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Resort Technology and Reservation: A study on UML Web Application Extension

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ABSTRACT

With the year of 2020 coming to an end, it is safe to say that in today's era, the world is advancing rapidly - everything around us is slowly being digitized and automated. With the ongoing pandemic, that has taken the world by force, even the smallest of things are being taken care of online nowadays, thus, web applications have been ever increasing in terms of their complexity. It has become harder to maintain Web Applications that are user friendly, and contain interactivity, business logic and customer satisfaction, while also handling large amounts of transactions that take place.

The intent of this paper is to verify whether the use of a more traditional software engineering technique, i.e., the Unified Modeling Language (UML) and the Web Application Extension, which has recently been added, resulted in a good design, regarding the maintainability of the application. To investigate the above factor, it was sub-divided into 3 parts, namely- documentation, extensibility and usability. These three criteria were then applied to my own web application. The maintainability was determined from the analysis of the final design.

The conclusion of this experiment was that UML WAE had a fair support for reusability, good support for extensibility and an extremely good support for documentation. Thus, it was finally concluded that UML WAE resulted in a good design, in terms of maintainability. This result, however, is related to the design of my web application. We may see a different result for a differently designed web application. Also, it should not be overlooked that the quality of design depends upon the quality of knowledge of the developer.

KEYWORDS:*Web Application Extension, Unified Modeling Language, Reusability, Extensibility, Documentation, Maintainability*

I. INTRODUCTION

This study aims to grab the attention of an audience that has an area of interest in Web Application Development. It is also directed towards one with interest in Web Modeling Techniques. Web Application Development was chosen as the topic of our research as a special model language for Web Application Development has not been heard of. Object Oriented Development has a number of models and methods (like the Object Modeling Technique (OMT) and the Unified Modeling Language (UML)), yet a distinguished model for Web Application Development has not been set up.

In this research, we will explore the Unified Modeling Language (UML), and check whether the final result using UML is a well-structured Web Application, and thereby conclude if it is an adaptable and usable approach to Web Application Development.

II. HYPOTHESIS

The use of Modeling Languages in Web Application Development is not really a popular choice. During this research, it has been assumed that modeling would improve the overall application design, and in turn, it will have several advantages. Thus, UML has been used while developing the web application, and the result has been analyzed accordingly.

"Web application development via the use of Unified Modeling Language in terms of maintainability, provides an overall better design."

To resolve the above hypothesis, we have divided the term "maintainability" into three sub-parts, namely - Extensibility, Reusability and Documentation.

Thus, the objective remains to answer the following questions that arise:

- How does UML WAE support Extensibility?
- How does UML WAE support Reusability?
- How does UML WAE support Documentation?

III. METHODOLOGY

1. Extensibility:

Coupling and Cohesion will be evaluated as follows:

- **Inter-Package coupling**
- **Inter-Page Coupling**
- **Intra-Package coupling**

Both, the "outer" coupling between the different packages and the "inner" coupling between the different pages inside the packages will thus be evaluated.

Cohesion will be evaluated inside the different packages.

The aim here is to create independent packages with high cohesion and low coupling between and inside them.

Coupling:

To measure the amount of coupling between the different packages, the number of calls made from each package to the other packages were counted, and the average value was then calculated. This average allowed the evaluation of whether the package had a low coupling or not.

To measure the coupling between the different pages inside the packages, the number of calls made from each page to other pages was calculated. From this, an average number was evaluated for the same. This average allowed the evaluation of whether the page had a low coupling or not.

Cohesion:

Cohesion inside the different packages was assessed by providing the current package a score on a scale from 1 to 9, 1 being the lowest (indicating low cohesion). Thus, a package handling numerous unrelated tasks was awarded the lowest score, whereas a package that handled a unified task received a 9 (indicating high cohesion). An average was then calculated for all the packages.

2. Reusability:

The concept of Lines of Code (LOC) is used to calculate Reusability.

- **(Reused Software (LOC)/ Total Software (LOC)) * 100**

As the code was not copied from anywhere, and the entire code was new, reusability here was calculated differently. Firstly, it was considered what packages could be reused. Secondly, what pages could be reused in the future, by another application.

