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An extensive framework for assessing the quality of websites

Sasi Bhanu Jammalamadaka[1], Bala Krishna Kamesh Duvvuri[2], Sastry Kodanda Rama Jammalamadaka[3], Vishnu Priya Biyyapu[3]
[1]CMR College of Engineering and Technology, Kandlakoya Village, Medchal District, Hyderabad, India
[2]MLR Institute of Technology, Dundigal, Hyderabad
[3]Department of Computer Science and Engineering, Faculty of Engineering, Koneru Laksmaiah Education Foundation University, Vaddeswaram, India

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ABSTRACT

The quality of the website is quite important in generating customer satisfaction and loyalty. A website's quality depends on several factors, features, and characteristics. Several computational methods are necessary to evaluate the quality of each factor and subsequently determine the overall quality of the entire website. Each factor does not contribute to the same level of quality required by the end users and thus requires a weighting system. Expert systems, which are either manually defined or learnt using artificial intelligence (AI), are to be modelled for assessing the quality of a factor/sub-factor or characteristics of a sub-factor. The quality of a website varies depending on the context. Context-based quality assessment of the websites is required. There is a need to generate example sets to assess the quality of websites and to establish relationships between web-related quality factors, subfactors, and characteristics. In this paper, a comprehensive framework is presented that caters to parametric structure building and mapping, parsers for computing characteristic values, context assessment, building expert systems, and learning models for assessing the quality of websites and weighing the factors that have specific significance on the quality of the website.

Corresponding Author:

Sastry Kodanda Rama Jammalamadaka
Department of Computer Science and Engineering, Faculty of Engineering
Koneru Laksmaiah Education Foundation University
Vaddeswaram, Guntur District, India
Email: drsastry@kluniversity.in

1. INTRODUCTION

The web has become a pervasive communication medium for all organizations [1]. The widespread introduction of information technologies is one of the primary development strategies that provide a foundation for creating a unified information environment based on a business portal. A web portal provides a solution for aggregating content, information systems and services for presentation to the end user in the required format. A business website can also be an effective marketing tool to attract consumers and form a positive Business image.

A high-quality website meets the requirements of both its owner and users. Determining the most important factors of a website is crucial. It helps system designers focus on the factors with the highest weight and identify the best policy to improve website effectiveness [2]. The good quality of a website has a direct and positive effect on its users' satisfaction [3]. According to prior studies, multiple factors influence a website's quality, including interface design, navigation, information content, loading time, usability, security, and others [4]. When assessing the quality of a website, researchers select one or more factors based on the context of their research. Tools and user surveys are some methods available for computing the quality of Websites. While one seeks to consider internal factors related to the internal processing of the pages, the survey method examines users' satisfaction. These methods are erroneous and subjective.

Websites are an integral part of everyday life, used to exchange and convey information between user communities. Conveyed information comes in different types, languages, and forms. It incorporates text, images, sound, and video intended to inform, persuade, sell, present a viewpoint, or even change an attitude or belief. Despite the proliferation of websites, quality assessment remains a challenging research area. Quality relates to customer satisfaction and the accomplishment of user expectations from a website.

The quality of a website can be assessed using various factors, including usability, reliability, functionality, portability, maintainability, privacy, security, adequacy of information, safety, content, and navigation. As many as 42 factors need to be considered. A selection of the 42 factors relevant to a website's needs must be made.

Website quality could be measured from two perspectives: programmers and end-users. Programmers' aspects of website quality focus on the degree of maintainability, security, and functionality. End-users pay more attention to usability, efficiency, and credibility. One of the primary goals for website quantitative evaluation is to understand the extent to which a given collection of quality characteristics fulfils a selected set of needs regarding a specific user view.

On the one hand, website domains such as electronic commerce, museums, and academic sites are becoming increasingly complex systems. Hence, an integral quantitative evaluation process regarding all relevant quality characteristics is also a complex issue. The evaluation complexity is caused by the large number of intervening characteristics and attributes, as well as the complex logical relationships among these attributes and characteristics. Besides, some relevant attributes cannot be objectively measured, so they can only be included after a subjective evaluation made by expert evaluators.

While discussing the quality assessment criteria, a set of quality parameters was established by [5]-[7] are required to define what is expected from the site characteristics. The set of website characteristics and their relationships form the basis for a quality assessment model. Moreover, to evaluate the quality of websites, it is necessary to analyse the required parameters, evaluation procedures, and user viewpoints.

Computing the quality of websites that represent virtual communities [8] is a complex task. Identifying the key factors is a complex process. A comprehensive framework is required that considers context mapping, parametric mapping, choice and application of computational methods, the evolution of expert systems, parametric weighing, and modelling parsers for computing the parametric/characteristic values. Some frameworks presented in the literature are purely subjective and dependent on the quality assessor; some are objective and dependent on statistical measurements.

Computing the quality of websites considering different contexts, factors, sub-factors, Features, and relative grading of these factors is complex. Many parsers, expert systems, and learning models are required to assess the quality of the websites. A system should combine the quality of all its factors, assigning proper weights to determine the overall quality of the system. A comprehensive solution requires a framework combining all the elements of quality assessment and overall website quality.

