Chapter 7
Publishing Paradigms for X3D

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7.1 Introduction: Publishing Paradigms

As the demands of data and user tasks evolve and expand, the field of Information Visualization presents many challenges for designers and systems developers. Of primary concern is the mapping of data records and attributes to a visual presentation that enables the user to detect patterns and relationships within the data. The goal of this mapping is to minimize the user’s cognitive requirements for understanding and insight into the nature of the data that may not be apparent from viewing it in its raw form. The mapping of data to a visualization must take into account the data’s volume and types and this chapter will discuss some approaches to this display problem. However, static presentations are limiting in their power to inform because the data and mappings cannot be interactively explored or rearranged. Computer-based visualizations can address this problem because users can now have control over the selection of data records, the encoding of those records as visual markers and the presentation of those markers in a 2D screen or a 3D world. In this chapter, we will examine how data may be mapped to interactive 3D worlds that may be published and distributed over the World Wide Web (WWW).

In the early days of Web publishing, repurposing data content for multiple formats and platforms was expensive and, as a result, a majority of useful information was locked into technology “silos” for a particular delivery format, method and platform. International standards organizations serve the computing community by developing and specifying open platforms for digital data exchange. By adhering to industry standards, organizations can lower their software and data integration costs and maximize their data re-use while guaranteeing reliability and user access beyond market and political vagaries. Extensible Markup Language (XML) and Extensible 3D (X3D) are two examples of such standards and are covered in this volume. This chapter provides an overview of issues, strategies and technologies used for publishing information visualizations with XML and X3D.

7.1.1 File Formats and the Identity Paradigm

Initially, the majority of published information on the World Wide Web was in a format called HyperText Markup Language (HTML). HTML was revolutionary in
that it specified a declarative language for sharing documents (Web pages) across a network. The resulting boom to now multiple millions of Web pages is largely due to the simplicity and portability of this language. Information and images can be easily laid out, linked and accessed from all over the globe. If the author knows the HTML content header and tags, a basic document can be produced with a text editor and an image editing program. A document's headings, layouts, images, links, colours and fonts are all described with HTML tags. More complex or innovative layouts require the use of `<table>` tags, which are difficult to manage without authoring software.

One major drawback of HTML is that its tags are strictly specified and overloaded. Tags in an HTML document represent both the informational content and the presentation of that content, that is, the data and the display information are included in the same file, often in the same tags. This limitation makes HTML tags less attractive as a data storage medium since it is difficult to repurpose data to other formats and applications. For example, if a customer's name and order number are enclosed by separate header tags, such as `<h1>`, there is no way to distinguish which information is the name and which information is the number from the tags in the file alone. Cascading Stylesheets (CSS) attempts to separate content and presentation in HTML by allowing the author to specify classes of tags with defined display attributes such as font, colour, fill and border. CSS provides flexibility by allowing definitions to reside within document files or as remote resources. CSS is useful for presenting the same page with different styles. However, this flexibility is not really a qualitative improvement in the language because the tagset is mostly unchanged and still finite in its descriptive power for data.

Virtual Reality Modelling Language (VRML) is an international standard (ISO/IEC 14772-1:1997 and ISO/IEC 14772-2:2002), but was designed as a portable format for describing and delivering interactive 3D worlds. The VRML standard is similar to HTML in that it is declarative, strictly specified and carries both data and display information. In contrast to an HTML page, the VRML scene contains spatial viewpoint and navigation information, 3D geometry with colours, transparency and textures, text, fonts, links, backgrounds and temporal information such as object animations and behaviours (defined in Interpolators, Sensors and Scripts). Also, in contrast to HTML, VRML authors have the ability to define their own node types through the PROTO(type) node. The PROTO definitions can reside within the document file or as remote resources.

In VRML and X3D, nodes are analogous to element tags and fields are analogous to element attributes. Nodes are instantiated in a directed, acyclic graph called the scenegraph. A VRML file describes a scenegraph of interactive objects in space which the user can see and navigate through. Coloured and textured objects are manifested in the world (the scene), animated and visualized from a viewpoint or camera. When discussing Web3D media, the “viewpoint” will be referred to as the Viewpoint node itself and the “camera” as the rendered result of the Viewpoint via any superseding transformations. Similarly, “navigation” refers to the scale and nature of the user’s control over their Viewpoint (by way of the values bound in the active NavigationInfo node).

Early ease of authoring was complicated by lack of browser compliance with the standards and scripting support for JavaScript (now officially “ECMAScript”) varied widely. In some cases, Web publishers were forced to maintain multiple, browser-specific copies of their content in order to guarantee the widest possible