

Conceptual Design of Web-Based Appointment Management System using Object WebML

Karen Ming Lu, Siti Hafizah Ab Hamid

Department of Software Engineering, University of Malaya, Malaysia

karen0423@hotmail.com, sithafizah@um.edu.my

Abstract

The rapid growth and diffusion of the Web are nurturing a novel generation of applications which grow in size and complexity. The development of such applications is a hybrid between traditional Information System development and Hypermedia authoring [8]. It challenges the existing tools and approaches for software production [8]. Currently the development of a Web application is somewhat chaotic and often ad-hoc process lacking systematic techniques and methodologies [6]. As a result, many companies today are experiencing severe problems in the management and maintenance of the web application. Ginige et al. use the term Web crisis to describe this situation [4]. In response to that, this project is to apply Web Modeling Language (WebML) which specified for web application and .Net four-tier architecture to the appointment management handling in the university/college environment. A web based appointment management system called WBAMS is designed and implemented so that students and lecturers can arrange meetings in an effective and efficient way.

1. Introduction

With the amazing growth of web technology in the past few decades, great changes have taken place in every area of our life, for example university/college environment. It brings about the evolution on the ways of teaching, registration/administration activities and processes, such as e-learning, e-library, online portal for administrative system and so forth. However, it is not in the case of handling appointment management (between lecturers and college students).

There are two common approaches in the universities/colleges. Lecturers either put sign-up sheets on their doors (manually) or release a fixed time over a period for students to reserve a meeting. These methods do not reflex the dynamic changes or cancellation of the appointments; take an example, managing consultation time, if the lecturer only release the consultation time, many students may want to meet at the same time.

A web based appointment management system is to utilize the web technology to manage the appointments online. Though there are some web based supports in the form of static web pages showing lecturers' available time for consultation, it does not provide appointment management or any interactions with the students. Therefore, it is necessary to refer similar systems for other services in order to define the features.

Based on the literature review, most of the existing appointment management systems were developed using ad-hoc approach with consideration on functionality only. There is little emphasis on the design and development process. Only few appointment management systems adopt UML, which is a widely recognized modeling standard to design system. However, due to its complexity; UML can not perfectly achieve the goals of web application development. Web Modeling Language (WebML) which is specified for Web application can reduce development efforts (cost and time) and allows a more structured development process.

This project is to turn the traditional approach of appointment system into a web based system. It is called WBAMS and applied Web Modeling Language (WebML) and .Net four-tier architecture, so that students and lecturers can arrange meetings in an effective and efficient way.

On this system lecturers can manage the consultation over the web, e.g. set up recurrent consultation time with booking restriction and maximum appointment volume by specifying dates, times, and durations. Students will be able to make appointment, login (password authentication) and cancel appointments and so on. The system provides the appointment reminder and important notice for both lecturers and students. Cancellations by both parties will cause notification in the important notice section.

This project is not only to fulfill these functional requirements, but also designed to satisfy three non-functional requirements which are usability, performance, and maintainability.

2. Justification of Using Web Modeling Language (WebML)

Due to maintenance problem in web applications development, an appropriate design methodology that can make the design effective and understandable to developers and its reader is needed. So far most methodologies used for website design is taken from different sectors (e.g. DB, software engineering), it cannot perfectly meet website's specified requirements. For instance, data centric methods do not cover the hypertext front-end; OO methods (e.g. UML profiles) do not capture the essence of web-based system and so on [18].

In response to this need, the W3I3 Project (funded by the European Community under the Fourth Framework Program) is focusing on "Intelligent Information Infrastructure" and has produced a novel Web modeling language, called WebML [14]. WebML is a design methodology that fully exploits the conceptual modeling approach of software engineering, from ideas to application [13]. It addresses the high-level, platform-independent specification and targets Web sites that require such advanced features like multi-device access (PCs, PDAs, and WAP phones), the one-to-one personalization (myYahoo, myCDNOW), and evolution management.

The model-driven approach has proved effectively in extending the classical methods and best practices of Software Engineering to the Web [15]. WebML guarantees the model-driven approach which can reduce development efforts (cost and time) and allows a more structured development process.

Besides these, according to the WebML official website and research, so far only few industrial projects (such as acer, DEI Web application etcetera) are developed with WebML. WebML which is customized for web application design need further promote in the industries.

