

Measuring Usability: Categorically Modeling Successful Websites Using Established Metrics

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PREVIEW

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ABSTRACT

By

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Although website usability continues to be a hot research topic and sets of usability guidelines abound, many websites are still plagued with severe usability problems. Many owners/designers cannot afford the expense and effort of a thorough professional website usability evaluation. It is difficult for a novice developer to digest the glut of available guidelines and guideline sets in order to determine which particular guidelines to include when designing a usable website in a specific category. Furthermore, guidelines are often too vague to be implemented properly.

The time from inception to completion of a website is relatively short (as compared to a software package) and as most websites are designed by amateurs, an economical and rapid usability assessment of their websites is necessary. Many of the currently available automated website rating systems are based on criteria that is often subjective and not based on "usability" per se.

Using a traditional website categorization that includes e-commerce, informational, interactive and portal, this dissertation employs datamining algorithms to develop predictive, categorized models of an ideal website, based on an established set of usability metrics in order to enable the novice – the individual or small business owner – to design better websites. It establishes an order of relevance for a quagmire of usability metrics and their associated guidelines. It also serves to validate or refute previous research. It introduces a framework illustrating the relative importance of guideline metrics gathered from a selection of automated web usability tools. Finally, a more user-centered categorization is proposed which may serve as an impetus for future research.

While acknowledging the importance of user interface quality in HCI, web user interfaces are differentiated from desktop GUIs. The focus of this dissertation will be strictly usability, using guidelines established specifically for websites, as opposed to graphical user interface guidelines that may or may not apply to websites.

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Chapter 1

Introduction

1.1 About Website Usability

Website usability is the amount of success a user experiences while interacting with a website. In other words, it is the extent to which a user can achieve the desired goal during a visit to a particular website. Some of its factors include, among other things: page layout consistency throughout the website, an easily identifiable search mechanism to enable immediate retrieval of information, hypertext links that allow immediate access to specific information on that page or any other page in the site, the inclusion of a site map that acts as a hypertexted table of contents for the entire website, the use of legible fonts and an adequate use of color to highlight and organize information and/or features, and a bail-out feature for an immediate exit when necessary. These factors all contribute to the ease of use that makes a person's visit to a website both useful and enjoyable.

According to the International Standards Organization, usability is a function of a site's quality, along with functionality, reliability, efficiency, maintainability, and portability (ISO 9126). ISO 9241 defines usability in terms of "effectiveness, efficiency and

satisfaction with which specified users achieve specified goals in particular environments”. Unfortunately, this standard applies to software interfaces, per se, not specifically to websites. Although the *textual content* of a web page has a confluence of published tenets for organization and graphic style [50], there are inherent differences between an interface to a software package and that of a website. Generally, a website is more than just a graphical user interface for software. First, software is designed for a particular platform and hardware – it is stated on the side of the box. A website may be designed on one platform for one browser and viewed on any number of browsers that aren’t compatible. There is no box on which to state the necessary system requirements for use. A website may be viewed by anyone, using any type of hardware running under any type of platform. Second, websites don’t come with instructions for use. Functionality must be implicit and obvious. The interface must be consistent and complete. Third, performance is critical during a website visit. Any more than a ten second wait for a page to appear may cost you a visitor. Software performance isn’t dependent on physical transmission media or internet traffic conditions. The potential loss of visitors is the concern of the remaining differences. As a software user, you are a captive audience – you have paid for this software and it is the only software at your disposal at this time. You have committed learning time and effort. Not so with websites: there are many websites that may simultaneously offer the same functionality geared to the same target audience available at a given time. If one site proves unusable, it only takes a link and a click to go elsewhere. Additionally, a website is often used as a storefront. A home-based business’ home page is the representation of their business; and the first impression of a potential visitor is critical to the overall success of that

business. Lastly, software packages are designed and implemented by professionals.

Most websites are designed and implemented by novices with no critical knowledge concerning who will be using their websites or how their websites will be used.

Usability, as a general topic in Human Computer Interaction, has been well-studied. Unfortunately, website usability has not. Hence, published usability standards for software have been in existence for some time; the IEEE has only recently released (2002) a set of best-practice design guidelines for web pages.

1.2 The Importance of Website Usability

There are currently over 4 billion pages in 8.5 million websites available for browsing on the World Wide Web [33]. The average page size is 10KB, contains 24 internal links, 5.6 external links and 14.4 images [69]. Of the e-commerce sites, 90% are estimated to be ill-designed and beset with unusable features that frustrate customers [52]. Interestingly, there are also 3 million sites that are still “under construction”[69]. All this, and only 20,000 user interface developers worldwide [62]. With millions of pages entering the web daily, there is an increasing shortage of qualified professionals able to meet the ever-expanding demand for web page design. Supply and demand dictates that website designers have become a costly commodity, perhaps too expensive for the individual or small business. As more and more non-professionals attempt to design and publish their own websites, visitors accessing these websites grow increasingly frustrated due to the

un-usability of these sites. Most importantly, usable websites save time for countless visitors who might otherwise access and immediately opt out of an ill-designed site.

