

S-OODM: A SECURE OBJECT ORIENTED DESIGN METHODOLOGY

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ABSTRACT: An object-oriented design methodology for web applications (OODM) was proposed because before this methodology (OODM), all hypermedia methodologies did not differentiate between design phase and implementation phase and there was no or minimum analysis phase in these methodologies. In other words the principles of software engineering were not followed. Security issues were not addressed in OODM. In this paper, security aspects of web applications are included in OODM and its extended version with security model is referred to as the Secure Object-Oriented Design Methodology (S-OODM) for web applications. The working of S-OODM through a case study and security aspect in the design are highlighted.

Keywords: - OODM, Design Methodology, Security, Web Application

INTRODUCTION

Due to increase in the users of the web ,the use of web applications also referred as hypermedia applications has been increased tremendously (Herman and Reynolds, 1994; Rumbaugh *et al.*, 1991; Shah, 2001) .The Web applications (WAs) have special characteristics that make them different from other traditional applications (Fernandes, 1991; Garzotto *et al.*, 1991; Rumbaugh *et al.*, 1991; Garzotto *et al.*, 1993; Balasubramanian *et at.*, 1994; Herman and Reynolds, 1994; Balasubramanian and Turoff, 1995; Isakowitz *et al.*, 1995; Yourdon, 1996). Traditional development methods, such as Structural Analysis and Design Techniques (SADT) and Object-Oriented Development Methods (OODM), are incapable of analyzing; designing, implementing and testing. Shah (2003) proposed OODM for the development of web based application. The OODM concentrates mainly on two phases i.e. Analysis Phase and Design Phase. Analysis phase consists of three models i.e Informational, Navigational and Operational Model. The analysis phase processes problem statements of WAs and captures initially three different aspects of the WAs. These are information structure, the navigation paths to be followed by different user-classes during access, and operations performed by the WAs. This phase works on the three aspects separately and develops corresponding three models. They are referred to as Building Information Model, Building User Navigation Model, and Operation Model respectively.

OODM was proposed for design of the web applications using object oriented technique. Security has become a serious issue with the web applications and there is no provision of handling security with OODM. To handle the security during the analysis and design phase is the research questions of the present research.

MATERIALS AND METHODS

Inclusion of Security Model: The modified architecture of the OODM with security model is given below:

Analysis Phase

ig. 1: Modified Architecture S-OODM

Building Security Model: The security is implemented in the S-OODM through a security model. This model consists of rules, permissions and level of security. Every model in the S-OODM calls this model for security. The problem statement, information model and operation model are its input, which are used for defining the securities policies, accessing the roles and permissions.

There are several roles e.g., Administrator, Super user, user which have set of permissions e.g. Update, Create, edit, delete Roles are inherited - a subfolder can have different permission set for the role as the parent folder. Users and groups are given roles. Again, user can have different roles in the different part of the site.

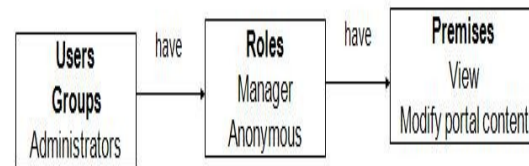


Fig. 2: Users with their Roles

For the other models of S-OODM the security model implemented the security as following:

Table 1: Building information model with security consideration

Page-class	User Roles	Permission	Level of Security
Department	User	View	Classified
Conference	User	View	Classified
Course	User	View	Classified
Library	User	View	Classified
Student	User	View	Classified
resume			
Employment	User	View	Classified
opportunity			
Research	User	View	Classified
Centre			
College	User	View	Classified
Policy	User	View	Classified
Degree	User	View	Classified
program			
Paper	User	View	Classified
Faculty	User	View	Classified
Course	Administrator	Create, update, delete, edit	Secret
Registration			
System			
Tel Directory	Super User	Create, update	Classified
System			
Library	Administrator	Create, update, delete, edit	Secret
management			
System			
Student	Administrator	Create, update, delete, edit	Secret
Academic			
records			WA
Management			
System			

Building Information Model: This unit identifies page-classes, their associations and their multimedia attributes from problem statement. The problem statement should be correct and taken from valid, authenticated and authorized users. To ensure validity, authentication and authorization of user's secured logging should be implemented.

