A Study on Modeling Standards for Web Applications and Significance of AspectWebML

Ravani Shakuntla[#1], Dr. Amita Sharma[*2], Dr. S.S. Sarangdevot[#3]

[#1]*Asstant Professor,Computer Science& Engineering department,*
Pacific School of Engineering, Surat, Gujrat, India

***Abstract*— Standard UML fails to model web applications effectively due to their complex and dynamic behavior. For better modeling, UML was extended with UWE and also WebML, which fully supports OOP principles, was evolved. AspectWebML is an extension to WebML that supports AOP features. It lays down new software modeling goals particularly for ubiquitous web applications. This paper outlines the evolution in modeling standards for web applications and makes a comparison between them. It signifies AspectWebML as an important standard for modeling ubiquitous web applications.**

***Keywords*— Modeling standards, Ubiquitous web applications, WebML, AspectWebML.**

I. INTRODUCTION

Modeling is an essential part in software projects both large and small. The model is an abstract representation of a system. By creating models which represents all specifications of the real world problem, a system will be easier to build and you can be assuring that it is functionally complete.

The Internet has grown very rapidly and many companies have realized the opportunity to represent their business on the Internet. In the beginning web developers approached the applications by simply 'building the solution' without considering the development process. In [1] Due to this many companies' realize that it is almost impossible to manage the Web applications, because of their growth, complexity and different requirements that evolve over time. In response to this web developers become more and more aware of the importance of using a modeling language to design and document the system. For these purpose some modeling standard like UML, WebML, UWE and AspectWebML are introduced.

Reference [3] shows UML (Unified Modeling Language) is a general purpose visual modeling language for specifying, constructing and documenting systems, which can be used in all major application domains and implementation platforms. It fully supports OOP principles.

WebML ([5], [9]) is a visual language for specifying the content structure of a Web application and the organization and presentation of such content in a hypertext. It is useful for modeling only web applications. It also fully supports OOP mechanism.

The UML is expressive enough to model all requirements that arise in modeling Web systems, but it does not offer Web domain-specific elements. To ease the modeling of special aspects of Web applications, At Later UML was extended with UWE. In [6] UWE defines special view for modeling web applications using UML's extension mechanisms. The aim of UWE is to cover the entire development life cycle of Web systems, providing techniques and notations to start with requirements models, moving through design models, as well as including architecture and aspect models. All these models are visualized using UML Diagrammatical techniques. It supports both AOP and OOP principles.

AspectWebML is an extension to WebML that supports AOP features. To provide customization to web application, Aspect oriented modeling bridges WebML to AOM, which allows seamlessly hook up the aspect oriented concept with webML in web application development. It allows introducing new functionality into all parts of a web application model but – at the same time – maintains a clear separation between the original model and the new functionality in terms of Aspects.

AspectWebML is more suitable for Ubiquitous web applications (UWA) in [7] which required to be customizable, meaning that their services need to be adaptable towards the context in which they are used, indicated by, e.g., user, location, time, and device. In this AspectWebML approach, this customization is provided by aspect oriented concepts.

The rest of the paper is organized as follows: Section 2 presents UML modeling for web application and Section 3 focuses on the WebML modeling for web applications. Section 4 explains the UWE modeling for web applications and section 5 presents AspectWebML modeling for Ubiquitous web applications, Comparison of these all modeling language discuss in section 6. The last section provides the concluding remarks.

II. UML BASED MODELING FOR WEB APPLICATIONS

According to reference [4] UML is the most popular standard used for describing systems in terms of object concepts and mostly used in software design in all major application domains and implementation platforms. The idea of UML is that complex systems have to be described through a number of different views since no single view is able to capture such a system as a whole. UML [1] began to develop in October of 1994 from the conjunction of Grady Booch and Jim Rumbaugh methods, the Booch and OMT (Object

Modelling Technique) methods. These methods were already recognized as the leading methods in object-oriented modeling.

