

# 1 Introduction

## *Multimedia*

*The bird sings a song.  
The artist paints a picture.  
They say the same things.*

## *Hypermedia*

*The grasshopper sings.  
She jumps to another leaf.  
So much more to see!*

Humankind has recorded information for tens of thousands of years [Clot95]. Information was captured initially as images before developing to a symbolic system of text. Time-based media became common-place only one hundred years ago through the development of technologies such as film and gramophone records. The introduction of computer technology, around fifty years ago, had an impact as a new storage medium, but had little consequence for the media types used in digital encodings of documents. Instead, the computer provided a convenient means for creating and storing familiar media. Initial support was for textual documents, followed by image support. Computing power is now sufficient that support can also be provided for time-based media, such as film and audio.

The ability to record information brings with it the ability to comment on and make explicit relationships between pieces of information. When adding commentary in paper-based textual documents, a scholar requires to refer to both the original work and to the interpretations offered by other scholars. The ability to reference existing material has also been implemented for computer-based documents [EnEn68]. This gives the advantage that references to other computer-based material can be followed directly. Computer support provides in this case not only convenience but a qualitative improvement with far-reaching consequences. The most familiar example of computer support for direct referencing among documents is the World Wide Web [BuRL91].

The media used for recording information are no longer bound to their carrier technology, such as paper, film or audio tape, but become unified in a digital environment. This allows the different media to become part of a larger whole. An important example is the creation of on-line time-based presentations [HoSA89]. These allow the specification of pieces of information along with when and where they are to appear on the screen.

## Introduction

Computer-based presentations are thus currently able to include text, image and time-based media elements, synchronization among elements and referencing among presentations. In order to create and view these presentations, tools for building and playing them are required. Before embarking on the development of such tools, however, consensus needs to be reached on the underlying form of the presentations, that is, to define the underlying document model for these presentations.

This thesis has two goals. The first is to define a document model which allows the description of presentations incorporating multiple media types, including time-based media, synchronization among elements and referencing among presentations. The second is to determine the authoring system requirements for the model.

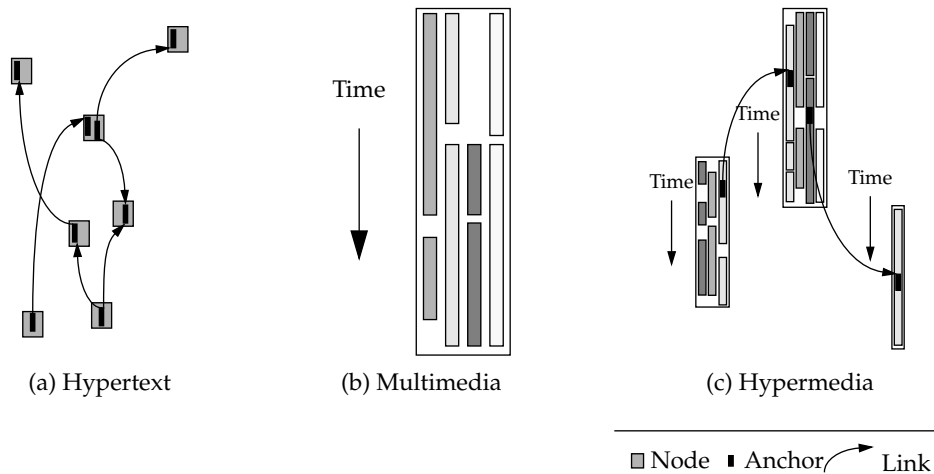
## Terminology

We use the term *presentation* to refer to the runtime behaviour of the information units presented to the user. We use the term *document* to refer to a static description of the presentation which can be stored. The document can include static and dynamic information units and may be presented via different display media such as video or paper. A document may be a declarative or procedural description of the presentation. In order to display a presentation based on a particular document description both the document, plus a player environment that is able to interpret the document description, are required.

