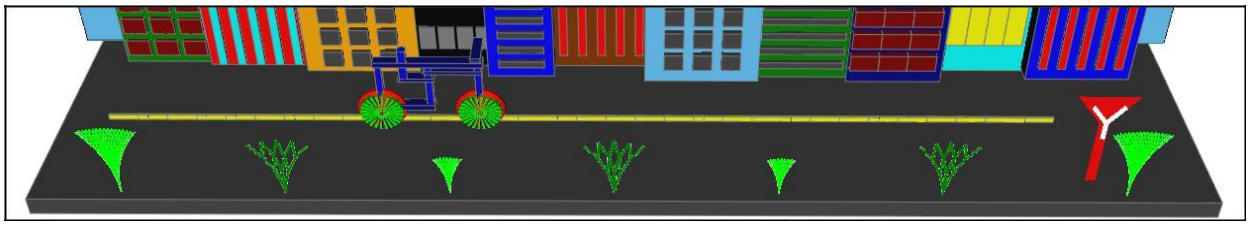


Fig 3: Trees and Sign Boarding

List of classes that have been used:

- SnModel
- GsModel
- SnManipulator
- SnTransform
- SnPrimitive
- GsPrimitive
- SnLines
- SnShape
- SnGroup

Machine Specification on which this assignment was made and code testing was done:

Processor	Intel i3 - 3217U CPU @ 1.80GHz (8GB RAM)
Graphic card details	Internal Intel® HD Graphics 4000

Evaluation Table:

Processor	Number of Triangles / Scene size	FPS	Rendering time (sec)
Intel i3	500 triangles, 206 primitives, 744 Lines	15.53	0.11246533
Intel i5	500 triangles, 206 primitives, 744 Lines	14.99	0.11172545
Intel i7	500 triangles, 206 primitives, 744 Lines	15.24	0.10952525

Code Structure:

Lines	Description
0 - 13	Header files
15 - 39	WsViewer Constructor
41 - 48	add_ui function
50 - 69	add _model function - Manipulator
71 - 87	add _model function -static objects
89 -148	Function for Fractals - Trees
151 -379	Function for Bicycle wheels
383 - 453	Function for Sign Boards
454 – 991	build_scene function
994 – 1184	run_animation function
1186 - 1199	handle_keyboard function
1201 - 1210	uievent function

Rendering time taken by different functions of the city model:

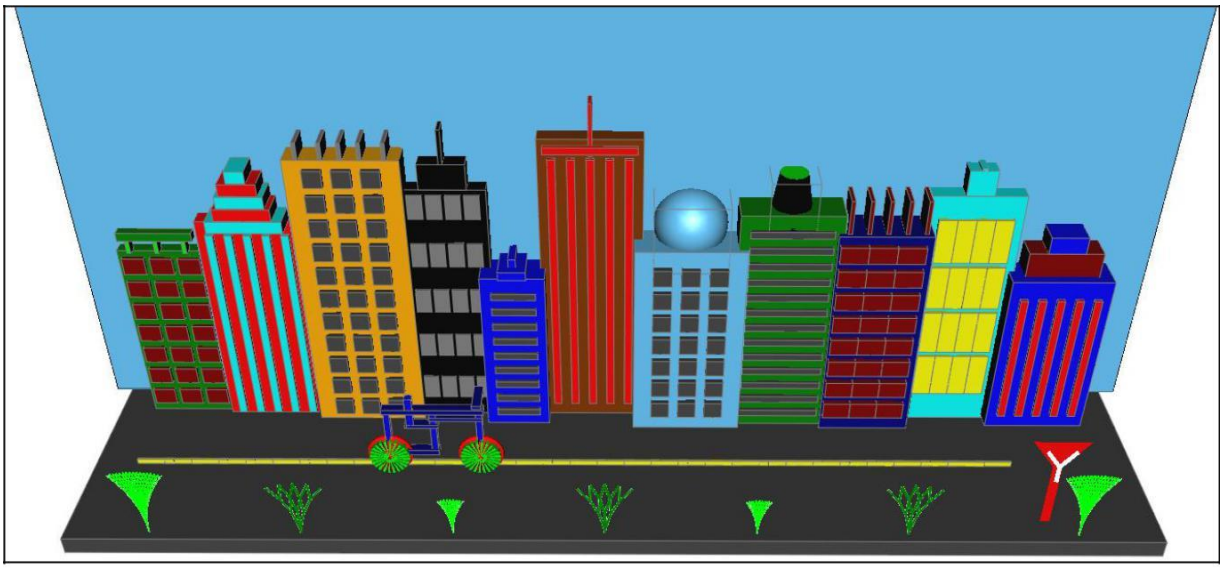
Function	Number of Triangle's/Lines	Rendering time (Sec)
Wheels of Bicycle	194 triangles	0.07325623
Megaplex	206 primitives	0.09156462
Number of Lines in Tree	744 Lines	0.06526892
Whole Scene graph	500 triangles	0.09172166
Build Scene	500 triangles	0.09758435
My Viewer	500 triangles	0.11246533

