Three Hypermedia Design Patterns

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Abstract

Hypermedia authors are now acquiring experience to build good hypermedia systems and assess their quality, and this experience should be compiled and organized in order to be shared with other authors. We propose three hypermedia design patterns for hypermedia publishing: hyper-book, hyper-map and virtual product.

Introduction

From the appearance of the first hypertext systems [Enge63,Nel65] authors have stretched the limits of their imaginations creating hypertext and --more recently-- hypermedia applications. Authors have also learned what works better for certain circumstances and have gathered a collection of *tricks of the trade* that help them design more effective applications. Authors try different approaches to solve a given problem, evaluate what solutions work best and carry on this experience in subsequent designs.

Many problems are ubiquitous. Designers are likely to eventually face them. Common sense dictates that designers that face a newly encountered problem should not invent solutions from scratch for it; rather, they should take advantage of the knowledge acquired previously by others. A design pattern "describes a problem which occurs over and over again and then describes a solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice" [AIS77] A design pattern attempts to collect experience from the expert to pass on to other experts or novices in the field, hence avoiding others reinventing them.

Design Patterns for Hypermedia

Design patterns for hypermedia attempt to provide the designer with a multitude of well-known problems and their known solutions. When the designer becomes familiar with them, he or she can 1) more rapidly identify the problems being faced --correlating them with some problems already documented as patterns--, 2) avoid the expense of trying new solutions for the problem --the development of the patterns implies that several different solutions have been tried and the best are documented--, 3) evaluate beforehand the cons and pros of such solution --since this information is already available in the "consequences" part of the pattern. Design patterns are not new to multimedia. Unfortunately, few work has been done in a attempt to identify them and organize them [GC97,RSG97]. A catalog of design patterns will be of tremendous help to the expert and novice alike.

Design Pattern Language

Catalogs of patterns, in order to be effective, need to be present patterns in a standard format with uniform nomenclature. A pattern language is an informal description. The pattern language by Gamma

Name	A unique identifier for the pattern.
Intent	A brief description of what this pattern does.
Motivation	Why does this pattern need to exist? What are the situations in which it is likely to occur?
Applicability	The problems this pattern solves.
Structure	A diagram showing the structure of the pattern.
Participants	The different parts of the pattern.
Collaborations	A description of how the participants are related.
Consequences	A description of the benefits and the tradeoffs that result from applying the pattern.
Known uses	A list of well-known applications of the pattern.

Design patterns are not intended to be procedures to follow to solve a given problem; instead, they are guidelines that give the designer the foundation to be able to cope with the problem. This is the reason why they are described with an informal notation.

A Catalog of Design Patterns

In order to clarify our ideas, we present three patterns using the language described above.