Some frameworks presented in the literature consider key dimensions of website quality. Usability is one dimension that encompasses ease of navigation, accessibility, and user satisfaction, all of which are critical for enhancing the user experience. Expert analysis is predominantly used in quality assessments, which rely on expert judgment to evaluate website features [9].

Few fuzzy approaches have been presented, focusing on the interaction among key quality parameters. Utilising the fuzzy decision-making trial and evaluation laboratory (fuzzy-DEMATEL) method enables nuanced evaluations that consider the interactions among various quality parameters. Tools developed for specific domains, such as academic websites, can quantitatively assess quality based on predefined criteria [10]. Some have evaluated the quality of Websites from a performance perspective, pointing out that Loading time and overall site performance for retaining user engagement.

Some have focused on factors such as relevance, accuracy, and comprehensiveness of information, which are essential, particularly for academic websites [11]. Several other frameworks have been proposed in the literature to evaluate the quality of a website based on user surveys, taking into account specific geographical regions [12], composite analysis of webpages [13] quality management of e-commerce sites [14], assessing the quality of websites based on [15], and based on the methodology used for assessing the quality of the websites [16].

While these frameworks provide structured approaches to website quality assessment from the perspective of a few factors, usage context is not used. Important aspects such as structure, navigation, quality of multimedia objects, look and feel, have not been considered in the frameworks presented in the literature. It is important to recognise that user perceptions and experiences can vary significantly, suggesting that user perceptions should also be integrated into the assessment process.

Website quality evaluation is a multifaceted process incorporating various frameworks and methodologies to assess quality dimensions. A comprehensive approach involves identifying key factors such as usability, content, and performance, which can be systematically analysed through established models.

Khandare *et al.* [17] evaluated the usability of an engineering college website using three automated tools: Website Grader, SEOptimer and Qualidator. They have also utilized website grader to evaluate websites within the tourism field. They recommended automated evaluation over human judgment because human judgment can be subject to bias.

Jayakumar and Mukhopadhyay [18] established the website quality assessment model (WQAM). This methodology evaluates the quality of e-learning websites based on four high-level quality indicators: correctness, feasibility, utility, and propriety. The questionnaire sample (QS) gathers these quality measures.

Zahran *et al.* [19] discussed classifying the evaluation process into web and website evaluation. He suggested some criteria to select the proper assessment method. Much research has been done using statistical evaluation of website quality as well. For instance, in Medyawati and Mabruri [20] an attempt was made to assess the service quality of two banking websites offering e-banking services through a questionnaire-based analysis of e-banking service users. They considered accessibility, interaction, adequacy of information, usefulness of content, lifestyle and personality as quality measuring factors.

Rocha [4] have considered three aspects of website quality assessment: content quality, service quality, and technical quality. In terms of content quality, attributes such as accuracy and precision, completeness, relevance, opportunity, consistency, coherence, update, orthography, and syntax are evaluated. In service quality, attributes such as security, reliability, privacy, performance, efficiency, accuracy, opportunity, availability, response time, timesaving, empathy, reputation, and personalization are evaluated. Technical quality attributes, such as navigation map, path, search engine, page download time, browser compatibility, broken links, and accessibility, are evaluated. They have used the method recommended by [21]. All three dimensions are evaluated within a framework that includes the website's Point of view and operational, representational, contextual, and intrinsic categories, which are classified into characteristics and sub-characteristics. They have proposed that analysers must be determined, and mechanisms must be evolved to compute the quality value of each characteristic on a 5-point Likert scale. However, they have not recommended an empirical formulation.

Irawan and Hidayat [22] have considered two dimensions: technical and democratic deliberation for computing the quality of e-governance websites. They have presented a synthetic model for evaluating websites. They have used SortSite 5.3.5 software to compute the quality, considering the technical dimension. While they have used the software to compute the technical dimension, they have computed the factors related to democracy through visual inspection. On the technical dimension, they have observed the following metrics: errors (percentage of broken links), accessibility (percentage of accessibility issues that do not follow WCAG 2.0 guidelines), compatibility (percentage of compatibility issues), and standards (percentage of pages that do not comply with W3C standards). On the democratic deliberation dimension, they have considered three metrics: content, transparency, and communication. The content metric is evaluated based on the characteristics, including search features, basic information, service details, and security and privacy statements. In the transparency metrics, they have considered web links directed to various websites, the availability of last year's financial reports, and the whistleblower link. Concerning communication, they considered the availability of social media, online chat, email service, and hotline calls.

Several authors have proposed various models for assessing the quality of e-governance websites. Karkin and Janssen [23] have presented a common website evaluation model that details six metrics: content, privacy and security, usability, quality, accessibility, and citizen engagement. Fan *et al*. [24] Considered factors that included privacy/security, usability, e-content, and e-services, decomposing each factor into further attributes and providing feedback on the site. They have not recommended the computational mechanisms for the selected metrics. Holzer and Manoharan [25] Have considered privacy/security, usability, content, services, and citizen social engagement. Fietkiewicz *et al.* [26] have considered the formation, communication, transactions, integration, and participation, which are evaluated through different questions and provide answers based on which statistical analysis is carried out. Lee-Geiller and Lee [27] considered transparency, service quality, and citizen engagement.