3. UML and WebML Comparison

UML is the only formal modeling language used for designing process among the existing similar systems. UML is a widespread language used by the industries to model system. However, it is not best suited for web application development. The below are the comparison between UML and WebML:

- UML is a widely recognized modeling standard used to specify, visualize, construct and document the artifacts of a system for different areas, like software engineering modeling, business process modeling [11]. It is a general purpose modeling language, which tries to achieve compatibility with every possible implementation language [17] while WebML is specifically developed for modeling web applications
- WebML has support for both modeling web application design and html forms. In the hypertext model, which pages the application consists of, what they contain and how they are linked are

defined [16]. It also shows when data has to be sent between pages to display the content.

These features give both the customer and the developer a good overview of the web application structure and design. Hypertext model which use data entry units to model the html form is better than any model that UML provides [8].

In addition, UML is considered relatively large and complex with twelve models according to OMG (Object Management Group) while WebML consists of only four models; data model, hypertext model, user model and presentation model. WebML is a small modeling language in comparison to UML. Because of that, it is easier to understand and less time consuming than UML in the modeling process.

From the above comparison and previous section justification, it is clearly seen that WebML is more suitable for web application development; thereby WebML is chosen for our project.

4. Functional Requirements

There are six modules involved which are:

4.1 User Access Module

This module is to authenticate and authorize the user. It includes registration online and validation on username and password to access the system.

4.2 User Maintenance Module

This module is to manage and maintain the user groups. Administrator is given privilege to maintain lecturer and students accounts. Lecturers and students can also update their contact information and password through the system.

4.3 Consultation Module

This module is mainly for lecturer to manage their consultation, such as setup recurrent consultation, track appointment attendance and cancel consultation. A maximum number of appointments during the consultation session can be specified to the number of students. The lecturer can also specify booking restriction to students group, e.g. open to BSC Software Engineering students only. Based on the above setting, the system will automatically calculate each appointment's duration and allocate on the lecturer's schedule. Recurrent consultation is allowed to re-occur automatically on a weekly basis, fortnight basis or monthly basis. Besides that, the system will keep the appointment status to "OK" once the appointment time is over. If student is absent, the lecturer need change the appointment status to "absent". Through this way, administrator can track the appointment attendance for further action.

4.4 Appointment Module

This module is to handle appointments for students. Student can select the available timeslot of particular lecturer in the same faculty to make appointment reservation. The system will automatically check the student's status according to the booking restriction set by the lecturer. If qualified, the appointment will be confirmed immediately. Besides that, the system does a complete check to avoid appointment conflict. Once appointments are full, the system will change the consultation status to "full". During booking, student need specify the appointment purpose and make the reservation at least one day before so that the lecturer can do the preparation. In the same way, students are asked to cancel the appointment at least one day prior to the appointment. Students can view their current appointments and appointments history.

4.5 Setup Calendar Module

The administrator can set customized calendar (Public holidays, break) in this system.

4.6 Report Module

Administrator has the right to view all the lecturers' appointments and absent students for the appointment in the report format. The lecturer also can view their appointments list. Since all the appointments are stored in the database, the users are able to trace back whenever they need to. There are also appointment search functions to allow the user to locate appointment quickly. In addition, the user can easily print the report through PDF format or export the appointment information into Excel.

5. Non-Functional Requirements

5.1 Usability

The system provides an intuitive interface by considering human-computer interactions factors, i.e. navigation, feedback, help and use of color and so forth. It is desirable to have features like one-to-one personalization.

5.2 Performance

As the user expect low latency and will not tolerate the site simply refusing the request. The response time should not exceed the user's thinking time (3 second) and be relatively stable in peak conditions.

5.3 Maintainability

The system or component can be easily modified through one or few modules without affecting the rest.

6. WebML Model Designs

WebML Models e.g. Data model, Hypertext model, and User model (see below figure) are designed using WebRatio for WBAMS. WebRatio is a CASE tool to support the WebML design process. It offers a visual environment for drawing the data and hypertext conceptual schemas [14].

6.1 Data Model / Structure Model

Data modeling is one of the most traditional and consolidated disciplines of Information Technology [13]. In WebML process, it does not propose another data modeling language, but exploits the most successful and popular notation, which is Entity-Relationship (E-R) model as Figure 1.