Hyper-Book

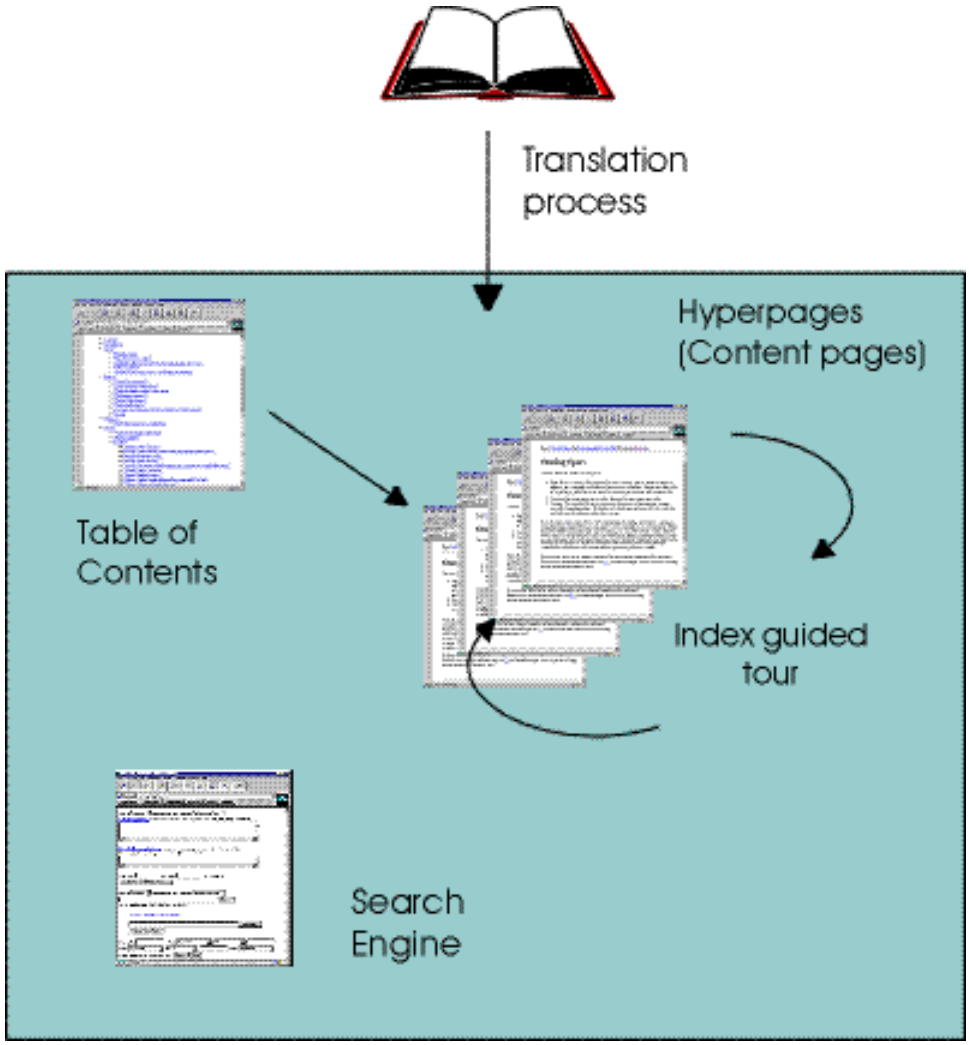

Fig. 1. Diagram showing the participants of the hyper-book design pattern

Name **Hyper-Book**

Intent To present, in the most effective way, a hypertext version of a textual document such as a book, article, report, etc. which was originally written in a sequential manner.

Motivation Except for reference material, "paper" documents are linear entities. A reader is required to read previous pages before any particular one, or at least to have some knowledge about them. The contents of a page are hardly independent from the rest. Hypermedia systems allow the reader to jump to any page, hence readers require some information about the context in which they have arrived. Pages are a physical restriction imposed on the content and do not necessarily reflect the structure of the document; in the hypermedia world, this restriction is non-existent. The size of a hyperpage --unless restricted by the hypermedia environment-- should be defined by the structure of the document.

Applicability The conversion of a document with linear nature to its hypertext equivalent. For example multi-page books, articles, essays, etc.

Structure Figure 1 shows the different participants and their relationships.

Participants In the hyperbook, the main participants are the table of contents, the content pages and a search engine.

- Content Hyperpages. Let us assume that the source document is marked with structural information (e.g., using SGML, XML, or LaTeX). Hence, the document can be seen as a tree, where each node is labeled with the type of element (chapter, section, subsection, appendix). The level of granularity of the final hyper-book depends on the domain of the document, but it must be such that each contains a complete "region" of the work (a section, subsection, etc.) and that they are not perceived as too long or too small for an average reader. Each hyperpage must include information equivalent to that of headers and footers provided in printed versions (title of the work, chapter, title), and should provide information about the context of the hyperpage on the whole work --for users jumping straight into the page-- and the means to navigate to other sections of the document.
- Table of Contents. It should serve two purposes: 1) as an outline for the work, 2) as a way to easily jump into a particular part of the document. The level of detail of the table of contents depends, again, on the application domain, and how much potential information it provides to the person browsing it. In general, it is automatically created.
- Search engine. It substitutes for index of a document. It is an easy way for a user to find any sought information.

Collaborations All the hyperpages must be linked contiguously to mimic the sequential nature of the original document. This is to make it easy for the readers to go from hyperpage to hyperpage as they sequentially read the work. At the same time, links to their parent's hyperpages are valuable for easy navigation and context determination. The table of contents should include --at least-- one link to each hyperpage and potentially links to different important parts inside each hyperpage. Finally, the search engine allows the reader to find keywords inside the document and jump directly to the place where they occur.

Consequences The structure depicted in the table of contents shows the natural structure of the document and it provides an overview of the document. The search engine makes it easier for the reader to find sought information or to find hyperpages they have previously visited. The navigation links on each hyperpage make it easy for the reader to "sequentially" read the work.

Applications Latex2Html converts LaTeX documents into their HTML counterparts using this pattern. Most SGML browsing tools such as SoftQuad Panorama present SGML documents to the reader using this pattern. Sun Microsystems presents the electronic version of their documentation in different mediums (CD-ROM, World Wide Web) using this pattern.

