Automating Restructuring of Web Applications

Eleni Christopoulou¹,², John Garofalakis¹,², Christos Makris¹,², Yannis Panagis¹, Evangelos Sakkopoulos¹,² and Athanasios Tsakalidis¹,²

¹Department of Computer Engineering & Informatics
School of Engineering, University of Patras
Rio Campus, 26500 Patras, Greece

²Research Academic Computer Technology Institute
Internet and Multimedia Technologies Research Unit
61 Riga Feraioi Str. 26110 Patras, Greece
E-mail: {hristope, garofala, makri, panagis, sakkopul, tsak} @ceid.upatras.gr

ABSTRACT
In this work we propose a common framework for the automation of two emerging cases: web site reorganization and web page classification. We suggest a combined XML and object-oriented hypermedia framework that will enhance and automate the instantiation of any site reorganization and page classification proposals.

KEYWORDS: Web engineering, reorganization, page classification.

CATEGORIES & SUBJECT DESCRIPTORS: H5.2 (hypertext/hypermedia).

GENERAL TERMS: Design, Standardization

INTRODUCTION
Nowadays a lot of sites are characterized by an ad-hoc design, mostly due to subjective assessment of content importance. Lately there is substantial work on aiding the design decision of the site maintainer, by pointing out pages that were incorrectly placed within the site ([2],[5]). Another important issue is to classify web pages in directory categories [3]. All of these techniques propose a number of hyperlink redirection, notation, transformation and categorization, each one in different style of reports or lists. The changes proposed can be performed manually, yielding high precision results. Yet, the amount of work to be done is huge and thus it is worthwhile devising an automatic restructuring method.

Even though there are encouraging results in the previous areas, the final instantiation of restructuring is still an open subject. In this paper we propose a framework with XML (see W3 Consortium for specification) and object-oriented hypermedia method, to further automate the above processes and to provide visual manipulation characteristics.

WHAT IS ASKED: REORGANIZE AND CLASSIFY
The proposed solutions to the problem of website reorganization comprise adding a few links to a page or changing the hierarchical design of the site, after having computed some classification figures. In a similar vein, in web page classification, there are provided suggestions on updating directory trees, e.g. the addition of new categories.

To our knowledge there has been no provision of a unifying software approach to visualize and automatically manipulate such a process (called restructuring from this point on). This is feasible via object-oriented technology and XML, since reorganization and classification have a similar restructuring pattern. In the following sections we propose a framework that allows automatic implementation of restructuring both in dynamic and static web sites.

HOW IS IT BUILT? WEB ENGINEERING
Web application development is a multi-facet activity involving different players with different skills and goals [1]. In order to achieve coherence and successful results, several years’ now standardized representation is used for both static and dynamic web sites. Therefore current trends impose both the use of XML schema representations of the web applications’ structure and a combination of hypermedia design techniques as the Object-Oriented Hypermedia Design Method (OOHDM) [4]. This synthesis of methods allows standardization and separation of concerns that is a key requirement for any Web modeling procedure.

The design and development process is addressed as follows: Assuming that a number of different kinds of specialists played distinct roles, then different specialists should be able to adjust the re-organizing or categorizing suggestions. These are: 1) the data expert who designed the structural model; 2) the application architect who designed pages and the navigation between them; 3) the style architect who designs the presentation styles of pages and 4) the site administrator who designs users and personalization options, including business rules. This is in fact the layout description of the OOHDM which uses abstraction and composition mechanisms in an object oriented framework to describe complex information items and specify navigation patterns and interface transformations.

THE IDEA: RESTRUCTURING FOR WEB ENGINEERS
A summary of the methodology proposed includes the top-down analysis of suggestions so as to separate them into different parts. In accordance to the Web development procedure the restructuring proposed is differently implemented if it has to do with: 1) the conceptual design (in this step the data expert is eligible to perform structural changes), 2) the navigational design (description of the navigational re-structure of the hypermedia application in terms of navigational contexts – e.g. changes in nodes, links, indices, and guided tours), 3) the changes in interface design (the inter-
face changes are built by the web designer—e.g. a picture, a menu style, etc.) or 4) the final publication of the changes (the administrator makes public all the changes to users). Therefore we believe that any restructuring proposals have to be shaped in such a way that enables the corresponding development specialist to perform it accordingly. Furthermore delivering the restructuring proposals in an organized common framework will enable automation in implementation and visualization of the changes through any XML-capable web design tool and not only technique-dependant software as SOALA in [2].

**FUNDAMENTAL ELEMENTS USED.**

In order to instantiate the suggestions of any restructuring technique there is a need for the fundamental elements that describe the changes to be made. Such entities are containers of data elements, and relationships, which enable the semantic connection of elements. Entities have named attributes, with an associated type; properties with multiple occurrences can be organized by means of multi-valued components, which correspond to the classical part of relationship. Entities can be organized in generalization hierarchies. Relationships were given cardinality constraints and role names. As an example, the following XML code represents the specification of the structural schema described in the suggestions made in [2] and [5]:

```xml
<DOMAIN id="Web Site Proposals" values="Reorganization"/>
<ENTITY id="Hyperlink_Redirection">
  <ATTRIBUTE id="Developer_Group" type="String"/>
  <ATTRIBUTE id="Target_Page" type="String"/>
  <ATTRIBUTE id="Actual_Location" type="String"/>
  <ATTRIBUTE id="Expected_Location" type="String"/>
  <ATTRIBUTE id="Total_Hits" type="Int"/>
  <ATTRIBUTE id="Relative_Accesses" type="Int"/>
  <ATTRIBUTE id="Redirection_Comments" type="Text"/>
</ENTITY>
</DOMAIN>
```

Notice that this entity involves a simple but structured hyperlink redirection, that occurs in site reorganization. It includes an attribute indicating the different developer specialist group that is supposed to deliver the final change.

Moreover in order to support alternative restructuring techniques (e.g. that may include not only hyperlink redirection but also more complex changes) we propose a series of complementary entities that include suggestions describing navigational changes such as a) hyperlink notation, b) hyperlink removal/addition, or design transformation as a) text hyperlink to image b) text hyperlink to dynamic form script and the reverse.

In order to enable the automatic appliance of the suggestions to dynamic data web applications (sites and directories) we suggest also the enhanced version of the above entities. Coupled with the proper relationships to the database schema supporting the application, these entities automate transformation also directly to the dynamic conceptual architecture. As a result the latter entity includes also:

```xml
<RELATIONSHIP id="link2DB_Table" to="BD_Table" minCard="1" maxCard="N"/>
<RELATIONSHIP id="link2DB_Record" to="DB_Record" minCard="0" maxCard="N"/>
```

The relationships describe the redirection of a hyperlink to a database based web element (e.g. whole page or layer) that exists in the site’s existing XML-schema database description.

**Figure 1: Automating Web Restructuring**

**OVERALL FRAMEWORK**

The proposed framework is depicted in Figure 1. It presents the middle transformation layer, we introduce, and how it can automate the restructuring procedure allowing the corresponding specialist to visualize and implement automatically the proposal in the site’s XML schema structure, if judged so.

**CONCLUSIONS**

We believe that the proposed technique is a useful tool for the community of web designers, administrators and even researchers, since they can facilitate it in order to automatically perform their proposals concerning the reorganization of web sites and the classification of web pages. Future work leads us to incorporate restructuring of personalized web content.

**REFERENCES**