Application of Glscene Technology in Satelitte Tracking Software

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Abstract – **GLScene is a library which provides all the components and support classes to build 3D scenes and display them on the screen. Basically , what GL Scene represents is an OpenGL extension to be used with Borland Delphi compilers. This paper will show one of the possible implementations in Satellite Tracking Software.**

Keywords - **GLScene, Satellite, Tracking, OpenGL, Delphi**

I. INTRODUCTION

In the past, Delphi programmers, unlike ones using Visual C++ or any other Microsoft development tools, had to deal with a problem of making 3D animations and rendering 3D scenes. DirectX or OpenGL solutions were in most cases turned towards C++ programming audience.

GLScene is a open source project which has started in 1998. Even though it has been a while since development started, GLScene has not yet reached version 1.0.

Although its' origin use isn't to create 3D games, one may try to write some successfully. The focal points, however, lie in other areas, mainly GUI (graphical user interface).3D components can be built and look really natural, scene editors for the games, screen savers or even 3D logo for WWW home page. Limits are only given by ones' imagination.

After many hours of working with OpenGL, the Open Graphics Library from Silicon Graphics Inc., open source society managed to wrap it into an object-oriented shell using Delphi.

Since Delphi versions 8 and 9 are based on Microsoft .Net framework, writing a code to support 3D object rendering and movement shouldn't be a problem. So, the focal point of GLScene is Delphi version 7 or lower.

II. GLScene features

Among all of the features GLScene provides the most important ones are :

- hierarchical scene management;

- optimized transformation and object handling to get out the highest speed possible;

- optimized floating point assembler routines for geometric calculations;

- multiple viewers for one or more scenes, easy change of viewpoint by just changing one property (Camera);

- well working camera model using focal length and target resolution (screen, bitmap, printer) instead of field of view and far/near plane parameters;

- as many objects as memory allows;

- predefined objects (cube, disk, sphere, cylinder, cone, torus, 3D text, mesh, free form, teapot, dodecahedron), easily extendable;

- more than 150 predefined colors like clrCornflowerBlue or clrCoolCopper, easily extendable;

- polymorphic object creation with one function;

- render to a file, a bitmap or to the printer in any color and pixel resolution;

- full screen support with dynamic resolution changes;

- viewer window transparency simulation;

- various image formats support (*.jpg, *.tif, *.tiff, *.pic ...);

- precise frame speed determination;

- 3D Studio file import with automatic and precise normal vector calculation (using the given smoothing groups of the file) and texture coordinate import.

For OpenGL is, in opposition to DirectX, supported on almost all operating systems available today (Windows95, Windows NT from version 3.51, all kinds of Unix , OS/2 and even the Macintosh) porting applications to operating systems like Linux wouldn't be a problem, specially with the upcoming Kylix 2, Linux version of Delphi. [2].

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III. USER INTERFACE

There are two basic components to be placed on the form. TGLScene and TSceneViewer [1]. TGLScene is the scene manager, responsible for holding the tree structure and other lists describing the scene. TSceneViewer (Fig.1) is the viewing window used to actually display a scene. It's connected via a camera which determines the look direction, focal length and other things; with scene viewers one can render the same scene from different locations or different scenes as well.
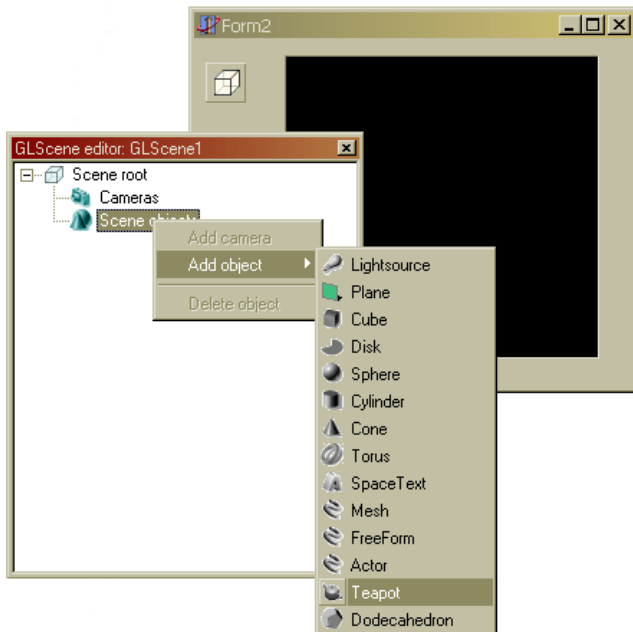

Fig. 1. User interface example

There's a large number of predefined objects, ready to be used in application. An object can simply be added to the scene from the Add object menu. More complex objects can be defined using OpenGL sintax, or imported from 3D Studio®.

Object's properties can be edited, so any shading or material can be applied and combined with several types of light sources.

IV. APPLICATION IN SATELLITE TRACKING SOFTWARE

Most objects in space are small, but quite a few are large enough to be seen with the unaided eye. It appears that some, like the Space Shuttle and the Russian Mir space station, are very large and very bright.

There are over 7,000 objects in space for which orbital information is kept by military and civilian space organizations.

Satellites can only be seen when sunlight reflects of their surface, since they do not give off light of their own. But the daytime sky is too bright for their reflected light to be seen.