Most models presented in the literature select parameters based on the type and nature of the website. The attributes are computed using tools, manual inspection, or surveys. All the chosen methods are generally flawed, and no model can fit all the conditions. Kaur and Gupta [10] have presented a framework that focuses on the computing quality index of a website from the perspective of website design, which is represented as a structure. The parameters chosen to reflect the quality of the website's design have been quantitatively measured. They have proposed a weighting technique based on the fuzzy-DEMATEL method, applied to the metrics representing the website's design. They have computed Fuzzy trapezoidal numbers to assess parameters and the final design quality index value.

Moustakis *et al.* [28] have used the quality factors: content, navigation, structure and design, appearance, multimedia, and uniqueness. Content is the information conveyed to the end user through a user interface. The content reflects the quality, completeness, degree of specialisation or generalisation, and reliability of the information presented on the website. Navigation reflects the support provided to the user when moving in and around the site. Navigation elements include ease of movement, ease of understanding site structure, and the availability and validity of links. Structure and design incorporate aspects that affect the order of presentation, speed, and browser. Appearance and multimedia capture aspects that relate to the site's "look and feel" with special emphasis on the state-of-the-art graphics and multimedia artefacts. Uniqueness refers to the user's perception that the site offers something that makes it stand out in a world of sites. A computational method known as the analytical hierarchy process (AHP) has been employed to assess a website's quality.

Granić *et al.* [29] have presented the quality of a website from a portability perspective. Portability refers to the ability to transfer a website from one hosting platform to another, ensuring that the platform that runs the site remains functional on the new host. Anusha [30] have considered portability, reliability, functionality, usability, maintainability, and efficiency to assess the quality of a website. Ricca and Tonella [31] have considered content, design, organisation, and user-friendliness as the quality factors that must be considered in evaluating the quality of a website. The organization of a website includes identifying web pages and the way they are linked hierarchically. The web pages are linked, making navigation easy. The web pages must be simple and user-friendly, presenting content according to the user's preferences.

Alwahaishi and Snášel [32] have considered playfulness and the Level of representation of the content as the most important factors to consider when evaluating the quality of a website. Most of the presentations on the basement of the quality framework have provided neither a framework nor appropriate computational methods to compute the quality of a website.

Hasan and Abuelrub [33] have proposed a general criterion for evaluating the quality of any website, regardless of the type of service it offers. They contend that the quality criteria include content, design, organization, and user-friendliness. These dimensions, along with their comprehensive indicators and checklists, can be used by web designers and developers to create high-quality websites that enhance the online presence and image of any organization.

Singh *et al.* [34] have noted that the rapid growth of web applications increases the need to evaluate them quantitatively. Web quality evaluation model (WebQEM) has been utilised to objectively evaluate web applications. Weighing a web attribute has been proven to be subjective and mostly dependent on expert judgements. The authors have presented a quantitative evaluation strategy to assess the quality of websites and applications.

Wah [35] have presented the argument that websites must be evaluated and measured for quality. He has presented several metrics related to usability, associated with good design elements, such as word count, total pages, size in bytes, body text percentage, average link text count, and others. He has presented the computation of website quality based on 16 factors. He has used support vectors to predict whether web pages are good or bad. A quantitative analysis of web page attributes has been presented.

Most frameworks related to assessing website quality focus primarily on usability characteristics and do not consider other key factors, such as appearance, structure, navigation, multimedia, and completeness, which are among the most important aspects of a website. None have attempted to address factors, sub-factors, characteristic values, human cognitive systems, learned cognitive systems, and parsers to process the website code and compute the count of elements related to different factors and sub-factors. A comprehensive framework is needed that caters to every aspect of the quality assessment of a website from different perspectives.

This paper proposes a comprehensive framework that combines all the elements of assessing a website's quality. Without this framework, any quality assessment will be flawed, and the dependability of a website for the required information cannot be reliably ascertained.

The overall objectives of this research include development of the methods for identifying different contexts embedded within various websites, studying different factors that reflect the quality of websites from various perspectives and contexts, finding the relative impact these factors on overall quality of websites, studying and determining the characteristics to be considered when evaluating the quality of the different factors required to assess the comprehensive quality of the websites, studting and finding the kind of parsers required for computing the characteristics, determing the reference models which can be used to determine the extent of deviation from ideal measurements, and Invent and implement learning models that help the quality of the factors based on their characteristic values. Develop a framework that integrates all the elements required for computing the quality of the websites. Every business establishment can use the framework presented in this paper to assess the quality of its website and analyse competing establishments**.** Individual business establishments can also identify webpages that require improvements to make the website highly sought after for browsing and content acquisition.

2. METHOD

2.1. Experimental framework

One hundred websites have been considered, and the users' perceived quality has been captured through a separate survey. As explained in the framework sections, an example set is created by generating counts for each factor using a separate parser, as explained in the framework section. Each example tuple is mapped to an expected quality level as perceived by the users or computed using a human expert model. The source code of a website is a fundamental input used to compute all the components required for assessing the website's quality.