Therefore, website usability is important to both the creator of the website who has some product to deliver – either tangible, like goods and services; or intangible, like information – and wants to ensure that the product is easily transferable; and to the visitor of the website who seeks that commodity in an efficient, effective and effortless way.

1.3 The Scope and Purpose of This Study

Website design guru, Jakob Nielsen discusses ways to alleviate the problem: “grow” more professional website designers through the introduction of web design classes into school curriculums or enable non-professionals to produce better quality sites by providing easy-to-follow guidelines [62]. Existing guidelines have been developed heuristically, although some attempts have been made to empirically validate their significance toward designing better sites [37]. These guidelines are well-documented by many website - as well as user interface - design gurus [4][43][48][50][68]. Although ISO 9241 includes published HCI guidelines for software usability (Part 11) and ergonomics (Part 10), there are currently no website guideline standards, although attempts have been made to study, document and organize such guidelines [78]. Unfortunately, these guidelines may be difficult to implement or entirely misunderstood. Sometimes, the guidelines proposed are not website-specific (“Choose option buttons

over checkboxes to provide choices”), too vague (“Use a legible font”), or incomprehensible to the average person who employed vendor software to produce the site (“There should be a KEYWORDS meta-tag on every page”). Sometimes, the guidelines are completely contradictory (“Content should be long”, “Content should be short”). There exists no established set of metrics to apply to these guidelines. Furthermore, there are site guidelines, page guidelines, and even homepage guidelines. To add to the confusion, there are many site categories (or genres, such as: e-commerce, news, link, children, educational), but no formal method or consensus on a particular categorization, and a set or subset of guidelines to improve a website in one category may be may be less applicable to another category. These guideline anomalies make website design a difficult task for the novice, as well as experienced, designer.

Once a web page or site is designed according to the ability of the designer, it may be tested by its intended audience or, perhaps, a group of experts for “usability”, that is, the amount of success a user may expect to experience while interacting with a site or page. Usability is a function of a site’s quality, along with functionality, reliability, efficiency, maintainability, and portability (ISO 9241). Employing human evaluators is expensive and time-consuming; the results may be subjective and inconsistent. Heuristic testing, using some empirically-supported usability evaluation method, would allow a novice web designer to measure the extent of their conformance to a set of well-defined and generally accepted guideline metrics. A categorized website usability framework would provide structure, organization and clarification to the glut of existing guidelines. Automating this phase of web development would render it user-controllable and timely.

An automated website conformance indicator, derived from categorical models of successful websites, would offer the non-professional or novice website developer the ability to evaluate a website's conformity to established guidelines before releasing the site to the general public. Besides consistency and repeatability, automation provides increased cost benefits to the developer. It would improve the website design process and provide valuable test feedback. Most importantly, it would save time for countless visitors, who might otherwise access and immediately opt out of an ill-designed site.

There have been some recent attempts at automating the evaluation of a website, but these have been too broadly focused, somewhat incomplete, or plagued with anomalies.

1.3.1 Objectives

This study will offer a succinct categorization of websites based solely on the functional goal of the developer. It will propose the acceptance of a set of well-respected guidelines, based on the offered categorization, as a standard. These guidelines will have either been heuristically or empirically validated and will become the basis for the sub-framework based on one previously suggested [78]. While acknowledging the importance of user interface quality in HCI, web user interfaces will be differentiated from desktop GUIs and a subsequent set of usability guidelines will be proposed that pertain strictly to websites. Models of usable websites for each category will be derived.

In this dissertation, two hypotheses are posited:

H1: The relative importance of web usability guidelines is dependent on genre.

H2: The selection of web usability guidelines changes with genre, i.e. some guidelines may have no importance for a particular genre.

Hypothesis One deals with the relative value of a set of guidelines in a specific context; Hypothesis Two addresses whether all guidelines in a set have value in a specific context.

Accordingly, the objectives of this study are to:

- Investigate which guideline metrics were inherently followed during the design of the website for each category.
- Investigate the relative importance (weight) of each metric contained in each of the categories.
- Profile successful websites as a function of a website's genre.

1.3.2. Limitations

This study focuses only on general usability guidelines, choosing not to delve into the other factors contributing to the quality of a website, including accessibility, maintainability or portability [15]. This study deals strictly with website usability, not quality. Quality is the parent of usability, which has siblings, such as accessibility. If a site or page is unusable, it will be presumed to be unusable for the physically challenged. Page content is not addressed, except for a spelling check, as it is more a function of a site's "usefulness" than "usability". It is assumed in all cases that the

website author has something important to relay and is able to communicate it to the audience in an interesting, understandable, and grammatically correct fashion.

