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Web Quality Model for Websites Developed in Punjabi and Hindi

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***Abstract*—A systematic and quantitative engineering-based approach is followed in this research, to develop a web quality model following well-known international standards and guidelines. The quality model can be used to measure the external quality and to evaluate and compare the quality of web-sites developed in Punjabi and Hindi. The quality model consists of two parts first includes the attributes that need visual observation and the other part can be automated.**

***Keywords: Web Quality model, External Quality, Quantitatively, Punjabi and Hindi websites*.**

I. INTRODUCTION

The diversity, complexity and usage of websites are rising constantly. According to the World Internet Stats [1], on 30 June, 2012 (date of updation) the internet users in India are estimated to be around 1.37 billion whereas 24 billion are all over the world. India is the fourth country in the world regarding Internet users.

As per the Internet Systems Consortium [2], in March 2011 there were around 800 million websites on world wide web. As the websites are increasing at a drastic pace and our dependency is increasing day by day. So, it is the need of the hour to ensure their quality. Quality is not universally definable and measurable. A good mechanism for controlling the quality of web sites is the use of metrics. To measure, evaluate and to control quality, we need some measurable attributes. However, hundreds of attributes have been defined by various researchers for websites developed in English but they have not been standardized yet and no research has been carried out for measuring, evaluating and to control the quality of websites developed in Punjabi and Hindi.

Cachero [3] et. al. proposed an approach to evaluate web quality that provides all the elements which, according to the ISO/IEC 14598, are essential parts of a software quality evaluation, namely: Quality model, a software measurement process, supporting tools and a method of evaluation

Software Engineering has a widely adopted quality model, the ISO/IEC 9126 revised by ISO 25010 and several researchers in Web Engineering have adopted it as a basis for their quality models. In this research also same will be followed, by keeping the existing top characteristics.

According to ISO 25010 [4] as shown in figure (1) there are eight characteristics:

- - The degree to which the software product provides functions that meet stated and implied needs when the software is used under specified conditions.
- Reliability - The degree to which the software product can maintain a specified level of performance when used under specified conditions.
- Operability - The degree to which the software product can be understood, learned, used and attractive to the user, when used under specified conditions.
- Performance efficiency - The degree to which the software product provides appropriate performance, relative to the amount of resources used, under stated conditions.
- Security - The protection of system items from accidental or malicious access, use, modification, destruction, or disclosure.
- Compatibility - The ability of two or more software components to exchange information and/or to perform their required functions while sharing the same hardware or software environment.
- Maintainability - The degree to which the software product can be modified. Modifications may include corrections, improvements or adaptation of the software

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to changes in environment, and in requirements and functional specifications.

- Transferability - The degree to which the software product can be transferred from one environment to another.

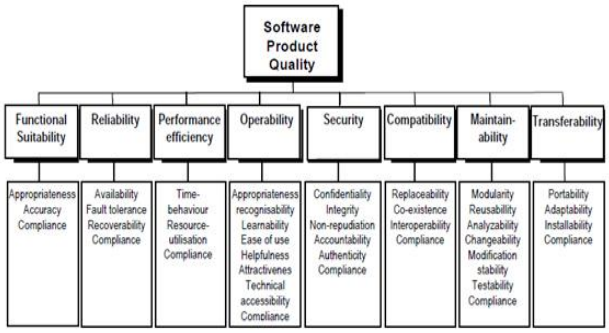

Fig. 1{source Figure 5 – Software product quality model [4]}

II. RELATED WORK

Several quality models have been proposed, each with their own set of characteristics and sub-characteristics. Some of the best known software quality models that provide the basis for developing quality models are discussed by Fenton et al. [5]. Fenton discussed Mc-Call's hierarchical quality model and Boehm's hierarchical quality model. The model-builders of both these models focus on product quality, and identify the key attributes of quality (quality factors to specify) from the user's perspective. Both models assume that the quality factors cannot be measured directly. Hence, they further decompose quality factors into lower-level attributes called quality criteria. Subsequently, quality criteria are further divided into directly measurable attributes (both product and process) called quality metrics

On the other hand, Software Engineering has a widely adopted quality model, the ISO/IEC 9126 as discussed above, and several researchers in Web Engineering have adopted it as a basis for their quality models. Luis Olsina and Rossi [6,7] are pioneers in this area. They proposed a quality model and an ontology of characteristics based on ISO 9126, which was refined several times [8]. The model considers visitors, and manager's points of view. They applied it to the museums domain [9], as well as in academic sites [10] and online shops[11]. The characteristics used were usability, functionality, reliability and efficiency with their sub-characteristics as proposed by Dr.Luis Olsina which he implemented in all his research work. They also added another category, named content [12].