2.2. Materials, procedures, variables and measurements

2.2.1. Proposed overall framework

Figure 1 illustrates the overall method for computing the quality of a website. The overall framework is constituted using four sub-frameworks. In the first sub-framework, reference repositories and the related mapping are created at the user's discretion. This sub-framework creates repositories for factors, sub-factors, characteristics, parsers, computational methods, and lookups. The relationship among those elements is created and maintained through user interaction with a suitable interface. In the second framework, the generation of contexts and related URLs, the selection of factors, subfactors, characteristics, parsers, and computational methods, as well as how these are used to compute the counts of characteristic elements, is generated considering the filtered websites based on the contexts. The third sub-framework involves developing a cognitive model based on human expertise or through a Machine learning model to assess or predict the quality of characteristics or sub-factors. Within the framework, provisions are made to invoke any machine learning model, although the multi-layer perceptron model is recommended for experimentation. The fourth framework relates to the quality assessment of sub-factors, factors, and the website using a human-driven cognitive or machine-learned predictive model.

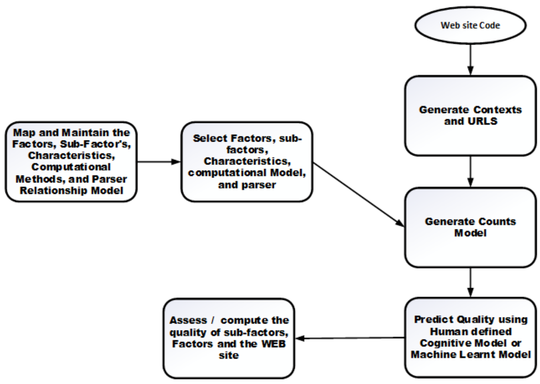

Figure 1. Overall framework

2.2.2. Sub-framework - reference model

The sub-framework for creating the reference model is illustrated in Figure 2. Several factors, sub-factors, and their characteristics associated with website quality assessment have been surveyed, and a repository has been created. The repository can be created and updated using the user interface. Computational models have been developed to assess the quality of each factor based on its associated features, and a repository for these models has been established. Parsers have been developed that can be dynamically added and invoked. Based on a selected factor, the parsers compute the counts of features or characteristics using the computational methods associated with each feature. The individual reference repositories have been utilized to establish relationships (factors – sub-factors, sub-factors – characteristics, characteristics – computational methods, factors – parsers) through the user interface. Users are responsible for establishing relationships by their expected design. This sub-framework serves as a reference model for other sub-frameworks.

The source code of example websites has been considered, and the sub-framework framework is used to compute the quality of the web site. To start with, Reference and relation tables are established. A repository of factors (appearance, structure, navigation, multimedia and completeness) has been considered, sub-factors (font, text, paragraph, screen, tables, menu, images, videos, Wave files, URLs, sub-trees, depth of a sub-tree, number of edges in a sub-tree, extent of connectedness, highest length of URL, average length of

URL quick link usage, circular references, average number of frequent links, graphics, animations, missing images, missing videos, missing audio files, unmatched tables, unmatched forms, unmatched PDF, and characteristics (type, style, size, colour, case, pitch, margin, line spacing, background colour, foreground color, no of columns, no. of rows, first row color, coloring style, alternate coloring, font, text, line, paragraph, tree menu objects, file menu objects, tab menu objects, taskbar menu objects, width in pixel, height in pixel, width, height, frames per second, decibels, and representation type, number)). Each characteristic is associated with a default characteristic value, which can be used for computing the variation from the expected value. Using a computational method. A set of computational methods that the user prefers is collected and maintained in a repository. The characteristics are mapped to computational methods. For every computational method (counting, relative distance, counting and averaging, comparing and averaging, and the maximum), a parser is identified, generated, and stored in a specific repository. The parser is called whenever a specific computational method is to be executed.

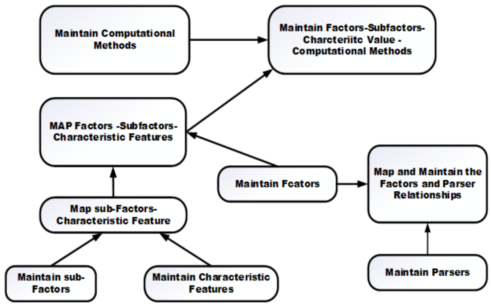

Figure 2. Reference model – sub-framework

2.2.3. Computing characteristic counts through context generation – sub-framework

Figure 3 shows the sub-framework relating to count generation. The web source code is processed to find contexts using separately designed parsers, and the web pages relating to a specific context are identified. A repository has been created. Each web page is related to a specific context. This sub-framework computes various metrics using parsers mapped to a specific computing method. The following Algorithm 1 is used for computing the counts, considering the metrics associated with those counts.