Reference [4] shows that UML diagrams are generally use in analysis and design phase of software development. In analysis phase the focus of developer is on the functional requirements, concepts and operations in relation to a system. UML diagrams like Use Case, Conceptual model, Sequence are used for analysis of requirements. During the design phase a logical solution is developed with the creation of interaction diagrams. Interaction diagrams illustrate sequences of messages that are exchanged among instances in the class model. The interaction diagrams are defined into two diagrams, which focus on different aspects, collaboration, and sequence diagrams. As for UML2.0 [4], it proposes several different viewpoints, including some for Structure- (Class, Component and Composite structure, Object, Deployment and Package), Behavior- (Activity, State Machine, Use Case) and Interaction diagrams (Communication, Interaction Overview, Sequence, UML Timing).

A. Advantages of UML Based Modeling For Web Applications

Advantages of UML Based Modelling For web applications are like below:

- UML is a most useful method of visualization and documenting software systems design.UML uses object oriented design concepts and it is independent of specific programming language.
- The UML uses set of symbols to represent graphically the various components and relationships within the system and UML can be used for business processing modeling and requirements modeling, it mainly is used to support object oriented system analysis and to develop the object models.

B. Disadvantages of UML Based Modeling For Web Applications

Disadvantages of UML Based Modelling For web applications are like below:

- UML has specific diagrams like the Class and Object ones which deal the internal of object-oriented applications, but its notation does not contain the concepts of link or database queries which are the very important part of web application development.
- UML has not ability to model the html forms. Another feature missing was the ability to model the design of the web application, which is what the pages contain and how they are connected to each other.
- UML is a huge and partly difficult modeling language, consisting of many different diagrams that make modeling of web application time consumable for its implementation in an organization.
- In development of web applications, the problem with UML is that, it is highly generic, and it lacks the semantic for expressing a web application's user experience.

III. WEBML MODELING FOR WEB APPLICATIONS

Web applications are being built in a rapidly changing environment where requirements are usually unstable. Short-time design and implementation are needed in response to the new technologies. In [8] Our work focuses rather on the design and construction of Web applications, than management. Flexibility is a major requirement in such applications, and also in a database-backed environment for the structure and presentation of the sites, which can be modeled by WebML. All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

Reference [10] shows that WebML is a graphical language for the specification of web applications. It is akin in aspect to Entity-Relationship Diagrams. In [5] WebML enables the high-level description of a Web site under distinct orthogonal dimensions: its data content (structural model), the pages that compose it (composition model), the topology of links between pages (navigation model), the layout and graphic requirements for page rendering (presentation model), and the customization features for one-to-one content delivery (personalization model). All the concepts of WebML are associated with a graphic notation and a textual XML syntax. WebML specifications are independent of both the client-side language used for delivering the application to users, and of the server-side platform used to bind data to pages, but they can be effectively used to produce a site implementation in a specific technological setting.

A. Advantages of WebML Based Modeling For Web Applications

Advantages of WebML Based Modelling For web applications are like below:

- By WebML we can find following requirements to develop web applications.
    i. units of computation (database queries or external interactions)
    ii. links between pages and units of computation
    iii. creation of entities and relationships instances
    iv. session management with custom units
    v. Forms, with orthogonal population and data storage.
- WebML consists of only four models while UML has numerous amounts of models, twelve according to OMG (Object Management Group). Due to that WebML only consists of four models we find it to be a small modeling language in comparison to UML and therefore easier to implement.
- In WebML the hypertext model could describe how the web application is structured and designed better than any model that UML provides.

B. *Disadvantages of WebML Based Modeling For Web Applications*

Disadvantages of WebML Based Modelling For web applications are like below:

- [1] WebML does not support use cases. Two features with UML found very useful when developing web applications, use cases and class diagrams. The use cases are useful when you want to see the interaction between the application and the user. This makes it easier for both the developer and the customer when they can see the interaction from the user's point of view. Using use cases makes the communication between the customer and the developer easier; it is easy for the developer to explain to the customer how the web application works with the help of the use cases. Unfortunately WebML does not support use cases that the companies found very useful.

IV. UWE MODELING FOR WEB APPLICATIONS

Reference [6] shows UML modeling techniques comprise the construction of static and dynamic views of software systems by object and class diagrams, component and deployment diagrams, use case diagrams, state and activity diagrams, sequence and communication diagrams. The UML extension mechanisms are used to define stereotypes that we utilize for the representation of Web constructs, such as nodes and links. In addition, tag definitions and constraints written in OCL (Object Constraint Language) can be used. For these purpose UML-compliant notation—a so-called UML lightweight extension UWE (UML based Web Engineering) notation is defined.