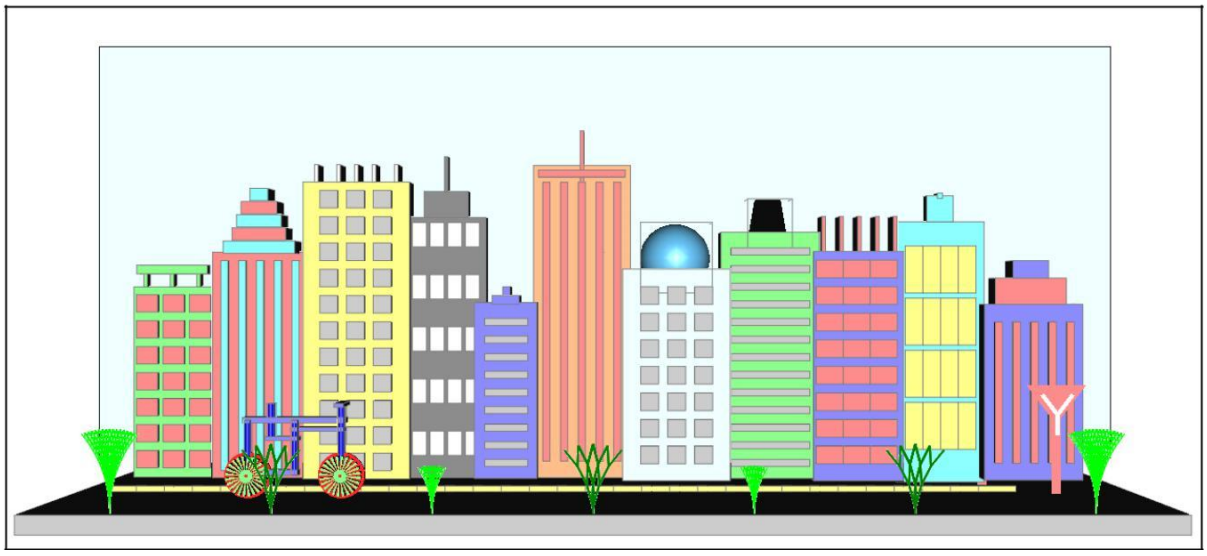
Interesting conclusion:

An interesting thing was seen while collecting the results and the final testing phase. The smoothness of the translation matrix varied after implementing the concept of fractals and trees were made. It would not be a problem if the trees were also dynamic and were moving along any axis. However, in this project the trees are kept static. Additional of trees to the scene graph made the Bicycle to move in slightly rigid manner. Although, the bicycle is moving in a smooth manner.

Second Conclusion that was seen is that the lines take less time to render as compared to the other primitives and shapes.

Final Result:





References:

- Research papers on Transformation and Fractals for clear understanding of concept
- http://ijirt.org/master/publishedpaper/IJIRT100363_PAPER.pdf
- http://ieeexplore.ieee.org/document/5540927/
- In-details study of SIG Library
- Online websites for Architectural designs and Fractals.