Though the World Wide Web is a global entity, only guidelines pertaining to English and the Western culture will be addressed at this time. Only Western, English language sites will be considered at this time. At the very least, adjustments to text position and order, color, and font and language (presently, an English Dictionary is used) would have to be made in order for the tools to process global websites and pages.

The Gestaltan view of a website's usability as a function of more than the sum usability of each of its pages is acknowledged. There are guidelines that pertain to the site as a whole, particularly relating to consistency, that are indeed important to the development of a successful site. It is assumed that there are some metrics that are common to all usable websites, independent of category. This study chooses to concentrate on the specific page metrics that may have participated in the creation of a successful website in a particular category.

While acknowledging that web development is moving towards providing more dynamic content via Macromedia Flash multimedia and Javascripts, only static web content will be analyzed in this preliminary study. All of the tools used in this study parse static HTML.

A victim of web evolution may well be the guideline. As users become increasingly familiar with web surfing, they adapt to, and subsequently imbue, any new experiences they may encounter. This eventually changes their expectations and influences heuristics. Therefore, a better approach to automated web usability evaluation would be to enable the inclusion of a dynamic guideline set or adaptive profiling that changes as web users “mature”.

A dataset sample consisting of 120 websites (2631 pages) was analyzed during the course of this study. While this was hardly a parsimonious page sample, it would be prudent to increase the number of pages in order to better train the models and increase their accuracy. More sites would need to be added to the dataset to study the sitewise metrics and increase the accuracy of the in datamining schemes involving a large number of classes.

This study does not claim to exhaust the set of usability guidelines as the set continually evolves as new and improved web design technologies and techniques surface. Hence, this body of work claims only that guideline importance changes with genre.

1.4 Summary

Website usability is the primary focus of this dissertation. As such, various methods for measuring it, both traditional and automated, will be discussed in Chapter 2. Measuring

usability involves metrics representing guidelines followed during the development phase. Guideline sets and attempted frameworks from several experts will be introduced, including a section on guideline patterns. The dataset compiled for the study in this dissertation depends on several automated web usability evaluation tools, therefore, a survey of ten currently available automated web usability evaluation tools, from which three have been selected, is presented. The work in this dissertation is unprecedented as it studies the relationship (not causal) of website category to the inclusion of a particular set of guidelines. A section on categorization includes a description containing the specific characteristics of each web category used in this study. Finally, studies on the effect of user expectations on web object placement, from two authors, are described.

Chapter 3 describes the methodology used in the study and its extension to previous research. Two scenarios - one to derive (and contrast) the order of importance of various metrics characteristic of usable websites in specific categories and another that produces decision tree models (and rule sets) for predicting the most usable websites in a specific category- will be discussed. The research components – the website sample, the dataset, and the tools used to analyze the dataset – are described in detail.

This work serves to exploit the differences among websites of different genres. To that end, a sample of websites have been analyzed to determine which guidelines may have been followed in producing an exemplar website for a particular category. Two artifacts

were created for each category while datamining the sites' metrics: a list of metrics ranked in the order of their importance when classifying pages by usability rating; and categorical models, and associated rule sets, for developing successful pages. The results are described in Chapter 4. Future work is the main subject of Chapter 5.

PREVIEW

Chapter 2

Related Work

2.1 Introduction

There is a plethora of research exploring and developing heuristic guidelines in the Human Computer Interaction domain; some of these concern software interface usability per se [21][46][53][62][79], others delve specifically into website usability [4][13][43][62]. Another proponent of website usability suggests evaluating a website according to its un-usability [73]. Recently, there have been some attempts to automate the process of evaluating the usability of a website [27][43][49][87][89][90][101]. For a survey of the currently available automated website evaluation tools, please refer to [20]. Automation provides homogeneity, stability, timeliness, user empowerment, and monetary savings. A few researchers have proposed indices and metrics but seem to disagree on an appropriate usability model or even which guidelines to include in developing one. Moreover, sites have been categorized using different criteria, whether by type of user, content or genre.

