Cognitive Approach Towards the Maintenance of Web-sites Through Quality Evaluation in Operative Phase

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Abstract

It is a well established fact that the Web-Applications require frequent maintenance because of cutting– edge business competitions. The authors have worked on quality evaluation of web-site of Indian e-commerce domain. As a result of that work they have made a quality-wise ranking of these sites. According to their work and also the survey done by various other groups Futurebazaar web-site is considered to be one of the best Indian e-shopping sites. In this research paper the authors are assessing the maintenance of the same site by incorporating the problems incurred during this evaluation. This exercise gives a real world maintainability problem of web-sites. This work will give a clear picture of all the quality metrics which are directly or indirectly related with the maintainability of the web-site.

Keywords: Web-Applications, Quality, Maintainability Factors, Maintainability Sub-factors.

1. INTRODUCTION

The software maintenance as defined in IEEE standards [2] is: The modification of a software product after delivery to correct faults, to improve performance or other attributes or to adapt the product to a modified environment. According to Basili and Mills [3] the software maintenance may be looked as : Most software systems are complex, and modification requires a deep understanding of the functional and non-functional requirements, the mapping of functions to system components and the interaction of components.

Maintainability is an important attribute in all the software applications as it is learned that only 25% to 33% of the total effort put in during the complete life cycle of a software system goes in actually building the system [5]. The rest is consumed by effort expended towards the operational maintenance of this system. This figure clearly indicates that maintenance takes more efforts as compared to the development of the software. The maintainability of software system has always been a problem with software professionals. Since the third-party maintenance is now becoming a reality as more and more organizations are opting for third-party maintenance of their Web-Applications. It is the high time that software maintenance be looked in the right perspective so that a realistic cost estimates be prepared for the software maintenance. Most Web-Applications involve critical business assets which promote their services through internet. Because of globalization and cut-throat business competition, these Web-Applications evolve continuously during their life-cycle. Lehman et.al. [1] gave two laws of software evolution that affect the evolution of Web-Applications. They are

1. The law of continuing change: A program used in real world must change or eventually it will become less useful in the changing world.

2. The law of increasing complexity: As a program evolves it becomes more complex and extra resources are needed to preserve and simplify its structure.

Web-Applications are different from traditional software systems in the sense that they involve heterogeneous technologies in hardware as well as software. For successful development of large Web-Applications, we need a team of people with wide ranging knowledge and skills. We need Graphic designers to develop the look and feel, we need people with library science background to organize, navigate and search information. We need database designers and programmers to develop code, network security and other security aspects. We often involve architects to get better aesthetics in the Web-Applications. The code development will involve hypertext structures, JSP, Servlet, scripting languages, etc. It is a common practice that Web-Applications are hosted and maintained by third party. Because of heterogeneousity of such Web-Applications, the maintenance becomes a cumbersome process and becomes impossible to predict maintenance cost using traditional models and metrics. When we talk about the web-application maintenance the structure of a web-application should be considered. Web-Applications are different from traditional software systems in the sense that they involve heterogeneous technologies in hardware as well as software. Web-Applications are built up of different items coded with different programming languages. Any web-application is an arrangement of web pages. These pages can be static as well as dynamic. Dynamic pages are generated at run-time. The static pages are normally written in HTML. The dynamic pages are normally written using the scripting languages, and the back end is typically written using the database management languages.

2. LITERATURE SURVEY

An object-oriented model for describing the component of a web-application is proposed by Conallen [12]. The model is also used in reverse engineering [13, 14, 15] of a web-application. This model is a UML class diagram depicting each type of relevant item of a WA as a class, and possible relationships between these items as UML association, aggregation/composition, and generalization relationships. The relevant classes of this model include *pages* that can be distinguished into *server pages*, i.e., pages that are deployed on a web server, and *client pages,* i.e., pages that a web server actually sends back to a client request. Several types of relationships interconnect the classes of this model. These relationships include: the *link* one between pages that are interconnected by static hyper textual links, the *submit* relationship between a form and the server page that elaborates the form data, the *redirect* one between a script and a web page, the *include* one between a client/server script and a client/server module/page, the relationship *build* between a server page and the client page it dynamically builds, and the *load_in_frames* relationship between a *Client page with frame* and the set of pages referred by its <frame> tags, have to be considered.