This measurement was further divided into Black-box and White-box Reusability.

In the case of black-box reuse, no changes were tolerated in the examined object. When measuring white-box reuse, an estimate of the amount of modifications needed was calculated, to fit the examined object to a new environment.

Black-box

- **(Reused Packages/ Total No. of Packages) * 100**
- **(Reused Pages/ Total No. of Pages) * 100**

White-box

- **(Reused Packages/ Total No. of Packages) ∗ 100**

3.Documentation:

Documentation can be assessed in terms of Traceability.

- Trace in forward direction from requirements
- Trace in backward direction to requirements
- **(Reused Pages/ Total No. of Pages) ∗ 100**

All the requirements were assessed bidirectionally. It was evaluated in either directions, whether the name and meaning of the requirement remained unchanged, if the context was intact and easy to follow. The entire documentation criteria was assessed and then represented by the following grades:

F: Failed to support

G: Good support

VG: Very good support

*: Could not be measured

IV. RESULT AND ANALYSIS

1. **EXTENSIBILITY**:

Coupling:

Package Vs Couplings	
Login/Logout	2
Add Comment	2
Edit Resort Information	3
Edit Comment	3
Database	4
Login/Logout	1
Place Order	3
Database	2
Homepage	5
Show all Resorts	5
Payment	2
Database	4

Total couplings = 36

Packages = 11

Outer Couplings per package = 36/11 = 3.2 couplings/package

Cohesion:

Package Vs Cohesion	Result
Login/Logout	5
Add Comment	7
Edit Resort Information	8
Edit Comment	6
Database	7
Login/Logout	7
Place Order	3
Database	6
Homepage	5
Show all Resorts	7
Payment	4
Database	7

Total Package Cohesion = 72

Packages = 11

Outer Couplings per package = 72/11 = 6.5 Average Cohesion

- **Low Coupling:**

The design resulted in an average coupling of 3.2 couplings/package. This is definitely considered a low value for a web application.

- **High Cohesion:**

Cohesion was evaluated and was found to have an average value of 6.5 on the scale from 1 to 9. This value was found to gravitate more towards the upper end of the scale. The packages that were created were individual, and did a specialized task for the system that they were designed for.

2. **REUSABILITY**:

Total numbers of packages = 11

Total numbers of pages = 17

- **Black-box Reuse:**

Packages: (0/11) x 100 = 0%

Pages: (0/17) x 100 = 0%

Black-box testing comprises strict rules, which caused the 0% outcome for both - pages and packages. However, this result was almost expected as achieving Black-box reuse involves humongous amounts ofeffort.

- **White-box Reuse:**

  Packages: (4/11) x 100 = 36.36%

  Pages: (6/17) x 100 = 34.52%

The number - 34% and 36% is basically the count of the reusable client pages in the web application. This implies that the larger this value, the better it is in terms of reusability.

3. DOCUMENTATION:

Diagram	Small but Detailed	Large, Non-detailed
Use Case (Top Level)	G	*
Use Case (Sequence)	G	*
Use Case (Analysis)	G	*
Detailed Class	*	F
Overview Class	*	VG
Sequence Diagram	VG	*
Component Diagram	*	VG

Overall Grade for Traceability: VG

- Based on the criteria for evaluation, the Web Application Extension got a good grade overall. The final grade obtained was slightly over'G'.

- UML WAE exhibited a good traceability, as the documentation allowed easy understanding of the entire web application. The process was initiated via broad models, and gradually gravitated towards more complex models. This created an easy to follow transitional flow from requirements till the finishedproduct.

V. CONCLUSION

The use of UML WAE for Web Application Development showed massive success in terms of our defined criteria.

In terms of Extensibility*, high cohesion, along with low coupling, was supported. This opened up the possibility to create generalized/specialized hierarchies.*

In terms of Reusability*, white-box reuse was found to be supported. However, not much success was found in terms of black-box reuse.*

In terms of Documentation*, the produced output had traceable components, was easily understandable and simple to follow.*

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