



## Modelling job

**VRML makes it possible to bring 3D graphics to Internet pages. The World Wide Web will never look so good, as Benjamin Woolley explains.**

In 1884 the pseudonymous author "A Square" (his real name was Edwin A Abbott) published a book called *Flatland*, which told the tragic story of two-dimensional creatures trapped in a flat universe. Until 1994, the World Wide Web was like Flatland, totally two dimensional. Then along came VRML or "Virtual Reality Modelling Language", a new standard for a 3D version of HTML.

### Best of both worlds

HTML, the *lingua franca* of the World Wide Web, was interesting and novel because it was, in a sense, both a data file format and a programming language: as well as containing some of the data to be displayed (the text), it included the instructions specifying how that text should be laid out, the source of any pictures that would accompany it, and the behaviour of hypertext links that referenced other data. Among other things, this meant it was easier to make programs that interpreted HTML (browsers such as NetScape Navigator) "platform-independent", capable of running on Unix boxes, PCs and Macs alike.

It was a couple of programmers from Massachusetts, Mark Pesce and Tony Parisi, who came up with the notion of adopting the HTML model for integrating 3D graphics into the World Wide Web. They presented the idea at a special session of the first international WWW conference in Geneva in 1994, and thus VRML was born.

The specification for the VRML 1.0 standard now in use was set after a few months of discussion over the Web among graphics industry enthusiasts. It was decided to base it on an existing file format, the one developed by Silicon Graphics (SGI) for its "Inventor" system. Inventor is a whole set of tools and libraries for creating and manipulating 3D objects on SGI graphics workstations. The bit borrowed for VRML is just the file format, to which extensions have been added to make it more suitable for use over the Web, specifically anchors

and inlines. These are nodes for making objects links to other objects stored anywhere on the World Wide Web. In the case of anchors, when you point at the specified object, the scene to which it is linked replaces the current scene. In the case of inlines, the linked scene is imported into the current scene.

Within months of its introduction, VRML has spawned countless browsers, including SGI's own WebSpace, WebFX from Paper Inc (now Live3D, about which more below) and a plug-in for Microsoft's Internet Explorer.

A VRML file, like an HTML file, is relatively simple: a straight ASCII text file containing instructions and data. The fundamental object (programming object, that is) is the node, which can be a 3D geometry or mesh (a cube, say, or a light), a texture, surface features such as shininess and so on. Nodes are arranged hierarchically to determine how they influence each other.

### Light, camera, action

In the panel below, we have a simple example of VRML which creates a red sphere and a blue cube lit by a directional light and viewed by a camera. There is one overall Separator node for the entire scene, with sub-nodes and sub-separators describing various elements and how they should be rendered. The blue cube, for example, is created using a material node which specifies its colour, a transform node which specifies its position and orientation, and the cube node, which specifies its shape.

You could add another node, Texture2, to give a texture property, which will wrap the cube with a particular image (a picture of a stone surface, for example).

There are 36 different types of nodes in the first version of the VRML standard. Bearing in mind that these nodes are all you have to describe a scene using VRML, this is not that many. There are no nodes for animating objects or giving them any sort of behaviour. There are no nodes for advanced features such

### Simply red and a bit of blue

```
#VRML V1.0 ascii
Separator {
  DirectionalLight {
    direction 0 0 -1 # Light shining from viewer into scene
  }
  PerspectiveCamera {
    position -8.6 2.1 5.6
    orientation -0.1352 -0.9831 -0.1233 1.1417
    focalDistance 10.84
  }
  Separator { # The red sphere
    Material {
      diffuseColor 1 0 0 # Red
    }
    Translation { translation 3 0 1 }
    Sphere { radius 2.3 }
  }
  Separator { # The blue cube
    Material {
      diffuseColor 0 0 1 # Blue
    }
    Transform {
      translation -2.4 .2 1
      rotation 0 1 1 .9
    }
    Cube {}
  }
}
```



as NURBs (for describing complex curved surfaces) or environmental properties (for adding features such as fog). Some of these, however, appear in the specification for VRML 2.0 (see later).

Nevertheless, there are enough nodes to create scenes quite complex enough for most PCs, and VRML has already demonstrated itself capable of creating rich, complex spaces and providing the user with the means to "walk" or "fly" through them.

You can, in theory, create such worlds by hand. All you need is a text editor and a great deal of patience. Most people, however, create their models using one of two methods: a standard 3D modelling package and some form of converter, or a VRML authoring tool.

The former strategy works quite well in the SGI world, since much 3D software that runs on Silicon Graphics systems uses the Inventor tools from which VRML was derived. Converting an Inventor format file into a VRML format file is, theoretically at least, simply a matter of changing the header information and adding WWW Anchor and WWW Inline nodes with a text editor. Of course it is not that easy in practice, as many Inventor nodes are unsupported by VRML. However, if you keep the model simple, you are unlikely to have any problems.