Americo et al. [13] introduced a web quality model by keeping the existing top characteristics standardized by ISO 9126 The main aim of the research was to assess whether a universal web quality model can be built or need to build a domain specific web quality model. For that Americo et al. analyzed more than sixty automatically collectable quality metrics including forty proposed by other researchers. Based on their study they planned to refine, their website quality model consisting of two parts: one part will be "universal' (will include domain independent metrics) and the other will be customized for a specific domain(will include domain dependent metrics). Ghazwa et al. [14] presented a probabilistic approach for building web quality models and the associated assessment method. Using GQM approach they illustrated the important quality characteristics of navigability design. Based on the proposed model they conducted an experimental study with 20 subjects and 40 web pages. Results show that the scores given by the used model were strongly correlated with navigability as perceived and experienced by the users

Priyanka et al. [15] proposed usability metrics for Academic web sites. Priyanka et al. have discussed the usability characteristic as described by ISO 9126 model and various researchers concluded that usability requirements varies for websites of different domains and hence to evaluate usability common set of metrics cannot be used. They modified a model proposed for Luis et al. and identified four characteristics (Global Site Understandability, On-Line Feedback and Help Features, Interface and Aesthetic Features and Miscellaneous Features) further divided into 32 measurable attributes based on their small experiment

Dominguez-Mayo [16] had discussed about the importance of Model Driven Web Engineering (MDWE) with reference to Quality Evaluation criteria, Software metrics and Quality models. A quality model for Usability characteristic is proposed with a set of quality attributes. Furthermore, the relationship is made between the attributes and sub-characteristics of Usability. In order to achieve a fully developed Quality Model, attributes, sub-characteristics, characteristics and their associations have to be studied.

Calero et al. [17] defined the web quality model, a cube with three dimensions Web Features (Navigation, Content, Presentation), Quality Characteristics (Functionality, Reliability, Usability, Efficiency, portability and Maintainability) and Life cycle processes(Development, Operation, Maintenance, Effort and Reuse). The authors present an extensive list of 385 metrics, compiled from 60 papers, and classify them within the proposed quality model. Some of those metrics are capable of automation,

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others are not. The metrics are also classified according to granularity level, theoretical validation and empirical validation.

Signore et.al. [18] had proposed a five dimension quality model for web applications. The model discusses the relation among external and internal characteristics. The quality model constitutes: correctness, presentation, content, navigation and interaction. Although the model description is very detailed, regarding the way each characteristic can be measured, this paper does not provide evidence that data collection actually took place.

III. WEB QUALITY MODEL

Prior to developing a web quality model for websites developed in Punjabi and Hindi the set of websites for three application domains i.e. Academic, Government and Newspaper that are developed in Punjabi and Hindi was prepared between 1st September, 2011 to 30th November, 2011 and the following data was collected :

- There are eighty four Hindi newspaper websites and sixty three Punjabi newspaper websites all over the world.
- Seventy three websites are developed in Hindi of government domain (considering only Apex bodies, Ministries and their departments at the Union level of India) and seventeen websites are developed in Punjabi (Punjab government).
- Among four hundred forty nine universities in India, websites of forty nine universities are developed in Hindi and four in Punjabi.

So, considering the amount and importance of the websites in these domains in India and all over the world (Newspaper domain) a web quality model has been developed.

As mentioned by Americo et al. [13] the quality indicators are domain dependent and thus the quality model has been developed in two phases: global (domain independent) and domain dependent. In this paper the proposed quality model (domain independent for websites developed in Punjabi and Hindi) based on ISO 25010 standard [4] has been developed. The model is represented by hierarchical two-level tree structure and consists of five top-level characteristics i.e. functional suitability, operability, reliability, security and performance efficiency. These characteristics have the most impact on users' perception of the quality (external quality), while compatibility, maintainability and transferability are mostly visible from the administrators' perspective (internal quality).