The aim of UWE is to cover the entire development life cycle of Web systems, providing techniques and notations to start with requirements models, moving through design models, as well as including architecture and aspect models. All these models are visualized using UML diagrammatic techniques. UWE is "Conservative" means that the modeling elements of the UML meta-model are not modified, e.g., by adding additional features or associations to the UML modeling element Class.

The UWE process is driven by the separate modeling of concerns describing a Web system. Models are built at the different stages of requirements engineering, analysis, design, and implementation of the development process and are used to represent different views of the same Web application corresponding to the different concerns (content, navigation structure, and presentation). In [6] The content model is used to specify the concepts that are relevant to the application domain and the relationships between these concepts. The hypertext or navigation structure is modeled separately from the content, although it is derived from the content model. The navigation model represents the navigation paths of the Web system being modeled. The presentation model takes into account representation and user–machine communication tasks.

UWE proposes at least one type of UML diagram for the visualization of each model to represent the structural aspects of the different views. However, in addition, very often UML interaction diagrams or state machines are used to represent behavioural aspects of the Web system. [6] Another concern also handled separately is adaptivity. In Personalized and context-dependent Web systems provide the user with more appropriate information, links, or pages by being aware of user or contextual features. By taking adaptability as a cross-cutting concern and use aspect-oriented techniques to better modeling of these type of web system.

A. *Advantages of UWE Based Modeling For Web Applications*

Advantages of UWE Based Modelling For web applications are like below:

- UWE is continuously adapting, on the one hand, to new features of Web systems, such as more transaction-based, personalized, context-dependent, and asynchronous applications. On the other hand, UWE evolves to incorporate the state of the art of software engineering techniques, such aspect-oriented modeling.
- [7] Because of it support AOM has advantages in the maintenance and Re-engineering of web system.
- It supports use case diagram, which provide interaction between customer and developer.

B. *Disadvantages of UWE Based Modeling For Web Applications*

Disadvantages of UWE Based Modelling For web applications are like below:

- Reference[14] shows that Customization mechanisms provided by UWE do not allow dealing with all different parts of a web application in terms of its content, hypertext and presentation levels and their structural and behavioural features (Figure 1), thus, disregarding the crosscutting nature of customization. Customization in UWE currently is limited to the hypertext level of web applications and does neither support the content level nor the presentation level.
- In UWE, customization in [7] is often tangled with the core web application, thus, neither a context model nor adaptation operations enter web application models in an explicit, self-contained and extensible way. This leads to inefficient development processes, high maintenance overheads and a low potential for reuse.

V. ASPECTWEBML MODELING FOR WEB APPLICATIONS

AspectWEBML has been developed by andreas schauerhuber in her thesis [12] applying aspect-orientation to the model-driven development of ubiquitous web

applications' in order to address some of those shortcomings of webml and uwe. it is an extension of webml. it fully supports both aop and oop principles.

it introduces a new model element named aspect. an aspect is composed of a pointcut part and an advice part. In[12] it is a (graphical) statement expressing that, in addition to the features specified in the aspect oriented model, each model element selected by the pointcut also has features specified by the advice. in other words, a complete description, including both general system functionality and additional, cross-cutting features of the quantified model elements, is given by the composition of the principal model and the aspect. the process of composition is called weaving. separation of concerns offers advantages in the maintenance and re- engineering of a web system as well as for the generation of web systems for different contexts and platforms.

A. *significance of aspectwebml in modeling of ubiquitous web applications*

with the emergence of mobile devices as new access channels to the internet, we are now facing a new generation of web applications, called ubiquitous web applications. uwas are characterized by the anytime/anywhere/any media paradigm, taking into account that services are not exclusively accessed through traditional desktop pcs but through mobile devices with different capabilities, by users with various interests at anytime from anyplace around the globe. ubiquitous web applications (uwa) are required to be customizable, meaning that their services need to be adaptable towards the context in which they are used, indicated by, e.g., user, location, time, and device.

there are already some approaches dealing with the ubiquitous nature of web applications and the model-driven development thereof, the most prominent examples being webml in [11], uwe in [8] , concerning customization modeling, however, they are still in their early stages due to the following reasons.