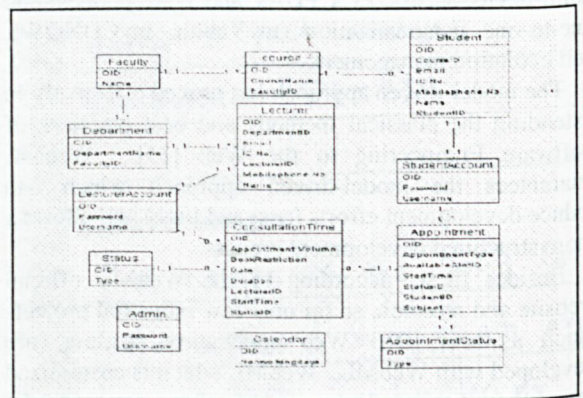


Figure 1. Data Model

Figure 1 shows the system data schema describing information about Faculty, Department, Course, Student, Student Account, Lecturer, Lecturer Account, Appointment, Appointment Status, Consultation Time, its Status, Admin and Calendar. The last two tables Admin which stores the admin user name and password and Calendar that used to record the non-working days have no relationship. The relationship between the first eleven tables is either one to many or one to one. for instance, there are one or many departments within the Faculty, and one lecturer is only allowed to have one lecturer account.

6.2 Hypertext Model

6.2.1 Student Site View.

In Figure 2 which represents student site view, it consists of appointment area and student area.

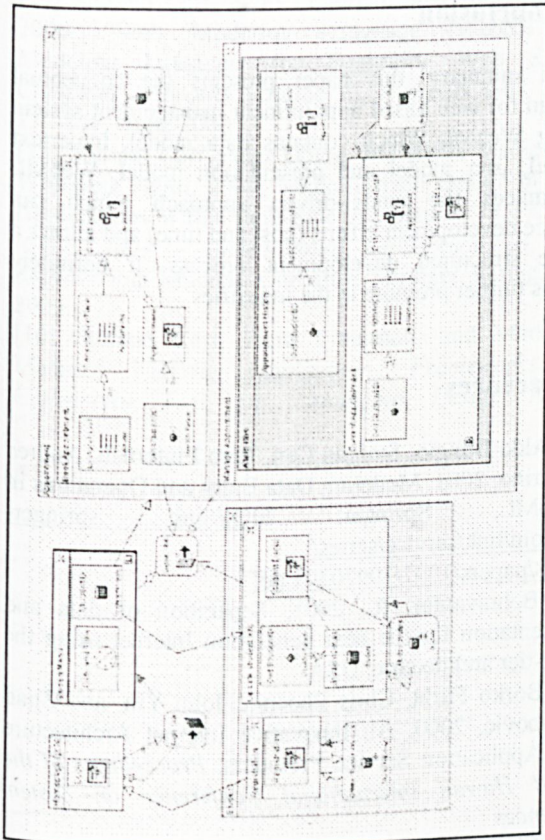


Figure 2. Student Site View

6.2.2 Lecturer Site View.

Similar to Student Site view, there are two areas: Lecturer and Appointment in the Lecturer Site View. Lecturer area consists of two pages: Registration and UpdateUser Profile. Appointment Area includes SetupAvailableSlot, ViewReport and ManageAppointment pages. For instance, in ViewReport page, LecturerID is a Global Parameter. From it, the Particular Lecturer's Appointment Lists can be retrieved from Database and displayed as index unit.

6.2.3 Administrator Site View.

The home page is presented by default when the users access the URL. From it, the user can login into AdminMenu page which is landmark page reachable from all the other pages in the site view. In the administrator site view, there are four areas: admin, appointment, lecturer and student. Each area comprises two pages. For example, AddLecturer page, through Lecturer Entry Unit, administrator can add lecturer account. If succeed (OK link green color), the information will be stored into the database and display the successful information. Else (KO link red color), the error message will appear in the AddLecturer page.