The model describing the WA components and their relationships is provided in Figure 1[12] as a UML class diagram. Each WA can be represented by an instance of this model, that provides a description of the internal organization of the WA, where each actually implemented page and page component, and each actual relationship between them is explicitly represented. This model is obtainable by statically and dynamically analyzing the source code of an existing web-application [13]. Also web-application may be executed on different computers in a distributed architecture.

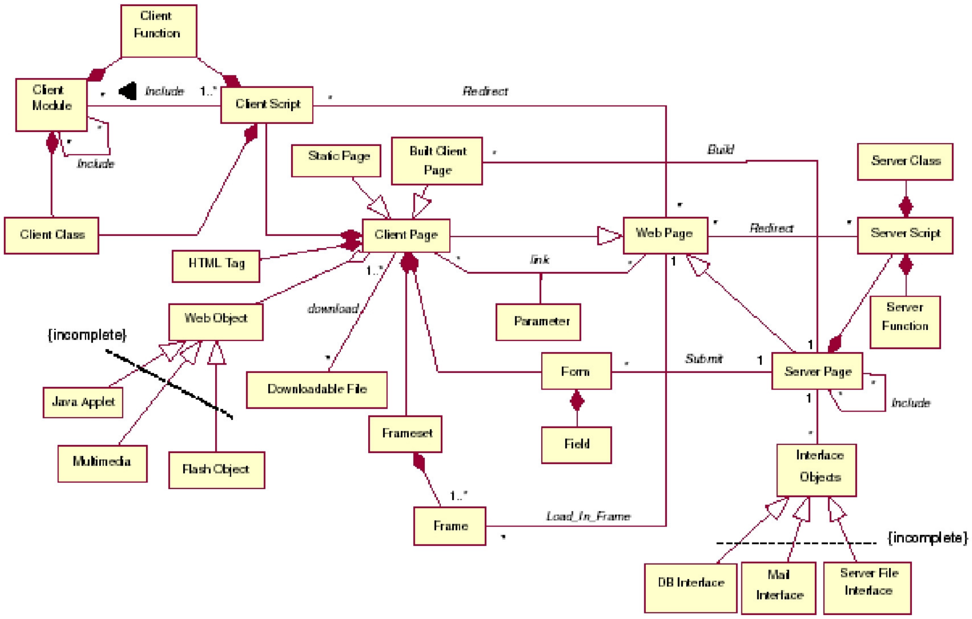

FIGURE 1: Reference model for a web-application

Pressman [6] describes maintainability as the ease with which a program can be corrected if an error encountered, adapted if its environment changes, or enhanced if the customer desires to change the requirements. Following ISO9126[5] guidelines state the factors of maintainability. Many papers discussing maintainability models for traditional software systems are present in literature. The model proposed by Oman and Hagemeister[11] is one of the most exhaustive and complete models which considers the additional strong factors associated with the maintainability of a software in general. It is important to note

that it is not sufficient to measure the attributes of a software system alone without considering the environment in which it is working.

3. THE OMAN AND HAGEMEISTER MAINTAINABILITY MODEL

Oman and Hagemeister presented a maintainability model based on a hierarchical tree structure comprehending 92 attributes affecting the maintainability of a software system. The leaf nodes in the hierarchy represent an identified maintainability attribute and, for each of these, attribute metrics are defined to evaluate that maintainability characteristic. In Figure 1 the top level of the OHMM hierarchy is showed. At this level, three main categories of factors are pointed out:

- Management: practices of management employed, and facts related with them; Operational environment: environment, in terms of hardware and software, involved in the operation of the system under examination;

- Target Software System: the examined software system under maintenance, including the source code and support documentation.

