Spatial Graph Grammars for Web Information Transformation

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Abstract

This paper presents an approach to spatial specifications for Web information transformation[1]. Extended from the Reserved Graph Grammar (RGG), a Spatial Graph Grammar (SGG) is proposed. The paper illustrates a detailed example that applies the SGG to transform a XML Web document to a WML structure for the display on mobile devices. The SGG formalism is general enough for a wide range of applications such as multimedia interfaces, electronic publishing and XML document conversion.

1. Introduction

With the rapid development of the Internet technology, more graphs and media-rich contents are delivered on the Web. There are various kinds of viewing conditions when surfing the Internet, such as varying screen sizes, style preferences, and different device capabilities. In order to adapt to different clients, we need an executable mechanism to automatically transform the presentation layout. There are increasing demands for the ability of automatic transformation and visualization to meet the client side requirements.

Visual programming languages (VPLs) are capable of expressing and communicating structural information more effectively than textual languages. As the underlying theory of VPLs, graph grammars provide a sound and well-established foundation in defining logic relations among the language components [13]. The recently developed Reserved Graph Grammar (RGG) formalism is powerful in expressing various types of diagrams, with a parsing complexity of polynomial time under a non-ambiguous condition [17][18]. Zhang *et al.* presents a visual approach to XML document design and transformation, which uses RGG to define the XML syntax and specify the transformation among different XML formats [20].

Although RGGs are expressive and efficient, they cannot be used in document layout transformations without support for spatial specifications. This paper presents a spatial extension to the RGG, called the *spatial graph grammar* (SGG), and illustrates its application in Web information transformation. The process of Web transformation is illustrated in Figure 1, where there are two types of input documents: XML/XSL or XHTML specified, or graphs representing envisaged document structures. We first obtain the tree structure of the input Web document, which is then transformed to a host graph to be processed by a spatial graph grammar. The SGG is defined to transform the host graph to the desired presentation layout. The layout graph is finally automatically translated into a WML (Wireless Markup Language) document for displaying on mobile devices or XML/XSL/XHTML document for desktop displaying. This paper presents our approach to this process but omitting the conversion part for textual or graphical documents to their tree structures (i.e. the white boxes in Figure 1). WML [16] is a markup language based on XML, and is intended for use in specifying the content and user interface for narrowband devices, including cellular phones and pagers, and more recently PDAs.

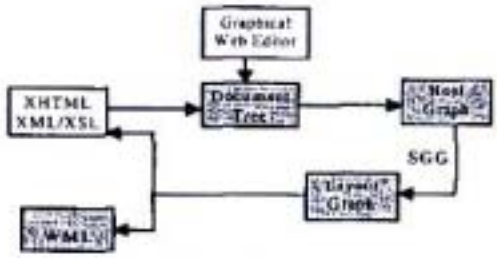

Figure 1 Web page transformation process

Section 2 briefly introduces the RGG formalism. Section 3 describes the Spatial Graph Grammar, in particular, the notations for spatial specifications and their application in layout transformation. Sections 4, 5, and 6 walk through an example to illustrate the application of the SGG to the transformation of a XML/XSL or XHTML tree into a WML document. Section 7 discusses related works, followed by the conclusion and future work in Section 8.

2. Reserved Graph Grammars

Most graph grammars consist of a set of rewriting rules called *productions* as shown in Figure 2. Each production consists of two sub-graphs, called *left graph* and *right graph*. Graph transformation is a sequence of applications of productions. Applications are classified into L-applications and R-applications. An L-application (or R-application) is to replace a sub-graph (called a *redex*) in the host graph, which is isomorphic to the left (or right) graph

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