Hypertext, multimedia and hypermedia are common terms with no consensus on their definitions, so we give the definitions as used throughout this thesis. *Hypertext* is a description of the referencing information among self-contained units of information. A *hypertext document* is a collection of information units and referencing information, called links, Fig. 1.1(a). A *hypertext presentation* is the runtime manifestation of one or more hypertext documents with which a reader can interact allowing the reader to navigate through the hypertext document. The information units in a hypertext document may include media types other than text. A commonly used term for this is hypermedia.

*Multimedia* is a collection of multiple units of information that are constrained by temporal synchronization relationships. A *multimedia document* is a collection of information units and associated synchronization information, Fig. 1.1(b). A *multimedia presentation* is the runtime manifestation of a multimedia document. A reader can interact with a multimedia presentation by, e.g., starting or pausing the presentation.

We use the term *hypermedia document* to denote a collection of information units along with referencing and synchronization information, Fig. 1.1(c). A hypermedia document is thus a collection of multimedia documents along with referencing information. A *hypermedia presentation* is the runtime manifestation of one or more hypermedia documents. A reader can interact with a hypermedia



**Figure 1.1.** Hypertext, multimedia and hypermedia documents

presentation either as a multimedia presentation, by starting or pausing a multimedia presentation, or as a hypertext presentation, by navigating through the information units.

### Scope of the thesis

A requirement for a hypermedia model is that it is sufficiently expressive that the same document can be presented on different platforms while preserving the author's original intentions. On the other hand, when a model becomes more complex there is a danger that it becomes too difficult to specify for any particular presentation, with the consequence that an authoring system becomes cumbersome to use. In the extreme case, a hypermedia presentation can be programmed directly in a non-specialist programming language which provides flexibility but minimal reuse and an unsupportive authoring environment. A simple model, supported by easy-to-use tools, is in turn too restrictive to allow the specification of all the required aspects of the presentation. The goal is to find a pragmatic trade-off between these two extremes.

In order to derive the requirements for a model of hypermedia documents we consider a typical presentation illustrating the aspects of a presentation we wish to model. This combines aspects of both multimedia and hypertext in a generalised model. Multiple media types, including moving images, sound, images and text, should be eligible for inclusion in a document.

## Introduction

Once we have defined a model we investigate how authoring support can be provided. Our goal is to integrate multiple items of differing media types within a single document, so we do not discuss editing environments for individual media, e.g. word processors or sound editors. We assume, instead, that the media items have been created or that an author has access to the appropriate tools for creating them.

Existing authoring systems for multimedia do not use a uniform approach to creating presentations. We analyse the different approaches in order to gain insight into the utility of these approaches in a more complete hypermedia authoring environment.

Using this analysis and the hypermedia document model definition we construct a list of authoring system requirements for hypermedia documents. Having derived the required functionality, a system interface also needs to be specified. This requires a complete interface design and falls outside the scope of the thesis. We do, however, provide examples of existing user interfaces for parts of the document model. The thesis includes a description of the authoring system CMIFed [RJMB93] to show that the majority of the requirements derived in the thesis can be implemented within a single environment.

### Structure of the thesis

Chapter 2 presents a simple example hypermedia presentation and describes the aspects that need to be recorded in a hypermedia document model to allow the presentation to be reproduced. This ensures that a model based on the requirements will contain necessary features for describing a presentation. In the second part of the chapter we compare these requirements with existing candidate models for hypermedia. We conclude that these models are insufficient and that a new model needs to be defined. In Chapter 3 we define a model for hypermedia based on the requirements. We show that the model is sufficient as a model for hypermedia by describing the document models implicit in a selection of hypertext, multimedia and hypermedia systems in terms of the model. We conclude that the proposed model is a suitable model for hypermedia documents.

Chapter 4 analyses the authoring paradigms embodied in existing authoring systems. We conclude that each paradigm is particularly suited for at most one of the multiple authoring tasks in creating a hypermedia presentation. In Chapter 5, we formulate and argue the authoring requirements for a hypermedia document based on a careful decomposition of the authoring process by way of the model defined in the first part of the thesis. We concentrate in particular on the aspects of temporal and spatial layout within a presentation and of creating links among presentations, since these are the defining characteristics for hypermedia presentations. In Chapter 6 we describe the CMIFed environment which satisfies the majority of the authoring requirements.