Outside the SGI world, things start to get more difficult. Translators for converting 3D Studio files to VRML emerged soon after the VRML standard was agreed, and Autodesk now supplies one as a plug-in (or "IPAS", in their terminology), complete with facilities for adding anchors and inlines. Unfortunately, the distance in the methods used by 3D Studio and Inventor are so great that conver-

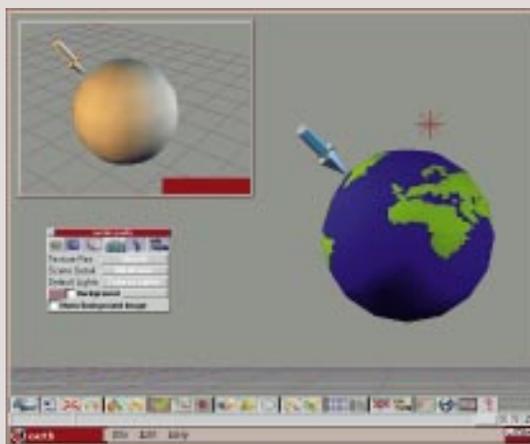
### VRML authoring flows from the Fountain

Truespace from Caligari was the first full-bodied 3D graphics modelling and animation to be developed for Windows and, thanks to its interface, it can be a pleasure to use. That interface now forms the basis of the same company's VRML authoring program, Fountain, which, at the time of writing, was in the final stages of Beta testing.

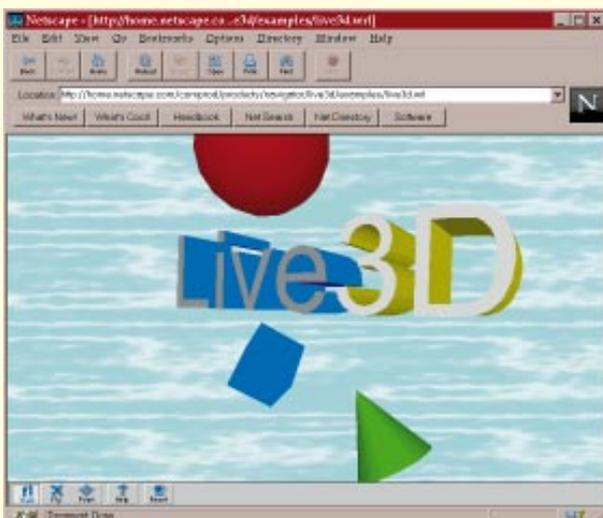
Fountain provides some neat

tools for creating simple geometries and adding properties such as textures and anchors. It also supports such extra facilities as LOD (Level of Detail, which allows for simplified versions of particular objects to be rendered while they are distant) and GZIP file compression.

The Beta 5 version pictured is still very much a Beta release, and it is hard to get consistent results with the VRML files it generates. That said, Fountain is an excellent starting point for VRML authoring on the PC. There is also one feature, introduced with this release, which is particularly attractive: the concept of creating your own neighbourhood. This is the 3D equivalent of a bookmark file. You simply select the neighbourhood icon, point at an object (usually one that links to another world or Web page, though this is not necessary), and it will be copied into a separate VRML file. You can then edit this file to create your "neighbourhood" of favourite places. Neat.



*The Fountain interface, with a VRML scene of the globe in the main window, and a panel showing a separate, non-textured version of the same scene from a different angle. The spear-shaped object pointing at the globes is a pointer put there by Fountain to show that the globe is the currently selected object*



*The Live 3D logo viewed using the Live 3D plug-in for Netscape Navigator*

sion is a hit and miss affair, producing VRML files that some browsers render incorrectly (putting textures on the wrong object, for example) and others are unable even to parse (decode).

A more satisfactory strategy is to use a

VRML authoring tool, something that has the limitations and peculiarities of VRML built into its basic design. There are, as yet, not many on the market. One for the SGI is Ez3d from Radiance (a Windows NT version is due this year), and SGI itself has produced WebSpace Author. For the PC world, there are several in development, but perhaps the best known is Fountain (see panel).

### VRML 2.0

In early February the VRML 2.0 announcement came, though not in the manner we had expected. SGI and NetScape decided they had no time for the drawn-out discussion that usually accompanies the emergence of a new industry standard. They pre-emptively declared that SGI's "Moving Worlds" specification become VRML version 2.0, and got 50 leading Internet and graphics companies to agree with them. NetScape simultaneously announced the Live3D plug-in for its Navigator browser, a VRML browser which supports the Moving Worlds extensions. Two big names, Apple and Microsoft, were missing from the

original announcement. Both had been pushing alternative specifications for VRML 2.0. What Moving Worlds promises to provide is yet another dimension to the World Wide Web — the fourth dimension of time. Objects can now move. They can change shape, precipitate and react to events, be programmed to display certain behaviours. There is a whole layer of extra nodes and features, and I will be grappling with them in future editions of this column.

### PCW Contacts

**Benjamin Woolley**, a writer and broadcaster, can be contacted at [woolley@illumin.co.uk](mailto:woolley@illumin.co.uk). His home page is at [www.illumin.co.uk/woolley/](http://www.illumin.co.uk/woolley/).