

## Multimedia layout adaptation through grammatical specifications

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**Abstract.** Online multimedia presentations, such as news, need to be constantly updated. Increasing demands are also being made for accessing online multimedia documents from mobile devices such as PDAs. There is an urgent need for a sound but practical formalism that supports automatic adaptation to the change of media content, display environments, and user intention. This paper presents a visual language approach to the layout adaptation of multimedia objects. The underlying theory of our approach is a context-sensitive graph grammar formalism enriched with facilities for spatial representation and specification. The paper focuses on the issues and techniques for size adaptation and style adaptation in response to the change of device requirements and user interactions.

**Keywords:** Multimedia authoring and presentation – Graph transformation – Graph grammars – Visual languages – Adaptive presentation

### 1 Introduction

With rapid advances in Internet and Web technology, an increasing volume of graphs and media content is delivered over the Web. The content and the presentation structure of an online multimedia presentation may also be frequently updated. On the client side there are various kinds of viewing conditions, such as varying screen size, style preference, and device capabilities. For example, consider a diagram representing an organizational structure on the Web that may be of considerable complexity occupying a large screen space, and thus may be unsuitable for small displays [18]. Thus, if the diagram is to be viewed on the screen of a mobile device, such as a PDA (Personal Digital Assistant), the original diagram layout may not be appropriate. Another example is a news Web site, which generally needs to be constantly updated with incoming news items. Such a site may have to adapt itself frequently to the changing space and style requirements for different news categories. It would be highly desirable for the site to be able to dynamically adapt its layout.

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With current document markup languages such as HTML and WML the layout of a Web page is relatively static and fixed [4]. When a user's requirement or the device capability is changed, the layout may become unsatisfactory. The reason is that such markup languages do not provide any mechanism powerful enough for specifications to be adaptable to the changing context. Though SMIL [35] and CSS [36] provide more flexible markups for multiple alternative layouts, the markups provide absolute layout functionality rather than being adaptable to user intentions or the existing layout. Therefore, a metalevel design mechanism capable of adapting multimedia presentations in response to dynamic changes in information content is highly desirable.

To illustrate the concept of multimedia adaptation that we perceive, we use Ishizaki's schematic diagram of a process between content creation and information reception [14] as depicted in Fig. 1. The design system should be able to adapt itself to the changes in information content and in individual users' intentions. As mobile devices provide an increasing proportion of online content accesses, we argue that a multimedia authoring system should support an additional type of context changes – i.e., adaptation to the change of device capabilities. In other words, the designer of a multimedia system needs to be able to specify how the presentation would evolve based on the change of environments (e.g., from a desktop screen to a mobile display panel), user intention (e.g., zooming in or out), and information content (e.g., news update).

This paper presents a visual language approach, specifically a spatial graph grammar, for adaptive multimedia authoring and presentation. The approach is highly intuitive yet also sound in theory. The central theme of this paper is to demonstrate how to use a graph grammar formalism to spec-

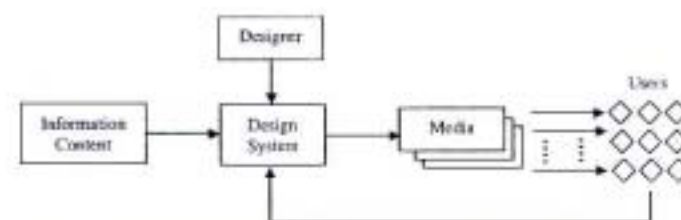


Fig. 1. Multimedia presentation design and delivery process