Building Navigation Model: This unit designs the information structure of WAs while navigating through web pages. During user navigation secure session management should be done to reduce user disorientation and cognitive overhead.

Building Operation Partitioning Model: This unit categorizes operations into client operations and server operations. For completing and refining the operation partitioning model valid and authorized client and server should be identified.

Building User Interface: This processing unit deals with the designing of user's perception and interaction with WAs. For designing the user interface the information about user's perception should be gathered from valid users.

introduced, we have presented a case study The S-OODM emphasizes on the security issues and this case study illustrates the main steps to implement the security model. As in OODM, a case study for University has

Table 2: Building navigational model for Faculty page-class with security consideration.

Agent	Action	Web Resource	Secure Session management
Current User	Access University home page	University home page	Yes
Current User	Access CRS page	CRS page	Yes
Current User	Access registration form	Registration Form	Yes
Current User	Enter course data	Registration Form	Yes
WA	Validate course data	Course data	No
WA	Check Course conflicts	Course Data	No
WA	Adds the course	New Course is added	Yes
WA	Acknowledge Completion	Registration form	No
Current User	Read Acknowledge message	Registration form	Yes

been given. Its blue prints of its home page design are present. According to OODM case study, university web page should contain the following information about colleges, departments, degree programs, courses, research papers, conferences, exhibitions, projects, libraries, magazines, publications, employment opportunities, and faculty members and so on.

Table 3: Building navigational model for Prospective student with security consideration For Prospective Student

RESULTS AND DISCUSSION

To show how the security model has been

Seq	Agent	Action	Web Resource	Secure Session management
1	Prospective student	Access University home page	University home page	No.
2	Prospective student	Find 'Computer College'	College index	No
3	Prospective student	Access 'Computer College' page	'Computer college' page	No
4	Prospective student	Find 'CS' department page	Department index	No
5	Prospective student	Access 'CS' department page	'CS department' page	No
6	Prospective student	Find offered graduate degree programs	Degree programs guided tour	No
7	Prospective student	Read degree program page	Degree programs page	No

management.

Building User Interface: Proper login page is provided before starting of web application.

Table 4: Building navigational model for current user with security consideration For Current User

In addition, the university website should also provide its users access to existing computerized systems at the university. It includes Library System: search for publications, books, Student Academic Record Management System: students get transcripts, Courses Registration System: register student for the next courses and print the time table, Tel. Directory System: keeps telephone numbers for university staff. The security model at Analysis Phase will be implemented and realization of the security needs at its different phases has been done as under

Building Information Model: Page-classes, their associations and their multimedia attributes are identified in the case study of University. (Table-1).

Building Navigational Model: The security in navigation can be maintained (Table-2).

Building Operation Partitioning Model: On the client side, secure socket layer should be enabled in the browser. Client should be registered in the administrative domain. User name and password should be provided in order to make it authenticated access to the server. On the server side make sure that web application is placed on the proper place according to need of session

Validate (account No, password): Boolean IsActive (account No): Boolean IsActive ()

2

Setup_Details

Check_role (account No): String

Fig. 3: The registration operation detail using OIG with security consideration

Conclusion: An extension in Object-Oriented Design Methodology (OODM) for the designing of secure WAs has been proposed. The architecture of the OODM methodology has also been modified to accommodate the security issues and a new architecture has been given. In S-OODM security has been introduced at each level and in each phase of S-OODM. After getting requirements the vulnerabilities in the system that may cause internal or external attack to the system and security requirements are identified. In the next phase we identify the classes, sub classes, their relationships, and multimedia attributes of each class or subclass and their security definitions in each model i.e. Building Information Model, Building Navigational Model, Building Operation Partitioning

Model and Building User Interface Model.

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