Keevil proposes a usability checklist (see <http://www3.sympatico.ca/bkeevil/sigdoc98>) and percentage index measure of how well a site conforms to the checklist. It is far from

automated. Lincoln D. Stein developed a website that will accept a URL as input, download, and scan the static html of the homepage (and a subset of subordinate pages), and automatically perform measurements of various usability criteria: an information index that calculates the link percentage of the page, the number of graphics on the page, the number of “doodads” (java applets, ActiveX controls, etc.), the number of colors utilized in the design, the amount of frames and ads, and the proportion of “cool” words (“groovy”, “neat”, “wild”, etc) and exclamation marks to the total sentence content of the pages [87]. This service was meant as a lighthearted, but quantifying, accompaniment to a paper detailing the glut of useless pages returned via search engines. An unprecedented and thorough approach to empirically proving which usability metrics should determine the automatic rating was proposed by Melody Y. Ivory [37]. Expert-rated (WebbyAwards, PC Magazine, WiseCat) sites’ pages were download, parsed and reverse-analyzed to derive specific metrics, resulting in a set of 141 quantitative page-level and 16 site-level metrics. These measures, along with the expert ratings, were used to generate statistical models of favorably rated sites that reflected the content, function, size and structure of the site. The accuracy of the page-level models was superior to that of the site-level models (93%-96% compared to 68%-88%), which according to Ivory could be due to a small site sample. It would be interesting to apply this research method to sites that were expert-rated based on their adherence to a well-established, specific set of usability guidelines, such as those proposed by Nielsen or the more empirically-driven studies conducted by the Psychology Department of Wichita State University [4]. Ivory’s research was based on the premise that the experts rated the sites as usable, rather than aesthetically-pleasing or

according to some other personal preference. In fact, subjectivity is one of the major shortcomings of human expert ratings, especially when the guidelines are ambiguous or too general. A brief visit to one website rating service revealed a list of voting criteria that didn't particularly address "usability", nor were the judges necessarily "experts" [99]. As the work was deemed by the Ivory as unprecedented, it should be repeatable and verifiable. Therefore, one study could prove the results attained in the previous attempt are, indeed, feasible. This may be accomplished by traffic analysis to ensure that the user's experience while visiting a site that was rated as "good" is positive. According to Chris Paul (Creative Director, IBM WebSphere Web Analytics UI Design and Development), the symptoms of a bad visitor experience include: lots of visitors, yet few actual purchases; abbreviated visits; few repeat visitors; and superfluous visitation, only the homepage is visited and none of the links [73]. If the website seems symptomatic, he proposes evaluating the site – not according to positive guidelines – but by seeking out the mistakes that were made during the design of the site: inconsistent navigational scheme, long response times as a result of ill-conceived expectations concerning users' equipment, not conducting the test using actual users, and amateur design.

As many of these guidelines and studies stemmed from HCI research in the user interface area, there looms the question of whether user interface usability is exactly equal to that of the web, where access is more time-constrained, search spaces are huge, and users are content-driven as opposed to task-driven. This question is addressed by Dick Berry who feels that although there is some overlap in the guidelines, the web is

constrained by the client's hardware specifications, the browser and other underlying applications, the server's hardware capability, and the overall latency of the network [12]. The web exposes a less-consistent interface as each website seeks to be unique. In addition, there is an unprecedented security requirement on the web as many sites involve some type of monetary transaction: out of the some 20 million running websites, 1.2 million enable some e-business transaction [22]. Nonetheless, an automated usability conformance index provides the novice designer with instant and inexpensive feedback during the testing of the site and will allow adjustments to be made to perfect the site before releasing it to the public. As many home-based businesses join the e-commerce frenzy, their home page is the representation of their business and the first impression of a potential visitor is critical to the overall success of that business. A lost visitor represents a potential loss in revenue, and the loss due to an ill-conceived site design is silent and irrevocable: the visitor opts out and usually doesn't return. The individual and/or small business does not have the funds to conduct usability studies employing dozens of people. There are some companies offering a more inexpensive automated study, but these, too, are either limited in use or may become costly with the repeated use necessary for iterative design feedback.

Automatically generated ratings could also be included in the site set returned by search engines or included in favorites or history lists to control the amount of wasted revisits to a particular site and to decrease superfluous web traffic.

2.2 Measuring Website Usability

ISO 9241-11:1998 states that usability can be measured in terms of the effectiveness (number of tasks successfully completed vs. number of tasks attempted), efficiency (the amount of time to complete a task), or satisfaction (rating users' experience while performing the task) [92]. Experts agree that adhering to specific "rules" during the design of the website will increase the probability that a user will enjoy a successful visit when the site is published. These rules become the factors that comprise the website. As discussed, the factors are the guidelines that were followed (either wittingly or unwittingly) by the designer while developing the website.

Guidelines have been traditionally derived from heuristics, although there has been some recent attempts to empirically validate them. A web usability guideline has been defined as "any statement ensuring some adequacy of a particular user interface of a website with respect to a particular context of use where a given user population has to fulfill interactive tasks within a given system" [78]. In order to measure the extent of a guideline's impact on the usability of the web page or site, the factors must be converted into metrics, quantified guidelines derived from generally-accepted or empirically-validated thresholds. Not every guideline is quantifiable. It would be difficult to associate an amount with the meaningfulness of a hypertexted link or the consistency of the interface throughout the website. Guidelines that cannot be quantified may be tested via an accompanying automatic user survey or visual analysis.