Therefore only during a comparatively brief period after sunset and before dawn, when the sun is below the horizon for Earth based observers but is still illuminating space overhead, they reflect light in a dark sky. For that hour to hour-and-a-half it is easy, if patient, to see artificial satellites. Obviously, darker the sky and more is revealed to the observer's eye.

Determination of what satellite one is viewing can be difficult task. But, if one knows an orbit tracking program and updated spacecraft orbital elements, it is usually pretty easy to figure it out. Bright objects like the shuttle and Mir space station can be viewed from even light polluted city skies at certain time.
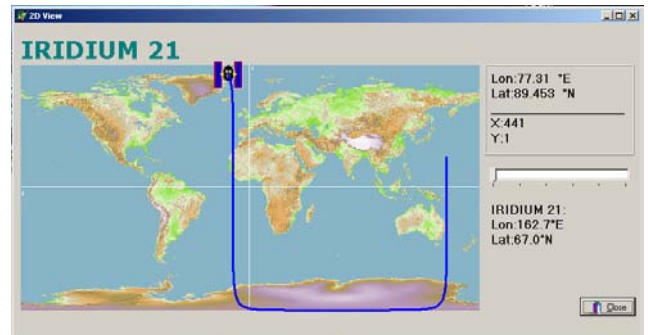

Fig. 2. 2D Display

Also, there are orbit tracking programs for Macintosh and IBM compatible computers. They are either free or shareware and can be obtained from public access sites via a modem or Internet connection. They require updated orbital elements which can also be easily obtained.

Orbit tracking programs requires information about the shape and orientation of satellite orbits. These data are known as "Keplerian elements," named for Johannes Kepler. There are two forms of Keplerian elements; the long version which has each value described, and the short form or "two-line elements" (tle) which are a standard way of formatting the data so computer programs can read them automatically. [5].

This satellite tracking software is based on mathematical SGP4/SDP4 model [3]. The whole model is encapsulated in ActiveX® control, so it acts like a black box. The data is provided from two elements set and on the other end viewport coordinates are calculated. The software provides detailed information on satellite, restored from the two line elements set. (Fig. 3).
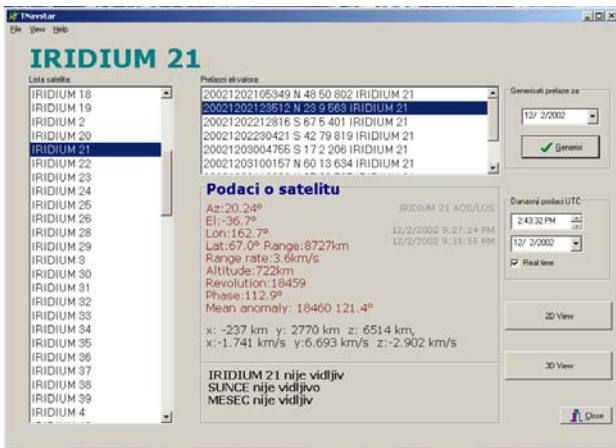
Fig. 3. Satellite list

Also, satellite 2D footprint tracking is available, as well as 3D view. It is possible in 3D view to make prediction on satellites position in the future, or to see its' position in the past. All is based on the information gathered from TLE's . [4].
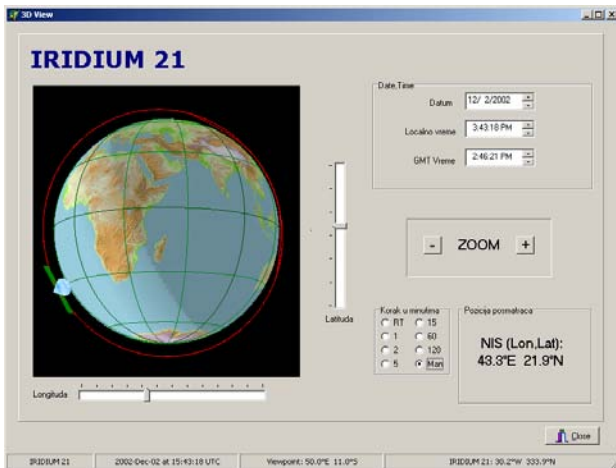

Fig. 4. 3D View made with GL Scene

In 3D View, options for variable view angle, zoom and time increment are implemented. This gives user ability to view satellite from all angles and opportunity to see the path (orbit), area on Earth covered by its' signal (in a form of beam) and real-time movement, as well as possible faster movement caused by time speed up.

The part of Earth not covered with Sun light is dimmed on the globe, so the user is able to predict when it will be possible to see the satellite by naked eye.

The software was tested in parallel with Maghelan GPS device and it acted very well. The coordinates of the satellite given by the GPS device matched with data provided by NAVSTAR software perfectly. At night it was possible to observe low-orbit satellites visually since they regularly reflect light in various directions due to the rotation. That was the third way to check software's prediction capabilities.

V. CONCLUSION

GLScene is library that finally eases the process of creating 3D animations and scene rendering in Delphi applications . Although it has not yet reached version 1.0 it represents a very usable tool. The fact that it's freeware helps in deciding whether or not should you use it.

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