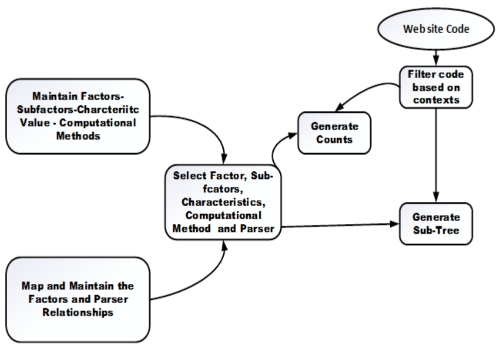

Figure 3. Counts generation – sub-framework

Algorithm 1. Computing characeristic counts

```
for every factor
{
        for every sub-factor
               {
             For every feature
                    {
                 Call the parser.
                        Store the counts in a dimensional array indexed by factor, sub-
        factor, and feature.
                     }
               }
}
```

2.2.4. Developing cognitive and prediction model – sub-framework

Figure 4 shows the sub-framework for capturing a cognitive quality model or learning a quality model through a multi-layer perceptron. The counts compute a sub-factor’s quality or feature by referring to a manually captured cognitive or machine-earned model. To begin with, manual cognitive models have been developed for each of the characteristics and sub-factors, which are used to compute the quality of these sub-factors and characteristics. One hundred websites were considered, and users' perceptions of quality were assessed through a separate survey. An example set is created by generating counts for each factor using a separate parser. Each example tuple is mapped to an expected quality level. The counts and expected quality of the website are learned using a multi-layer perceptron model. In the case of the factor “completeness,” the model is used to predict the quality of the factor “completeness” for a website. The framework, as such, provides a provision for the user to choose any learning algorithm.

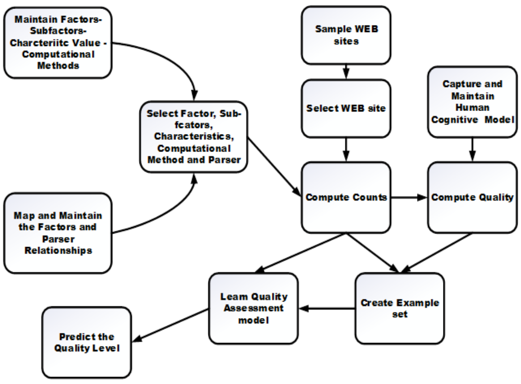

Figure 4. Counts generation sub-framework

2.2.5. Assessing sub-factors quality, factors, and the website – Sub-framework

The quality assessment sub-framework is shown in Figure 5. The quality of each subfactor is assessed by computing each characteristic’s aggregate. The quality of each factor is calculated by aggregating and averaging the quality of each related subfactor. The overall quality of the website is calculated by taking a weighted average of the quality of the selected factors. The quality of a website is computed at the website level, factor level, and sub-factor level. The quality is computed using a human-defined expert or a machine learning model. When a machine learning model is used, the quality is computed at the sub-factor level.

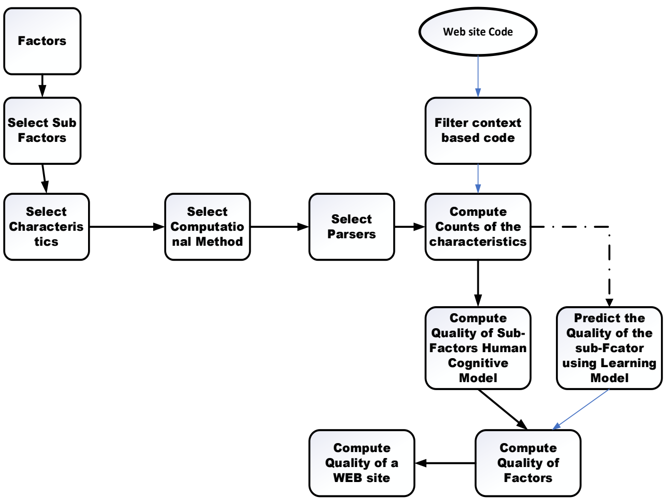

Figure 5. Quality assessment framework

The following procedure is used for computing the quality when the human expert model is used (Algorithm 2).

Algorithm 2. Computing the quality of sub-factors using an expert model
```
Qweb = 0
Qfcator=0
For each factor
{
        Nsub-fcator = 0
        Qsub-fcator =0
For each of the sub-factor
        {
                TQcha = 0
                Ncha - 0
For each characteristic
                {
                        TQcha = TQcha + Qcha
                        Ncha = ncha+1
                }
                Qsub-Fcator =  TQcha \ Ncha
                Qsub-factor =  Qsub-factor * Wsub-factor
                Nsub-factor =  Nsub-factor  + 1
                TQfactor = TQfcator + Qsub-fcator
        }
Qweb =  TQFcator /  Nsub-Fcator
}
```

The following procedure is used for computing the quality when the machine learning model is used (Algorithm 3).

Algorithm 3. Computing the quality of the websites using machine learning models
```
Qweb = 0
Qfactor=0
For each factor
{
        Nsub-fcator = 0
        Qsub-fcator =0
For each of the sub-factors
        {
                Nsub-factor =  Nsub-factor  + 1
                Qsub-factor =  Qsub-factor * Wsub-factor
                TQfactor = TQfcator + Qsub-fcator
        }
Qweb =  TQFcator / Nsub-Factor
}
```

3. RESULTS AND DISCUSSION
3.1. Results

A look-up table is created using a user interface, utilising the reference creation sub-framework explained in Section 2.2.3. Individual repositories establish relationships among factors, sub-factors, features, and computational methods. Table 1 presents the lookup table of reference components for an example website, as captured by a user. The computations and counts for necessary factors, sub-factors, and characteristics have been calculated using the algorithm explained in section 2.2.3. The counts computed for each characteristic are shown in Table 1, in the last column. The count values must be captured for each website separately by the user.