The model consists of more than hundred attributes that have been defined and a metric is chosen for each indicator as shown in Appendix. Further, eighty seven attributes are to be tested manually out of which forty nine have been proposed by other researchers [19-39], and fifteen attributes proposed by other researchers are automated . For those fifteen attributes five free open source testing tools have been proposed.

TABLE I: DETAILS OF QUALITY MODEL

	Attributes	Proposed by other Researchers	Proposed by Authors	Total
I	**Domain Independent**			
a	Manual Testing	49	38	87
b	Automated Testing	15	NIL	15

TABLE II: WEB QUALITY MODEL

Characteristic	Attribute Name
Functional suitability	Color changes of visited links
Functional suitability	Back Button
Functional suitability	Home button
Functional suitability	Current Position Indicator
Functional suitability	Identity Author
Functional suitability	Identity Site Name Title
Functional suitability	Scoped Search
Functional suitability	Search Box Local
Functional suitability	Search Box Global
Functional suitability	Number of Graphic links on a page
Functional suitability	Zooming
Functional suitability	Home Page Media Count(Audio/Video recording)
Functional suitability	Language Correctness
Functional suitability	Notices Marquee
Functional suitability	Images Count
Operability	Home Page All Contents in Punjabi/Hindi
Operability	Level of contents in Punjabi/Hindi
Operability	Language Button Size
Operability	Floating E_ Keyboard Punjabi/Hindi
Operability	Frames in Home Page
Operability	English Label
Operability	Font color
Operability	Font size uniformity
Operability	Font face uniformity
Operability	Website Explanatory Help
Operability	Attractiveness
Operability	A-Z Site Index
Operability	Bookmark
Operability	Comments and Suggestions
Operability	Contact Us email address
Operability	Contact Us Phone Internal Extensions
Operability	Contact Us Post Address

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Operability	FAQ Feature
Operability	Image Map
Operability	Image title
Operability	Languages Count
Operability	Links Visibility

Characteristic	**Attribute Name**
Operability	Print Support
Operability	Alternative text support.
Operability	Frames Uniformity /consistency
Operability	Link Color style Uniformity
Operability	Home Page Audio Clip Duration
Operability	Home Page Video Clip Duration
Operability	Developed By
Operability	Domain Name
Operability	Location Emblem/Logo
Operability	Ownership Information
Operability	Referred Websites
Operability	Relative URL's
Operability	Copyright Punjabi/Hindi
Operability	Facebook PH
Operability	Latest News Announcements Marquee
Operability	Online English To Punjabi Dictionary
Operability	Thought for the Day
Operability	View Comments
Operability	RSS
Operability	A consistent Page layout
Operability	Terminology Uniformity
Operability	Disposition Text
Operability	Overlapping Text
Operability	Contrasting Text
Operability	Character Spacing
Operability	Line Spacing
Reliability	Style Uniformity
Reliability	Visitor Counter
Security	CAPTCHA
Operability	Language Label Location
Operability	Language Label size
Operability	Language Label color brightness
Operability	Language Label font size
Operability	Label Language Hindi/Punjabi
Operability	Label Language to English
Operability	Feedback Section
Operability	Online Dictionary
Operability	Search Box
Operability	Last Updated Information
Operability	Last Updated Frequency
Operability	Bilingual Updated
Operability	Unicode Homepage
Operability	Menu Lists Unicode
Operability	Options Contents Unicode
Operability	Unicode Forms
Operability	Site Map
Operability	Horizontal Scrollbar
Operability	Vertical _Scrollbar

Automated Attributes	
Reliability, Operability	Broken links
Performance Efficiency	Response Time
Performance Efficiency	Total Size
Performance Efficiency	Total Down Load Time
Performance Efficiency	Total Images in Home Page
Performance Efficiency	Size of images
Performance Efficiency	HTML Down Load Time
Performance Efficiency	Number of CSS Files
Performance Efficiency	CSS Size
Operability	Link Count (Total links on a page).
Operability, Reliability	Browsers Independence
Operability, Reliability	Browsers Version Independence
Operability, Reliability	Count browsers Full Support