Oman's work focuses mainly on the Target Software System; Figure 2, shows a detail of the sub-tree concerning this category. Three major categories can be identified in this sub-tree:

- Maturity Attributes: maintainability characteristics referring to the maturity degree of the system under evaluation, relying on the aging, stability, reliability, number of defects; and number of maintenance interventions, techniques of development used;

- Source Code: maintainability characteristics due to those ones of the source code; Supporting Documentation: maintainability characteristics due to the supporting documentation; they are divided in two categories:

- Documentation Abstraction: characteristics related with content (completeness, correctness, and descriptiveness) of supporting documents set;

- Physical Attributes: characteristics related with the form (readiness, modifiability) of supporting documents set.

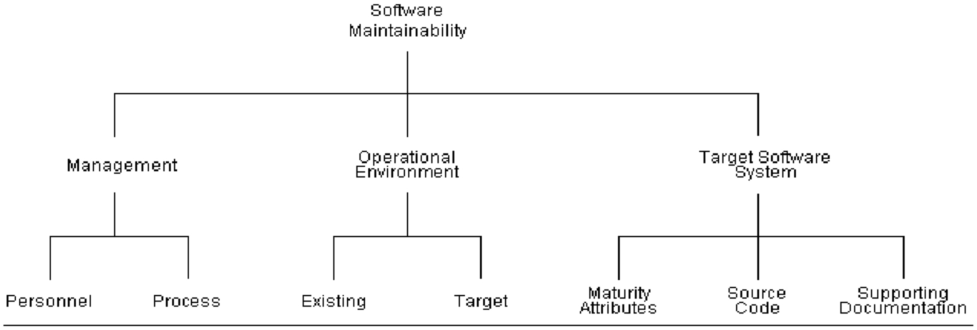

FIGURE 2 : Oman Hagemeister model of maintainability

4. IMPORTANT CONSIDERATIONS USED FOR THE SURVEY

The authors have proposed the quality metrics for e-commerce based web-sites and also validated their quality model[19]. They have evaluated the few web-sites and given them qualitywise ranking. The quality model is a hierarchical tree divided into factors. The factors are further divided into sub-factors and metrics. Based on those results we have planned to assess the maintenance part of those sites. Presently we are working on the site of futurebazaar. The relevant measurement goals for the assessment of maintenance are determined using the Goal-Question-Metric (GQM) approach [17], which is based upon the assumption that any measurement must be defined in a top-down fashion. The result of applying the GQM approach is a model that has three levels: The conceptual level - Goal; ii) The operational level - Question; and iii) The quantitative level - Metric. The goal is refined into several questions and each question is then refined into metrics, either objective or subjective.

To validate a measure following four questions should be asked [16].1) Is the measure adequately capturing the attribute it purports to measure (i.e., construct validity)?2) Is the attribute itself well-defined based on an explicit empirical model (i.e., empirical relational system) ?3) Is there any empirical evidence supporting the underlying hypotheses of the empirical model?4) Is the measure useful from a practical perspective?

A survey approach offers the following advantages [18]: i) reaches many users; ii) makes use of existing experience; iii) makes use of standard statistical analysis techniques; and iv) confirms that an effect generalizes to many projects/organizations.