To start with, human-defined Cognitive models have been captured and maintained. A website feature is considered excellent, good, average, or poor. Specific characteristics found or counted and calculated, are mapped to an expert model to determine the quality of the characteristics. The mapping is shown in Table 2, which is used to compute the quality of the characteristic quality value. Quality can also be computed using the counts generated as sub-factors. An example set is generated with features as the sub-factors and quality as obtained through a survey. A multi-layer perception model is learnt considering the example set and the output as the quality levels. In this case, quality is assessed at the sub-factor level based on the counts generated by the parsers. The user can specify any learning model to be used.

Table 3 shows the quality assessment of a sample website considering the factor “look and feel” and the Human cognitive model described in Table 2. The quality computation is clear and comprehensive. The framework helps compute a website’s quality based on the user's choices and configurations. The framework combines both user perception, technological assessment and machine learning models.

Table 1. Characterization of quality factors and mapping with computational methods

Quality factor number	Factor	Sub-factor	Characteristics	Reference characteristic value	Typical counting method	Parser	Metric values
1	Appearance	Font	Type	Time new roman	Relative distance	Parser-1	0
2			style	Bold	Relative distance	Parser-1	0
3			size	12 Points	Relative distance	Parser-1	0
4			colour	Black	Relative distance	Parser-1	1
5			case	Sentence	Relative distance	Parser-1	0
6		Text	Pitch	standard	Relative distance	Parser-1	1
7		Paragraph	Margin	1 cm	Relative distance	Parser-1	2
8			Line spacing	1	Relative distance	Parser-1	1.5
9		Screen	Background colour	Black	Relative distance	Parser-1	2
10			Foreground color	white	Relative distance	Parser-1	0
11		Tables	No of columns	4	Relative distance	Parser-1	1
12			No. Of rows	20	Relative distance	Parser-1	1
13			First row color	Navy Blue	Relative distance	Parser-1	0
14			Colouring style	Alternate	Relative distance	Parser-1	2
15			Alternate coloring	Sulphate	Relative distance	Parser-1	3
16			Font	Default	Relative distance	Parser-1	1
17			Text	Default	Relative distance	Parser-1	1
18			Line	Default	Relative distance	Parser-1	1
19			Paragraph	Default	Relative distance	Parser-1	
20		Menu	Tree menu objects	3	Relative distance	Parser-1	2
21			File menu objects	20	Relative distance	Parser-1	2
22			Tab menu objects	10	Relative distance	Parser-1	2
23			Taskbar menu objects	20	Relative distance	Parser-1	2
24		Images	Width in pixel	1100	Relative distance	Parser-1	2
25			Height in pixel	1100	Relative distance	Parser-1	2
26			Color	Mixed	Relative distance	Parser-1	2
27		Videos	Width	1100	Relative distance	Parser-1	2
28			Height	1100	Relative distance	Parser-1	2
29			Colour	Mixed	Relative distance	Parser-1	1
30			Frames per second	10	Relative distance	Parser-1	3
31		Wave files	Decibels	1000	Relative distance	Parser-1	3
32			Representation type	Radio button	Relative distance	Parser-1	0
33	Structure	URLS	Number	10	Counting	Parser-2	10
34		Sub-trees	Number	10	Counting	Parser-2	5
35		Depth of a sub-tree	Number	4	Counting	Parser-2	3
36		Number of edges in a sub-tree	Number	8	Counting	Parser-2	3
37		Extent of connectedness	Number	5	Counting	Parser-2	4
38	Navigation	Highest length of URL	Number	4	Comparing	Parser-3	5
39		Average length of URL	Number	4	Counting and averaging	Parser-4	4
40		Quick link usage	Number	4	Counting and averaging	Parser-4	3
41		Circular references	Number	2	Counting	Parser-2	2
42		Average number of frequent links	Number	5	Counting and averaging	Parser-4	3
43	Multimedia	Images	Resolution	800×600	Comparing and Averaging	Parser-5	4
44			Format	Jpeg	Comparing and averaging	Parser-5	4
45			Intensity	80%	Comparing and averaging	Parser-5	4
46			Brightness	80%	Comparing and averaging	Parser-5	4
47			Size	80 K	Comparing and averaging	Parser-5	4
48		Videos	Frames per minute	40	Comparing and averaging	Parser-5	5
49			Colors	60	Comparing and averaging	Parser-5	4
50			Resolution	800×600	Comparing and averaging	Parser-5	4
51			size	50 K	Comparing and averaging	Parser-5	4
52		Wave files	Waves asserted	50	Counting	Parser-2	5
53			Frequency of wave files	8 Ghz	Counting and averaging	Parser-4	4
54			Duration	4 secs	Counting and averaging	Parser-4	4
55			Echo	14 db	Counting and averaging	Parser-4	5
56		Graphics	Graphs with all the salient features	80%	Counting	Parser-2	4
57		Animations	Frames	40	Counting and averaging	Parser-4	4
58			Duration	5secs	Counting and averaging	Parser-4	4
59			Animation rate	6 Frames/Sec	Maximum rate	Parser-5	4
60	Completeness	Missing images	Number	2	Counting	Parser-2	2
61		Missing videos	Number	2	Counting	Parser-2	1
62		Missing audio files	Number	2	Counting	Parser-2	2
63		Unmatched tables	Number	2	Counting	Parser-2	1
64		Unmatched forms	Number	2	Counting	Parser-2	2
65		Unmatched PDFS	Number	2	Counting	Parser-2	1

Table 2 Human-defined cognitive model

Object	Characteristic	Count				Quality Value			
		Excellent	Good	Average	Poor	Excellent	Good	Average	Poor
Image	Image resolution	1000×1100	1100×800	800×600	600×600	1.00	0.75	0.50	0.20
	Image format	Vector	BMP	GIF	JPEG	1.00	0.75	0.50	0.20
	Image intensity	100	80-90	70-80	<70	1.00	0.75	0.50	0.20
	Image brightness	100	80-90	70-80	<70	1.00	0.75	0.50	0.20
	Image size	20-40 K	40-60 K	60-80 K	>80 K	1.00	0.75	0.50	0.20
	Missing images	1	2	3	4	1.00	0.60	0.40	0.00
Video	Video frame per minute	40-50	30-40	20-30	<20	1.00	0.75	0.50	0.20
	Video resolution	40-50	30-40	20-30	<20	1.00	0.75	0.50	0.20
	Video size	20-40 K	40-60 K	60-80 K	>80 K	1.00	0.75	0.50	0.20
	Video colors	100 K	80 K	60 K	40 K	1.00	0.75	0.50	0.20
	Missing videos	1	2	3	4	1.00	0.60	0.40	0.00
Audio	Waves	50	40-50	30-40	20-30	1.00	0.75	0.50	0.20
	Frequency of waves	12 Ghz	10 Ghz	8 Ghz	6 Ghz	1.00	0.75	0.50	0.20
	Duration in secs	2	4	4	6	1.00	0.75	0.50	0.20
	Echo in decibels	10	12	15	16	1.00	0.75	0.50	0.20
	Missing audios	1	2	3	4	1.00	0.60	0.40	0.00
Graphics	% of salient features of the graphics	100	80	60	40	1.00	0.75	0.50	0.20
Animations	Animation frames	>50	40-50	30-40	20-30	1.00	0.75	0.50	0.20
	Animation duration	3	4	5	6	1.00	0.75	0.50	0.20
	Animation rate	10	8	6	14	1.00	0.75	0.50	0.20
Tables	Missing fields	1	2	3	4	1.00	0.60	0.40	0.00
Forms	Missing fields	1	2	3	4	1.00	0.60	0.40	0.00
PDFS	Missing PDFS	1	2	3	4	1.00	0.60	0.40	0.00
Navigation	The average length of URL	3	4	5	6	1.00	0.75	0.25	0.00
	Weighted quick links	4	3	2	1	1.00	0.75	0.25	0.00
	Circular references	0	1	2	3	1.00	0.75	0.25	0.00
	Frequent links	5	4	2	0	1.00	0.75	0.25	0.00
Structure	Average depth	<2	3	4	5	1.00	0.75	0.50	0.25
	Average edges	<4	5	6	>7	1.00	0.75	0.50	0.25
	Connectedness	<5	6	7	>7	1.00	0.75	0.50	0.25
	Disconnectedness	<5	6	6	>7	1.00	0.75	0.50	0.25
Look and feel	Font (% variation from reference values considering all the attributes)	0.0	20	40	60	1.00	0.75	0.50	0.25
	Text (% variation from reference values considering all the attributes)	0.0	20	40	60	1.00	0.75	0.50	0.25
	Screen (% variation from reference values considering all the attributes)	0.0	20	40	60	1.00	0.75	0.50	0.25
	Tables	0.0	20	40	60	1.00	0.75	0.50	0.25
	Menus	0.0	20	40	60	1.00	0.75	0.50	0.25
	Images	0.0	20	40	60	1.00	0.75	0.50	0.25
	Videos	0.0	20	40	60	1.00	0.75	0.50	0.25
	Audios	0.0	20	40	60	1.00	0.75	0.50	0.25

3.2. Discussion

A comprehensive, extendable framework has been presented that captures users' perceptions. The framework includes human- and machine-learned expert systems, which compute the quality of characteristics based on the computed counts. Several types of parsers (context finder, structure finder, object finder, and count finder) have been included to support the requirements of various factors. Users can also add more parsers. The framework is easy and adaptable to Taylor, making it the same for any user-conceived website. The quality assessment of any website becomes remarkably simple, involving the customisation of a framework to evaluate its quality. Table 4 compares existing frameworks with the proposed framework. None of the existing frameworks available in the literature is comprehensive and extendable by users. The framework presented in this paper encompasses all 42 factors that should be considered when evaluating the quality of any website.

Table 3. Quality computation for the factor appearance of a sample website

Factor	Weight	Subfactor	Number of objects	Object serial	Characteristic	Count value	Quality value as per cognitive model	Weighted quality
Appearance	0.3	Font	1	1	Type	0	1.00	0.30
					Style	0	1.00	0.30
					Size	0	1.00	0.30
					Color	1	0.75	0.23
					Case	0	1.00	0.30
		Text	1	1	Pitch	0	1.00	0.30
		Paragraph	1	1	Alignment	0	1.00	0.30
		Colors	1	1	Foreground color	0	1.00	0.30
					Background color	1	0.75	0.23
		Tables	1	1	Number of columns	4	1.00	0.30
					Number of rows	20	0.00	0.00
					First row color	Navy blue	2.00	0.60
					Coloring styles	Alternate	3.00	0.90
					Alternate colour	Sulphate	1.00	0.30
					Font	Default	1.00	0.30
					Text	Default	1.00	0.30
					Line	Default	1.00	0.30
					Paragraph	Default	1.00	0.30
		Menu	1	1	Table menu objects	3	0.75	0.23
					File menu objects	20	0.75	0.23
					Tab menu objects	10	0.75	0.23
					Taskbar menu objects	20	0.75	0.23
					Total characteristics	22	Total quality	6.75
						Weighted quality		0.31

Table 4. Comparing existing frameworks with the proposed framework

Framework elements used	Morales-Vargas *et al.* [9]	Kaur and Gupta [10]	Elliot and Berleant [11]	JKRS (Author)
Basic factors (look and feel, structure, navigation, completeness, multimedia) used	Usability	None	Relevance, accuracy	YES
Total factors used	3	3	3	12
Is the context-based assessment done?	NO	NO	NO	YES
Are the human-defined expert models used?	YES	YES	NO	YES
Are machine-learned expert models used?	NO	NO	NO	YES
Metric computation methods used?	No	No	NO	YES
Are the models human extendable?	No	No	No	YES
Number of parsers used	None	One	One	8
Is the quality assessment survey-based	Yes	YES	Yes	No
Is the user perception used?	Yes	Yes	Yes	YES
Are the interactions among key factors used?	No	Yes	No	No

4. CONCLUSION

A comprehensive Framework is required for computing the quality of any website and domain. User perception and computational methods, metrics, and parsers must be considered to quickly compute the quality and identify weaknesses to remove them promptly, thereby increasing the hit rate of such sites. The framework presented in this article is comprehensive, as it considers all factors, subfactors, and characteristics, and encompasses both human-defined and Machine expert systems. The framework is extensive and can be easily extended without requiring changes to the core.

All business establishments can utilize this framework to assess the quality of their websites, identify areas for improvement, implement the necessary changes, and monitor the hit rate accordingly. The framework needs to be extended to include factors such as usability, security, privacy, maintainability, interlinking, computing architecture, performance, and many other relevant factors.

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AUTHOR CONTRIBUTIONS STATEMENT

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Sasi Bhanu Jammalamadaka	✓	✓		✓	✓	✓		✓	✓	✓			✓	
Bala Krishna Kamesh Duvvuri	✓	✓	✓	✓	✓	✓		✓	✓		✓			
Sastry Kodanda Rama Jammalamadaka	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓
Vishnu Priya Biyyapu	✓	✓			✓	✓	✓		✓		✓			

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interest.

DATA AVAILABILITY

Data availability does not apply to this paper as no new data were created or analyzed in this study.

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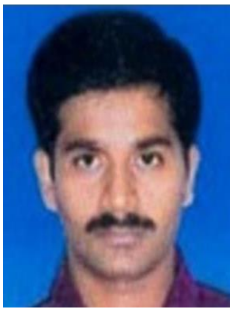
BIOGRAPHIES OF AUTHORS

Sasi Bhanu Jammalamadaka received a Ph.D. degree in Computer Science and Engineer- ing from Jawaharlal Nehru Technological University, Kakinada, India in 2015. She is presently a Computer Science and Engineering Professor at CMR College of Engineering and Technology, Hyderabad. She has published 50 Scopus Indexed and 10 WoS-indexed publications as of the date of this publication. She can be contacted at email: bhanukamesh1@gmail.com.



Bala Krishna Kamesh Duvvuri received the Ph.D. degree in Computer Science and Engineering from Shri Venkateswara University, India in 2012. He is presently a Computer Science and Engineering Professor at MLR Institute of Technology Hyderabad. He has published 50 Scopus Indexed and 10 WoS-indexed publications as of the date of this publication. He can be contacted at email: kamesh.dk@mlrit.ac.in.

Sastry Kodanda Rama Jammalamadaka has 30 years of IT experience and 16 years of academic experience. Double doctorate in CSE and MGT. Has been qualified in B.E. (Electrical), M.E. (Control Engineering), M.B.A. (Finance), and M.Sc. (Stat). Has guided 23 scholars and has published 247 papers, 21 in SCI, 140 in Scopus, and the rest indexed in Google Scholar. The number of citations of the papers published has crossed 800. He specializes in AI, ML, DL, embedded systems, IoT, web technologies, cloud computing, software engineering, and big data analytics. Twenty-three scholars have been awarded Ph.D. He is presently working as a Professor at KLEF University, Vaddeswaram, Guntur District, India. He can be contacted at email: drsastry@kluniversity.in, drjkrsastry@gmail.com.

Vishnu Priya Biyyapu has been awarded a Ph.D. degree by KLEF Deemed University in Computer Science and Engineering. She has published five Scopus-indexed and one Web of Science (WoS) indexed publication. She can be contacted at email: vishnupriyab@gmail.com.