- first, the provided customization mechanisms frequently do not allow dealing with all different parts of a web application in terms of its content, hypertext and presentation levels and their structural and behavioral features (figure 1), thus, disregarding the crosscutting nature of customization.
- .second, in all of above approaches, customization is often tangled with the core web application, thus, neither a context model nor adaptation operations enter web application models in an explicit, self-contained and extensible way. this leads to inefficient development processes, high maintenance overheads and a low potential for reuse.

Reference [7] shows that to cope with these problems, aspectwebml is proposed, using aspect-orientation as driving paradigm to incorporate customization in ubiquitous web applications at the modeling level [13] (Figure 1).

Unlike WebML, AspectWebML allows introducing new functionality into all parts of a web application model but – at the same time – maintains a clear separation between the original model and the new functionality in terms of Aspects As a proof of concept, we use reference architecture for aspect-oriented modeling ([12],[13]), which describes the necessary concepts of aspect-oriented modeling (AOM).

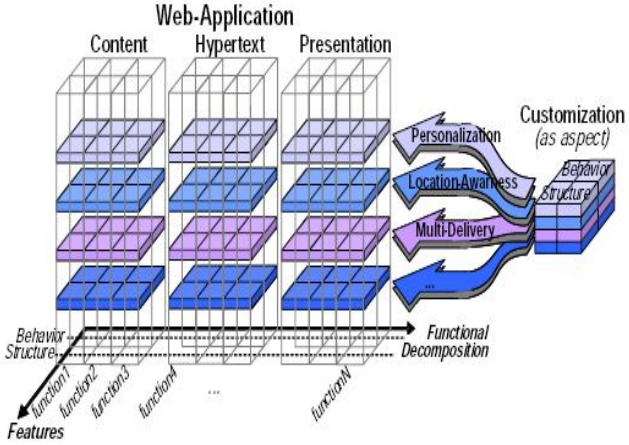

Fig 1 Customization as an Aspect served in Ubiquitous web applications.

B. *Advantages of AspectWebML Based Modeling For Web Applications*

Advantages of AspectWebML based web applications are like below:

- It takes into account the crosscutting nature of customization, allowing influencing all parts of a web application.
- In AspectWebML clear separation between the core services and cross-cutting functionality can be maintained. It provides low maintenance overhead and high potential of reuse.
- Reference [1] shows that the aspect-oriented extensions applied to UWE are tailored to a specific aspect, only, being the access control aspect and the navigation adaptively aspect, In contrast to that, AspectWebML uses the AOM reference architecture as a blueprint to extend the WebML meta model with AOM concepts, thus, allowing to model different aspects with one coherent set of concepts.

C. *Disadvantages of AspectWebML Based Modeling For Web Applications*

Disvantages of AspectWebML Based Modelling For web applications are like below:

- From the survey and the case study we have discovered that WebML lacks the ability to model the web application from the user's perspective. And AspectWebML is also extension of WebML.

Modelling Techniques	Is provides OOP support?	Is Provides AOP support ?	Is Capable to model database and HTML form ?	Model Complexity	Maintenance overhead	Is provides user interaction?	Potential of Reuse	Potential of Customization	Level of Flexibility
UML	Yes	No	No	High	High	Yes	Low	Low	Low
WEBML	Yes	No	Yes	Low	High	No	Limited	Limited	Limited
UWE	Yes	Limited	Yes	High	High	Yes	Limited	Limited	Limited
ASPECTWEBML	Yes	Yes	Yes	Low	Low	No	High	High	High

Table I. Comparison between UML, UWE, WebML, AspectWebML with respect to Customization and other functionality.

So it also lacks the ability to model web application from user's perspective.

VI. Comparision between UML, WEBML, UWE, ASPECTWEBML

After studying the various Modeling techniques for web applications discussed above, we compare them with their benefits and limitations. The comparison is shown in a Table I.

VII. Conclusion

In this paper we discussed various web modeling techniques and the significance of Aspect WebML for capturing customization of ubiquitous web applications at modeling level. Furthermore, we compared various modeling techniques like UML, WebML, UWE and AspectWebML with customization and other functionalities.

From whole study of web modeling techniques, we have discovered that AspectWebML lacks the ability to model the web application from user's perspectives. By extending AspectWebML with use cases, it will make it a more complete modeling language.