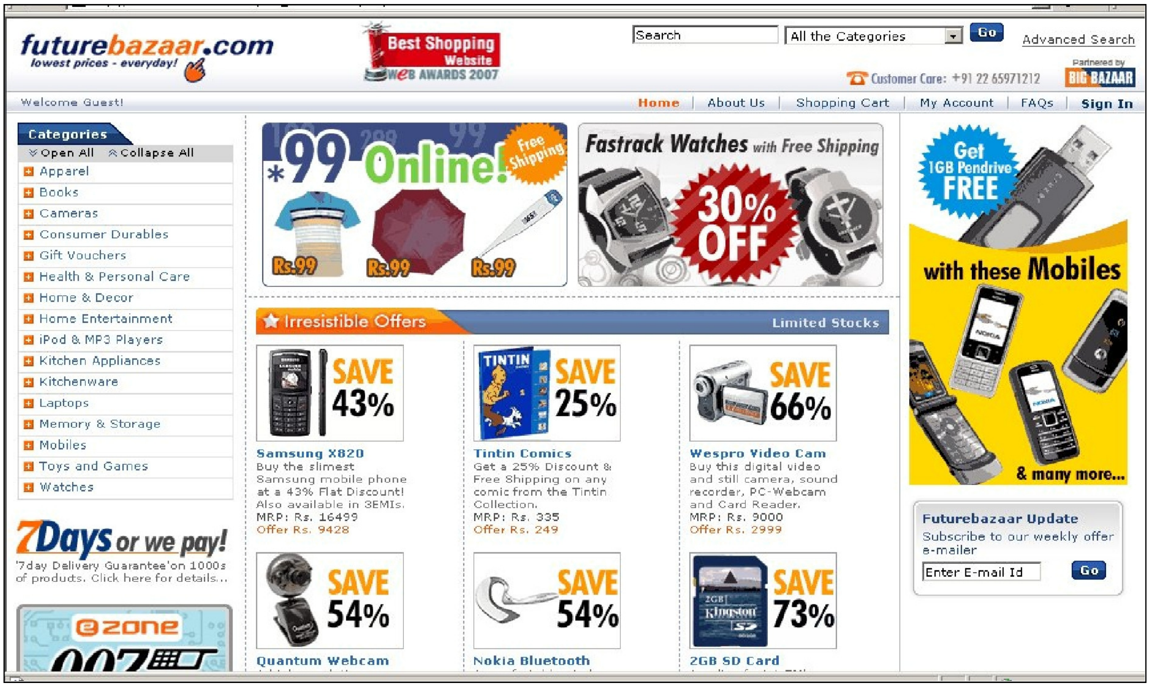

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FIGURE 3: Homepage of http://www.futurebazaar.com

5. RESULT AND DISCUSSION

The software quality and maintainability are directly related[10], i. e. a good quality software is expected to have low maintainability. The authors[9] in a recent paper have discussed the quality attributes of Web-Applications and mentioned that maintainability is also a quality factor. The Authors in their previous work have proposed quality metrics for e-commerce based web-sites after evaluating the quality of few Indian e-commerce based web-sites[19,20]. After evaluating the sites they have ranked www.futurebazaar.com as one of the best sites. In this paper the authors have selected the metrics to be incorporated as a maintenance process of the web-sites. The survey conducted by the authors give following results [See Table 1]. The survey based on questionnaire is being carried out and the participants were the persons involved in web-application maintenance and developers working with software development companies of international repute(TCS, IBM to name a few). We have analysed 55 questionnaires and following metrics have selected to be incorporated in the web-sites in their operative phase. The domain selected by the authors are of Indian e-commerce base. We further wish to extend this work to web-sites of other domains also. It has been already established that the Functionality & Content[10] affects the quality of the web-site. Considering the component of a web-applications proposed by Conallen [12] the authors propose to examine the relationship in context to the maintenance as their future work. In future the authors wish to assess the actual maintenance efforts in incorporating these changes in the web-site already in the operative phase.

Factor/sub-factor/Metrics for Maintenance	**Recommended (In %)**
Usability/On-Line Feedback & Help /Last update date	79
Usability/Address Directory /Customer Care	82
Functionality/Removal of Broken Links	85
Functionality/Calculation of any discount offered for a period-Business Logic Change	88
Functionality/Removal of the items which are not available (database updation)	86
Functionality/Adding the new items in the existing list	84
Functionality/Customer-oriented & Domain Related Features/New & Forthcoming	80
Usability/Online Feedback & Help /Best Sellers	84

TABLE 1: Recommendation of the survey conducted for the metrics to be incorporated for maintenance

Disclaimer: The information given in this paper shows views of the authors and not of the company.

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