Purdue University

Purdue e-Pubs

VRML Applications in Construction

Purdue ECT Team
Purdue University, ectinfo@ecn.purdue.edu

Recommended Citation

VRML Applications in Construction

The Need

Traditionally construction process information is communicated with paper documents and 2D CAD drawings. Recently, the industry has embraced many kinds of web-based technologies, but information still uses document-based model. It is believed that transition to model-based information can be done through web-based 3D user interface. Moreover, there is a need to easily model structures to be used in a web-based user interface.

Figure 1VRML World of the NIST Fire Research Facility Emissions Control System

The Technology

The applicability of the Virtual Reality Modeling Language (VRML) is being investigated for visualizing the activities at a construction site and creating an advanced web-based 3D user interface for construction process information by the Computer-Integrated Construction Group at NIST.

In principle, VRML is an open standard that offers the possibility of accessing many types of construction project information using readily available and well-accepted graphical user interfaces based on 3D visualization of a model rather than paper over the Web. In order to view the VRML worlds, the users should have a VRML browser, which can be a stand-alone application, a helper application, and a plug-in. The most commonly used VRML browser is the plug-in such as Cosmo Player, Cortona, Blaxxun Contact, and WorldView.

Many of the commercial CAD systems are primarily geometry modelers, rather than object modelers. Regardless of the file format used to export a model (including VRML), they frequently export the 3D model as only a collection of surfaces representing the geometry that contains far too many polygons and unnecessary details. They also fail to preserve the aggregation of geometry elements into objects and the relationship

Internet Based - Web-based Engineering Software

between objects. There is no possibility of accessing and viewing information in the 3D model other than the geometry.

Intelligently constructed VRML representations of steel structures can be done in an object-like fashion. Object-like VRML representations make it easier to update models or to extend the implementation of the object without having to change the model.

Several VRML worlds have been generated in NIST including:

- **The NIST Fire Research Facility Emissions Control System (ECS).** The structure was modeled almost entirely with a Beam PROTO. The Beam PROTO, based on the VRML Extrusion node, allows for the creation of a wide variety of beams and other building elements typically used for steel structures.
- **A User-Controlled Excavator, Tower Crane, and Dump Truck.** This VRML model can handle some of the issues related to construction site activities, including: user-controlled articulation and motion of equipment, collision detection between equipment, driving over nonuniform terrain, deforming (digging) the terrain, and moving objects between pieces of equipment.
- **Virtual Cybernetic Building Testbed.** This simulation deals with the interaction between a fire and HVAC system. The VRML world is used to display the results of a coupled fire and ventilation system simulation.

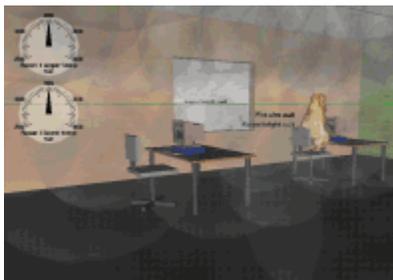**FIGURE 2 VRML EXCAVATOR, TOWER CRANE, AND DUMP TRUCK**

FIGURE 3 VIRTUAL CYBERNETIC BUILDING TESTBED

THE BENEFITS

VRML can successfully be used in construction industry applications and give benefits including:

- Easily model structures to be used in a web-based user interface.
- Web-based user interface is easily accessed by all project participants

- VRML can represent steel structures in an object-like fashion.
- Object-like VRML representations are easier to update or to extend.

STATUS

NIST Fire Research Facility ECS construction project recently started tracking materials and equipment, generate VRML model from spatio-temporal database to track materials as they arrive onsite and are assembled query database for geometric and non-geometric information from VRML model, and real-time tracking of construction equipment using DIS-Java-VRML.

BARRIERS

The success of VRML application in construction industry depends on object-oriented CAD technology and standard data exchange protocols. Object-oriented CAD systems are emerging into the construction industry design practice and, at the same time, new data exchange protocols are emerging that enables the extraction of complete models in the form of object instances, such as CIMSteel Integration Standards (AISC), Industry Foundation Classes (IFC), and Standard for Exchange of Product Data (STEP).

POINTS OF CONTACT

Robert Lipman. NIST
Email: robert.lipman@nist.gov

REFERENCES

1. Blueline Online's ProjectNet - Web-base Document Management, Construction Administration, and Project Collaboration, A-E-C Automation Newsletter, Volume 23, Issue 10, October 1999.

REVIEWERS

Peer reviewed as an emerging construction technology

DISCLAIMER

Purdue University does not endorse this technology or represents that the information presented can be relied upon without further investigation.

PUBLISHER

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana