

Using 3-Dimensional Models As A Front End For Knowledge

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The objective of this research project is to connect a three-dimensional (3D) model of the human body to ontologies or hierarchies of knowledge in the corresponding anatomy. We are implementing this by connecting a visualization program, based on Visualization Toolkit (VTK), to the Foundational Model of Anatomy developed at the University of Washington. The Visualization ToolKit is an open source, freely available software system for 3D computer graphics, image processing, and visualization. In the future, the user will be able to position the cursor within the 3D space to query the anatomical ontology. Querying the Foundational Model of Anatomy will return other information, including information such as what organs surround a selected organ

The anatomical ontology is implemented using Web services that provide connection through the Web to various kinds of information and operations. Web services are based on some recent fundamental Web concepts including: Extensible Markup Language (XML) and Simple Object Access Protocol (SOAP). SOAP is a lightweight protocol intended for exchanging structured information in distributed environments. Web services are powerful because they provide greater interoperability and extensibility thanks to the use of XML. Programs providing simple services can interact with each other in order to deliver sophisticated added-value services. In this research project, web services are used to connect the Foundational Model of Anatomy, an ontology of anatomy, to a 3D representation of anatomy using a Web service. This work supports the ORNL Virtual Soldier Project.

Visualization (VTK)

- ✓ Visualization ToolKit (VTK): an open source software system for 3D computer imaging, image processing and visualization
- ✓ Facilitates transformation of data or information into pictures
- ✓ Consists of C++ class library and several interpreted interface layers including tcl/tk, java, and python
- ✓ Used to display 3D anatomy from Visible Human

Overview

- ✓ Provides support to DARPA Virtual Soldier Project
- GOALS:**
- ✓ Display a three-dimensional (3D) model of the human body
 - ✓ Connects anatomy to Foundational Model of Anatomy using Web services



Anatomical Ontology

- ✓ Defines terms used to describe and represent an area of knowledge
- ✓ Used by people, databases, and applications that require domain information
- ✓ Include computer-usable definitions of relationships between concepts



VTK Program Displays Surfaces of Organ Segments

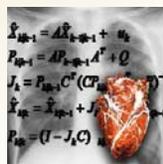
- ✓ Displays each organ segment as it traverses that segment
- ✓ Emulates a bullet wound to the right ventricle
- ✓ Surfaces rendered using VTK



Track.tcl

The Virtual Soldier Project

- ✓ Purpose: Transform the way we view, study and interact with information about the human body
- ✓ Focus on the human heart
- ✓ Provide capability to diagnose battlefield injuries, specifically penetrating wounds heart



Web Services

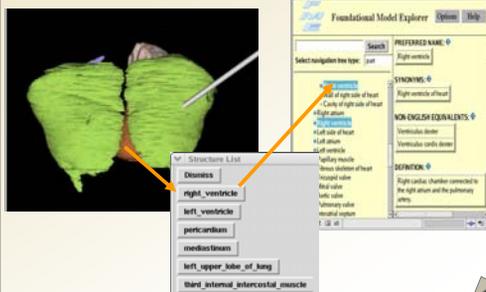
- ✓ Used for Web-based enterprise applications
- ✓ Make software functionality available over Internet to other programs
- ✓ Goal : Develop technologies that employ Web services to their full potential in the Virtual Soldier project

Linking 3D Imagery to Anatomy Ontology

- ✓ Tcl/Tk connects 3D anatomy with information
- ✓ Information obtained by link to web site or web services.
- ✓ Web services used to obtain contents heart from the Foundational Model of Anatomy



Linking 3D Imagery to Web Site



Conclusions

- ✓ Goal: To Link 3D anatomy to information.
- ✓ VTK used to display anatomy from Visible Human
- ✓ Tcl/Tk used to provide an interface to information
- ✓ **button** is created for each intercepted organ segment
- ✓ **exec** command executes script launching Web services.
- ✓ Web services effectively connect to information in the form of an ontology
- ✓ Provides useful prototype for connecting anatomy and information for Virtual Soldier Project