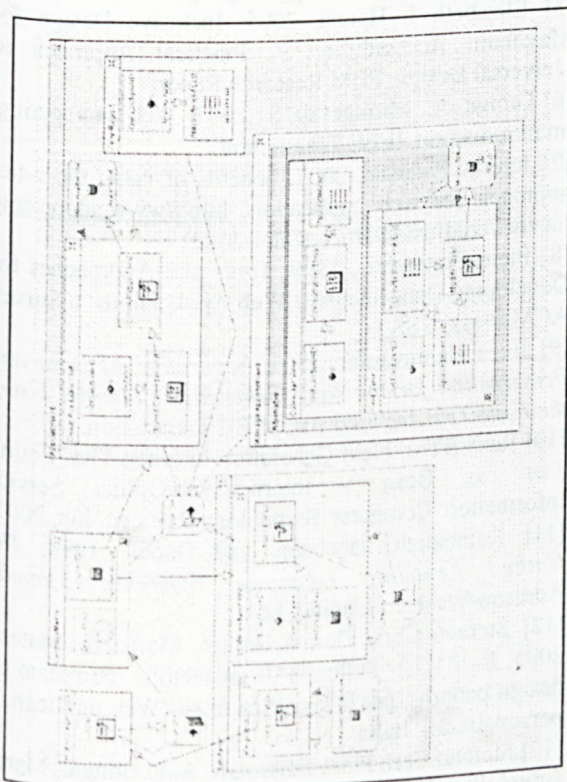


Figure 3. Lecturer Site View

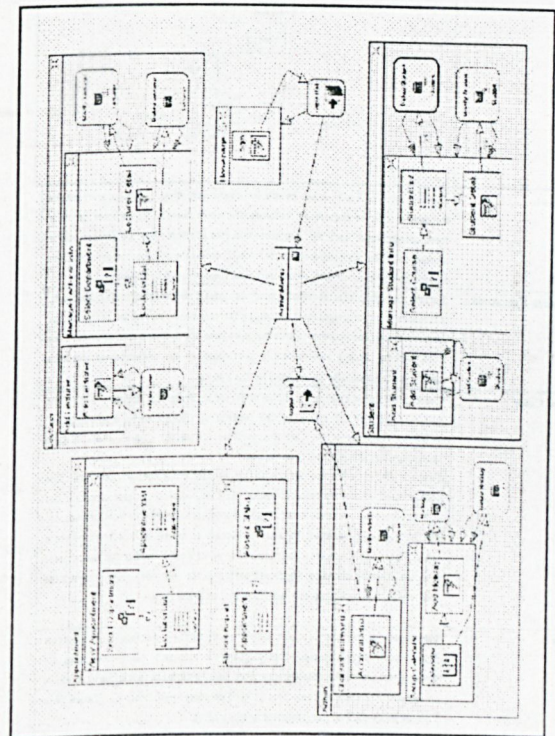


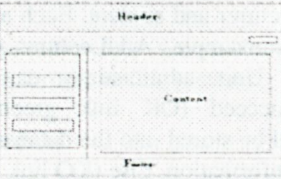
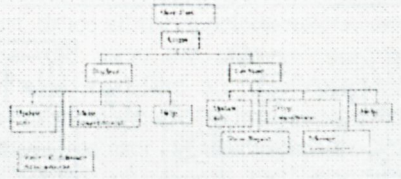
Figure 4. Administrator Site View

7. User Model

Based on the requirements analysis, there are three user groups: student, lecturer and administrator. Different site views shown in previous section defined for these three groups of users.

8. Presentation Model

The proposed system is designed to be simple and straightforward in order to eliminate the complexity and provide simplicity to the processes and operation. The human computer interaction (HCI) guidelines based on the books [19, 20] are considered to design the presentation model.

Interaction Style	<p>The interaction style between the system and the user is direct manipulation. WYSIWYG (what you see is what you get) is the style of the screen. Users do not need to learn any extra computational skills to use the system.</p> <p>The screen layout for lecturer is shown in the below:</p> 
Navigation	<p>The navigation of the system is based on the options provided. There are four options in the student view e.g. book appointments and five options in the lecturer's menu. The structure chart for the user website part is displayed as following:</p> 
Feedback	<p>Adequate feedback is necessary for every operation or action selected by the users. This is important, because the user needs to know how they have progressed and to confirm that the system has performed their operation. Take an example, in WFAMS, when the mouse is over a certain button, the help content for the particular function will be displayed.</p>
Minimize User Action	<p>Keying is often the slowest input compared with other input methods. Therefore a good design will minimize the number of keystrokes required for instance, once the student selects the start time for appointment, the end time field will be added automatically according to the appointment duration, which is automatically calculated by the system.</p>
Use of Color	<p>Color is the most crucial factor to consider in designing the interface of the system. The use of color in the system is taken careful consideration, including considered the partial user. Throughout the system, color is used sparingly to make it more presentable.</p> <p>The use of color for the screen design is following the contrast rule. The background of the system is white, and the objects in the interface for buttons, buttons are dark blue. Dark blue leads to a serious mood effect. The background color of the text is also set to white, and text set in black color. This high contrast combination is good evidence that for some users who are older or partially sighted. Besides it, the use of color will attract the user's attention and keep the interface in a uniform style.</p>
Font	<p>The choice of the font is more likely to affect the presentation of a screen. The same font type is applied throughout the system to avoid confusion. By doing so, more readability, standard font or sans serif fonts, with function, mainly recognizable characters are best [19]. Therefore serif font, i.e. Times New Roman is adopted in the interface of the system.</p> <p>On the website, the font size is 12pt. For the important texts that need to attract the user's attention, such as the title of the screen, the size of the font is 16 point.</p>
Help System and Documentation	<p>As the system is new to the users, it is necessary to provide help functions to guide them to use the system. There are separate help function and User Manual (see Appendix User Manual) in the system.</p>