Hyper-Map

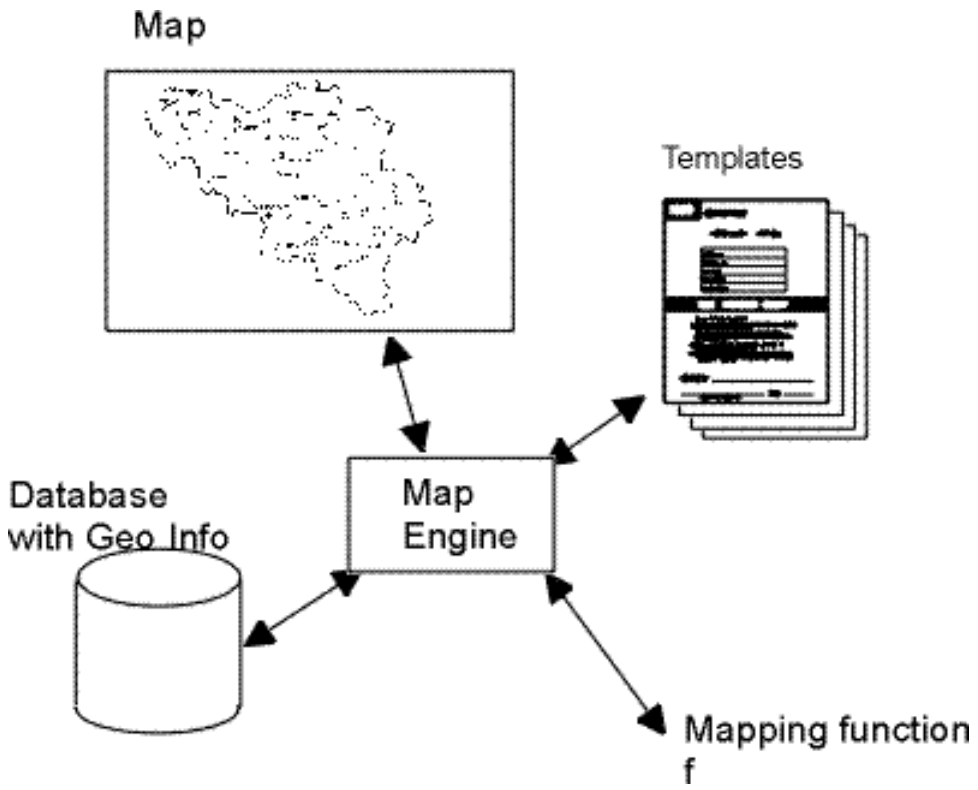

Figure 2. Diagram showing the participants of the hyper-map design pattern

Name	**Hyper-Map**.
Intent	To be an interface to spatial data, particularly data related to a two dimensional plane
Motivation	The term hyper-map was first introduced by Kraak [Kra96]. Data, in which regions in a two-dimensional space are correlated to some kind of information, is difficult to read if it is presented in tabular form. A better alternative is to present a plane in which the user can point to a given sector and get information regarding it. This allows the reader to "visualize" what the data corresponds to. Hyper-maps are a natural interface to spatial data.
Applicability	Geographical information systems.
Participants	Three main participants are involved: • The mapping function f *f:(x,y) -> data*, which, for a given point on the hyper-map will return data associated with the region in which that point lies. In its simplest form, it is a table of polygons and data that is scanned and it returns the first row in which the point lies inside such polygon. • The map. The visual interface to the reader. It should provide some feedback with respect to where to click to obtain the sought information. • Templates. Given the number of potential different regions, it might be impractical to develop a hypermedia node for each one. A more practical approach is the use of a template (or set of templates) that is to be filled with the data returned by *f* after some massaging has been applied to the latter.
Collaborations	When the user clicks on a point of coordinates (x,y) on the map, a method is triggered that computes the value of *f(x,y)* and uses its return value to fill the given skeleton, which is then returned to the user.
Diagram	Figure 2 shows the participants involved in this pattern and their relationships.
Rational	The graphic allows the reader to easily find the information sought, and does not overwhelm him or her with a long listing of data. Clicking on a map is a simple but effective user interface.
Applications	Most geographical information systems use this pattern . It is also present in Multimedia interactive atlases such as Microsoft's Encarta. The *imagemap* primitive

present in the World Wide Web is an expression of this pattern.

Virtual-Product

Figure 3. The Virtual-Product pattern

Name	**Virtual-Product**
Intent	Displays a product as part of an electronic catalog.
Motivation	Electronic catalogs are becoming important hypermedia applications. A good catalog might be the difference between a successful virtual store and one that is not.
Applicability	World Wide Web electronic stores. CD-ROM catalogs.
Structure	Figure 3 shows the participants and their interrelations.
Participants	• Product identification information (such as product number, catalog number) • Description. A concise but complete description of what the product is. • Photos. A collection of photos that enhance the description. • Cost. This should include handling and shipping fees. • Links to further information and reviews. If available, they give extra information to the reader with regard to the quality or suitability of the product for his or her needs. Third party reviews are more valuableContact information. Information on how to buy the item. The "shopping basket" has become a common metaphor for allowing the reader to quickly buy the item --for electronic stores in the WWW. In other cases, a telephone number might suffice. • Links to related virtual-products in the same catalog. • Navigation bar. To link to the other sections of the catalog
Consequences	The description, photos and reviews are meant to entice the reader into buying a particular good. The contact information will allow the reader to "buy" the item. If the reader is not sure if that particular product fulfill s his or her needs, further information or reviews might convince her, or the links to related products might assist her to find the exact product sought
Known Uses	Internet Shopping Network (ISN, www.isn.com), Amazon Bookstore (www.amazon.com). Notoriously, both companies, ISN and Amazon, are successful virtual stores

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