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WebWinds Visualization Tools Development

Introduction/Background

The focus of this project will be the addition of several tools to the WebWinds' Tool Suite. WebWinds (http://webwinds.jpl.nasa.gov/) is an interactive visualization tool written primarily in Java, with some components that offer access to OpenGL routines written using the JNI[1]. WebWinds is available for free to users of most operating systems. The tools will be created using Java, OpenGL and C. Java is a cross platform[2] programming language that allows for graphical interface programs to be written once and deployed across several computing platforms. OpenGL is a cross platform 3D graphics application programming interface (API) used by WebWinds to provide native 3D graphics. The OpenGL calls are made using the JNI. C is a programming language that in it's basic form (ANSII) is cross platform, however when calls are made to platform specific routines (i.e. Graphical User Interfaces, Networking, etc.) the code becomes platform specific and is no longer easily portable. Specifically, these tools will focus on volumetric data representation, transparency of the volumetric data, and viewpoint transformations allowing for data viewing from within the volumetric data. Hearn and Baker (1997) define volumetric rendering as a method for visualizing a three-dimensional data set in their textbook Computer Graphics. The viewpoint can be visualized as the viewfinder in a video camera, transformations are then analogous to moving that same video camera.

These volumetric tools were originally available in LinkWinds, but have not yet been added to the WebWinds' Tool Suite. LinkWinds (http://linkwinds.jpl.nasa.gov/) is an interactive visualization tool written in C and OpenGL. The switch from C and OpenGL (LinkWinds) to Java and OpenGL (WebWinds) created new possibilities, but it also meant that several of the old tools wouldn't be available initially in the release of WebWinds.

Objectives

The objective of this project is to port several visualization tools from C and OpenGL to Java and OpenGL, allowing their addition to the WebWinds' Tool Suite. These tools will provide the functionality of several of the original LinkWinds tools, *IsoView*, *OrthoView*, and *VolumeView*. *IsoView* will provide a method for building up an isovalue surface and rendering it in Planar, Polar or Spherical projections (with or without lighting effects as well). In their textbook, Hearn and Baker (1997) define isovalue surfaces as three-

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[1] **JNI** – (Java Native Interface) Platform specific code (native) may be added to Java via the JNI. JNI is a component of the Java Development Kit (JDK).

[2] **Native (Platform Specific) and Cross Platform (Platform Independent)** – Native code is the name given to programs or code segments that are specific to a particular operating system. These programs must be altered any time they are moved to a different operating system. Cross Platform code refers to programs, code segments and development methods that allow a program to run on several different operating systems, with either no modification or with only a recompilation of the source code.

dimensional contour plots. Transparency is used when rendering isovalue surfaces to allow viewing of the shape of underlying surfaces. *OrthoView* displays a psuedo-volume rendering of all the points in a 3D data set which lie between two values select by the user. *VolumeView* displays a volumetric rendering of the data set with transparency dependant upon the data value, allowing for viewing the overall structure of a data set. In addition to these tools, the creation of a control that will allow for greater user manipulation of the viewpoint when viewing 3D data will be rolled into WebWinds.

Success of this project is dependent on the integration of these tools to the WebWinds Tool Suite.

Approach

The porting from C and OpenGL to Java and OpenGL will require familiarity with the existing code base and structure of WebWinds, and knowledge of the older LinkWinds code. Time will need to be spent porting the C and OpenGL code, additionally some time will be spent working with the C code for the JNI interfaces providing access to OpenGL through Java.

Each one of the older tools (*IsoView*, *OrthoView*, and *VolumeView*) can be ported one at a time, providing natural milestones for the project. The addition of the camera transformation control can be added after all of the visualization tools have been ported, since it will involve more than just the porting of code. The most difficult part of the project will be the porting of the first tool to WebWinds (whichever tool that might be). This will be most difficult, because time will need to be spent becoming familiar with the existing structure of WebWinds. Difficulties understanding the structure and inner workings of WebWinds can be discussed with the existing WebWinds team. Other problems that are faced (OpenGL, Java, JNI, etc) can be dealt with using existing documentation on the web, e-mail list serves, or Usenet.

Some members of the WebWinds group may work on related items, such as the JNI interfaces, but the completion of the routines needed for the new tools are the only limiting factor, and those may be done by myself instead of another team member.

I have been working with a combination of OpenGL and several programming languages (primarily Java, C, and C++) over the last year. My first internship was actually writing software for CAD (Computer Aided Design) applications. Several of the projects required me to become familiar with a large code base in a short time. These experiences make me confident that I could handle working with both the WebWinds source code and the LinkWinds source code to address this problem. I have a great deal of experience working with computer graphics and all of the programming languages involved in this project. I enjoy being able to work on my own, but also as part of a team, as often times your best work is accomplished when you are able to bounce ideas off of those around you.

During the summer of 1999 I was able to spend a week working with some of the WebWinds team members at JPL. In that time we were able to create a new installer for the WebWinds Application. I had the opportunity to get to know the members of the WebWinds team and the approach they take to getting work done. I would like to continue making a contribution to the WebWinds team, and this seems to be the best way to do so.

References

Donald Hearn and M. Pauline Baker, 1997:
Computer Graphics (C Version) – Second Edition
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