Web Comprehension by UML Stereotypes

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Abstract
Web applications use components developed in various technologies through an abstraction space richer than that of the object oriented paradigm. The architecture of web applications can be represented by showing specific web components, their compositions, navigations and inter-component relationships. In this research, we propose a component-centric UML based approach for modeling the architecture of web applications. Our approach is based on a classification of components and inter-component relationships that typically occur in web applications. We use UML extension mechanisms to represent specific web components.

Keywords
UML, Components, Profile, Modeling, OMG, Framework

I. Introduction
A typical web application uses components developed in various technologies through an abstraction space richer than that of the object oriented paradigm. Web applications have concepts like session and cookies, which are specific to the domain of web applications. The aim of this project is to develop a UML based modeling language for describing the architecture of web applications. This language should be able to specify, design and document the functionality and behavior of a web application that could be developed using any of the available web technologies. Our work includes the use of UML extension mechanisms to describe web specific components and their relationships with other web components and traditional middle-tier elements. Our final goal is to design various diagrams for modeling static and dynamic behavior of the web applications precisely. In this chapter, we will first introduce the scope of UML in design and development of software systems. Then we explain the need for UML extensions to describe the architecture of web applications. Next we present a summary of already proposed UML extensions and introduce our approach for modeling the architecture of web applications.
UML is a standard and industry accepted graphical modeling language to model the software systems. However, since it is a general purpose modeling language, it lacks elements to model and represent concrete concepts of specific domains. This lack of expressiveness also exists for the domain of web applications. As a solution, OMG (Object Management Group) has created a mechanism for extending the syntax and semantic of UML to express more specific concepts of certain application domains.

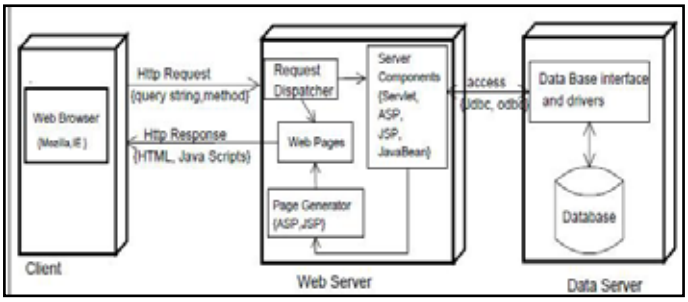

Fig. 1: UML Profile for Extension

II. UML Extension Mechanism
UML extensibility mechanisms permit us to extend the language in controlled ways. The controlled ways means the changes are easily understandable by the UML users. These mechanisms include stereotypes, tagged values, and constraints. We extend the UML by adding new model elements, creating new properties, and specifying new semantics.

III. Our Approach
We propose a component-centric UML based approach for architectural modeling of web applications. Our approach comprises representations of specific web components, their composition, navigation and inter component relationships.
Initially, we categorize the web application components and their inter-component relationships. Based on that categorization, a stereotype suite for UML is developed. We analyze various web technologies including HTML, ASP, JSP, PHP, Servlet and JavaBean to develop the consolidate stereotypes. To explain the extension suite, we work on three case studies of already implemented web applications.