9. Conclusion

In summary, this paper presents the conceptual design for web based appointment management system using WebML which contains data model, hypertext model, user model and presentation model. WebML guarantees the model-driven approach which can reduce development efforts (cost and time) and allows a more structured development process. It definitely needs further promote in the industries.

References

- [1] Aldo Bongio, Stefano Ceri, Pero Fraternali, Andrea Maurino, 2001, Modeling Data Entry and Operations in WebML, Springer, <http://link.springer.com/link/service/series/0558/papers/1997/19970201.pdf>
- [2] Behravanfar, R., 2001, Separation of data and presentation for the next generation Internet using the four-tier architecture, USA
- [3] Borko Furht, Chris Phoenix, John Yin, and Zijad Aganovic, 2000, An Innovative Internet Architecture for Application Service Providers, *Proceedings of the 33rd Hawaii International Conference on System Sciences*
- [4] Clemens Kerer, 2003, XGuide - Concurrent Web Development with Contracts, http://en.wikipedia.org/wiki/Unified_Modeling_Language, Australia
- [5] Elizabeth I. Hanna, 2005, Inclusive Design for Maximum Accessibility: A Practical Approach to Universal Design, PEM Research Report
- [6] Ginige, A.; Murugesan, S., 2001, Web engineering: an introduction, IEEE Transaction.
- [7] Jeremy Petersen, 2007, benefits of using the n-tier approach for web application, <http://www.adobe.com/devnet/coldfusion/articles/ntier.html>
- [8] Piero Fraternali, 1999, Tools and Approaches for Developing Data-Intensive Web Applications: a Survey, ACM Press, USA
- [9] Reza Behravanfar, 2001, *Separation of Data and Presentation for the Next Generation Internet Using the Four-Tier Architecture*, IEEE Transaction.
- [10] Reza B'Far, Next Generation Internet: The "Fourth Tier" Is Born - Internet/Web/Online Service Information, Computer Technology Review, Jan, 2001
- [11] Rumbaugh, Jacobson, and Booch, 1999, *The Unified Modeling Language Reference Manual*. Addison-Wesley, Reading, MA
- [12] Stefano Ceri, Florian Daniel, Maristella Matera, 2005, R. 7.1.3. - Sviluppo di un metodo, corredato da design patterns, per la specifica di siti Web multicanale personalizzati, Italia
- [13] Stefano Ceri, Piero Fraternali, Aldo Bongio, Marco Brambilla, Sara Comai, Maristella Matera, 2002, *Designing Data-Intensive Web Applications*, Morgan Kauffmann.

[14] Stefano Ceri, Piero Fraternali, and Aldo Bongio. 2000, "Web Modeling Language (WebML): A Modeling Language for Designing Web Sites.", *Computer Networks* Volume 33, Numbers 1-6 , pages 137-157, June 2000

[15] Stefano Ceri, Peter Dolog, Maristella Matera, and Wolfgang Nejdl, 2004, Model-Driven Design of Web Applications with Client-Side Adaptation. *In Proc. of ICWE 2004 - International Conference on Web Engineering*, Munich, Germany, Springer Verlag, July 2004.

[16] Stefano Ceri, Piero Fraternali, and Maristella Matera, *WebML Application Frameworks: a Conceptual Tool for Enhancing Design Reuse*,

http://webml.elet.polimi.it/webml/documents/frameworks_www10.pdf

[17] Unified Modeling Language, http://en.wikipedia.org/wiki/Unified_Modeling_Language

[18] WebML Team, *Model-driven design of web application: WebML*, http://www.webml.org/webml/upload/ent17/1/WebML_printable.pdf

[19] Youngman, M., Zacks, J., et al., 2006, *Research-Based Web Design & Usability Guidelines*, USA Health and Human Services Dept.

[20] Yvonne Rogers, Jenny Preece, Helen Sharp et al., 1994, *Human-Computer Interaction*, Addison-Wesley, UK.