Acknowledgment

We are heartily thankful to our respected chairperson ma'am of Jayoti Vidyapeeth Women's University, Ms. Vidushi Garg, who provide us good environment and facilities to complete this paper and whose encouragement, guidance and support from initial to final level enabled me to develop an understanding of the subject.

Lastly, we would like to thank Dr. S.S. Sarangdevot for fruitful discussions related to this paper and aNonymous references for helpful hints.

References

[1] KonstantiNos Spiridopoulos, Erik Widén, *Modelling web applications WebML versus UML* Blekinge Institute of TechNology,Department of Computer Science and Software Engineering, CA: DVC001 Bachelor Thesis of International Administrator Processing, 2002.

[2] Gefei Zhang, Hubert Baumeister, Nora Koch, Alexander Knapp, "AspectOriented Modeling of Access Control in Web Applications," In *Proc. 6th Int. Workshop on Aspect Oriented Modeling*, pp. 1–7, 2005.

[3] Nathalie MoreNo, Piero Fraternali, Antonio Vallecillo, "WebML modelling in UML," *In Proc. IET Journal* , vol. 1, pp. 569 - 576, Mar. 2007.

[4] Gerhard Preisinger, *Towards Model-driven Web Application Development with AspectWebML - An Integrated Graphical Development Environment,* Master thesis, Institute of Software TechNology and Interactive Systems, Vienna University of TechNology, Austria, Dec. 2007.

[5] StefaNo Ceri , Piero Fraternali , Aldo Bongio, "Web Modeling Language (WebML): a modeling language for designing Web sites," *Proc. In The International Journal of Computer and Telecommunications Networking*,vol. 33,pp. 137-157,2000.

[6] Nora Koch, Alexander Knapp, Gefei Zhang,Hubert Baumeister, "UML-BASED WEB ENGINEERING, An Approach Based on Standards", Institut für Informatik, Germany, DFG Tech. Rep. 157-191, 2006.

[7] A. Schauerhuber, M. Wimmer , W. Schwinger , E. Kapsammer ,W. Retschitzegger, "Aspect-Oriented Modeling of Ubiquitous Web Applications: The aspectWebML Approach," *In Proc. ECBS '07 Proceedings of the 14th Annual IEEE International Conference and Workshops on the Engineering of Computer-Based Systems* , USA, vol. 1, pp. 67-80, Jun. 2007.

[8] Attila Adamkó, "UML-Based Modeling of Data-oriented WEB Applications," *In Proc Journal of Universal Computer Science*, vol. 12, pp.1104-1117, Nov 2006.

[9] Andrea Schauerhuber, Werner Retschitzegger, Manuel Wimmer, "A Survey on Web Modeling Approaches for Ubiquitous Web Applications," In Proc. International Journal of Web Information Systems , Italy, pp. 1-45, Nov. 2007.

[10] WebML: overcoming UML for web applications. [Online]. Available: http://css.dzone.com/articles/webml-overcoming-uml-web

[11] S. Ceri, P. Fraternali, A. Bongio, M. Brambilla, S. Comai,M. Matera, "Designing Data-Intensive Web Applications," Pub. In Communications of the ACM, USA,Vol-50,Issue-4,April 2004.

[12] Andrea Schauerhuber, "AspectUWA: Applying Aspect-Orientation to the Model-Driven Development of Ubiquitous Web Applications," *In Proc. 5th International Conference on Aspect-Oriented Software Development (AOSD'06)* , Germany, March. 2006.

[13] Andrea Schauerhuber, W. Schwinger, E. Kapsammer, W. Retschitzegger, and M. Wimmer, "Towards a Common Reference Architecture for Aspect-Oriented Modeling," *In Proc. 5th International Conference on Aspect-Oriented Software Development (AOSD'06)* , Germany, March. 2006.

[14] Andrea Schauerhuber, W. Schwinger, E. Kapsammer, W. Retschitzegger, and M. Wimmer, "A Survey on Aspect-Oriented Modeling Approaches," *In Proc. 7th International Conference on Web Engineering (ICWE'07)*, Italy, Oct. 2007.

[15] Hubert Baumeister , Nora Koch , Gefei Zhang, "Modelling Adaptivity with Aspects," *Proc. In International Conference on Web Engineering (ICWE)*,pp. 406-416,2005