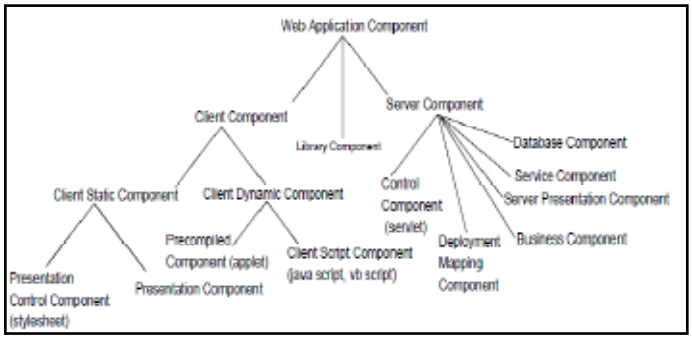

Fig. 2: Classification of Web Application Components

IV. Related Work
Web analysis and designing requires clear separation of navigation, presentation and business logic of web applications. Baresi, Garzotto and Paolini propose a hypertext oriented UMLHDM framework [2] that is a combination of UML and HDM(Hypermedia Design Model) for describing the design of web applications. The framework defines methods for requirements analysis, state evolution design, hypermedia design and visibility design.
In papers, Hennicker and N. Koch propose a UML, WSDM and OOHDM based object oriented approach(UWE) [9], for modeling web applications. The rest of paper is organized as follows: We describe the summary of related work. Whereas, Next part describes a typical architecture of web applications, and develops a classification of web components on the basis of their functionalities.
In next part, we introduce various web technologies that are used to develop a web application. Then we describe the construction of UML profile for modeling the architecture of web applications. Next it explains various diagrams used to describe the architecture of web applications. In next part, we use our defined UML profile to describe the architecture of already implemented web applications. At last in conclusion of current work and future possibilities are shown.

To model the data intensive websites, Ceri, Fraternali and Matera propose a new web modeling language(WebML) [5, 10]. WebML is a conceptual web modeling language, which adopts the entity-relationship model for data structure description, and original high level notations for representing web content, composition and navigation of data intensive web applications. Aforementioned approaches emphasis on navigation and presentation aspects of web applications.

In paper, Jim Conallen proposes an approach(WAE) [11], to model the architecture of web application with UML. WAE contains a set of new classes and association stereotypes to model web applications in an object oriented manner.

Because a web page may contains logical components that are executed either on the client side or the server side, their approach represents web pages as two different classes, one belonging to the stereotype class server page and the other to the client page. In their approach page scope variables are modeled as attributes of the class and internal modules as methods.

As observed in WAE is page based modeling approach, and only suitable for the web applications that have the simple business logic and are based on the basic web application architecture. WAE also neglects the modeling of navigation structure for web applications. In paper Jian and Ping also propose an approach for modeling web application architecture with UML.

Their approach describes the abstraction of web applications by three models: business model, navigation model and implementation model. The business model represents the business objects and their relationships. Navigation model describes the navigational map of system with the navigation tree. Implementation model represents the web pages and interlinked relationship which exhibit the implementation of system.

We observe apart from WAE and ping approaches, all other approaches are either totally different from the UML or emphasis on navigation and presentation aspects of web applications. We also observe ping's approach represent business models of web applications by use of class diagrams similar to object oriented systems. These models are only suitable for designing the web application and do not provide any architectural information. A typical web application uses various web components that are implemented by use of various technologies including Script, Applet, Servlet and Java Bean. The abstraction of such components and their relationships are also not covered by proposed approaches.

V. conclusion

Although two software projects have already been conducted to informally evaluate the method and modeling profile, systematic evaluations could be proposed to reach conclusions that have more scientific value.

This paper presents an Architecture Framework for web application. This framework is based on the separation of concerns and takes into account the unique characteristics of web systems. The framework has two dimensions in a matrix structure. One dimension concerns "structure (what), behavior (how), location (where) and pattern" of the web system. Another orthogonal dimension concerns the perspectives of various participants of the system.

This framework can serve as a strategic guide to the development of the web systems. It can also be used as a tool for analysis and re-engineering of existing web systems.

Web systems have other characteristics at organizational level. Such as web systems typically face high level of client uncertainty of their needs and also in understanding whether a design will satisfy their needs; have high levels of requirement, project scope and focus change due to the evolution of business model, have shorter delivery time; demand fine-grained evolution and maintenance with an ongoing process of content updating, editorial changes and interface tuning (Lowe et al. 2001).

Authors are currently working on "why (motivation model), who (role model), when (scheduling model), how much (cost model)" for each perspective to focus on the organizational characteristics of web application systems. This framework assumes the target is the web application at this stage. Future research direction could be establishing an architecture framework for web services in the similar perspectives and classification focus on the unique characteristics of web services.

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