IV. FUTURE WORK AND CONCLUSIONS

In the next phase, domain dependent indicators will be proposed i.e. for Academic, Newspaper and Government websites developed in Punjabi and Hindi and subsequently three domain dependent quality models will be developed for measuring and evaluating these specific domain websites. Subsequently, data will be collected for all the above set of 290 websites (developed in Punjabi and Hindi of Academic, Newspaper and Government domains) in three stages for the attributes mentioned in the quality model (domain independent) and for domain dependent attributes Accordingly, quality will be measured quantitatively and comparison between websites of the above mentioned domains will be performed

Consequently, questionnaires will be prepared to measure 'quality in use' for the above mentioned websites and for validating the quality model developed.

Lastly, the proposed quality model can be useful not only as a frame of reference to evaluate existing web sites and fix errors, but also can be helpful in improving their quality through re-engineering.

The major challenge faced in this research is that the web is continually evolving, with ever changing contents, functions and services. Moreover, with time, the importance of characteristics vary e.g. earlier accessibility was considered more important characteristic but now-a-days usability is given more importance. However, the research will be valuable to researchers and practitioners interested in designing, implementing and managing

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websites developed in Punjabi and Hindi. Also, analysis and comparisons among web sites developed in Punjabi and Hindi could be performed in a consistent way.

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Appendix: Example of Attributes with their Description

S.No.	Attribute_Name	Attribute_Definition	Characteristic(As per ISO 25010)	Interpretation_of_Measured_Value	Data_ Collection _Type	Measurement_ Tool	Proposed By Researcher
1	Languages Count	Number of languages the website supports.	Operability	2 Languauges=0.5 ,3 languages=0.75, More than 3=1.0	Manual	—	NO
2	Unicode HomePage	To check whether Unicode encoding is used for developing website's homepage or not.If the Unicode encoding is not used then the user needs to install fonts.	Operability	Y=1 ,N=0,NA=" "	Manual	—	NO
3	Language Label Location	Location of Label to view the website in Punj/Hindi languages. Position of the label should be such so that it is easily tracaable to the user.	Operability	Top=1.0,Bottom without Scrolling=0.5 ,Menu/L=0.25,Bottom with scrolling=0.0	Manual	—	NO
4	Language Label size	The size of the label to view the website in other languages should be big enough to be easily noticable.	Operability	Very small=0.25,Mediium=0.5, Big=1.0	Manual	—	NO
5	Language Label colour brightness	The label to view the website in other languages should be bright enough to be easily noticable and visible.	Operability	Very Dull=0.25,Bright=0.5, Very Bright=1.0	Manual	—	NO
6	Language Label font size	Label font size should be big enough to be easily legible	Operability	Very small=0.25,Mediium=0.5, Big=1.0	Manual	—	NO
7	Feedback Section	Feed back form is in English or in Punjabi/Hindi also.	Operability	Present in regional language=1,Present but in English only=0.5 ,Absent=0	Manual	—	YES
8	Floating E Keyboard Punjabi/Hindi	Facility of floating keyboard to type in Punjabi/Hindi.	Operability	Y=1 ,N=0,NA=" "	Manual	—	NO
9	Language Online Dictionary	To find the meaning of English word in Punjabi/Hindi.	Operability	Y=1,N=0,NA=" "	Manual	—	NO
10	Search Box	Search box facility assists the user to find some information from website	Operability	Y=1, Present in English only=0.5, N=0, NA=" "	Manual	—	YES
11	Site Map	Availability of Site map.	Operability	Y=1, Present in English only=0.5, N=0, NA=" "	Manual	—	YES
12	Response Time	Response time for the website.	Performance Efficiency	More than 30 msec=0;More than 20 msec=0.5;Less than 20 msec=0.75;Less than 10 msec=1	Automated s/w tool	http://www.websitepulse.com	YES
13	Total Down Load Time	The time taken by the website for downoading.	Performance Efficiency	More than 30 msec=0;More than 20 msec=0.5;Less than 20 msec=0.75;Less than 10 msec=1	Automated s/w tool	http://www.websitepulse.com	YES